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Y. P. Mancha, D. J. U. Kalla, K. M. Bello, S. T. Mbap, M. Abdulkarim, T. Igila and S. Danbirni

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EFFECTS OF SOLAR DRIER SUPPLEMENTED WITH LANTERN OR ELECTRIC BULB HEAT ON JAPANESE QUAIL EGGS HATCHABILITY

[*1]Idahor K.O., [1]Musa A.A., [2]Kaye J., [2]Igoche L.E., [3]Egbuji A.N., [3]Sati N.M., [3]Emennaa P.E. & [3]Mwadkon P.B.

[1]Department of Animal Science, Nasarawa State University, Keffi, Shabu-Lafia Campus
[2]Department of Animal Production, Faculty of Agriculture, University of Jos
[3]National Veterinary Research Institute, Vom, Plateau State
[*]Correspondence email address: koidahor@nsuk.edu.ng

ABSTRACT
Artificial incubation in Japanese quails commercial production is unavoidable because the hens do not incubate their eggs. But artificial incubators require electricity, expertise and are not readily accessible hence alternative strategies that seem affordable and easy become indispensible. Two separate studies: electric incubator and solar drier supplemented with lantern heat; electric incubator and solar drier supplemented with electric bulb heat were carried out using two hundred Japanese quail eggs. Incubation period, number of hatchlings, chick weight, fertility rate, hatchability and chick yield were determined. Thermometer was used in monitoring the incubation temperature and relative humidity. Hatchability failure was recorded in both solar drier supplemented with lantern and electric bulb heat but 74.3%; 85.7% was recorded in control. All the incubated eggs in both solar drier supplemented with lantern and electric bulb appeared unfertile. These observations could be due largely to irregular incubation temperature of 30.3 to 58.8^{o}C; 23.9 to 42.6^{o}C during the day and 21.3 to 36.5^{o}C; 27.1 to 38.7^{o}C during the night in solar drier supplemented with either lantern or electric bulb heat. Therefore, solar drier supplemented with lantern or electric bulb heat, may not provide the required microclimatic conditions required to sustain Japanese quail embryos development.
Keywords: Embryo growth, incubator, Japanese quails, physiological status

INTRODUCTION
Initially, Japanese quails were known for singing, with time it was observed that the eggs and meat were nutritionally rich with medicinal attributes (Fah, 2009; Howes, 1964). More importantly, it is preferred in avian research to other poultry species (Reese and Reese, 1962). Unfortunately, the hens hardly incubate their eggs, so use of artificial incubators is inevitable for commercial production. Regrettably, artificial incubators are not manufactured locally, available, affordable and it is powered by electricity which may not be available always. Hence, the quest for alternative heat source to provide the required microclimatic conditions, required to sustain Japanese quail embryos development with improved hatchability. Consequently, this study was aimed at investigating the use of solar heat in poultry eggs incubation, in order to make good some elements of climate change.

MATERIALS AND METHODS
Study I
One hundred Japanese quail eggs obtained from National Veterinary Research Institute, Vom, were weighed and 50 each were randomly allotted to electric incubator: control (38°C) and solar drier. At night, hurricane lantern was placed inside the solar drier to supplement heat only at night (See plates 1 and 2).
Study II
Anotherclutch of 100 Japanese quail eggs from the same source as in study I, were weighed and randomly allocated (50 each) to control (38°C): electric incubator and solar drier. A 100W electric bulb was fixed inside the solar drier and switched on only at night to supplement heat (See plates 1 and 2).
DATA COLLECTION AND ANALYSIS
The studies were conducted separately and incubation temperature as well as relative humidity was recorded daily during the day: (midday and evening) and during the night: (midnight and morning) using a thermometer with a sensitive probe. At hatch, incubation period, number of hatchlings, chick weight, fertility rate, hatchability and chick yield were determined as described by Copper Akpinar *et al*. (2017). After the emergence of chicks, 5 days allowance was given for late hatching and on incubation day 22, the unhatched eggs were carefully windowed and the physiological status of the eggs vis-à-vis the developing embryos was recorded as proposed by Idahor *et al*. (2018), but was

modified to include further categorisation as either "Unfertile: no evidence of embryo growth" or "Fertile: evidence of embryo growth".



Plate 1: Electric incubator: Control



Plate 2: Solar drier where lantern or electric bulb was used to supplement heat only at night

Those that were "infertile", "caked" and "not clear whether fertile or not" were categorised as **Unfertile**: **no evidence of embryo growth**. Whereas, those with "early dead embryos", "fully developed but dead embryos", "pipped and dead embryos", "pipped and alive but not able to emerge embryos" as well as "pipped and hatched alive" were considered as **Fertile**: **evidence of embryo growth**. Data were subjected to descriptive statistics and ANOVA at $\alpha_{0.05}$ using SPSS (2010).

RESULTS AND DISCUSSION

Temperature and relative humidity in electric incubator and solar drier supplemented with lantern heat is presented in Table 1. There were statistical differences (P<0.05) in all the parameters measured, except temperature during the day and night in electric incubator (control) and relative humidity during the day in solar drier supplemented with lantern heat.

Table 1: Temperature and relative humidity of electric incubator and solar drier supplemented with lantern heat

	Treatments (±STD)							
	Electric incubator (Control)				Solar drier (Supplemented with lantern heat)			
	During the day		During the night		During the day		During the night	
ID	Temp (°C)	RH (%)	Temp (°C)	RH (%)	Temp (°C)	RH (%)	Temp (°C)	RH (%)
0	38.15±0.13	35.50±6.25^{b}	38.78±0.21	37.25±6.08^{d}	48.00±9.13^{ab}	31.45±2.01	29.25±10.90^{bc}	43.15±6.12^{ab}
1	38.20±0.08	32.00±5.48^{b}	38.58±0.63	44.00±2.94^{bc}	45.75±6.65^{ab}	30.05±4.88	26.00±10.71^{c}	40.48±3.75^{ab}
2	38.25±0.06	40.75±1.89^{a}	38.18±0.47	46.50±2.38^{abc}	47.25±3.40^{ab}	31.55±2.53	26.00±7.35^{c}	41.80±5.19^{ab}
3	38.75±2.90	44.75±2.99^{a}	38.98±0.62	50.75±1.89^{a}	45.00±8.12^{ab}	31.55±2.06	25.75±8.50^{c}	42.15±6.15^{ab}
4	38.03±0.49	41.25±1.71^{a}	38.58±0.54	50.75±1.89^{a}	49.25±5.06^{ab}	31.30±1.72	25.25±8.06^{c}	43.10±5.34^{ab}
5	38.13±0.22	43.00±1.41^{a}	38.53±1.16	51.00±2.94^{a}	44.75±12.55^{ab}	32.30±3.50	27.75±8.54^{c}	41.23±3.92^{ab}
6	38.18±0.05	41.75±2.06^{a}	38.58±2.60	51.25±0.50^{a}	49.50±10.21^{ab}	29.48±2.83	24.50±15.38^{c}	40.60±4.25^{ab}
7	38.00±3.54	45.75±6.95^{a}	38.70±0.56	50.75±0.96^{a}	49.50±10.21^{ab}	31.93±5.56	25.75±2.22^{c}	41.80±5.72^{ab}
8	38.08±0.46	44.00±2.45^{a}	38.35±1.48	49.25±4.11^{ab}	49.50±10.21^{ab}	31.45±2.40	25.75±13.35^{c}	44.77±2.42^{ab}
9	38.30±0.00	46.75±1.26^{a}	38.80±0.81	48.00±1.63^{abc}	49.00±13.95^{ab}	30.33±1.80	32.33±19.63^{b}	41.40±3.28^{a}
10	38.30±0.00	44.25±2.06^{a}	38.75±1.08	47.50±0.58^{abc}	47.25±12.29^{ab}	31.18±1.42	34.75±16.70^{ab}	39.58±4.09^{ab}
11	38.30±0.00	45.25±0.50^{a}	38.90±1.44	49.00±1.41^{ab}	52.751±7.46^{ab}	30.38±1.52	35.25±19.57^{a}	39.90±7.39^{ab}
12	38.28±0.05	44.75±1.50^{a}	38.35±1.59	47.25±1.50^{abc}	41.00±6.63^{ab}	31.90±3.65	33.75±13.51^{ab}	39.03±5.84^{ab}
13	38.30±0.00	45.75±1.71^{a}	38.53±1.98	49.00±1.15^{ab}	42.00±5.72^{ab}	32.45±3.30	33.50±18.20^{ab}	38.00±3.26^{ab}
14	38.20±0.08	47.50±1.73^{a}	38.10±1.19	49.75±0.96^{a}	30.25±10.21^{b}	31.85±4.13	30.50±10.34^{b}	37.25±3.23^{ab}
15	38.00±0.54	47.75±2.22^{a}	38.85±2.08	49.75±1.26^{a}	53.25±12.47^{ab}	32.40±4.84	21.25±4.72^{c}	41.75±3.39^{ab}
16	38.20±0.20	46.50±1.29^{a}	38.88±2.17	51.50±2.65^{a}	51.25±24.62^{ab}	31.85±4.13	33.25±13.63^{ab}	44.15±5.74^{ab}
17	38.13±0.10	41.00±5.83^{a}	38.03±1.56	38.00±0.16^{d}	58.75±12.53^{a}	30.28±2.00	21.25±8.30^{c}	36.20±3.92^{ab}
18	38.18±0.10	31.00±5.35^{b}	38.18±0.96	43.25±4.99^{c}	47.25±14.38^{ab}	31.55±4.30	28.75±14.87^{c}	39.88±4.85^{b}
19	38.25±0.06	37.75±4.79^{b}	38.30±0.92	43.50±2.38^{c}	49.25±12.24^{ab}	32.40±4.84	36.50±21.44^{a}	42.45±4.85^{ab}
20	38.32±2.89	44.00±3.56^{a}	38.93±0.51	49.25±1.89^{ab}	56.00±4.85^{ab}	31.85±4.13	28.75±17.46^{c}	39.88±4.85^{b}
21	38.05±0.51	41.50±2.08^{a}	38.98±0.79	51.75±0.50^{a}	44.75±2.19^{ab}	29.10±0.61	23.25±15.62^{c}	39.88±4.85^{b}

^{a,b,c,d}: Mean values on the same column with different superscripts differ significantly at p<0.05; ID: Incubation day; Temp: Temperature; RH: Relative humidity; STD: Standard deviation.

While the temperature was constantly 38°C in control, it fluctuated from 30.3 to 58.8°C during the day and 21.3 to 36.5°C during the night in solar drier supplemented with lantern heat. This was evidently out of a range of 36 – 38°C recommended for poultry eggs incubation (Archer and Cartwright, 2018; Sartell, 2018). The relative humidity varied between 29 and 45% in solar drier supplemented with lantern heat and 31 – 52% in electric incubator (control). These were within a range of 32 – 75% reported by Archer and Cartwright (2018).

Table 2 shows the temperature and relative humidity in electric incubator and solar drier supplemented with electric bulb heat. There were statistical variations ($P<0.05$) in all the parameters monitored, except temperature in control that was seemingly constant at 38°C both day and night but, varied from 23.9 – 42.6°C during the day and 27.1 to 38.7°C during the night in solar drier supplemented with electric bulb heat.

Table 2: Temperature and relative humidity in electric incubator and solar drier supplemented with electric bulb heat

	Treatments (±SD)							
	Electric incubator (Control)				Solar drier (Supplemented with electric bulb)			
	During the day		During the night		During the day		During the night	
ID	Temp (°C)	RH (%)	Temp (°C)	RH (%)	Temp (°C)	RH (%)	Temp (°C)	RH (%)
0	38.06±0.29	45.10±2.15^{a}	38.33±1.66	44.29±4.22^{b}	41.08±1.73^{a}	49.25±0.50^{b}	32.80±5.60^{b}	28.25±13.77^{cd}
1	38.29±0.14	38.70±4.43^{c}	38.23±1.11	42.23±3.11^{b}	40.18±5.95^{a}	49.25±10.44^{b}	33.15±7.04^{b}	25.50±13.60^{d}
2	38.45±0.44	40.75±1.89^{b}	38.10±0.20	41.39±2.66^{b}	42.58±8.34^{a}	43.50±11.68^{c}	38.75±4.26^{a}	25.25±9.43^{d}
3	38.11±1.11	44.75±3.09^{a}	38.03±0.55	43.05±1.44^{a}	40.15±8.26^{a}	52.00±2.83^{ab}	34.35±6.65^{b}	26.75±9.71^{d}
4	38.54±0.13	40.22±1.04^{b}	38.41±0.54	50.12±1.55^{a}	40.33±5.91^{ab}	43.50±14.36^{c}	33.85±6.06^{b}	23.00±7.07^{d}
5	38.33±1.32	42.11±1.45^{b}	38.13±1.12	51.54±3.03^{a}	39.85±5.61^{ab}	40.00±17.42^{c}	33.33±6.88^{b}	24.75±8.46^{d}
6	38.14±0.45	41.75±2.06^{b}	38.44±1.63	49.66±2.58^{a}	41.25±4.96^{a}	51.50±13.40^{ab}	34.00±7.06^{b}	29.50±24.37^{c}
7	38.09±1.01	41.34±4.85^{b}	38.00±0.33	49.55±3.33^{a}	39.85±9.28^{a}	52.00±13.37^{ab}	31.70±6.21^{b}	31.25±16.26^{b}
8	38.11±0.51	44.09±2.66^{a}	38.09±2.11	51.00±6.32^{a}	39.03±8.77^{a}	50.00±10.86^{ab}	32.13±4.28^{b}	26.00±14.45^{d}
9	38.25±1.08	46.11±2.23^{a}	38.22±1.66	50.88±4.88^{a}	39.60±8.64^{a}	47.25±13.57^{b}	34.68±7.58^{b}	24.25±17.29^{d}
10	38.10±0.07	44.25±2.06^{a}	38.32±1.08	49.59±3.22^{a}	41.68±7.72^{a}	48.50±15.15^{a}	31.38±7.12^{b}	24.75±16.03^{d}
11	38.22±0.07	46.25±3.51^{a}	38.40±1.76	49.07±4.81^{a}	37.25±6.03^{b}	44.50±19.16^{c}	31.38±5.47^{b}	35.00±15.25^{c}
12	38.44±0.44	34.79±1.53^{c}	38.84±1.00	48.92±3.44^{a}	40.00±7.02^{a}	55.00±21.92^{ab}	29.10±7.78^{b}	29.75±21.62^{b}
13	38.32±0.43	45.33±2.76^{a}	38.13±1.90	49.40±2.35^{a}	40.53±5.56^{a}	59.50±18.52^{a}	27.10±7.58^{c}	35.75±14.38^{c}
14	38.33±1.03	47.50±2.55^{a}	38.18±1.22	49.86±0.44^{a}	37.80±4.38^{b}	57.75±14.24^{ab}	34.18±5.93^{b}	35.50±13.20^{c}
15	38.22±0.22	47.75±2.29^{a}	38.77±1.92	49.34±2.04^{a}	42.18±5.29^{a}	43.50±4.73^{c}	32.60±4.00^{b}	28.00±11.17^{cd}
16	38.20±0.20	44.54±1.66^{a}	38.63±2.77	50.03±1.33^{a}	38.28±3.54^{b}	47.50±12.48^{b}	27.58±5.99^{c}	38.25±12.82^{c}
17	38.13±0.10	44.08±5.21^{a}	38.60±1.52	48.77±1.66^{a}	31.43±6.01^{c}	56.50±16.62^{ab}	27.23±6.78^{c}	61.50±31.84^{a}
18	38.38±0.19	31.34±5.57^{c}	38.66±0.93	48.25±4.44^{a}	38.65±3.62^{b}	64.25±24.09^{a}	27.73±7.64^{c}	32.25±13.40^{c}
19	38.50±0.06	35.75±2.33^{c}	38.38±0.92	43.11±2.76^{b}	35.70±5.37^{bc}	52.50±13.63^{ab}	30.28±5.96^{b}	43.25±17.80^{bc}
20	38.42±0.04	44.80±3.99^{a}	38.43±0.51	46.24±1.55^{ab}	35.98±9.29^{bc}	61.25±17.91^{a}	31.88±8.78^{b}	33.75±15.37^{c}
21	38.00±0.23	41.37±2.48^{b}	38.66±1.33	51.33±2.33^{a}	23.95±8.77^{d}	57.75±29.74^{ab}	31.95±3.23^{b}	50.00±26.23^{b}

^{a,b,c,d}: Mean values on the same column with different superscripts differ significantly at $p<0.05$; ID: Incubation day; Temp: Temperature; RH: Relative humidity; STD: Standard deviation.

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Though these values seemed to be close to 38°C given as normal incubation temperature in poultry eggs, the fluctuation margin was wider than a range of 0.2 – 3.0°C reported to be a margin of safety (Poultry Hub (2018; French, 2000). Relative humidity was close to the values given as normal during poultry eggs incubation (Archer and Cartwright, 2018).

Table 3 provides the physiological status and hatchability of Japanese quail eggs incubated in electric incubator and solar drier supplemented with lantern or electric bulb heat. There was hatchability failure in both solar drier supplemented with either lantern or electric bulb heat whereas, as high as 74.3%; 85.7% was recorded in control during the studies. This observation lent more credence to the report of Idahor *et al.* (2016) that improvising solar drier as poultry eggs incubator may not be possible. But was at variance with the findings of Osanyinpeju *et al*. (2016) who recorded 44% hatchability in fowl eggs incubated in solar powered poultry egg incubator. All the incubated eggs in both solar drier supplemented with lantern and electric bulb heat appeared unfertile. This probably signified unsuitable microclimatic conditions for the blastoderm to develop into embryos resulting in hatchability failure.

Table 3: Physiological status and hatchability of Japanese quail eggs incubated in electric incubator and solar drier supplemented with either lantern or electric bulb heat

	Treatments			
Parameters	**Control**	**Solar drier supplemented with lantern heat**	**Control**	**Solar drier supplemented with electric bulb heat**
Total eggs set	50	50	50	50
Egg weight (g)	10.43	10.06	10.28	10.17
IP (days)	17	-	18	-
Unfertile eggs: No evidence of embryo growth				
Infertile	5	0	7	0
NCWFN	1	38	1	35
Caked	2	12	3	15
Fertile eggs: Evidence of embryo growth				
EDE	3	0	2	0
FDDE	1	0	3	0
PDE	2	0	5	0
PAE	0	0	0	0
Hatched chicks	36	0	29	0
Fertile eggs	42	0	39	0
Fertility rate (%)	84	0.00	78	0.00
Hatchability and chick quality				
Hatchability (%)	85.7	0.00	74.3	0.00
Chick weight (g)	6.47	0.00	6.35	0.00
Chick yield (%)	62.0	0.00	61.77	0.00

IP: Incubation period; NCWFN: Not clear whether fertile eggs or not; EDE: Early dead embryos; FDDE: Fully developed but dead embryos; PDE: Pipped and dead embryos; PAE: Pipped and alive but not able to emerge embryos.

CONCLUSION AND RECOMMENDATION

Since hatchability was recorded only in the control (electric incubator), solar drier supplemented with either lantern or electric bulb heat, may not be feasible in Japanese quail eggs incubation. Therefore, further investigations on how to harvest solar heat during the day, conserve and stabilize it during the night become imperative, in order to make good some elements of climate change.

REFERENCES

Archer G.S. and Cartwright A.L. 2018. Incubating and hatching eggs. *Texas A&M AgriLife Extension Service*, AgriLifeBookstore.org. EPS-001 7/13.

Copur Akpinar G., Alasahan S. and Ayasan T. 2017. Selected traits of hatched and unhatched eggs and growth performance of yellow Japanese quails. *Braz. J. Poult. Sci.*, 19(3): 527 – 536.

Fah K.H. 2009. The nutrition and management of Japanese quail in the tropics Pp. 1 – 3. Accessed in March, 2009 at: file://k:/corturnixQuail.htm.

French N.A. 2000. Effect of short periods of high incubation temperature on hatchability and incidence of embryo pathology of turkey eggs. *Brit. Poult. Sci.*, 41(3): 377 – 382.

Howes J.R. 1964. Japanese quail as found in Japan. *Quail quarterly*, 1: 19 – 30.

Idahor K.O., Nwosuh C.I., Sokunbi O.A., Osaiyuwu O.H., Odu O., Sati N.M., Emenaa P., Shamaki D. and Babayemi O.J. 2018. Embryo Physiological status, chick yield and hatchability of Japanese quail (*Coturnix coturnix japonica*) eggs incubated in fabricated electric incubators at different temperatures. *Proc. 43rd Ann. Conf. NSAP*, FUTO, Pp. 315 – 318.

Idahor K.O., O. J. Jayeoba, B.O Matthew, N Isah, B. Lawani, A. Yakubu, I.M. Haruna 2016. Preliminary study on utilization of screen house and solar drier as poultry egg incubators. *Proc., XXVth World's Poultry Congress*, Beijing, China, Pp. 586.

Osanyinpeju K.L., Aderinlewo A.A., Adetunji O.R. and Ajisegiri E.S. 2016. Development of solar powered poultry egg incubator. *Proc. Int'l Conf. COLENG*, FUNAAB, Ogun State, Pp 278 – 288.

Poultry Hub 2018. Incubation temperature range and variation. Accessed in November, 2018 at: http://www.poultryhub.org/physiology/incubation/.

Reese E.P. and Reese T.W. 1962. The quail, *Coturnix coturnix*, as a laboratory animal. *J. Exwtl. Analysis of Behaviour*. 5(2): 265 – 270.

Sartell J. 2018. Incubation station: a reference guide to incubation terms, temperatures, times and humidity levels. *Community Chickens Newsletter*. Accessed in July 2018 at: https://www.communitychickens.com/category/coops/;

SPSS 2010. Statistical package for social sciences, SPSS Inc., 444. Michigan Avenue, Chicago, IL 60611.

HISTOPATHOLOGICAL STUDIES ON DROMEDARY CAMEL (*Camelus dromedarius*) MASTITIC MAMMARY GLAND

[1]Idi, Y; [1]Sanusi, M; [1]Kalla, D J U

[1] Department of Animal Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria.

[2]Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria.

Correspondence E-mail: idiyusuf5@gmail.com +2348038488924

ABSTRACT

The study aimed at investigating the effect of mastitis on dromedary camel **(*Camelus dromedarius*)** mammary tissue using histopathological examination. The study was carried out on seven (7) dromedary camel mammary gland; three (3) apparently healthy and four (4) mastitic mammary gland. The samples were collected from Maiduguri main abattoir, preserved and taken to histology laboratory, Faculty of Veterinary Medicine, University of Maiduguri. At slaughter, the udder was incised immediately, and mammary tissues were fixed in 10% formalin solution at room temperature. The tissue were subjected to routine histological staining using Haematoxylin and Eosin (HandE) staining method and safranin and fast green (SandFG) for examination under the light microscope. Histological studies indicated significant pathological changes in the tissue; dense interlobular connective tissue, atrophied gland, fibrous tissue proliferation, lower alveolar population and lower alveolar diameter.

Key words: Udder, Health, Disease

INTRODUCTION

Mastitis is a complex disease occurring worldwide among dairy animals, with heavy economic losses largely due to sub-clinical mastitis. Mastitis is an inflammation of the parenchyma of the mammary gland, which can result from cow exposure to a variety of infectious agents. It is characterized by an array of physical and chemical changes in milk (discolouration, presence of milk clots and presence of large number of leucocytes) (Al-Otaibi and El-Demerdesh, 2013), pathologic changes to the glandular mammary tissue, and at times systemic changes within the affected animal.

Mastitis may be due to pathogens, toxins or trauma (Schlafer and Miller, 2007). It is characterized by a decline in milk yield, physical and chemical changes in the milk and pathological changes of the udder. The pathogenesis of mastitis is well studied in cows and dependent on some factors including the species and virulence of the organism, ecology and host (Schlafer and Miller, 2007; Tibary and Anouassi, 2000). However, cases of mastitis in camel have been reported from different countries, particularly in pastoral production system of East Africa and Middle East (Abdelgadir, 2013).

Microorganisms that causes mastitis are generally classified as either contagious or environmental based upon their primary reservoir and mode of transmission. *Staphylococcus aureus* and *Streptococcus agalactiae* are contagious pathogens. Primary environmental pathogens include different types of bacteria: species of streptococci other than *Streptococcus agalactiae* (*Streptococcus* species), coliform species *(Escherichia coli, Klebsiella* species, *Enterobacter* species) and pseudomonas species. The study aimed at investigating the effect of mastitis on dromedary camel mammary tissue using histopathological examination.

MATERIALS AND METHOD

Experimental design

The study was carried out on seven (7) dromedary camel mammary gland; three (3) apparently healthy and four (4) mastitic mammary gland. The samples were collected from Maiduguri main abattoir, preserved and taken to histology laboratory, Faculty of Veterinary Medicine, University of Maiduguri for further processing.

Histopathological examination

At slaughter, the udder was incised immediately and the tissues fixed in 10% formalin solution at room temperature. The specimens were then removed from the buffered-formalin and dehydrated through a graded series of ethanol and xylene prior to paraffin embedment. After that, the specimens were embedded in paraffin, sectioned at the thickness of 5-6µ using rotary microtome, mounted on

slide, and stained with Haematoxylin and Eosin (H and E) Stain method and safranin and fast green (S and FG) for examination under the light microscope.

RESULTS

The udder section from apparently healthy dromedary camel showed no pathological lesions and the glands showed alveoli containing milk and thin interlobular connective tissue were observed (Plate IA and B). Milk was apparently observed in the lumen and it accumulated in the lactiferous duct of the mammary gland (Plate IIA and B). Protein cast were also observed in the convoluted duct system (Plate IIIA and B). However, the tissue section from mastitic udder revealed dense interlobular connective tissue and severe atrophied gland (Plate IVA and B). Infected mammary parenchyma tissue showed destruction of alveoli and fibrous tissue proliferation (Plate VA and B). Mastitic udder showed significantly lower alveolar epithelial cell population and alveolar luminal diameter. The lobular structure was completely replaced by scattered aggregates of granulation. The interlobular ducts were dilated and their lining epithelium was necrotic and disrupted (Plate VIA and B).

DISCUSSION

The most common histopathological findings in this study were dense interlobular connective tissue, severe atrophied gland, broken alveoli, fibrous tissue proliferation, lower alveolar epithelial cells population and lower alveolar luminal diameter. This result indicated pathological changes occurring in udder tissue, and could be due to severe tissue damage due to different mastitis pathogens or the toxins secreted by various species of mastitis pathogens. Similar changes in udder tissue was reported by Abeer *et al*, (2016) which observed profuse proliferation of fibrous tissue, necrotic, fragmented and atrophic mammary gland secretary acini. He went further and stated that, in advanced changes, the lobular structure were completely replaced by scaring and scattered aggregate of mononuclear cells or granulation. The histopathological changes included the number of alveoli, alveoli diameter and secretary alveolar cell population significantly decreased in mastitic cattle (Hussain *et al.*, 2012). Also, Quinn *et al* (1994) mentioned that, the chronic mastitis changes induced intensive proliferation of fibrous tissue in the inter and intra-lobular forming areas of scarring, infiltration of mononuclear cells, histocytes or macrophages, plasma cells and lymphocytes.

CONCLUSION

Histological studies on udder indicated significant pathological changes in the tissue; dense interlobular connective tissue, atrophied gland, fibrous tissue proliferation, lower alveolar population and lower alveolar diameter.

REFERENCE

Abdelgadir, A. E. (2013) Mastitis in camels (*Camelus dromedarius*):Past and recent research in pastoral productionsystem of both East Africa and Middle East. 1st International Conference on Sustainability of camel Population and Production, College of Agriculture and Food Science, King Faisal University, Al-has, Saudi Arabia, 17th – 20th February, 2013.

Abeer, A. M., Zakia, A. M., Muna, E. A. and Sabiel, Y. A. (2016) Bacteriological and pathological studies of mammary glands affections in camels (camelus dromedarius) at Tumbool abbatoir, Sudan. *British Microbiology Research Journal*. **15**(5): 1-8

Al-Otaibi and El-Demerdesh (2013) Nutritive value and characterization properties of fermented camel milk fortified with some date palm products chemical, bacteriological and sensory properties. *Int. J. of Nutrand food Sci*. 2(4): 174-180

Hussain, R., Javed, M. T. Khan, A., Mahmood, F. and Kausar, R. (2012) Mastitis and associated histo-pathological consequences in the context of udder morphology. *Int. J. Agric. Boil.*, 14: 947-952

Quinn, P. J., Carter, M. E., Markey, B. and Carter, G. R. (1994) Clinical veterinary microbiology. London, England. WOLFE publishers

Schlafer D. H. and Miller, R. B. (2007) Pathology of mammary glands. In Jobb, Kennedy and Palmer's Pathology of Domestic Animals. 5th ed., by Maxie, M. G, Saunders, Elsever. Edimburgh, London U.K. **3**:550-564.

Tibary A. and Anouassi A. (2000). Lactation and udder diseases. International Veterinary Information services (www.ivis.org.). Recent advances in camelid reproduction.

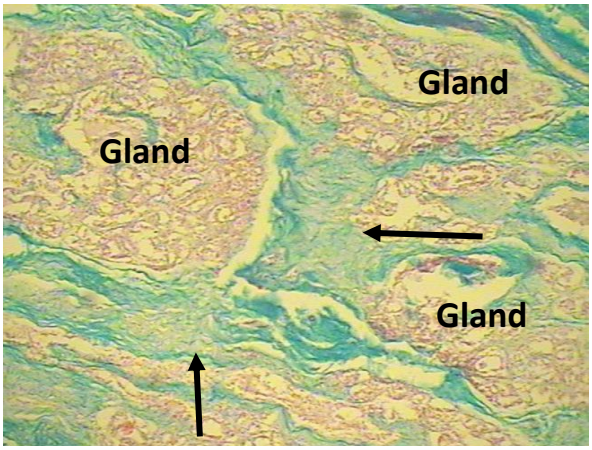


Plate IA: *Photomicrograph of apparently healthy mammary gland of an animal showing glands and thin interlobular connective tissues (arrows) S and FG x100H*

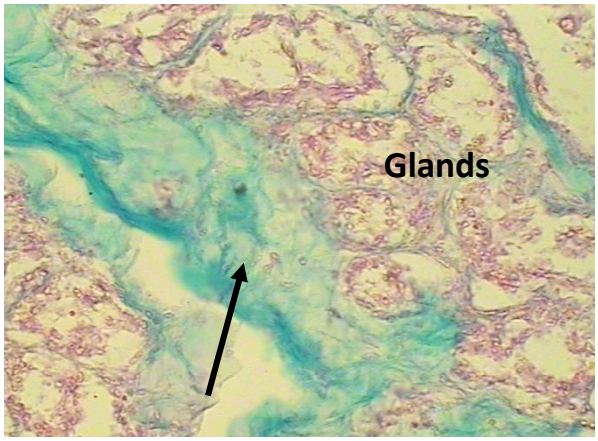


Plate IB: *Photomicrograph of apparently healthy mammary gland of an animal showing glands and thin interlobular connective tissues (arrow) S and FG x400* ***H***

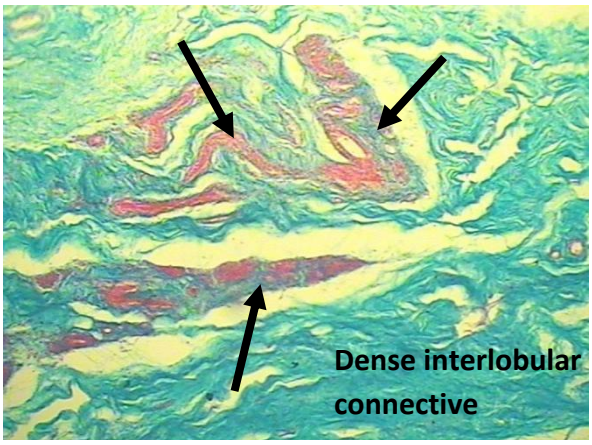


Plate IVA: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues and atrophied glands (arrows) S and FG x100* ***M***

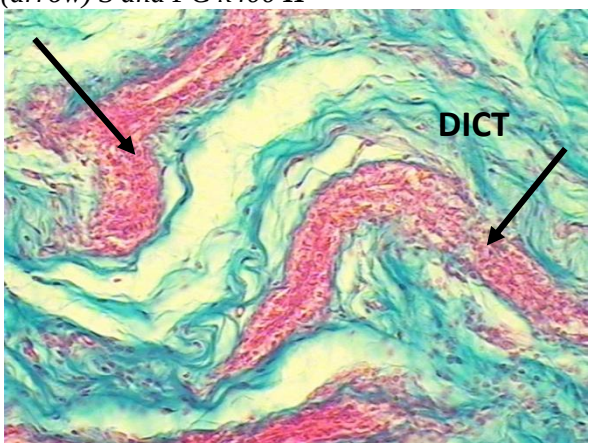


Plate IVB: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues (DICT) and atrophied glands (arrows) S and FG x400* ***M***

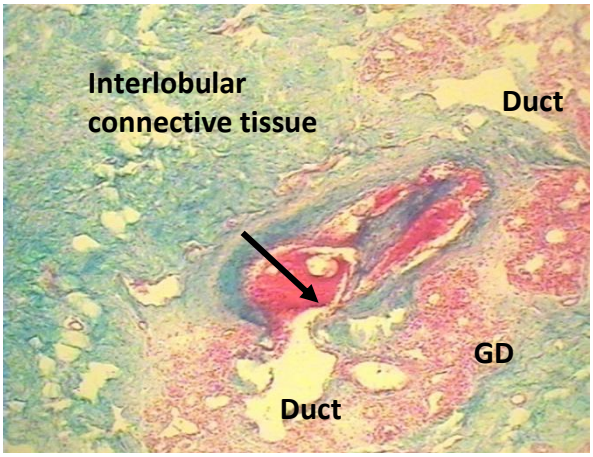


Plate IIA: *Photomicrograph of apparently healthy mammary gland of an animal showing glands (GD), protein cast (arrow) and thin interlobular connective tissues S and FG x100* ***H***

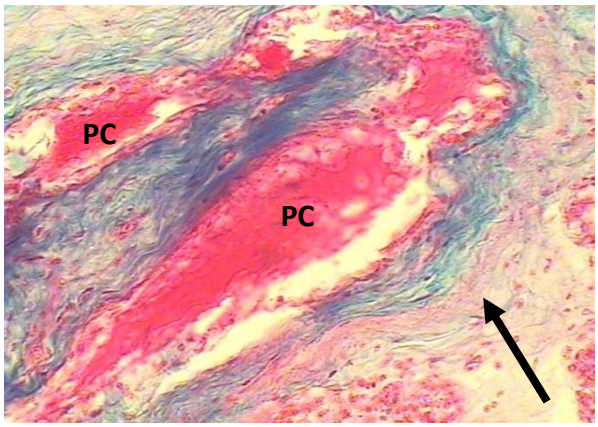


Plate IIB: *Photomicrograph of apparently healthy mammary gland of an animal showing*

interlobular connective tissues (arrows) and protein cast in the duct lumen (PC) S and FG x400 ***H***

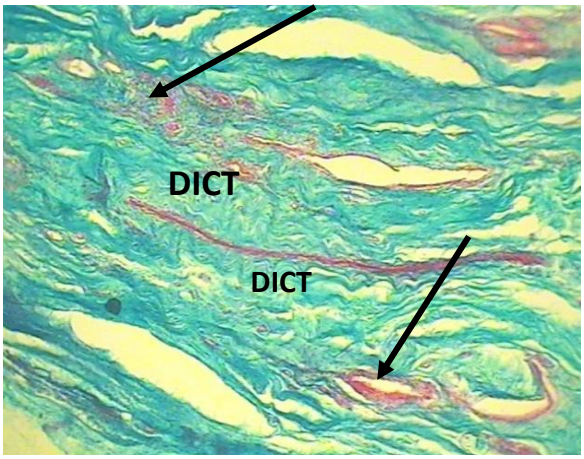


Plate VA: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues (DICT) and atrophied glands (arrows) S and FG x100* ***M***

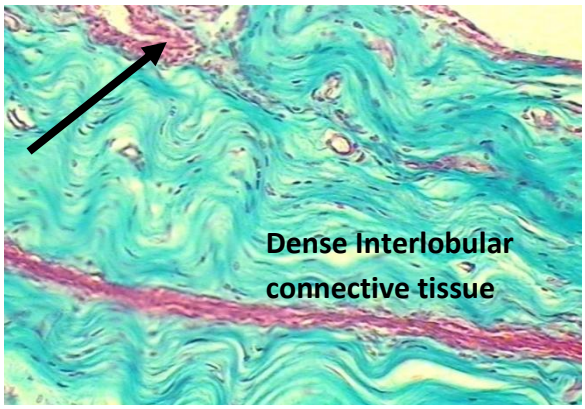


Plate VB: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues and atrophied glands (arrows) S and FG x400* ***M***

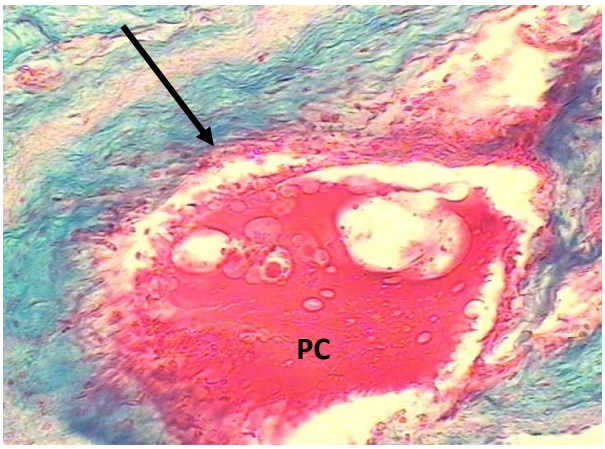


Plate IIIA: *Photomicrograph of apparently healthy mammary gland of an animal showing interlobular connective tissues (arrows) and protein cast in the duct lumen (PC) S and FG x400* ***H***

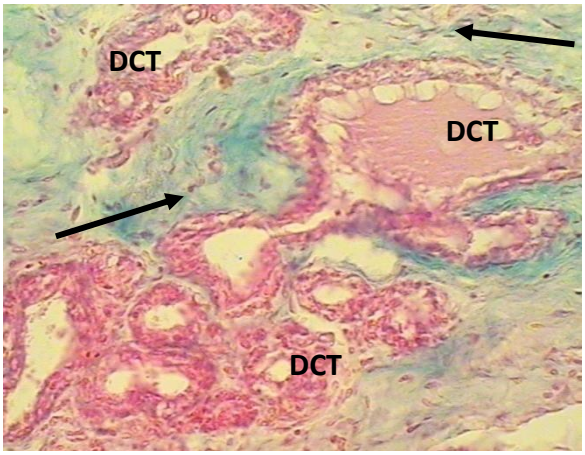


Plate IIIB: *Photomicrograph of apparently healthy mammary gland of an animal showing interlobular connective tissues (arrows) and protein cast in the convoluted duct system (DCT) S and FG x100* ***H***

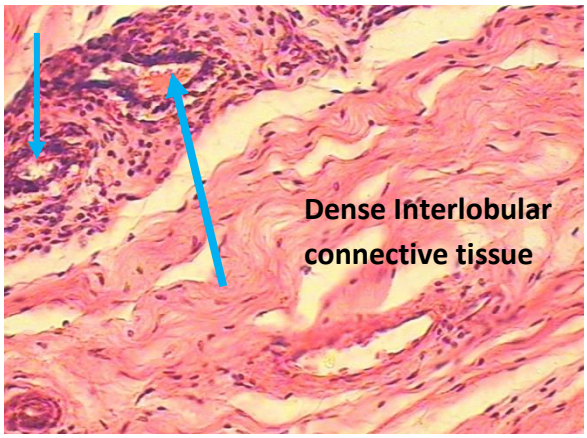


Plate VIB: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues (arrows) and atrophied glands (arrows) H and E x400* ***M***

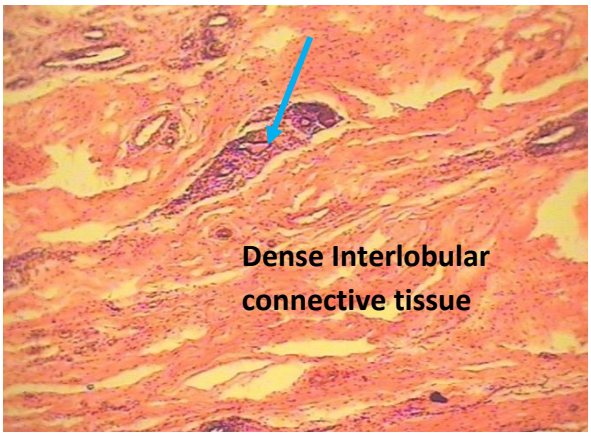


Plate VIA: *Photomicrograph of mammary gland of an animal showing dense interlobular connective tissues (arrows) and atrophied glands (arrows) H and E x100*

BETAINE HYDROCHLORIDE AMELIORATES THERMOREGULATORY RESPONSES OF BROILER CHICKENS UNDER DEXAMETHASONE INDUCED HEAT STRESS.

[1]L.A. Ademu*, [2]O.M. Daudu, [3]G.T. Iyeghe-Erakpotobor, [3]P.P. Barje, [1]J.A. Olusiyi
[1]Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria
[2]Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
[3]National Animal Production and Research Institute, Shika, Zaria Kaduna State, Nigeria
***Corresponding Author**: lawrenceademu@gmail.com*

ABSTRACT
A study was conducted to investigate the ameliorative effect of betaine hydrochloride under dexamethasone induced heat stress. A total of 300 day-old *Arbor acre* broiler chickens randomly assigned to five treatments in a completely randomized design were used in the study. The five treatments with three replicates (n= 20 birds/rep) made up of a treatment containing no dexamethasone and no betaine served as the control. Another treatment was fed 0.30% betaine only supplemented diets, with the other three treatments given daily dexamethasone concentrations at 1, 2 and 3 mg/L in water, respectively. All dexamethasone treated birds were fed 0.30% betaine HCl in their diets. Results indicated a decrease (P>0.05) in rectal temperature and respiratory rate with increasing dose of dexamethasone, especially with the betaine only group. Betaine HCl had a positive effect on thermoregulatory parameters of broiler chickens by ameliorating the negative effect of heat stress.
Keywords: Stress, Dexamethasone, Broilers, Betaine, Osomolyte

INTRODUCTION
Broiler chicken production under high ambient temperature and high relative humidity has been shown to induce heat stress (Ali *et al*., 2010). Heat stress results in the excess production of reactive oxygen species (ROS) which cause oxidative damage (Zhang *et al*., 2014). Given its similarity to endogenous corticosteroids, dexamethasone's ability to reproduce the effects of high levels of corticosterone, thus mimicking stress associated signalling pathways has been demonstrated (Eid *et al*., 2006; Aengwanich, 2007; Ademu *et al.*, 2018) A. With stress a costly problem for the broiler industry, nutritional strategies to lessen its effects are being developed. Betaine supplementation to diets for livestock has increased during the last decade (Fernandez-Figares *et al.*, 2008). Betaine, the trimethyl derivative of the amino acid glycine, is a naturally occurring compound, which is widely distributed in many plants and animal tissues. Betaine exerts an osmo-regulatory role in cells, regulating water balance, which is beneficial for alleviating physical reactions to heat stress (Ratriyanto and Mosenthin, 2018). The aim of the study was to investigate the ameliorative effect of betaine hydrochloride on the thermoregulatory responses of broiler chickens under induced heat stress conditions.

MATERIALS AND METHODS
The experiment was conducted at the Teaching and Research farm of the Department of Animal Science, Ahmadu Bello University Samaru, Zaria. Three hundred day old *Arbor acre* broiler chicks were used in the experiment. They were randomly allotted to five experimental treatments in a completely randomized design. Each treatment was replicated three times with twenty birds per replicate. A maize/soybean based broiler starter and finisher diet was formulated according to NRC (1994) nutrient requirement for broiler chickens. Birds receiving 0 mg dexamethasone and without betaine supplementation served as the control. Birds administered 1, 2 and 3 mg dexamethasone in drinking water along with a betaine only group were given diets supplemented with Betaine HCl at 0.30%. Daily doses of dexamethasone (1, 2 and 3 mg) was administered by dissolving in a litre of water and supplied for twenty-eight days beginning from when the birds attained 14 days of age.

THERMOREGULATORY MEASUREMENTS

Indoor temperature and relative humidity readings were recorded daily using an electronic digital thermo-hygrometer. Both readings were taken in the morning (8.00 am) and afternoon (3.00 pm) throughout the experimental period. Rectal temperatures and respiratory rates were measured by placing a digital thermometer in the rectum and counting of respiration (breath/minute) with the aid of a stopwatch respectively. Temperature-humidity index (THI) was calculated using the formular of Tao and Xin (2003).

$$THI = 0.85\,T_{db} + 0.15\,T_{wb}$$

Where,
THI = temperature-humidity index in °C,
T_{db} = dry-bulb or ambient temperature in °C and
T_{wb} = wet-bulb temperature in °C.
Wet bulb temperature was determined from ambient temperature and relative humidity using the empirical expression functions by Stull (2011). Heat stress was classified as absence of heat stress (<27.8), moderate heat stress (27.8-28.8), severe heat stress (28.9-29.9) and very severe heat stress (>30.0).

DATA ANALYSIS

All data collected from the experiment was subjected to analysis of Variance (ANOVA) using the general linear model procedure of JMP (2012).Where the result of ANOVA was statistically significant, test for multiple comparisons was performed to compare means of all groups using Tukey (1949).

RESULTS AND DISCUSSION

The average temperature humidity index (THI) inside the poultry house during the experimental period for mornings and afternoons is shown in Figure 1. THI in the afternoons were 25.4% higher than in the mornings indicating the absence of heat stress in the morning and the presence of very severe heat stress in the afternoon. Tao and Zin (2003) also observed that the body temperature of broilers tends to rise at THI 30.0.

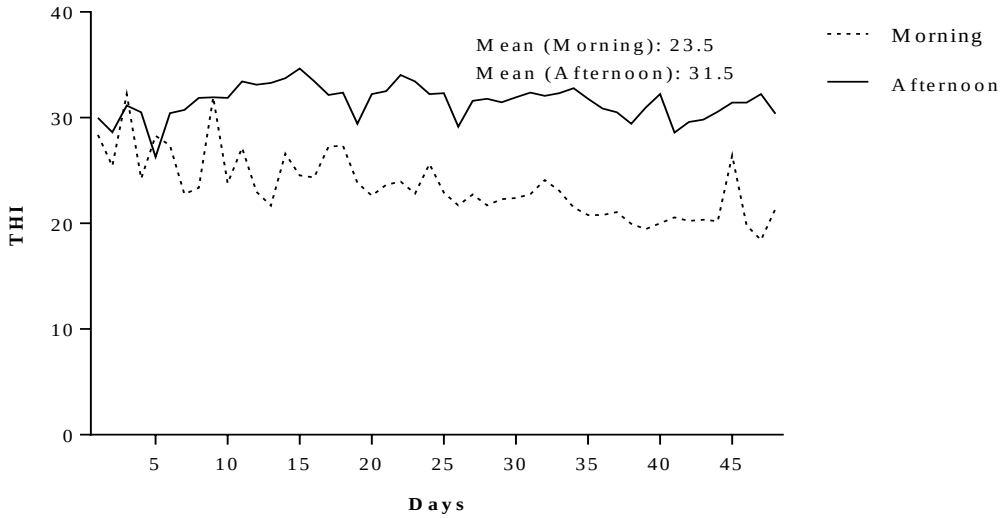


Figure 1: Daily Temperature-humidity index inside the poultry house during the experimental period

The effect of betaine HCl on rectal temperature of broiler chickens **under** dexamethasone **induced stress** is shown in Figure 2. A decrease in rectal temperature with increasing doses of dexamethasone was observed. Birds in the betaine only group had the lowest rectal temperature compared to other treatment groups. This result is supported by Hassan *et al*. (2011) and Nofal *et al*. (2015) who concluded that betaine supplementation in diets reduced rectal temperature. As an osmolyte, betaine may have a stabilizing function on cells subjected to osmotic stressors (Klasing *et al.*, (2002) by

regulating the water balance, resulting in the stability of tissue metabolism especially in the gastrointestinal tract (Lipinski *et al.*, 2012), protecting them from heat shock.

The respiratory rate (Figure 3) across the treatment groups was not significant (P>0.05). However, a decrease in respiratory rate with increasing dose of dexamethasone was observed. Birds in the betaine only group had the lowest respiratory rate. One of the visible symptoms of a bird under heat stress is panting or increased respiratory rate (Etches *et al.*,2008)When the environmental temperature exceeds the comfort limit, chickens suffer heat related stress resulting in physiological and metabolic changes (Borges *et al.*, (2007).

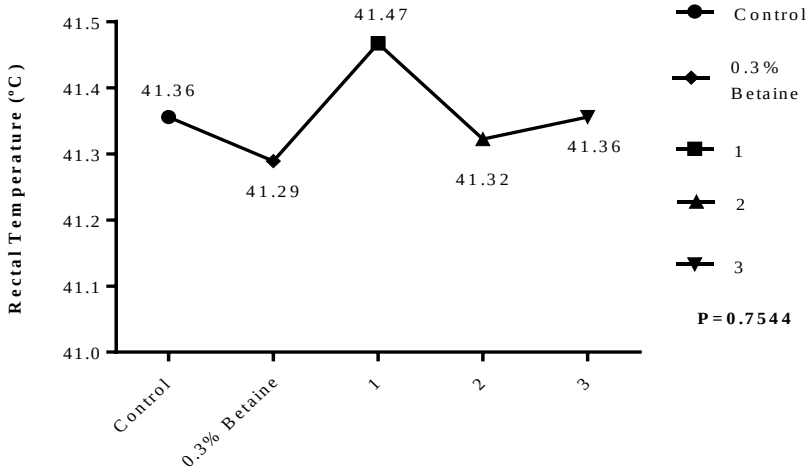


Figure 2: Effect of 0.30% Betaine HCl on Rectal Temperature of Dexamethasone Stress-induced Broiler Chickens

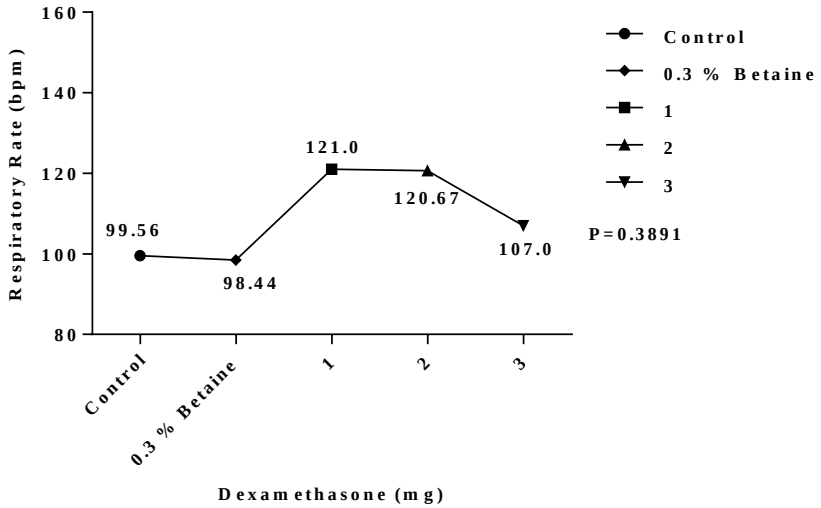


Figure 3: Effect of 0.30% Betaine HCl on Respiratory Rate of Dexamethasone Stress-induced Broiler Chickens

This study also agrees with Aengwanich (2007) who administered dexamethasone at 1-5 mg/kg to broiler chickens. Respiratory rate was found to be reduced even below that of the control group for the betaine only group indicating the ameliorative effect of betaine.

CONCLUSION

The supplementation of betaine HCl in broiler chicken diets had an ameliorative effect on thermoregulatory parameters of broiler chickens.

REFERENCES

Ademu, L.A., Iyeghe-Erakpotobor, G.T., Barje, P.P., Daudu, O.M. and R. J. Wafar (2018). Response of Broiler Chickens under Dexamethasone Induced Stress Conditions. *Asian Journal of Research in Animal and Veterinary Sciences,* 1(1): 1-9, 2018; Article no.AJRAVS.39782

Aengwanich, W. (2007). Effects of Dexamethasone on Physiological Changes and Productive Performance in Broilers. *Asian Journal of Animal and Veterinary Advances,* 2: 157-161.

Borges, S.A., Da Silva, A.V.F. and Maiorka, A. (2007). 'Acid-base balance in broilers'. *World's Poultry Science Journal*, 63(1): 73-81.

Ali, M.N., Qota, E.M.A. and Hassan, R.A. (2010). Recovery from adverse effects of heat stress on slow-growing chicks using natural antioxidants without or with sulphate. *Int J. Poult. Sci*. 9(2):109–117.

Devenport, L., Knehans, A., Sundstrom, A. and Thomas, T. (1989). Corticosterone's dual metabolic actions. *Life Sciences*, 45(15): 1389–1396.

Eid Y., Ebeid T. and Younis H. (2006). Vitamin E Supplementation Reduces Dexamethasone–induced Oxidative Stress in Chicken Semen. *British Poultry Science,* 47, 350 – 356.

Etches, R.J, John, T.M. and Gibbins, A.M.V. (2008) 'Behavioural, physiological, neuroendocrine and molecular responses to heat stress', in Daghir, N.J. (ed.) *Poultry Production in Hot Climate.* Second edition. Wallingford, UK: CAB international, pp. 31-66.

Fernandez-Figares, I., J. A. Conde-Aguilera, R. Nieto, M. Lachica and J. F. Aguilera (2008). Synergistic effects of betaine and conjugated linoleic acid on growth and carcass composition of growing Iberian pigs. *Journal of Animal Science*, 86: 102-111.

Hassan. R.H., Ebeid, T.A., Abd El-Lateif, A.I. and Ismail. N.B. (2011). Effect of dietary betaine supplementation on growth, carcass and immunity of New Zealand White rabbits under high ambient temperature. *Livestock Science*, 135: 103-109.

JMP® (2012) Software Version 6.12 of the SAS System for Windows. SAS Institute, Inc., Cary, NC, USA.

Klasing, K., Adler, K., Remus, J., and Calvert, C. (2002). Dietary betaine increases intraepithelial lymphocytes in the duodenum of coccidia-infected chicks and increases functional properties of phagocytes. *Journal of Nutrition*, 132: 2274-2282.

Lipinski, K., Szrambo, E., Jerochi, H. and Matasexicius, P. (2012). Effects of betaine on energy utilization in growing pigs- a review. *Annals of Animal Science,* 12:291-300.

NRC (1994). Nutrient Requirements of Poultry (9th Ed.). National Academy Press, Washington, DC.

Nofal, M.E., Magda, A.G., Mousa, S., Doaa, M.M.Y. and Bealsh, A.M.A. (2015). Effect of dietary betaine supplementation on productive, physiological and immunological performance and carcass characteristics of growing developed chicks under the condition of heat stress. *Egyptian Journal of Poultry Science,* 35: 237-259.

Ratriyanto, A.and Mosenthin, R. (2018). Osmoregulatory function of betaine in alleviating heat stress in poultry. *J. Anim. Physiol. Anim Nutr (Berl),* 102(6):1634-1650. doi: 10.1111/jpn.12990.

Stull, R. (2011). Wet-Bulb Temperature from Relative Humidity and Air Temperature. *Journal of applied Meteorology and Climatology,* 50: 2267- 2269.

Tao, X., Xin, H. (2003). Acute synergistic effects of air temperature, humidity and velocity on homeostasis of market–size broilers. *Transactions of the ASAE* 46(2): 491-497.

Tukey, J. (1949). Comparing Individual Means in the Analysis of Variance. Biometrics,5 (2): 99–114.

Zhang, B., Guo, X., Chen, J., Zhao, Y., Cong, X., Jiang, Z., Cao, R., Cui, K., Gao, S., Tian, W. (2014). Saikosaponin-D attenuates heat stress-induced oxidative damagein llc-pk1 cells by increasing the expression of anti-oxidant enzymes and hsp72. *Am. J. Chin. Med.* 42(5):1261–1277.

SEXUAL DIMORPHISM IN TWO STRAINS OF LOCAL TURKEY AT EARLY REPRODUCTIVE STAGE UNDER INTENSIVE SYSTEM OF MANAGEMENT IN ZARIA

[1]Olutunmogun, A.K. & [2]Yahaya, H.K.

[1]National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria, Kaduna State, Nigeria

[2]Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

Corresponding author: olutunmogunkayode@yahoo.com; +234 7039338987

ABSTRACT

The study was designed to access the variations existing in traits of local turkey's strains at their early reproductive ages with the purpose of recommending useful economic traits for selection at early reproductive age. Body weights, body length, neck length, breast girt, thigh length, shank length and keel length of 36 early reproductive turkeys reared in the intensive system of management were taken and analyzed in a one-way ANOVA. The results showed that variability was prominent between the two sex of turkey which favoured the male as an expression of sexual dimorphism for all traits while the white strain was superior over the black in traits of body weight and breast girth. It can be concluded that breeders can select this unimproved local turkey strains considering the high level of coefficient of variation exhibited between sexes and strains for improved productivity.

Key words: Sexual dimorphism, Strain, Local Turkey, Intensive system

INTRODUCTION

Turkey (*Meleagris gallopavo*) is a large gallinaceous bird that belongs to the of family *Meleagridae* and occupies an important global position next to chicken and duck in world poultry population (Besbes, 2009). In Nigeria, Turkey is not common among poultry growers: a number of farms are beginning to multiply the bird at commercial level owing to increasing interest as a provider of lean meat among all domestic avian species and complementing chicken meat (Das *et al*., 2018). They are mostly located in urban areas and are gradually spreading even to village farms (Ogah, 2011). They have a unique and remarkable phenomenon in adaptability to wide range of climatic conditions and can be raised successfully almost everywhere in the world if they are well fed and protected against diseases, predators and adverse weather conditions (Bhanja and Majumdar, 2001). Apart from the role in protein supply where some consumers refer to its meat as luxury meat (Das *et al*., 2018), the birds have an aesthetic value due to their beauty (Ogundipe and Dafwang, 1980). Many varieties of turkeys exist around the globe however principal varieties that have attained commercial importance in many parts of the world are, broad breasted large white and broad breasted bronze. Other varieties are White Holland, Beltsville small white, Black Turkey, Bourbon Red and Narrangansett Turkey (Ogundipe and Dafwang, 1980). Sexual dimorphism is a phenomenon where variations exits between the male and female either in size, plumage colour or ornamentals. In size or bodyweights, male animals are adjudged to be consistently bigger than their female counterparts, an attributed linked to sex differential hormonal effect on growth (Musa *et al*., 2015). Therefore, this current study is focused on investigating the body and linear measurements of two local Turkey strains at their early reproductive stage under intensive system of management in Zaria.

MATERIALS AND METHODS

Experimental location

The study was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria. The farm is located at latitude 11° 09' 06' N and longitude 7° 38' 55' E, at an altitude of 706 m above sea level (Ovimaps, 2019). The climate is relatively dry with a mean annual rainfall of 700-1400mm occurring from late April to mid-October. The temperature varies from 26°C to 35°C depending on the season while the relative humidity during the hamattan period, hot and wet seasons are 21, 37 and 77% respectively (IAR, 2019).

EXPERIMENTAL DESIGN AND DATA COLLECTION

A total of thirty-six (36) poult turkey toms and hens of two different strains (black and white plumage strains) were purchased from an open market in Gurbi, Zurmi Local government area of Zamfara State, Nigeria. The birds were initially quarantine for a period of about two (2) weeks and given anti-biotic medications against any possible infection. After which the birds were managed on the deep litter system with each of the turkey in separate pens for proper identification and collection of data. The birds were fed with compounded feed meant for adult turkey birds containing 3,350Kcal/kg metabilizable energy and 17% crude protein. Feed and clean drinking water were given *ad libitum*.

EXPERIMENTAL DESIGN AND DATA COLLECTION

Thirty-six (36) adult turkeys of two different strains (black and white plumages) were used for the study. They were randomly assign into individual pens in a completely randomized design (CRD) for easy data collection. Body measurements taken were as described by Gueye *et al*. (1998) with the weight taken with the aid of a weighing scale while body measurements were taken using a flexible measuring tape.

Body weight: This is the weight of the birds taken by use of a 20kg weighing scale in kilogram.
Neck length: This was considered as the distance between the occipital condyle and the cephalic borders of the caracoids.
Shank length: This was measured from the hock joint to the tarso-metarsus digit-3 joint.
Thigh Length: This was taken as the distance between the hock joint and the pelvic joint.
Body length: This was measured as length of the body from the base of the neck to the base of the tail.
Keel Length: This was taken as the length of the cartilaginous keel bone or metasternum.
Breast girth: This was taken under the wing at the edge of the sternum.

Statistical Analysis

Data collected from the study were subjected to one-way Analysis of Variance (SAS, 2002) and the differences between means were separated using the Duncan Multiple Range Test (Duncan, 1955). The appropriate statistical model used was:

$Y_{ijk} = \mu + T_i + A\sigma_j + e_{ijk}$

Where Y_{ijk} = observation of the kth random error on the jth covariate of age effect on the ith strain of turkey. μ = the overall common mean, T_i = the effect of ith strain of turkey (i = 1, 2), $A\sigma_j$ = the covariate of age, e_{ijk}= random error.

RESULTS AND DISCUSSION

The descriptive statistics showing means standard error (±SE) and coefficient of variation estimate (CV) of body weight and linear body measurements of the two strains of local turkey at early reproductive age has affected by sex is presented in Table 1 while Table 2 showed the pooled descriptive statistics. The result on sex effects showed that all the traits had significant ($p<0.05$) differences thereby been ascribed to sexual dimorphism. The pooled effect by strain showed that body weight, breast girth and keel length were significantly ($p<0.05$) different with the white strain been superior. This result shows a variance with that of Ogah (2011) who reported lesser values for body weight, neck length, thigh length and breast girth in indigenous turkeys. However, it was similar for shank length, body length and keel length with that of Ogah (2011). Similarly, the results in this present study differs from those of Fayeye *et al*. (2019) who reported black and mixed strain being superior over the white strain in body weights. In the report of Janjecic and Muzic (2007) in Zagorje turkey, body weights of 6.01kg for male and 3.97kg for female were similar with those of this current study. Oblakova (2007) reported different values on turkey broiler parents which is not in agreement with this study. The differences between this study and similar once could be associated to age, strain or management differences although these studies were able to identifier the phenomenon of sexual dimorphism. Also, the difference with those from tropical region may have been due to the unfavourable environmental conditions such as temperature, feed supply and non-selection characteristics of tropical animal genetic resources as discussed by Ogah (2011) and as observed from the high coefficient of variations in some traits. Furthermore, the differences could be attributed to sex

differential hormonal effect which affect growth and muscle development more in males as discussed by Musa *et al*. (2015).

CONCLUSION

The variations observed from the various traits between the sexes supports the phenomenon of sexual dimorphism as noted from the descriptive analysis while the white strain demonstrate superiority in traits of bodyweight and breast girth. Therefore, breeders can select this unimproved turkey strains considering the variability and high level of coefficient of variation between sex and strain for improved productivity.

REFERENCES

Besbes, B. (2009). Genotype evaluation and breeding of poultry for performance under sub-optimal village conditions. *World's Poultry Science Journal*, 65: 260–271.

Bhanja, S.K. and Majumdar, S. (2001). Formulation of turkey feed. In: Modern turkey production and management (AKD Roy, ed). Turkey Research Unit, Central Avian Research Institute, Izatnager, India. Pages 49–52.

Das, S.C., Yahya, M., Hasan, M.S., Hossain, M.A., Akter, T. and Sultana, M. (2018). Growth performance of White, Black and Bronze color heritage turkeys under semi-intensive system**.** *Journal of Bangladesh Agricultural University*, 16(3): 471-477.

Duncan, D.B. (1955). Multiple range and multiple F tests. *Biometrics*, 11: 1 – 42.

Fayeye T. R., Jubril A. E. and Gbadamosi, T.M. (2019). Effect of sex, strain and age on body weight in turkey poults. *Proc. of the 44thAnnual Conference of the Nigerian Society for Animal Production (NSAP), March, University of Abuja.* Page 174 – 177.

Gueye, E.F. (1998). Village egg and fowl meat production in Africa. *World Poultry Science*, 54: 73-86.

IAR (2019). Institute of Agricultural Research, Ahmadu Bello University, Zaria. Metrological Data Information of Samaru and its environs.

Janjecic, Z. and Muzic, S. (2007). Phenotypic traits in Zagorje turkey. *Acta Agraria Kaposvariensis*, 1(8): 1-5.

Musa, A.A., Okpanachi, A.M., Olutunmogun, A.K., Adedibu, I.I. and Oyibo, A. (2015). Investigation of some morphometric, haematological and biochemical markers for body weight improvement in Marshall strain of broilers. *Proc. 40th Annual Conference of the Nigerian Society for Animal Production (NSAP), 15-19th March, NAPRI/ABU, Zaria*. Page 42-45.

Oblakova, M. (2007). Weight development and body configuration of turkey–broiler parent Big 5. *Trakia Journal of Science*, 5(1): 28-32.

Ogah, D.M. (2011). Assessing size and conformation of the body of Nigerian indigenous Turkey. *Slovak Journal of Animal Science*, 44(1): 21-27.

Ovimaps (2019). Ovilocation map; ovi earth imaginery. Dated August, 2018.

Ogundipe, S.O. and Dafwang, I.I. (1980). Turkey production in Nigeria. National Agricultural Extension Research and Liaison Service (NAERLS). *Bulletin*, 22: 2–22.

SAS, (2002). Statistical Analysis System, Computer software, Version 9: Statistical SAS Institute Inc. Cary, Northern Carolina 27513, USA.

Table 1: Descriptive statistics of body weight and linear measurements (±SE) of two strains of local Turkeys has affected by sex at early reproductive age

	Black strain				White strain			
	Sex				Sex			
Traits	**Hens**	**Toms**	**CV**	**P-value**	**Hens**	**Toms**	**CV**	**P-value**
Body weight (g)	3400±39.31[b]	5411±50.12[a]	10.84	0.04	3602±38.92[b]	6004±50.12[a]	8.32	0.042
Body length (cm)	33.2±5.74[b]	38.29±6.00[a]	12.37	0.051	36.4±5.80[b]	40.46±6.00[a]	10.14	0.051
Neck length (cm)	20.3±4.20[b]	28.0±4.35[a]	4.33	0.04	21.03±4.10[b]	29.25±4.35[a]	3.06	0.04
Breast girth (cm)	52.4±5.95[b]	54.19±5.60[a]	16.39	0.05	64.3±5.90[b]	65.42±5.60[a]	12.02	0.05
Thigh length (cm)	18.01±3.00[b]	23.38±3.01[a]	12.98	0.04	18.44±3.01[b]	24.05±3.01[a]	11.45	0.04
Shank length (cm)	11.91±1.24[b]	14.63±1.47[a]	14.06	0.05	11.01±0.19[b]	14.58±1.47[a]	13.11	0.05
Keel length (cm)	13.55±1.11[b]	17.24±1.50[a]	25.41	0.04	11.27±1.10[b]	14.69±1.51[a]	23.04	0.04

[ab] = means in the same column with different superscript differ significantly ($p<0.05$), cv = coefficient of variation

Table 2: Pooled descriptive statistics of body weight and linear measurements (±SE) of two strains of local Turkey at early reproductive age

Traits	**Black strain**	**White strain**	**CV**	**P-value**
Body weight (g)	4406±45.02[b]	4803±45.02[a]	18.01	0.04
Body length (cm)	35.75±4.00[ns]	38.43±4.00[ns]	6.25	0.13
Neck length (cm)	24.17±4.05[ns]	25.13±4.05[ns]	9.38	0.20
Breast girth (cm)	53.32±5.32[b]	64.86±5.32[a]	20.10	0.04
Thigh length (cm)	20.68±3.00[ns]	21.24±3.01[ns]	6.00	0.06
Shank length (cm)	13.27±1.41[ns]	12.81±1.41[ns]	10.23	0.09
Keel length (cm)	15.04±1.10[a]	12.99±1.10[b]	30.24	0.05

[ab] = means in the same column with different superscripts differ significantly ($p<0.01$), ns = not significant, cv = coefficient of variation

BODY-WEIGHT AND MORPHOMETRIC ATTRIBUTES OF SOME CATTLE BREEDS IN NIGERIA

A. D. Oladepo[1], A. A. Adeoye[2], O. A. Jimoh[3] and O. A. Adeniyi[4]

[1]Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria.
[2]Department of Animal Production and Health, Ondo State University of Science and Technology, Okitipupa, Ondo State, Nigeria.
[3]Department of Agricultural Technology, The Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria
[4]Department of Animal Health and Production, Technology, Oyo State College of Agriculture and Technology, Igboora, Oyo State, Nigeria.

ABSTRACT

In Nigeria, population characteristics of selected indigenous cattle breeds have not been fully documented. Therefore, morphometric attributes of selected indigenous cattle breeds in Nigeria were assessed. Three hundred and one White Fulani (WF), Two hundred and forty two Red Bororo (RB), Two hundred and forty seven Sokoto Gudali (SG), Two hundred and thirty three Bornu Kuri (BK) and One hundred and eighty four Muturu cattle in the age group of 3 to $3^1/_2$ years were purposively sampled. Eighteen morphometric parameters were measured using standard procedures. Data were analysed using descriptive statistics, ANOVA at $\alpha_{0.05,}$cluster analysis and Euclidean genetic distance. The longest geneticdistance at the morphometric level was 146 between Muturu and BK and shortest (44) between BK and RB. Differences existed in face length, rear leg length; wither height and rump height among the breeds.

Keywords: Attributes, bodyweight, breeds, cattle, morphometric

INTRODUCTION

One of the ways of characterizing livestock breeds is to evaluate their morphostructural characteristics and determine genetic distance among contemporary populations (Metta *et al.* 2002).The initial step in characterization is identification of distinct populations using information on their geographic and ecological isolation, traditional nomenclature (traditionally, recognized populations), phenotypic distinctness and level of genetic differentiation among the population (Gizaw *et al.* 2011). Indigenous cattle breeds are important to preserve as they are well adapted to local climates, food supply and other local environmental factors, which often shows in their robustness and hardiness. Indigenous livestock resources are also strategic in the socio-economics of rural agricultural systems to ensure food security in developing countries. The selected cattle breeds are found throughout Nigeria, but are most common in the northern part the country.

The wither height and rump height among these breeds differentiated them. This study is designed to unveil the phenotypic and genetic diversity among selected Nigeria indigenous cattle breeds using primary data obtained from field morphological survey to assess diversity of the selected indigenous populations in order to update published variations as well as document genetic distances between the populations.

MATERIALS AND METHODS

Animals were sampled from four different isolated areas where they were abundant in Nigeria (Ipokia – Ogun State; Biliri – Gombe State; Bida and Kontagora – Niger State). Each location was divided into clusters of ten units for easy measurements and adult animals that were within the age bracket of 3 to $3^1/_2$ years were sampled. A total of one 1207 indigenous cattle comprising 301 White Fulani 247 Sokoto Gudali, 242 Red Bororo, 233 Bornu Kuri and 184 Muturu were sampled.

Eighteen linear body measurements (cm) were taken on each sampled animal with the use of a measuring tape (Table 1). Quantitative variables measured in this study were adapted from the standard cattle descriptor list (FAO 2002) and a final list of variables were developed and used. Documented morphological features described by (Hall 1991) were used as base line markers to ascribe sampled animals to a breed. Individuals that did not strictly conform to primary breed characters; visibly pregnant, sick and castrated animals were excluded. Data collected were subjected to Generalized Linear Model Analysis of Variance (ANOVA) procedure of the Statistical Analysis System (SAS 2002) and cluster analysis of Palenotological Statistics (PAST). Least Square Means (x) and Standard Error (SE) associated with each linear body measurements were estimated. Genetic distances among the five breeds based on their actual morphometric variables measured were

calculated using Euclidean genetic distance measure. The statistical model used for analyzing quantitative phenotypic variations among the breed populations was as follows:

$$Y_i = \mu + B_i + e_i$$

where Y_i are the observed body measurements, μ is the overall mean, B_i is the fixed effect of breed (i = 1,2,..5) and e_i is the standard error.

RESULTS AND DISCUSSION

Mean values of morphological variables and their SE are depicted in Table 1 for aggregated gender. Pairwise mean comparison showed significant differences for most of the morphological variables among the breeds. Wither height, rump height, body length, and tail length were significantly higher ($p<0.05$) for White Fulani and Sokoto Gudali as compared to other breeds considered in this study. Muturu breeds had significantly ($p<0.05$) larger face length and head width than other four breeds. The genetics distance among the cattle population ranged from 43.77 to 145.52 (Table 2). The longest genetic distance was observed between Bornu kuri and Muturu while the shortest distance was observed between Red Bororo and Bornu Kuri. The cluster analysis generated showed two main clusters having Muturu in a cluster and White Fulani, Sokoto Gudali, Bornu Kuri and Red Bororo in the other.

The significantly higher values for most of the morphometric measurements of White Fulani, Sokoto Gudali, Red Bororo and Bornu Kuri that were predominantly in the northern part of the country than Muturu that is predominantly in southern part of the country seem to be an adaptation where tallness (wither height) and large body size (heart girth and body length) are suitable for trekking long distances to water and grazing points and this is in agreement with what Mwacharo et al., 2006 and Hall 1991 reported. These observations could be as a result of genetic and species differences. The differences in body measurements of the five cattle breeds with respect to some morphological variables indicates that the five cattle breeds were sub-divided into distinct populations perhaps due to differences in availability of feed resources, breeding practices used and inherent genetic differences (Mwambene *et al.*, 2012).

A shorter genetic distance obtained between White Fulani and Sokoto Gudali suggests a close genetic relationship between the breeds while the longer genetic distance was observed between White Fulani and Muturu is an indication that an appreciable heterosis especially with regard to most body measurements which are of economic importance can be obtained by crossing any of the two breeds.The phylogenetic tree separated the five cattle breeds into two main clusters. In addition, the close genetic relationship between the breeds may also be attributed to similarity in ecological zones and production systems as well as the incidents of cross border livestock rustling contributing to the migration and movement of livestock and subsequent interbreeding between such livestock, this in agreement with had been reported by (Nwacharo *et al.* 2006). There were clear disparities in the wither height and body length of the five breeds. White Fulani was found superior to any of the other four breeds studied. Genetic distance based on morphological indices among the breeds as revealed by the cluster analysis showed that the breeds were genetically distinct.

Table 1. Means of body measurements (±SEM) amongst the five cattle breeds

	WF±**SEM**	SG±**SEM**	RB±**SEM**	BK±**SEM**	MU±**SEM**
FL	49.37±0.44^{b}	47.51±0.36^{c}	40.35±0.33^{c}	45.44±0.57^{d}	54.03±0.39^{a}
HW	22.62±0.16^{c}	22.57±0.15^{c}	21.21±0.14^{d}	24.11±0.18^{b}	28.53±0.68^{a}
HL	45.16±0.84^{a}	4.56±0.44^{d}	38.05±0.32^{b}	38.39±0.57^{b}	8.30±0.35^{c}
EL	23.86±0.52^{a}	24.17±0.65^{a}	24.07±0.52^{a}	24.17±0.56^{a}	14.61±0.24^{b}
NL	54.56±0.58^{a}	51.34±0.41^{b}	38.97±0.40^{c}	38.79±0.51^{c}	25.40±1.09^{d}
NC	54.71±0.51^{c}	59.08±0.51^{b}	76.85±0.32^{a}	77.75±0.81^{a}	60.93±0.18^{b}
WH	130.39±0.21^{a}	129.21±0.23^{a}	125.65±0.11^{b}	125.18±0.15^{b}	82.41±0.07^{c}
FLL	78.39±0.45^{b}	80.39±0.45^{b}	85.96±0.41^{a}	87.59±0.43^{a}	56.71±0.25^{c}
HG	83.20^{c} ±0.18^{c}	95.92±0.28^{b}	144.41±0.12^{a}	144.40±1.12^{a}	57.03±0.43^{d}
BL	116.45±0.11^{a}	116.03±0.08^{a}	111.17±0.06^{b}	112.64±0.41^{b}	73.55±0.21^{c}
RH	135.40±0.17^{a}	134.22±0.21^{a}	130.59±0.09^{b}	131.53±0.50^{b}	88.46±0.54^{c}
RL	30.56±1.19^{a}	30.58±0.26^{a}	31.03±0.75^{a}	30.97±0.21^{a}	20.89±0.41^{b}
RLL	105.45±0.21^{a}	105.41±1.01^{a}	104.64±0.19^{a}	105.06±1.17^{a}	73.93±0.63^{b}
TL	96.10±0.49^{a}	94.98±0.36^{a}	91.89±0.17^{b}	91.30±0.14^{b}	55.98±0.41^{c}
SC	25.06±0.43^{a}	24.75±0.39^{ab}	24.66±0.22^{ab}	24.40±0.08^{b}	21.86±0.14^{c}
HoL	50.90±1.11^{a}	50.05±0.71^{b}	50.07±0.47^{b}	49.41±0.43^{b}	32.74±0.35^{c}
RW	35.19±0.56^{a}	35.38±0.42^{a}	34.45±0.41^{b}	35.18±0.20^{a}	28.32±0.24^{c}
SW	68.02±0.52^{b}	69.59±0.34^{b}	80.89±0.46^{a}	81.85±0.11^{a}	63.58±0.22^{c}

Means with same superscript are not significantly different (P>0.05). SEM = Standard Error Mean
WF =White Fulani, SG = Sokoto Gudali, RB = Red Bororo, BK = Bornu Kuri, MU = Muturu
FL = Face Length, Head Width = HW, Horn Length = HL, Ear Length = ER, Neck Length =NL, Neck Circumference = NC, Wither Height = WH, Foreleg Length = FLL, Hearth Girth = HG, Body Length = BL, Rump Height = RH, Rump Length = RL, Rearleg Length = RLL, Tail Length =TL, Shin Circumference = SC, Hock Length = HoL, Rump Width = RW, Shoulder Width = SW

Table 2: Euclidean genetic distance estimate based on actual measured morphometric variables

	White Fulani	Sokoto Gudali	Red Bororo	Bornu Kuri	Muturu
	-				
Sokoto Gudali	54.36	-			
Red Bororo	70.44	65.63	-		
Bornu Kuri	54.54	54.54	43.77	-	
Muturu	114.87	83.86	136	145.52	-

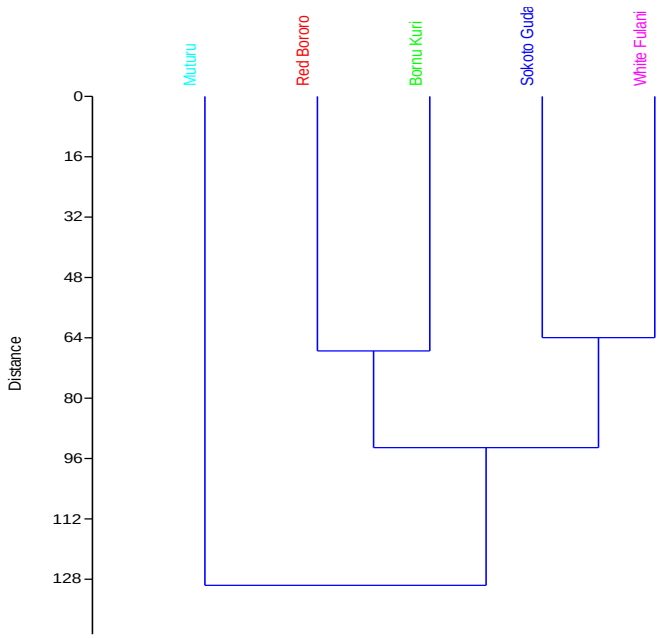


Figure 1. Dendogram showing genetic relationship among five indigenous cattle from Nigeria

CONCLUSIONS

Morphometric attributes are very good tools in differentiating cattle on the basis breeds. The closer genetic relationship among White Fulani, Sokoto Gudali, Red Bororo and Bornu Kuri five cattle breeds may be attributed to possible interbreeding among these populations that were predominantly abundant in the northern part of the country forming homogeneous population separated by no physical geographic boundaries.

REFERENCES

FAO. (2012). FAO Animal production and Health Guidelines No. 11, Rome.

Gizaw, S., Komen, H., Hanotte, O., Van Arendonk, J.A.P: Kemp, S., Aynalem, H. Mwai, Ol and Dessie, T. (2011). ILRI Research Report No. 27. Nairobi, Kenya. ILRI.

Hall, S. J. G. (1991). *Anim. Prod. (UK) 53, 61-69.*

Metta, M., Kanginakudru, S., Gudiseva, N. and Nagaraju, J. (2004). *BMCGenetic, 5:16 (doi: 1186/1471-2156-5-6 or http://www.biomedcentral.com/1471-22156/5/16).*

Mwacharo, J. M., Okeyo A. M., Kamande ,G. K. Rege, J. E. O. (2006). *Trop. Anim. Health Prod., 38: 65-76.*

Mwambene, P. L., Katule, A. M. Chenyambuga, S.W. and Mwakilembe, P. A. A. (2012). *AGRI, 51:51-29.*

SAS. (2002). User's guide: Statistic. SAS institute Inc. Cary, North Carolina, USA.

BREED VARIATION IN THERMOREGULATORY PARAMTERS AND THEIR CORRELATED RESPONSES IN SOME SELECTED INDIGENOUS CATTLE

[1]Abbaya, H.Y., [2]Adedibu, I.I., [2]Kabir, M. and [3]Iyiola-Tunji, A. O
[1]Department of Animal production, Adamawa state University, PMB 025 Mubi, Adamawa State
[2]Department of Animal Science, Ahmadu Bello University, Zaria, PMB 1044, Zaria, Nigeria.
[3]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria,
***Corresponding Author:** Abbaya, H. Y; **Email**: abbaya177@gmail.com*

ABSTRACTS
The study, breed variation in thermoregulatory parameters and their correlated responses in some selected indigenous cattle was conducted to evaluate breed differences in thermoregulatory parameters of four Nigerian indigenous breeds of cattle (Bunaji, Rahaji, Bokoloji and Adamawa Gudali). A total of eighty (80) cattle were used for the experiment (20 from each breed). Data were taken three times within the period of three months (August- October) and were subjected to ANOVA using SAS software. Parameters measured were rectal temperature, respiratory rate, pulse rate and Heat Tolerance Coefficient . There were significant ($p<0.05$) effect of breed all the parameters measured except ($p>0.05$) rectal temperature. Bokoloji recorded the highest in respiratory rate (21.80 beats/minutes) and Heat Tolerance Coefficient (1.91) while the highest recorded value for pulse rate (22.10) was in in Bunaji. The correlation coefficient between parameters shows that significant ($p<0.05$; $r = 0.40- 0.49$) positive relationship exist between HTC and RR in all the breeds studied. Also, significant ($p<0.05$; $r = - 0.29- 0.31$) negative relationship exist between PR and RT except for the positive relationship ($p< 0.05$; $r = 0.73$) in Rahaji breed. It was concluded that Bokoloji and Bunaji breeds of indigenous cattle are more reactive to heat stress than Rahaji and Adamawa Gudali. Also, correlated responses within breed for thermoregulatory parameters can be maximized for selecting animals for improved heat tolerance.
Key words: breed, thermoregulation, indigenous, cattle

INTRODUCTION
Tropical cattle are known for their ability to tolerate heat while maintaining standards of milk yield, reproduction, and disease resistance (Atrian and Aghdam, 2012). Thermo-tolerance in cattle is one of the desired adaptive ability of tropical cattle. Cow demonstrate certain physiological responses when under heat stress. It was reported that any change in the environmental conditions, as is the case during heat stress, threatens the normal metabolic balance and usually produces a positive feedback once the temperature is above the upper critical temperature (UCT) (Hayes *et al*., 2009; Atrian and Aghdam, 2012). Some physiological traits are related to the ability of the animal to cope with heat stress (Garner *et al*., 2016). For example, sweating rate, rectal temperature and respiration rate increase when animals are exposed to warm environment (Garner *et al*., 2016; Rashamol *et al*., 2018). Inclusion of these heat tolerance indicator traits in large-scale phenotype recording systems for selecting thermo-tolerant animals appears rather problematic in terms of logistics and costs (Nguyen *et al*., 2016).

High producing cattle have been reported to suffer more from heat stress than low producing cattle (West, 2002; Nayak *et al*., 2018). Heat-tolerant cows, ranked according to a genomic breeding value of heat tolerance based on milk yield, showed lower values of physiological indicators (core body temperature, rectal and intra-vaginal temperature) than heat-sensitive cows (Macciotta *et al*., 2016). Heat stress causes changes in phenotypic and genotypic traits in livestock and is quantified by the measurement of physiological responses such as respiration rate (RR), rectal temperature(RT), skin temperature(ST), pulse rate (PR) and sweating rate (SR) (Rashamol *et al*., 2018). Among the physiological parameters RR, RT and ST are identified as the biomarkers for quantifying the heat stress impact on livestock (Shaji *et al*., 2016).

Some physiological parameters were reported to be associated with thermo-tolerance in Indian Thartarker cattle, Angus cattle, Holstein- Friesian cross bred and Deoni cattle raised in India and Sahiwal cows in India. But there are dearths of information on the thermos-tolerant ability of the Nigerian indigenous cattle. Therefore, this paper seeks to present the thermo-tolerance of four selected indigenous cattle using physiological biomarkers.

MATERIALS AND METHODS

Study location: The study will be conducted in some selected dairy herds in Adamawa State. Adamawa State is located at an altitude of 200 to 300 metres, between latitude 9°20' and 9°33'N and longitude 12^0 30' and 12º50' E. It is bordered by Borno State to the North West, Gombe to the West and Taraba to the South West and has an Eastern border with Cameroun Republic. It has average daily minimum and maximum temperatures of 23.2 and 35.2ºC respectively. The average annual rainfall is 718.1 millimetres and relative humidity, 44.2 %. It occupies an area of 39,742.12 square kilometres. (National Bureau of Statistics, 2010; Ovimaps, 2018).

SOURCES OF EXPERIMENTAL ANIMALS AND MANAGEMENT

Eighty (80) clinically healthy dairy cows made up of twenty (20) each of Adamawa Gudali, Red Bororo, Sokoto Gudali and Bunaji of similar ages in selected Farms in Adamawa State were used for the experiment. The experiment spanned the period of three months (August- October). These The animals that will be used were in their first parity and early lactation stage (1-60) days.

THERMOREGULATORY DATA COLLECTION

Rectal temperature (RT):This was taken using a digital thermometer. The sensory tip was disinfected and inserted into the rectum at the display of L^0C by a thermometer (which is an indication that the thermometer was set for temperature reading) and was removed by the sound of alarm signal. It was recorded in ^0C.

Respiratory rate (RR): This was determined by counting the number of flank movements per minute. It was measured by placing the fingertips on the femoral arteries of the hind limb for 1 minute. It was recorded in beats/minute

Pulse rate: this was taken by using placing a stethoscope at the

Heat tolerance coefficient (HTC): HTC was calculated based on heat tolerance index developed by Benezra, (1954). The formula is based on both respiration rate and rectal temperature.

HTC: RR/23 + RT/38.33

Data Analyses

Statistical model

The statistical model for the experiment is as given below;

$Y_{ij} = \mu + B_i + e_{ij}$

Where; μ = general mean, $B_i = i^{th}$ fixed effect of breed; e_{ij} = experimental error

.

STATISTICAL ANALYSIS

The data collected on thermoregulatory parameters was subjected to analysis of variance (ANOVA) using General Linear Model of (SAS) (2002) while significant difference was separated using Duncan Multiple Range test (Duncan, 1955). The degrees of relationship between all pairs of thermoregulatory parameters was computed for all the animals within each breed groups using CORR procedure of the SAS (2002) statistical package.

RESULTS AND DISCUSSION

Table 1shows the breed variation in thermoregulatory parameters of four selected indigenous breeds of cattle. There were significant ($p< 0.05$) effect of breeds on the parameters measured except for rectal temperature ($p<0.05$). Bokoloji recorded the highest in respiratory rate (21.80 beats/minutes) and Heat Tolerance Coefficient (1.91) while the highest recorded value for pulse rate (22.10 beats/minutes) was in in Bunaji. Respiration rate which is the intake of oxygen and elimination of carbon dioxide under thermo-neutral condition that leads to evaporation and dissipation of moisture from the respiratory tract to maintain thermal balance (Rashamol *et al*., 2018) has been considered as one of the critical biomarkers for determining heat stress in farm animals. Breed variation in RR was also reported by Sailo *et al.* (2017), the RR were reported to be 15.738 in Sahiwal and 15.779 in Karan Fries cattle during winter. In another study, Valente *et al* (2015) reported a higher RR in Angus cattle (104 breaths/ minute at 37^0C) during a heat stressed condition. Heat tolerance coefficient measures the adaptability of an animal during heat stress. Hence lower HTC may indicate an improved thermo-tolerance which had been useful in genetic improvement in cattle (Kumar et al., 2017). From this study therefore, Rahaji is the most adaptable breed in the studied area.

Table 1: Breed variation in thermoregulatory parameters of some selected indigenous breeds of cattle in Nigeria

Parameters	Bunaji	Rahaji	Bokoloji	Adamawa Gudali
RT (^{o}C)	37.84	36.98	36.96	36.80
RR (beat/min.)	18.30^{b}	18.00^{b}	21.80^{a}	19.70^{ab}
P. R	22.10^{a}	16.90^{b}	16.10^{b}	16.80^{b}
HTC	1.78^{ab}	1.75^{b}	1.91^{a}	1.82^{ab}

Table 2: Correlation among thermoregulatory breeds of cattle

Breed		RT	RR	PR	HTC
Bunaji					
	RT		0.23	-0.29*	0.40*
	RR			-0.71**	0.98**
	PR				-0.72**
	HTC				
Rahaji					
	RT		-0.61**	0.73**	-0.43*
	RR			-0.43*	0.98**
	PR				-0.29*
	HTC				
Bokoloji					
	RT		0.31*	-0.31*	0.49*
	RR			-0.09	0.98**
	PR				-0.15
	HTC				
A. Gudali					
	RT		0.23	-0.29*	0.40*
	RR			-0.71**	0.98**
	PR				-0.72**
	HTC				

Table 2 shows the correlation among the various measured thermoregulatory parameters of the selected breeds. Significant ($p<0.05$; $r = 0.40- 0.49$) positive relationship exist between HTC and RR in all the breeds studied. Also, significant ($p<0.05$; $r = - 0.29- 0.31$) negative relationship exist between PR and RT except for the positive relationship ($p< 0.05$; $r = 0.73$) in Rahaji breed. Parameters that are positively correlated suggest that a significant increase in one parameter will result in significant increase on the other correlated parameter (vice- versa).The high positive correlation observed among thermoregulatory parameters (RR and RT) suggest that these traits are influenced by the same gene (pleiotropy) (Fayeye, 2014; Abbaya*et al*., 2018).

CONCLUSION

It was concluded that Bokoloji and Bunaji breeds of indigenous cattle are more reactive to heat stress than Rahaji and Adamawa Gudali. Also, correlated responses within breed for thermoregulatory parameters can be maximized for selecting animals for improved heat tolerance.

REFERENCES

Abbaya, H. Y. Akpa, G. N. Adedibu, I. I. and Attah, E. O. (2018). Relationships among egg quality traits in Japanese quails over three generations of selection for egg production. *Nigerian Journal of Animal Science,* 20 (1): 26-33.

Atrian, P. H. and Aghdam, S. (2012). Heat Stress in Dairy Cows (A Review). *Research in Zoology,* 2(4): 31-37.

Benezra, M. V. (1954). A New Index for Measures the Adaptability of Cattle to Tropical condition. *Journal of Animal Science,* 13: 1015.

Duncan, D. B. (1955). Multiple range and multiple F-test. *Biometrics*, 11: 1 – 14.

Fayeye, T. R. (2014). *Genetic principles and animal breeding*. Happy Printing Enterprises, Ilorin, Nigeria.

Garner, J. B., Douglas, M. L., Williams, S. R. O., Wales, W. J., Marett, L. C., Nguyen, T. T. T., Reich, C. M. and Hayes, B. J. (2016). Genomic selection improves heat tolerance in dairy cattle. *Scientific Reports,*6: 34114https://doi.org/10.1038/srep34114.

Hayes, B. J., Bowman, P. J., Chamberlain, A. J. and Goddard, M. E. (2009). Invited review: Genomic selection in dairy cattle: Progress and challenges. *Journal of Dairy Science*, 92(2): 433- 443.

Kumar, R., Gupta, i. d., Verma, A., Verma, N. and Vineeth, M. R. (2017). Single nucleotide polymorphism in heat Shock protein (HSP) 90AA1 gene and their association with heat tolerance traits in Sahiwal cows. *Indian journal of Animal resources*, 51: 64- 69

Macciotta, N. P. P., Biffani, S., Bernabucci, U., Lacetera, N. Vitali, A. Ajmone-Marsan, P. and Nardone, A. (2016). Derivation and genome-wide association study of a principal component-based measure of heat tolerance in dairy cattle. *Journal of Dairy Science*, 100:4683–4697.

National Bureau of Statistics, (2010).

Nayak, V., Pathak, P. and Adhikary, S. (2018). Rearing Climate Resilient Livestock for BetterProductivity. A Review. International Journal of Livestock Research, 8(3), 6 23.

Nguyen, T. T. T., Bowman, P. J., Haile-Mariam, M., Pryce, J. E. and Hayes, B. J. (2016). Genomic selection for tolerance to heat stress in Australian dairy cattle. *Journal of Dairy Science*, 99:2849–2862.

Ovimaps. (2018).Ovimap location: ovi earth imagery date 23th July, 2018.

Rashamol, V. P., Sejian, V., Bagath, M., Krishnan, G., Archana, P. R., Bhatta, R. (2018). Physiological adaptability of livestock to heat stress: an updated review. *Journal of Animal Behavior and Biometeorology*, 6:62-71.

Sailo, L., Gupta, I. D., Das, R., Chaudhari, M. V. (2017). Physiological Response to Thermal Stress in Sahiwal and Karan Fries Cows. *International Journal of Livestock Research,* 7:275-83.

SAS, (2002). Statistical Analysis System User Guide.SAS/STAT version 9.0 for windows. SAS institute Inc., Inc Cary, North Carolina, USA

Shaji, S., Sejian, V., Bagath, M., Mech, A., David, I. C. G., Kurien, E. K., Varma, G. Bhatta, R. (2016). Adaptive capability as indicated by behavioral and physiological responses, plasma HSP70 level and PBMC HSP70 mRNA expression in Osmanabadi goats subjected to combined (heat and nutritional) stressors. *International Journal of Biometeorology*, 60:1311–1323.

Valente, É. E., Chizzotti, M. L., de Oliveira, C. V., Galvão, M. C., Domingues, S. S., de Castro Rodrigues, A. and Ladeira, M. M. (2015). Intake, physiological parameters and behavior of Angus and Nellore bulls subjected to heat stress. *Semina Ciências Agrárias,* 16:4565-4574.

West, J. W. (2002). Effects of Heat-Stress on Production in Dairy Cattle. *Journal of Dairy Science*, 86: 2131– 2144.

EFFECT OF BREED ON MORPHOMETRIC CHARACTERISTICS OF TWO RABBIT GENOTYPES

M. I. Abdullahi, O. I. Suleiman, S. K. Inusa & S. S. Hussaina
Department of Animal Science, Faculty of Agriculture, Bayero University, Kano.
Correspondence: abdullahiisamustapha@gmail.com, 08035221176

ABSTRACT
The study was conducted to examine the influence of breed on morphometric characteristics of two rabbit genotypes. In achieving the objectives, linear body measurements were taken on the rabbits using a flexible tape. The measurements were body weight (BW), body depth (BD), body length (BL), fore-limb length (FLL), hind-limb length (HLL), tail length (TL) and ear length (EL). The coefficient of variability of the traits showed low to moderate values which ranged from 5.78% for ear length to 14.59% for body depth and BW had highest variability (17.22%). Breed had significant influence on morphometric characteristics with New Zealand White generally showing the best performance. The average body weights were 1.84 and 1.63 for the NZW and GRY respectively. Pearson correlation coefficients among the morphometric traits showed strong, positive and significant relationships with 'r' value ranging from 0.48 (BL×EL) to 0.86 (BW×BD). It can be concluded that morphology in the rabbits were influenced by breed. In addition, using linear body measurements to describe and evaluate body size would overcome the problems associated with visual evaluation and can be used to predict body weight.
Keywords: Morphological characteristics, breed, sex and genotypes.

INTRODUCTION
The rabbit (*Oryctolagus cuniculus)* is one of the most productive meat species among domesticated animals. The feeding habits offer no appreciable competition with man. It can subsist on greens as basal diets. Rabbits have high economic efficiency on account of inexpensive housing, low nutrient requirement, high reproductive rate, short generation interval and gestation period. Their daily weight gain is high hence rapid growth rate and sexual maturity (Aduku and Olukosi, 1990). The provision of suitable breeding stocks that are well adapted to backyard systems is a key requirement for the sustainability of low-input and smallholder rabbit production prevalent in many parts of sub-Saharan Africa (Oseni, 2012). On the basis of body weight, the rabbits can be selected for growth (Hassan *et al.,* 2012).Linear body measurements can also be used (Orheruata and Olutogun, 1994). Linear measurements provide information on animal morphology and have helped in making decisions on commercialization (Osario *et al.,* 2002). Morphometric traits are sometimes preferred because weighing machines can give biased measurements due to gut fullness (Obike *et al.,* 2010). Rabbits ranked third in protein content behind poultry and turkey and is overtaken them because of low cholesterol content (Tsado *et al.,* 2013). With reference to this and other indices, the productive potentials of rabbit stock and factors that affect them need to be identified. In Nigeria, low animal protein intake has remained a major nutritional problem, especially for low income earners and the unemployed (Amaefule and Obioha, 2005; Akinola, 2009). There is therefore urgent need to develop rabbit production as a cheap source of animal protein to bridge the wide gap between animal protein supply and consumption. The study examined the effect of breed on morphological characteristics of two rabbit genotypes.

MATERIALS AND METHODS
The study was conducted at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Bayero University Kano, Kano state Nigeria. Kano State is located in the semi-arid area of North-western and lies between latitude $10^{o}33^{'}$ and $12^{o}27^{'}$ north of the equator and longitude $7^{o}34^{'}$ and $9^{o}29^{'}$ east of the Greenwich meridian (KNARDA, 2006). The rabbits were kept under intensive management in hutches with feeding and drinking troughs provided. The hutches were made of wire measuring 52×44×32 cm and chicken wire mesh and raised on metal pole stands at 49 cm from the concrete floor.
Data on body weight (in kg) using a weighing scale and six other linear body measurements (in cm) were taken following the description of Akanno and Ibe, 2006. The measurements included the

following: (a) Body depth – the circumference of the thoracic cavity just behind the forelimb divided by two. (b) Body length – the distance from the point of the shoulder to the pin bone. (c) Tail length – the distance from the pin bone to the tip of the tail. (d) Fore-limb length – the distance from the hock to the proximal end of the humerus (e) Hind-limb length – the distance from the proximal end of the femur to the distal end of the fibula including the distal end of the femur. (f) Ear length – the distance from the base of the ear to the tip. Data were analysed using the General Linear Model (Proc GLM) procedure of SAS®(SAS, 2014). The GLM procedure included fixed effects of breed of rabbit, and body weight and morphometric measurement as response variables. Pearson correlation procedure of SAS was used to assess the relationship among variables.

RESULTS ANS DISCUSSION

Table 1 shows the summary statistics of the morphometric measurements. The mean body weight range is 1kg - 2.5kg. This range is in agreement with previous report (Lukefahr and Goldman, 1985) they reported a mean of 2.5kg for adult rabbits while a range of 1.70 - 2.1kg was reported by Omole, 1982. The present result is not in agreement with (Suleiman, Muhammad and Muhammad, 2017) who reported a range of 0.82 to 1.35kg body weight. Table 1 equally shows the means for other morphometric measurements. The coefficient of variabilities were low for ear length (5.78%), hind limb length (8.05%), tail length (8.35%) and body length (9.73%) indicating that selection base on them would tend towards homozygosity. The remaining measurements had moderate variabilities of 14.59% for body depth and 17.22% for body weight indicating that much more selection pressure can be applied on them.

Table 1. Summary statistics of morphometric characteristics measured

S/N	Variables	Mean	CV (%)	Min	Max
1	BW	1.78438	17.22	1.00	2.50
2	BD	14.23750	14.59	10.00	19.50
3	BL	25.37639	9.73	17.50	30.10
4	FLL	15.64097	10.84	11.00	18.50
5	HLL	22.61111	8.05	17.00	26.00
6	TL	11.25208	8.35	8.00	13.20
7	EL	11.56667	5.78	10.00	13.00

The mean value and variables were clearly showed. BW = Body weight, BD = Body depth, BL = Body length, FLL = Fore limb length, HLL = Hind limb length, TL = Tail length, EL = Ear length.

Table 2 shows the effect of breed on morphometric characteristics of the two rabbit genotypes. The breed generally had significant effects on morphometric characteristics ($P<0.01$) with NZW showing the better performance. This is an indication that rabbit breed has influence on morphological characteristics in terms of body form and structure.

Table 2. Effect of breed on morphometric characteristics of two rabbit genotypes

factors	BW	BD	BL	FLL	HLL	TL	EL
breeds	**	NS	*	NS	**	**	**
NZW	1.85[a]	14.39	25.65[a]	15.73	22.92[a]	11.39[a]	11.67[a]
GRY	1.63[b]	13.83	24.67[b]	15.42	21.79[b]	10.88[b]	11.28[b]
SEM	0.026	0.173	0.206	0.141	0.080	0.083	0.058

*(P<0.05),** (P<0.01), ***(P<0.001), SEM = Standard Error of Mean

Pearson correlation coefficients (Table 3) among the morphometric characteristics showed strong, positive and significant relationships with `r` ranging from 0.48 (BL×EL) to 0.86 (BW×BD). These results are similar to Suleiman, Muhammad and Muhammad, (2017) who recorded 0.38 (BD×EL) and 0.82 (BW×BL). This measurement on one character could be used to indicate another.

Table 3. Pearson correlation matrix for the morphometric traits of rabbit genotype

factors	**BW**	**BD**	**BL**	**FLL**	**HLL**	**TL**	**EL**
BW							
BD	0.86**						
BL	0.83**	0.79**					
FLL	0.77**	0.83**	0.74**				
HLL	0.79**	0.82**	0.75**	0.78**			
TL	0.78**	0.78**	0.72**	0.72**	0.76**		
EL	0.66**	0.56**	0.48**	0.62**	0.62**	0.60*	

** (P<0.01)

CONCLUSION AND RECOMMENDATIONS

From the results, it could be concluded that morphometric characters vary with breed of rabbits. Selection based on any of the morphometric measurements will positively influence the others. Furthermore, using linear body measurements to describe and evaluate body size would overcome the problems associated with visual evaluation and can be used for body weight prediction.

REFERENCES

Aduku and Olukosi, J.O. (1990). Rabbit management in the Tropics. Living Bookseries. G.U. Publication, Abuja, FCT: I.

Akinola, L.A.F. (2009). Economics of rabbit production in Gokan Local Government Area of Rivers State, Nigeria. In: *Proceedings of 34th Annual Conference of Nigerian Society for Animal Production (NSAP) held at University of Uyo, Akwa Ibom State on March 15* – 18th, 2009, 70 - 72.

Amaefule, K.U. and Obioha, F. U.(2005). Performance of pullet chicks fed raw or processed pigeon pea (Cajanus cajan) seed meal diets. *Live Reserved for rural Development*. *http.//cipav.orgco/lrrd.*Assessed on 23rd August 2009.

Hassan, H.E., Elamin, K.M., Yousif, I.A., Musa, A.M. and Elkhairey, M.A. (2012). Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. *Journal of Animal Science Adv*ance, 2(4): 407-415.

KNARDA, (2006). Kano Agricultural Rural Development Authority. Meteorological Station Report. Temperature Record Book, Land Management Unit, 11: 1-3.

Lukefahr, S.D. and GFoldman, M. (1985). A technical assessment of production and economic aspect of small scale rabbit farming in Cameroon. *Journal of Applied Rabbit Research 8:126-135.*

Obike, O.M., Ibe, S.N. and Oke, U.K. (2010): Estimation of pre-and post-weaning body weight ofrabbits in a humid tropical environment using linear body measurements. *Am-Eurasian Journal of Agriculture and Environmental Science,* 9(4):440-444.

Omole, T.A. (1982). The effect of level of dietary protein on growth and reproductive performance in rabbits. *Journal of Applied Rabbit Research,* 5: 83-88.

Orheruata, A.M. and Olutogun, O. (1994). Pre and post-weaning phenotypic relationship between some N'dama cattle linear measurements in the tropics. *Nigerian Journal of Animal Production,* 21: 76-82.

Osario, J.C., Das, O. N.M., Osorio, M.T.M., Jordim, R.D. and Pimente, M.A. (2002): Meat production in male lambs derived from crossing Border Leicester rams with Corridale and Polwarth ewes. *Revista Brasileria de Zootecnia,* 13:1469-1480.

Oseni, S.O. (2012). Rabbit production in low-input systems in Africa- prospects, challenges and opportunities. In: *Proceeding of 10th world Rabbit Congress, Shram El-sheik, Egypt, September* 3-6th 2012, 719-731.

Suleiman, O.I., Muhammad, A.S and Muhammad, H.A. (2017). Genetic and non-genetic factors affecting morphometric characteristics in seven rabbit genotypes. *Proceedings of 42nd Annual Conference of Nigerian Society for Animal Production* held at Landmark University, Omu-Aran 26-30th March 2017, 705-708.

Tsado, D.N. (2013). Influence of bilateral and unilateral castration on growth performance of New Zealand and Chincilla breeds of rabbit. *Proceeding of the 38th Conference of the Nigerian Society of Animal Production*. 17th to 20th March, 2013 at the Rivers State University of Science and Technology. Potharcourt, 106-109.

THE VALUE OF MINERAL ZINC IN ANIMAL PHYSIOLOGICAL FUNCTIONS

Achonwa[1] C.C., A.U.C. Ohanaka[1], N.J. Chukwuka[2] & I.C. Okoli[1]

[1]Department of Animal Science and Technology, Federal University of Technology, P.M.B 1526 Owerri, Imo State, Nigeria
[2]Department of Animal Health and Production Technology, Federal College of Land Resources Technology Owerri, Imo State, Nigeria
Corresponding author: *C.C. Achonwa; E-mail: chukwumachristian1@gmail.com*

ABSTRACT
Zinc is one of the most important trace elements in the body, and it is indispensable to the growth and development of microorganisms, plants, and animals. This review work looks at the value of zinc in animal physiological functions. In domesticated species, experimental zinc deprivation was produced first in chicks and pigs. Zinc - responsive disorders were induced by excess dietary calcium in poultry attributed to a potent and complex interaction with the major source of phosphorus in feed grains (phytate). Fetal growth is especially affected by lack of zinc.Zinc deprivation increases the expression of the gene for the appetite-regulating hormone cholecystokinin and also increases the susceptibility of endothelial cells to oxidant stress. The role of zinc is probably multi-factorial. Zinc regulates genes involved in signal transduction, responses to stress, reduction–oxidation reactions, growth and energy utilization.Itis also a potent inducer of metallothionein (MT), a zinc and thiol - rich metalloprotein that scavenges free radicals and could act as a reduction– oxidation sensor or active signaling switch in cells. Zinc aids in proper assimilation of vitamins, normal growth and development.Zinc supplementation also cured and prevented parakeratosis, a thickening and hardening of the skin found in pigs given grain-based diets, rich in calcium. It is therefore important that the value of zinc in animal physiological functions be assessed and deficiency corrected in some chronic animal diseases.
Keywords: animal physiological functions, mineral supplementation, pigs, poultry, zinc

INTRODUCTION
Zinc (Zn) is a ubiquitous trace element. It is one of the most important trace elements in the body, and it is indispensable to the growth and development of microorganisms, plants, and animals. It is involved in DNA replication and RNA transcription. The first unequivocal evidence that zinc is necessary for growth and health was obtained in laboratory animals (Todd *et al*., 1934) at a time when associations were being noted between zinc and carbonic anhydrase, an enzyme eventually shown to contain zinc (Keilin and Mann, 1940). In domesticated species, experimental zinc deprivation was produced first in chicks (O'Dell and Savage, 1957) and pigs (Stevenson and Earle, 1956). In all species, the disorder was characterized by loss of appetite, growth depression, abnormalities of the skin or its appendages and reproductive failure. In the field, zinc supplementation cured and prevented parakeratosis, a thickening and hardening of the skin found in pigs given grain-based diets, rich in calcium (Tucker and Salmon, 1955). Zinc - responsive disorders were also induced by excess dietary calcium in poultry and were eventually attributed to a potent and complex interaction with the major source of phosphorus in feed grains, phytate (Py) (Ziegler *et al*., 1961).
The quest to understand the pathogenesis of zinc deprivation continues and has led to the measurement of free intracellular zinc at femtomolar concentrations (Outten and O'Halloran, 2001), while therapeutic properties have been found for zinc at near-molar concentrations (Hill *et al*., 2001). Fear of zinc deprivation is being exploited commercially by feed industry which offers wide variety of mineral additives, including organically bounded trace elements as compounds for the enhanced bioavailability of a variety of 'organic' zinc supplements (Suttle, 2010).

GENE EXPRESSION
Fetal growth is especially affected by lack of zinc (Hurley, 1981) and this may reflect the roles that it plays in DNA synthesis and, nucleic acid and protein metabolism. Zinc regulates genes involved in signal transduction, responses to stress, reduction–oxidation reactions, growth and energy utilization, including a T-cell cytokine receptor and uroguanylin (Cousins *et al*., 2003). Teratogenic defects may mostly derived from the primary effects of zinc deprivation on gene expression – effects that are most marked when cells are rapidly dividing, growing or synthesizing (Chesters, 1992).

APPETITE CONTROL

Since O'Dell and Reeves (1989) reviewed the role of zinc in the regulation of appetite, advances have continued to come from studies with rats. The pattern and rate of food intake is affected and acute zinc deprivation causes rats to nibble at food rather than 'meal eat'. Little addition of zinc (3–6 mg Zn kg−1 dry matter (DM) removes the complication, but description of such diets as 'marginal' in zinc (e.g. Kwun *et al*., 2007) is inappropriate because the diets unequivocally provide insufficient zinc for normal growth and development.

Zinc deprivation increases the expression of the gene for the appetite-regulating hormone cholecystokinin (Cousins *et al*., 2003), but the role of zinc is probably multi-factorial. There is also increased expression of leptin, a cytokine hormone whose secretion from adipocytes acts as a satiety signal (Kwun *et al*., 2007), and reduced expression of pyruvate kinase (Beattie *et al.*, 2008), which is regulated by insulin. Changes in the concentrations of neurotransmitters in the brain have been reported in zinc deprivation, but may be secondary consequences of appetite reduction (Kwun *et al.*, 2007). In what might more accurately be called acute zinc deprivation, the reduction in appetite is selective, with carbohydrate being avoided and protein and fat preferred (Kennedy *et al*., 1998).

FAT ABSORPTION

When low plasma and liver concentrations of vitamin E and fat-soluble vitamin A were reported in zinc - deprived animals, attention became focused on the possible role of zinc in fat absorption. The pancreas secretes zinc - dependent phospholipase A2 (Kim *et al.*, 1998). This hydrolyses phosphatidyl choline, facilitating its absorption and the formation of chylomicrons, which are crucial for the absorption of fat micelles (Noh and Koo, 2001). Duodenal infusion of hydrolysed phosphatidyl choline greatly increases the absorption of fats and the fat-soluble vitamins A and E in well grown rats that are 'marginally deprived' of zinc. Partial alleviation of the effects of heat stress in quail by supra-nutritional levels of zinc (Sahin and Kucuk, 2003) may be mediated, in part, by secondary improvements in vitamin status.

ANTIOXIDANT DEFENSE

In addition to the contribution of a superoxide dismutase, CuZnSOD, in protecting cells from the superoxide radical, *in vitro* studies suggest that zinc may afford protection from iron - induced lipid peroxidation by blocking iron-binding sites at cell surfaces, acting synergistically with vitamin E (Zago and Oteiza, 2001). Zinc deprivation increases the susceptibility of endothelial cells to oxidant stress (Beattie and Kwun, 2004). In humans, zinc supplementation decreases the expression of anti-inflammatory cytokines (Prasad, 2007), but it is unclear whether this is beneficial to health. Zinc is also a potent inducer of metallothionein (MT), a zinc and thiol - rich metalloprotein that scavenges free radicals and could act as a reduction– oxidation sensor or active signalling switch in cells (Beattie and Trayhurn, 2002).

Zinc aids in proper assimilation of vitamins, normal growth and development. It is found in all the fluids in the body. It assists in the maintenance of body tissue, sexual function, immune system, chemical detoxification, synthesis of DNA and helps in reducing healing time. It is stored in the thyroid, pancreas, liver, kidney, bone, voluntary muscle, prostate, sperm cells, skin, hair, nails and white blood corpuscles and parts of the eyes (Sanchez, 2010). Zinc plays an important role in poultry, particularly layers, as a component of a number of metalloenzymes such as carbonic anhydrase which is essential for eggshell formation in the hens shell gland (Scheideler, 2008). Other important zinc metalloenzymes in the hen include carboxypeptidase and DNA polymerases. These enzymes play important roles in the hen's immune response, in skin and wound healing, and for hormone production (testosterone and corticosteroids). Classic deficiency symptoms of a zinc deficiency in poultry could include a suppressed immune system, poor feathering and dermatitis, infertility and poor shell quality (Scheideler, 2008).

Lack of zinc during embryonic growth grossly disturbs skeletal development and severe abnormalities of the head, limbs and vertebrae have been found in chick embryos from the eggs of severely deprived hens (Kienholz *et al*., 1961). Zinc deficiency in breeder diets reduces egg production and hatchability. Proper zinc supplementation has proven to be important in reducing early mortality of turkey poults (Larson, 2005).

CONCLUSION

Zinc is one of the most important trace elements in the organism, with three major biological roles, the catalytic, the structural, and the regulatory one. It is a multifunctional metal compatible with satisfactory growth, health, and well-being. It is essential for the structure and function of various proteins and cellular components and plays an important role in animal physiology from its involvement in the proper function of the immune system to its role in cellular growth, cell proliferation, cell apoptosis, as well as in the activity of numerous zinc-binding proteins. It is therefore important that the value of zinc in animal physiological functions be assessed and zinc deficiency be corrected in some chronic animal diseases.

REFERENCE

Beattie, J.H., Gordon, M.-J., Rucjlidge, G.J., Reid, M.D., Duncan, G.J., Horgan, G.W., Cho, Y.-E. and Kwun, I.S. (2008). Aorta protein networks in marginal and acute zinc deficiency. *Proteonomics* 8: 2126 – 2135.

Beattie, J.H. and Kwun, I.S. (2004). Is zinc deficiency a risk factor in atherosclerosis? *British Journal of Nutrition* 91: 177 – 181.

Beattie, J.H. and Trayhurn, P. (2002). Metallothioneins and oxidative stress. *Nutritional Sciences* 5: 228 – 233.

Chesters, J. K. (1992). Trace element – gene interactions. *Nutrition Reviews*. 50: 217 – 223.

Cousins, R.J., Blanchard, R.K., Moore, J.B., Cui, L., Green, C.L., Liuzzi, J.P., Cao, J. and Bobo, J.A. (2003). Regulation of zinc metabolism and genomic outcomes. *Journal of Nutrition* 133: 1521S – 1526S.

Hill, G.M., Mahan, D.C., Carter, S.D., Cromwell, G.L. and Ewan, R.C. (2001). Effect of pharmacological concentrations of zinc oxide with or without the inclusion of an antibacterial agent on nursery pig performance. *Journal of Animal Science* 79: 934 – 941.

Hurley, L. S. (1981). Teratogenic effects of manganese, zinc and copper in nutrition. *Physiological Reviews* 61: 249 – 295.

Keilin, D. and Mann, T. (1940). Carbonic anhydrase. Purification and nature of the enzyme. *Biological Journal* 34: 1163 – 1176.

Kennedy, K. J., Rains, T. M. and Shay, N. F. (1998). Zinc deficiency changes preferred macronutrient intake in subpopulations of Sprague - Dawley outbred rats and reduces hepatic pyruvate kinase gene expression. *Journal of Nutrition* 128: 43 – 49.

Kienholz, E. W., Turk, D. E., Sunde, M. L. and Hoekstra. W. G. (1961). Effects of zinc deficiency in the diets of hens. *Journal of Nutrition.* 75: 211 – 221.

Kim, E. S., Noh, S. K. and Koo, S. I. (1998). Marginal zinc efficiency lowers the lymphatic absorption of a - tocopherol in rats. *Journal of Nutrition*. 128: 265 – 270.

Kwun, I. S., Cho, Y. E., Lomeda, R. A. R., Kwon, S. T., Kim, Y. and Beattie, J. H. (2007). Marginal zinc deficiency in rats decreases leptin expression independently of food intake and corticotrophin-releasing hormone in relation to food intake. *British Journal of Nutrition* 98: 485 – 489.

Larson, C. K. (2005). Role of trace minerals in animal production. Paper presented at the 2005 nutrition conference, Department of Animal Science, University of Tennesse, Tennesse, USA. http:/www.tennessenutritionconference.org/conference2005.htm.

Noh, S. and Koo, S. I. (2001). Intraduodenal infusion of lysophosphatidylcholine restores the intestinal absorption of vitamins A and E in rats fed a low-zinc diet. *Experimental Biology and Medicine* 226: 342 – 348.

O'Dell, B. L. and Reeves, P. G. (1989). Zinc status and food intake. In: *Zinc in Human Biology*. ILSI Press, Washington, DC, pp. 173 – 181.

O'Dell, B.L. and Savage. J.E. (1957). Symptoms of zinc deficiency in the chick. *Federation Proceedings* 16: 394.

Outten, C.E. and O'Halloran, T.V. (2001). Femtomolar sensitivity of metallo-regulatory proteins controlling zinc homeostasis. *Science.* 292: 2488 – 2492.

Prasad, A. S. (2007). Zinc: mechanisms of host defence. *Journal of Nutrition* 137: 1345 – 1349.

Sahin, K. and Kucuk, O. (2003) Zinc supplementation alleviates heat stress in laying Japanese quail. *Journal of Nutrition.* 133: 2808 – 2811.

Sanchez, L. (2010). The ABC's of Minerals. http://www.antibiotics-alternatives.com/abc's of minerals.

Scheideler, E. S. (2008). *Trace mineral in poultry*. University of Nebraska, Lincoln, NE, USA.

Stevenson, J. W. and Earle, I. P. (1956). Studies on parakeratosis in swine. *Journal of Animal Science* 15: 1036 – 1045.

Suttle, N.F. (2010). *Mineral nutrition of livestock, 4th edition*. CAB International, Wallingford, Oxfordshire, United Kingdom.

Todd, W. R., Elvehjem. C. A. and Hart, E. B. (1934). Zinc in the nutrition of the rat. *American Journal of Physiology* 107: 146 – 156.

Tucker, H. F. and Salmon, W. D. (1955). Parakeratosis or zinc deficiency disease in the pig. *Proceedings of the Society for Experimental Biology and Medicine* 88: 613 – 616.

Zago, M. and Oteiza, P.I. (2001). The antioxidant properties of zinc: interactions with iron and antioxidants. Free Radicals in Biology and Medicine 31: 266 – 274.

GROWTH CHARACTERISTICS OF NOILER CHICKENS AS DETERMINED BY NONLINEAR ALGORITHMS

Adamu* J, Shuaibu A. Y. & Raji A. O.
Department of Animal Science, University of Maiduguri, Maiduguri, Borno State.
**Corresponding Author: Jummaiyalma1@gmail.com*

ABSTRACTS
This study sought to determine the adequacy of two mathematical functions in modelling growth characteristics of male and female Noiler chickens. The study was conducted at the Livestock Teaching and Research Farm, University of Maiduguri. Body weights were obtained weekly for 20 weeks from two hundred (200) Noiler chickens and fitted to the Gompertz and Logistic models. The results of the study showed significant difference ($P<0.05$) between males and females only at 20 weeks of age, with values of 3002.7 and 2718.7, respectively. The asymptomatic weight of the models revealed that Gompertz model had higher values for both male and female Noilers than the logistic. The coefficient of determination (R^2) of Gompertz model (0.8122) was higher than that of logistic (0.8103) for male Noilers. Similar trend occurred in female Noilers with Gompertz having a higher R^2. The Akaike information criteria (AIC) value of 6927.5 for Gompertz model was lower compared that of logistics (6933.0) in the male Noilers. Gompertz also had lower value of AIC for female Noilers compared to the Logistic. The study reveal that the Gompertz model was the better growth model for explaining the growth patterns of both male and female Noilers.
KEY WORDS: Mathematical models, Noilers, Body weight, Sex

INTRODUCTION
Poultry production is one of the best available sources for production of high biological value animal protein in terms of eggs and meat (Yakubu *et al*., 2007). The poultry sector contributed about 25% of the agricultural domestic products of the Nigerian economy (FAO, 2010). Nigeria presently produces above 550,000 mt of poultry meat per annum and 770,000 mt of eggs (FAO, 2010). Poultry meat and eggs account for about 30% of total livestock output in Nigeria, of which eggs account for over 80 percent (Fayeye *et al*., 2005).

Mathematical functions called growth models (each with a non-linear structure and sigmoid shape) have been used to explain the growth patterns of poultry species (Narine *et al*., 2017). The main advantage of non linear models is parsimony, interpretability and prediction (Bates and Watts, 2007). Growth curve parameters are highly heritable and have been widely exploited in poultry selection studies (Maginon-Grasteav, 2001). Studies had been carried out for the prediction of future growth at any age in poultry (Raji *et al.,* 2014).

The Noiler chicken is a dual purpose breed of chicken developed by Amo farm sieberer hatchery limited for small holders to address the challenges of food insecurity and financial dependency among rural populace especially women. It has been emphasized that the introduction of tropically adapted genotypes with high performance is beneficial to the resource poor poultry farmers (Yakubu and Ari, 2018). Knowledge of growth of Noiler birds is important to evaluate their development at any age. The objective of this study was to determine the most appropriate model for describing growth of Noiler chickens.

MATERIALS AND METHODS
The study was carried out at the Poultry unit of the Livestock Teaching and Research Farm of the University of Maiduguri, Borno State, Nigeria. Maiduguri is located between Latitude 11°50 N and 13 ^{o} 40 S and longitude 10°14E at an altitude of 354 m above sea level in the Northern Sudan Savanna belt of Nigeria (Kellou, 2005). The area falls within the Semi-arid zone of West Africa and characterized by short rainy season of about 3-4 months (June to September) and the mean annual rainfall ranges from 450-600 mm.

EXPERIMENTAL ANIMAL AND MANAGEMENT

A total of two hundred (200) day old Noiler chicks were obtained from a reputable hatchery. The birds were brooded for three (3) weeks on wood shavings using coal pots to supply heat, after which they were placed under deep litter management system for 140 days (20 weeks). All the birds were tagged individually for proper identification. They were fed with a commercial chick mash (1-8 weeks) containing 3000 Kcal/Kg of energy and 20% Crude protein (CP) and grower mash (8 – 20 weeks) containing 2650Kcal/kg of energy and16% crude protein (CP). Fresh clean water was given *ad libitum* and routine vaccination and other management practices were strictly adhered to.

DATA COLLECTION AND MODELS

The body weight was measured for each bird once a week for the duration of the experiment. Body weight was taken using a weighing balance calibrated in grames (g) and the data fitted into the following growth models

1. Logistic model's: the following equation describes the logistics (Roberison,1923) growth model Wt=Wa/[1+exp –K(t-Ti)] where
   Wt =the body weight at time t,
   Wa = asymptptic body weight,
   K= the exponential growth rate, and Ti the age at the inflection point.
2. Gompertz –Laird model: the laird form of the Gompertz equation (Laird *et al.*,1965) was fitted to the data. The following equation describes the Gompertz-Laird growth curve;
   Wt =Woexp [(L/K) (1 – exp Kt)] where
   Wt =weight of bird at time t,
   Wo = initial body (hatch)weight,
   L=instantaneous growth rate (per week).
   K =rate of exponential decay of the initialspecific growth rate,
   L= it measure the rate of decline in growth rate

DATA ANALYSIS

The data generated from body weight were subjected to analysis using statistix 9.0. The data was subjected to one-way Analysis of variances with sex as the fixed factor. Significant means were compared by least significant difference.

DETERMINATION OF GOODNESS OF FIT

The asymptotic body weight (A), Akaike's information Criterion (AIC) and coefficient of determination (R^2) were used for model comparisons. Goodness of fit for each model was determined by using the coefficient of determination (R^2), and Akaike's Information Criterion (AIC).

RESULTS AND DISCUSSION

The effect of sex on body weight of Noiler birds at different ages are presented in Table 1. The results showed that sex had significant influence ($p<0.05$) only on body weight at 20 weeks of age. At this age the males had superior body weight (3002.7±111.8g) than their female counterparts (2718.7±84.99g). This agrees with the findings of Rondelli *et al.* (2003) and Keshri *et al.* (1985) who reported that at growing stages, males were heavier than females. The result of the present study also agreed with Dogan *et al*.(2010) which investigated the values of 3657g for female and 4362g for male though the values were higher than the present studies.

Table 1. Effect of sex on Body weight (kg) of Noiler chickens at different Ages.

	Age (week)							
Sex	2	4	6	12	14	16	18	20
Male	102.05 ±5.55	252.73 ±13.72	414.51±2 6.08	1686.5±9 0.41	1975.7±2 20.5	2316.2±1 02.3	2624.3±1 04.3	3002.7±1 11.8[a]
Female	107.22 ±4.22	251.31 ±10.43	409.97±1 9.83	1600.0±6 8.74	2076.6±1 67.7	2121.9±7 7.81	2378.1±7 9.7	2718.7±8 4.99[b]

ab means within column with different superscripts are significantly different (P<0.05)

Table 2 presents the model parameters and goodness of fit criteria for body weight of male and female Noiler chickens. Brown *et al.* (1996) stated that asymptomatic weight (A parameter) values offered the best opportunity for direct comparison of model. The asymptomatic weight of the models showed that Gompartz model had a higher value for both the male and female Noilers than logistic. The results of this study was in line with the report of Raji *et al*. (2014) in Japanese quails. The models with higher coefficient of determination (R^2) and lower Akaike information criterion (AIC) are the best models for describing the parameter in question (Brown *et al*., 1996). The coefficient of determination for both male and female Noilers were higher in Gompertz model than Logistic model. While the AIC for body weight of male Noilers was lower (6927.5) in Gompertz than (6933.0) for Logistic model. The AIC in female Noilers followed similar trend with Logistic model having higher values than Gompertz.Gompertz model that were determined the best in the present study were found to be in agreements with the literature reports performed using different genotypes (Aggrey,2002 and Ahmadi and Golian 2008).

T**able 2. Model Parameters and goodness of fit for Body Weight of Male and Female Noilers**

Trait	Parameter	sex	A	B	C	AIC	R^2
BW (g)	Gompertz	Male	3891.9	1.5858	0.1396	6927.5	0.8122
		Female	3365.9	1.5832	0.1518	1231.9	0.7250
	Logistic	Male	3133.6	3.5544	0.2900	6933.0	0.8103
		Female	2817.2	3.5081	0.3021	1232.5	0.7233

Where: BW = body weight, A = asymptomatic weight, B = scale parameter (constant),
C = relative growth rate, AIC = Akaike Information Criteria, R^2= Coefficient of determination

CONCLUSION

The results of this study showed that the body weight parameter of male and female Noiler chickens differed (p<0.05) and such differences were more obvious during the later growing phase with the male having greater values. The comparison of the two growth models in terms of asymptomatic body weight and goodness of fit criteria revealed that the Gompertz model was better for describing the growth pattern of both male and female Noiler chickens.

REFERENCES

Aggrey, S. E. (2002). Comparison of three nonlinear and spine regression models for describing chicken growth curve. *Journal Poultry Science* 81:1782-1788.

Ahmadi, H.and Golian, A.(2008).Non linear hyperbolastic growth models for describing growth curve in classical strain of broilers chickens. *Resource Journal of Biological Science. 3(11);1300-1304*

Bates, D.M. and Watts, D.G. (2007). Nonlinear Regression analysis and its application. Wiley Ser. Probab. Stat. John Wiley and Sons, New York, USA.

Brown, J. E., Fitzhugh, H. A and Cartwright T. C. (1996). A comparison of nonlinear models for describing weight -age relationships in cattle. *Journal of Animal Science* 42: 810 – 818.

Dogan/ N.,Tulin, A., Emre, K.and Deniz, I.C.(2010).Analysis of fitting growth model in Mediu growing chickens raised indoor systems. *Trends in Animal and Veterinary Science Journals* 1(1);12-18.

FAO,(2010). Small Scale poultry production (Technical guide) by Sanaiya and Swan FAO. Animal production and Health manual No 1.

Fayeye, T. R., Ayorinde, K. L., Ojo, V. and Adesina, O.M. (2006). Frequency and influence of some major genes on body weight and size parameters of Nigerian local chickens. *Livestock Resource and Rural Development*.18;1-8

Kellou, K. M. (2005). Development of multinational block for dry season supplementary feeding of sheep in a semi- arid environment. Msc. Thesis Department of Animal Science University of Maiduguri Nigeria. Pp 23-38

Keshri, R. C., Verma, S. S., Sinha, S. P., Sharma, R. P., Singh, P. B., Ray, A. K. D. and Shyamsunder, G. (1985) .The relationship between pure bred broiler strain . *Indian Journal of Poultry Science. 20 (4);297-299*

Laird, A. K., Tyler, S. A. and Burton, A. D. (1965). Dynamic of Normal growth. *Growth* 29: 233-248. 248

Mignon-Grastea, S., Beaumont, C and Ricard, F.H. (2001). Genetic analysis of a selection experiment on the growth curve of chickens. Journal of Poultry Science.80:849-54:7SS

Narine, D., Oksuz, N. and Aygum, A. (2017). Growth curve analyses in poultry science. *Journal of Poultry Science*, 73:395-408.

Raji, A. O., Alade, N. K. and Duwa, H. (2014). Estimations of model parameters of the Japanese quail growth curve using Gompertz model. *Journal of Arid Agriculture*, 63 (4):29-35

Robertson, T .B.(1923) .The chemical basis of growth and senescence. Monograph of Experimental Biology. J.B. Lippincott. Philadelphaia, PA.

Rondelli, S., Martinez, O. and Gracia, P. T. (2003). Sex effect on production parameters, carcass and body fat composition of two commercial broilers chickens. *Journal of Poultry Science 5 (3); 169-173.*

Statistix for windows Manual. Copyright@1985-2008. Analytical Software.Version 9.0, Tallahasse FL, USA, 2008.

Yakubu, A. and Ari, M. M. (2018). Principal component and discriminate analyses of bodyweight and conformation traits of Sasso, Kuroiler and indigenous Fulani chickens in Nigeria. *Journal of Animal and Plant Science*.

Yakubu, A., Salako, A. E. and Ige, A. O. (2007). Effect of genotype and housing system on the laying performance of chickens in different seasons in the Semi Humid Tropics. *International Journal of Poultry Science, 6:43-49.*

EGG FERTILTIY AND EMBRYO VIABILITY OF TURKEY HENS INSEMINATED WITH VARIED SEMEN DILUTION RATIO AT DIFFERENT INTERVALS

Adebisi, K. A. & Ewuola, E. O.

Animal Physiology and Bioclimatology Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

Corresponding Author: Adebisi, K. A.; Email: karamatsanusi@yahoo.co.uk; +2348023503018

ABSTRACT

When semen is diluted, the number of sperm cells inseminated is reduced and this reduction can affect fertility especially with the frequency at which insemination is done. The objective of this study was therefore to determine the effect of the interaction of semen dilution ratio and insemination intervals on turkey fertility and embryo viability. Local turkeys were used for the study, ten toms and sixty-four hens. The hens were randomly divided into eight groups of four replicates. In a 4x2 factorial arrangement of a randomized complete block design (old and young hens), two insemination intervals (one and two weeks) and four dilution ratios of semen to normal saline (1:0, 1:1, 1:2 and 1:3) were used in insemination. Eggs collected were incubated weekly for 10 weeks. Fertility and embryo mortality (early and mid) were assessed by breakout of candling clears, while unhatched eggs were considered late embryo mortality. Analysis of variance was done on square root transformed data at $\alpha_{0.05}$.

Results of the main effects indicated no significant difference in fertility between weekly or fortnight inseminations, however, dilution of 1:0 and 1:2 were significantly higher than 1:3. When the interaction of factors was observed, 1:0 (89.3±2.8%) and 1:2 (86.8±3.0) were significantly ($p<0.05$) higher than 1:3 (72.8±4.4%) at fortnight inseminations only, though values were not significantly different from all other groups. Embryo mortality was not affected by the interaction. Therefore, to maximize fertility in local turkeys, semen should not be diluted beyond 1:2 (minimum of $30x10^6$ motile spermatozoa) at fortnight insemination intervals.

Keywords: Embryo mortality, Hatchability, Insemination interval, Semen dilution, Turkey fertility

INTRODUCTION

The additional cost incurred on insemination needs to be justified with the frequency of insemination and optimum use of semen from the toms. This is expected to reduce the labour cost associated with insemination, minimize handling of birds and also, reduce the number of males kept for breeding purpose. Thus, increasing the dilution ratio of semen at a less frequent insemination, without compromise on fertility and hatchability is expected to achieve this goal. Adebisi and Ewuola (2019a) observed optimal fertility in local turkeys at two weeks insemination interval using undiluted semen. Normal saline was also reported as a suitable diluent, if insemination is done immediately after semen collection (Adebisi and Ewuola, 2019b). Turkey semen is relatively high in sperm concentration and viscosity when compared to other poultry species (Bramwell, 2012). Its dilution prior to Artificial Insemination (AI) is therefore very essential, to increase the volume of semen and serve a wider coverage of hens to be inseminated. In diluting semen for insemination, several factors need to be considered regarding the dilution effect on the quality of the sperm cells and the effect of reduced number of cells inseminated on fertility. A typical dilution effect was observed by Sexton (1976) when turkey semen was diluted at a ratio of 1:8 and 1:12. This dilution led to an increased respiration of cells and corresponding decline in fertilizing capacity. However, at dilution rates of up to 1:4 with Lake's diluents at weekly insemination intervals, no significant difference was observed in fertility with undiluted control when held at 25℃ or 5℃ for 30 minutes prior to insemination Sexton (1976). The objective of the study was therefore to assess the effect of the interaction of insemination intervals (one and two weeks) and semen dilution ratio (1:0, 1:1, 1:2, and 1:3, semen to diluent) on fertility, embryo mortality and hatch parameters in local turkey hens.

MATERIALS AND METHODS

The research was carried out at the poultry unit of the Teaching and Research Farm, University of Ibadan, Nigeria. Locally-adapted turkeys were used for the study, ten toms and sixty-four hens. The hens were randomly divided into eight treatment groups of four replicates with two hens each. The experimental design was a randomised complete block design in a 4 x 2 factorial arrangement.Factor A was the semen dilution ratio, while factor B

was the insemination intervals.The block effect was the hen age groups (old hens of 16 months old and young hens of 9 months old). Semen was harvested from the toms, pooled and 0.02mL inseminated into hens. A portion of pooled semen inseminated was evaluated for semen quality characteristics Hens in groups 1 to 4 were inseminated with semen diluted with normal saline at a ratio of 1:0, 1:1, 1:2 and 1:3 at weekly interval while those in groups 5 to 8 were inseminated at interval of 2 weeks with the same varied dilution ratios as with groups 1 to 4. Insemination and weekly egg collection for incubation was done for 12 weeks. Candling was done on day 25 of incubation. Fertility, embryo mortality, hatch of fertile eggs and hatch of set eggs were determined as described by Adebisi and Ewuola (2019b).Data collected were analysed using two-way analysis of variance (of square root transformed data) using general linear model of SAS (2003). Means were separated using Duncan's multiple range test of same software.

RESULTS

The characteristics of pooled semen prior to dilution and insemination over twelve weeks are presented in Table 1. Spermatozoa concentration ranged from $4.29x10^6$ – $6.12x10^6$ cells/mL, progressive spermatozoa motility, 80% - 95%, while liveability was 91.3% – 97.4%.

Table 1: Characteristics of Weekly Pooled Semen Prior to Dilution and Insemination over Twelve Weeks

Semen quality parameter	Mean value	Range
Spermatozoa concentration($x10^9$ cells/mL)	5.37±0.56	4.29 – 6.12
Progressive spermatozoa motility(%)	86.39±4.86	80.00 – 95.00
Spermatozoa liveability (%)	94.83±1.87	91.30 – 97.40

The effects of semen dilution ratio, insemination intervals and their interactions on fertility and hatch parameters are presented in Table 2. Results of the main effects indicated no significant difference in the parameters between weekly or fortnight insemination. However, fertility and hatch of set eggs in groups inseminated with a dilution ratio of 1:0 and 1:2 were significantly ($p<0.05$) higher than 1:3. Interaction of the factors also indicated a significantly ($p<0.05$) higher fertility in groups of hen inseminated with diluted semen ratio of 1:0 (89.3±2.8%) and 1:2 (86.8±3.0) than 1:3 (72.8±4.4%), but at 2 weeks insemination intervals only. These values were however, not significantly different from all other groups. There were no significant differences ($p>0.05$) in the hatch of fertile or set eggs. The block effect of hen age was also not significant for any of the parameters. The effect of the interaction of semen dilution ratio and insemination intervals on early (EEM), mid (MEM), late (LEM) and total (TEM) embryo mortality in turkeys is presented in Table 3. There were no significant ($p>0.05$) differences among the groups for each of the parameters.

Table 2: Effects of Semen Dilution Ratio, Insemination Intervals and their Interactions on Fertility and Hatch Parameters of Eggs from Turkey Hens (Mean±SE)

Factors	Levels		Parameters measured (%)		
			Fertility	**Hatch of fertile eggs**	**Hatch of set eggs**
Insemination intervals	1 week		80.8±1.6	84.6±1.8	68.2±2.0
	2 weeks		81.8±1.6	84.3±1.7	69.3±2.0
P – Value			0.7512	0.8889	0.7116
Semen dilution ratio	1:0		87.1±2.2^{a}	82.3±2.5	72.4±2.8^{a}
	1:1		78.2±2.2^{bc}	83.9±2.5	65.8±2.8^{ab}
	1:2		85.3±2.3^{ab}	86.2±2.5	73.4±2.8^{a}
	1:3		74.8±2.3^{c}	85.5±2.4	63.4±2.8^{b}
P – Value			0.0002	0.6995	0.0257
Insemination intervals X Semen dilution ratio	1 week	1:0	84.9±2.8^{ab}	83.8±3.4	70.7±3.7
		1:1	78.0±3.3^{ab}	83.2±3.8	65.4±4.2
		1:2	84.2±3.2^{ab}	87.5±2.9	73.6±3.8
		1:3	76.7±3.4^{ab}	83.9±3.1	63.7±3.5
	2 weeks	1:0	89.3±2.6^{a}	81.4±3.9	74.4±3.9
		1:1	78.3±2.5^{ab}	83.4±3.7	66.0±3.7
		1:2	86.8±3.0^{a}	83.9±3.3	72.1±3.8
		1:3	72.8±4.4^{b}	87.2±4.2	63.2±4.9
P – Value			0.570	0.8352	0.9290

a, b – means along same column with different superscripts are significantly different ($p<0.05$)

Table 3: Effects of Semen Dilution Ratio and Insemination Intervals on Embryo Mortality in Turkeys (Mean±SE)

		Embryo mortality (%)			
Insemination intervals	**Semen dilution ratio**	**EEM**	**MEM**	**LEM**	**TEM**
1 week	1:0	6.6±2.5	1.3±1.3	8.4±2.3	16.3±3.4
	1:1	7.1±2.6	0.0±0.0	7.1±2.1	14.2±3.1
	1:2	3.3±1.6	0.4±0.4	7.6±2.5	11.3±2.8
	1:3	4.8±2.0	0.6±0.6	10.7±2.6	16.1±3.1
2 weeks	1:0	3.7±1.5	2.1±1.4	12.9±3.9	18.7±3.9
	1:1	5.5±2.3	0.5±0.5	9.4±3.0	16.6±3.7
	1:2	3.2±1.7	1.8±1.4	10.3±2.7	15.3±3.3
	1:3	6.7±3.2	1.3±1.3	4.9±2.7	12.8±4.2
P – Value		0.6045	0.9385	0.2213	0.7723

Means along columns are not significant (P>0.05); EEM – Early Embryo Mortality; MEM – Mid Embryo Mortality; LEM – Late embryo Mortality; TEM – Total Embryo Mortality

DISCUSSION

The similarity observed for the weekly and fortnight insemination intervals is in line with observations from Adebisi and Ewuola (2019a) using undiluted semen for insemination in local turkeys. The significance of the interaction of the factors implied that at weekly intervals, fertility was similar across the dilution ratios, while at 2 weeks interval, 1:3 was significantly lower than 1:2 and undiluted semen. The mean characteristics of semen inseminated during the period of the study (Table 1) implied that 1:0, 1:1, 1:2 and 1:3 contained approximately $90x10^6$, $45x10^6$, $30x10^6$ and $22.5x10^6$ motile sperm cells, respectively per 0.02mL insemination dose. The results on weekly inseminations are in line with recommendations from Sexton (1976) who reported that as few as 25 million sperm cells per weekly insemination were needed for optimum fertility in Turkeys, which is similar to 1:3 dilution at weekly intervals in this study. The significantly low fertility observed for the dilution ratio of 1:3 at 2 weeks interval may be as a result of an overall relatively lower number of sperm cells inseminated and length of insemination interval of two weeks. Ogasawara (1981) reported that at least 100 million sperm cells should be inseminated in turkeys to produce optimal fertility. Haque and Hossain (2011) suggested 80-100 million sperm cells, while Bramwell (2012) recommended 150 - 300 million viable sperm cells for insemination. There seemed to be an increasing requirement for sperm cells for insemination over the decades and this could be related to the genetic improvement of the birds over time. Requirements by Sexton (1976) may have similarities with the results from this study because the birds used at that time may not have had much genetic advancement, as with those used in this study, which were random-bred and unimproved strains.

Christensen *et al.* (2005) observed that the selection of turkeys for nearly 40 generations for increased 16-week body weight has decreased fertility and embryo survival compared with its random bred control line. They reported that in lines selected for rapid body growth, the dams affected fertility over time. The implication of this may mean more sperm cell requirement for insemination by the improved hens to attain optimal fertility. Breed differences may also cause differences in fertility. There are reports that bronze turkeys fertilised at a faster rate than that from large white turkeys when

inseminated with equal numbers of viable sperm cells (Christensen *et al.*, 2005). They therefore concluded that genetic selection for economically important traits may affect sperm hydrolysis of the perivitelline layer and subsequent fertility and embryo liveability. Despite the differences observed in fertility, the hatch parameters of the interaction of factors did not show significant differences. There were also no significant differences observed with the embryo mortality at various stages. Hemming and Birkhead (2015) suggested that under natural conditions, a minimum number of sperm cells must enter the ovum to ensure zygote formation and development. When too few cells penetrate, embryo survival is significantly reduced. The penetration of too few sperms into the perivitelline layer can be a consequence of very low number of inseminated sperm cells. The absence of significant differences in the embryo mortality and hatch parameters among the treatments is also an indication that the embryo mortality was not affected by the reduced number of sperm cells inseminated as implied from the higher dilution ratios of 1:2 and 1:3. They also added that when inseminated sperm cells are too low, female birds compensate by allowing a greater proportion of sperm reach the site of fertilisation to ensure sufficient supernumerary sperm cells penetrate the germinal disc.

CONCLUSION AND RECOMMENDATION

The result from this study therefore implied that as few as 22.5 million motile sperm cells (1:3 dilutions) inseminated at weekly intervals over a period of 12 weeks, was sufficient to ensure fertilisation and embryo survival. However, if fortnight insemination is to be adopted, semen for insemination should not be diluted beyond 1:2 (a minimum of $30x10^6$ motile spermatozoa).

REFERENCES

Adebisi K. A and Ewuola E. O. 2019a. Egg fertility and embryo viability of turkey hens inseminated at varied intervals. *LRRD. 31 (6), article # 87.*

Adebisi K. A. and Ewuola E. O. 2019b. Comparative effects of saline solutions as diluents on *in-vitro* semen storage, egg fertility and hatchability in turkey hens. *Nigerian J. Anim. Sci.* 2019, 21(3): 107-116.

Bramwell, R.K., 2012. An overview of artificial insemination in poultry. The Merck veterinary manual for veterinary professionals. Retrieved Sept. 11, 2014 from www.merckmanuals.com.

Hemmings, N. and Birkhead, T. R. 2015. Polyspermy in birds; sperm number and embryo survival. Proccedings of the royal society of biological sciences. Published 28th October, 2015. Doi:10.1098/rspb.2015.1682.

Christensen, V.L., Fairchild, B. D., Ort, D. T. and Nestor, K. E. 2005. Dam and sire effects on the periviteline Layer and resulting fecundity of different lines of turkeys. *JAPR* 14: 483-491.

Haque, N. and Hossain, S.A. 2011. Methods of mating and artificial insemination in poultry. Retrieved Sept. 18, 2014 from http://www.poulvet.com

Ogasawara, F.X. 1981. Mechanisms associated with reproductive tissues and their implications on fertility level and duration: Reproductive efficiency of turkeys. *Western Regional Research Publication*. 142: 26 - 44.

Sexton, T. J. 1976. Studies on the dilution of turkey semen. *Br. Poult. Sci.* 17(2):179-184.

CRYOSURVIVAL OF GOAT SPERMATOZOA IN TWO TRIS BASED EXTENDERS SUPPLEMENTED WITH VITAMIN E

Adekunle, E.O., Majekodunmi, B.C., Logunleko, M.O. & Daramola, J.O.
Department of Animal Physiology, Federal University of Agriculture Abeokuta, Nigeria

ABSTRACT
Tris Coconut Water (TCW) and Tris Skim Milk (TSM) extenders supplemented with different levels of vitamin E were studied for their ability to support *in vitro* cryosurvival of spermatozoa obtained from West African Dwarf (WAD) goat bucks. Semen samples collected with the aid of artificial vagina were diluted with two tris extenders supplemented with 2, 4, 6 and 8mM of vitamin E for 30 days in liquid nitrogen. Spermatozoa cryopreserved with 6mM and 8mM inclusion levels of vitamin E for TCW extenders and 8mM inclusion levels of vitamin E for TSM based extenders had highest ($P < 0.05$) percentage motility. However, the results showed highest ($P < 0.05$) percentage acrosome integrity and membrane integrity at 4mM, 6mM, and 8mM inclusion levels of vitamin E in TCW extender. Highest ($P < 0.05$) percentage live spermatozoa were observed at TSM extenders supplemented with 4mM, 6mM and 8mM inclusion levels. Spermatozoa cryopreserved with 6mM and 8mM TCW extenders had the lowest ($P < 0.05$) percentage abnormality. Moreover, TCW and TSM extenders supplemented with 6mM and 8mM of vitamin E had highest ($P < 0.05$) spermatozoa that underwent acrosome reaction and capacitation. The findings indicated that spermatozoa obtained from WAD goat bucks were better preserved in TCW extender.
Keywords: cryopreservation, goat, oxidative stress, sperm viability, Trisbased extenders

INTRODUCTION
Goat is the most numerous domestic livestock species in Nigeria and presents a great potential to alleviate the problem of protein malnutrition (FAO, 2006). As the demand for these animals is constantly increasing, key steps in rapid multiplication of these animals will be important tools to reduce malnutrition. Frozen semen is normally used for artificial insemination (AI) in goat, sheep and cattle and semen extenders are the main constituents to accomplish freezing; semen extenders provide energy, maintain osmolarity, reduce bacterial contamination and protect sperms at low temperature. Quality of frozen-thawed semen is the main factor for successful application of AI. However, it is proven that the fertility of frozen semen is lower than fresh semen in all mammals including caprine (Lessard *et al.*, 2000; Watson, 2000).
The mechanism by which cryopreservation causes sperm damage is still to be explored, however, it is proven that reduction in viability and fertility occurs due to the damage on sperm plasma membrane (Abavisani *et al.*,2013). Sperm membrane is a highly dynamic structure that controls extra and intra cellular processes and plays an important role during fertilization. Formation of ice crystals reorders lipid, reduces membrane fluidity and permeability during freezing. Choice of semen extender is an important aspect of semen processing for AI and many extenders have been proposed for goat semen (Iaffaldano *et al.*, 2005). The adoption of AI technique in animal production in Nigeria has been generally low and this has accounted for the little or no documented information on storage and AI technique for goat reproduction in Nigeria. Vitamin E (α-tocopherol) functions as a peroxyl radical scavenger which helps to maintain the integrity of long chain polyunsaturated fatty acids in the membranes of cells and thus maintain their bioactivity (Traber and Atkinson, 2007).

MATERIALS AND METHODS
Experimental Location and animal
The study was carried out at the Teaching and Research Farm of Federal University of Agriculture, Abeokuta. Eight intact WAD bucks aged 2.5-3 years were used for this study.

SEMEN COLLECTION
Semen samples were collected from eight WAD bucks with the aid of artificial vagina.
Semen dilution and storage
The effect of adding different levels of vitamin E in two tris extenders on viability of spermatozoa obtained from WAD goat bucks was carried out in a study repeated twice. Only ejaculates showing >80% motility were pooled to minimize individual differences (Bucak and Tekin, 2007). The pooled semen samples were diluted at 32°C in a two-step process with a Tris-based extender composed of 2

fractions. The Fraction 1 solution contained Tris-hydroxymethyl-aminomethane (2.42g), citric acid (1.36g), glucose (1g), penicillin (0.028g), Sodium citrate (2.9g) and distils water made up 100 mL as control followed by addition of Tris-egg yolk, skimmed milk and coconut water based extender each at (20mL), consisted of Tris-hydroxymethyl-aminomethane (2.42g), citric acid (1.36g), glucose (1g), penicillin (0.028g), and distils water make up 100mL. Fraction 2 solution had the same composition as the Fraction 1 solution with the addition of 14.0% glycerol (v/v). The pooled semen samples were splited into 9 equal aliquots, diluted with the Fraction 1 solution and supplemented each with 0mM, 2mM, 4mM, 6mM and 8mM of vitamin E respectively with pH of 7.05 at a final concentration of 789 $\times 10^6$ spermatozoa per millilitre. Fraction 2 solution was subsequently added to fraction 1. Diluted semen samples were then loaded into 2 mL plastic straws, sealed with polyvinyl, cooled to 4°C at a rate of 0.25^{o}C/min and equilibrated at 4°C for 10 min in TYFSF Refrigerated Incubator. Subsequently, the straws were then placed in a canister at 4cm above liquid nitrogen in the vaporous phase for 10min before plunging them directly and quickly into liquid nitrogen for 30 days and thereafter evaluated for sperm quality characteristics.

SEMEN EVALUATION

Subjective microscopic evaluation of sperm motility, acrosome Integrity, sperm membrane integrity, sperm abnormality, live sperm, *In vitro* acrosome reaction and *In vitro* capacitation were carried out.

RESULTS

The results in Table 1 showed that spermatozoa cryopreserved with 6mM and 8mM inclusion levels of vitamin E for TCW based extenders had highest ($P < 0.05$) percentage motility. Similarly, spermatozoa cryopreserved with 8mM inclusion levels of vitamin E for TSM extenders had highest ($P < 0.05$) percentage motility. Highest ($P < 0.05$) percentage acrosome integrity and membrane integrity in 4mM, 6mM, and 8mM inclusion levels of vitamin E were observed among TCW extender and highest ($P < 0.05$) membrane integrity was also realized when 6mM and 8mM inclusion levels of vitamin E in TSM extender was used. Highest ($P < 0.05$) percentage live spermatozoa was observed among both extenders supplemented with 4mM, 6mM and 8mM inclusion levels of vitamin E and TSM supplemented with 6mM and 8mM inclusion levels of vitamin E. However, Spermatozoa cryopreserved with TCW extender supplemented with 6mM and 8mM inclusion levels of vitamin E had the lowest ($P < 0.05$) percentage abnormality.

The results in Table 2 showed that more spermatozoa ($P < 0.05$) cryopreserved with vitamin E underwent acrosome reaction and capacitation compared to the control. However, TCW and TSM based extenders supplemented with 6mM and 8mM of vitamin E had highest ($P < 0.05$) spermatozoa that underwent induced acrosome reaction.

Table I: Effects of spermatozoa viability of buck semen using three different Tris-based extenders supplemented with vitamin E

		Parameters				
		MOT (%)	**ACI (%)**	**MI (%)**	**LIVE (%)**	**ABN (%)**
	Control	29.20± 3.97^e	46.50 ± 2.22^e	48.50 ± 1.50^e	52.50 ± 5.00^c	3.75 ± 0.63^a
	2 mM	50.60 ± 2.69^c	69.50 ± 0.96^b	66.50 ± 0.96^b	67.00 ± 4.08^b	3.00 ± 0.41^b
Tris-	4 mM	62.40 ± 3.11^b	74.50 ± 1.26^a	77.50 ± 0.96^a	67.50 ± 2.50^b	2.50 ± 0.50^c
coconut	6 mM	70.00 ± 4.38^a	77.00 ± 1.73^a	75.50 ± 0.50^a	72.50 ± 2.50^a	1.40 ± 0.41^d
water	8 mM	71.20 ± 4.50^a	78.50 ± 0.96^a	74.50 ± 0.96^a	70.59 ± 4.79^a	1.00 ± 0.41^d
	2 mM	56.00 ± 5.29^c	55.50 ± 2.63^d	61.00 ± 0.58^c	65.00 ± 6.45^b	3.00 ± 0.00^b
Tris-skim	4 mM	55.00 ± 7.34^c	58.50 ± 2.21^c	67.00 ± 1.00^b	70.00 ± 0.02^a	2.75 ± 0.63^b
milk	6 mM	62.60 ± 5.68^b	63.50 ± 1.50^c	72.50 ± 0.50^a	70.00 ± 5.77^a	2.50 ± 0.29^c
	8 mM	71.20 ± 2.69^a	66.50 ± 2.22^b	75.00 ± 1.29^a	75.00 ± 2.89^a	2.00 ± 0.41^c

$^{a, b, c,d,e}$Values within the same column with different superscripts differ ($P < 0.05$), MOT: Motility, ACI: Acrosome Integrity, MI: Membrane Integrity,ABN: Abnormality,SE:standard error.

Table 2: Effect of two Tris-based extenders on *in vitro* acrosome reaction (%) and capacitation (%) of spermatozoa cryopreserved with vitamin E

		Parameters	
	Extenders	***In-vitro*acrosome reaction (%)**	***In-vitro*sperm capacitation (%)**
Tris coconut water	Control	43.00 ± 1.91[e]	40.00 ± 1.63[e]
	2 mM	61.00 ± 6.61[c]	58.00 ± 1.15[c]
	4 mM	73.00 ± 5.00[b]	71.50 ± 8.09[b]
	6 mM	84.50 ± 2.06[a]	78.00 ± 5.29[a]
	8 mM	81.50 ± 1.50[a]	80.00 ± 4.90[a]
Tris skim milk	2 mM	72.00 ± 10.67[b]	69.00 ± 5.74[b]
	4 mM	76.50 ± 2.36[b]	71.00 ± 4.43[b]
	6 mM	78.00 ± 0.81[a]	72.00 ± 5.89[b]
	8 mM	78.50 ± 2.99[a]	81.00 ± 2.52[a]

[a, b, c, d, e] Values within the same column with different superscripts differ significantly, ($P < 0.05$), SE: standard error.

DISCUSSION

The addition of different levels of vitamin E in this present study to TCW and TSM based extenders improved the percentage of sperm motility and viability, The improvement in motility in this tris based extenders supplemented with vitamin E suggests the beneficial effect of vitamin E on sperm motility and viability which could be due to its potential antioxidant capacity. The highest sperm motility and percentage live sperm observed from TCW following supplementation of vitamin E could be linked to the fact that vitamin E suppressed deleterious effect of ROS on WAD buck and the protective effect of coconut water which result to high content of lipids which is a major component of sperm membrane that is involved in a series of biochemical and functional change ultimately required for fertilization (Brque *et al*., 2003). The combination of vitamin E and TCW is a more complete nutrient composition that provide important source of energy for sperm to maintain their lifespan during storage and also coconut water is poor in phospholipids and rich in complex organic molecules, such as proline, glycine, glutamic acid and indole-acetic acid (IAA) which protect and extend the spermatozoa life span.

The higher acrosome and membrane integrity during cryopreservation with the tris based extenders supplemented with vitamin E indicated that vitamin E as antioxidant has capacity to increase the onset of the physiological acrosome reaction and the Indole Acetic Acid present in coconut water had a beneficial effect on goat sperm acrosomal and membrane integrity.

Evaluation of sperm abnormality is one of the commonest methods of investigating survival of frozen thawed semen and the relationship between sperm abnormality and fertility has been evaluated (Raina, 2002). Vitamin E functions as antioxidants which in turn may provide direct protection of sperm cells from morphological damage by preventing free radical oxygen from damaging sperms (Luvoni, 2006).

The physiological acrosome reaction involves activation of several signal transduction pathways, the induced acrosome reaction mainly involves a chemical effect on calcium influx that partially reflects the physiological acrosome reaction process (Breitbart and Spungin, 1997) and only capacitated spermatozoa have ability to undergo acrosome reaction (Arnoult *et al.*,1996).The present *in vitro* study indicated that vitamin E was able to maintain fertilizing capacity of spermatozoa in, TCW and TSM extenders as evidenced by better percentage of capacitation and acrosome reaction of cryopreserved spermatozoa. In ram spermatozoa, vitamin E administration increases plasminogen activator activity, known to be involved in sperm capacitation and acrosome reaction (Tsantarliotou *et al.,* 2008). This result was in agreement with Arabi and Seidaie (2008) who demonstrated that vitamin E determined capacitation of buffalo spermatozoa *in vitro*.

CONCLUSION

The findings of the present study indicated that the use of coconut extenders supplemented with vitamin E for goat semen cryopreservation could, in the future, improve the effectiveness of goat AI programs and it is concluded that there were no apparent disadvantages to switching from egg yolk extenders to coconut extenders for goat semen cryopreservation.

RECOMMENDATION

Coconut extender supplemented with 6mM and 8mM vitamin E could be used to preserve goat semen.

REFERENCES

Abavisani, A., Arshami, J., Naserian, A.A., Kandelousi, M.A.S. and Azizzadeh, M., 2013.Quality of bovine chilled or frozen-thawed semen after addition of omega-3 fatty acids supplementation to extender.*Int. J. Fertil. Steril*. 7: 161-168.

Arabi, M., and Seidaie, S.R.,2008. Assessment of motility and membrane peroxidation of bull spermatozoa in the presence of different concentration of vitamin C. *Vet. Med. J.* 2: 39-46.

Arnoult, C., Zeng, Y., and Florman, H.M., 1996. ZP3-dependent activation of sperm cation channels regulates acrosomal secretion during mammalian fertilization. *J. Cell Biol.* 134, 637-645.

Breitbart, H., Spungin, B. 1997. The biochemistry of the acrosome reaction. Mol.Hum.*Reprod.* 3:195-202.

Brèque, C., Surai, P., and Brillard, J. P. 2003. Roles of antioxidants on prolonged storage of avian spermatozoa in vivo and in vitro.*Mol. Reprod. Dev*. 66: 314–323

Bucak, M.N. and Tekin, N. 2007. Protective effect of taurine, glutathione and trehalose on the liquid storage of ram semen. *Small Ruminant Res*. 73, 103-108

Etches, R.J., 1996.Reproduction in Poultry. CABInternational, Wallingford, UK, pp: 241-250.

FAO (Food and Agriculture Organization) 2006. World agriculture towards 2030/2050. Interim report, Global Perspective Studies United Nation. Rome, Italy

Iaffaldano, N., Rosato, M.P., Manchisi, A.,Centoducati, G. and Meluzzi, A., 2005. Comparison of different extenders on the quality characteristicsof turkey semen during storage.Ital.*J.Anim. Sci.*4: 513-515.

Leeuw, F.E.; Leeuw, A.M.; Den Daas, J.H.G.; Colenbrander, B. and Verkleij, A.J. 1993. Effects of various cryoprotective agents and membrane-stabilizing compounds on bull sperm membrane integrity after cooling and freezing. *Cryobiolo.* 30: 32-44.

Lessard, C., Parent, S., Leclerc, P., Baileys, J.L. and Sullivan, R., 2000. Cryopreservation alters the levels of the bull sperm surface protein P25b. *J. Androl.*, 21: 700-707.

Luvoni G.C. 2006.Gamete cryopreservation in the domestic cat. *Theriogenol* 66: 101-111.

Moussa, M., Martinet, V.,Trimeche, A.,Tainturier, D., and Anton, M., 2002. Low density lipoproteins extracted from hen egg yolk by an easy method: cryoprotective effect on frozen-thawed bull semen. *Theriogenol*57:1695-1706.

Raina, V. S., A. K. Gupta and K. Singh, 2002.Effect of antioxidant fortification on preservability ofbuffalo semen.Asian-Austr.*J. Anim. Sci*. 15: 16-18.

SAS. 1999. SAS User's Guide: Statistics Inc., Cary, N.C., Pp. 923.

Toniolli, R.; Bussière, J.; Courot, M.; Magistrini, M. and Combarnous, Y. 1996.Effect of indole-3-acetic acid (plant auxin) on the preservation at 15°C of boar semen for artificial insemination.*ReprodNutr Dev*. 36: 503-511.

Traber, M.G. and Atkinson, J. 2007.Vitamin E antioxidant and nothing more. Free radic. Bio. Med.43: 4-15

Tsantarliotou, M.P., Kokolis, N.A., and Smokovitis, A., 2008. Melatonin administration increased plasminogen activator activity in ram spermatozoa. *Theriogenol.* 69, 458-465.

Watson, P., 2000. The causes of reduced fertility with cryopreserved semen.*Anim. Reprod. Sci.* 60: 481-492.

SEMEN CHARACTERISTICS AND GROWTH INDICES OF MALE RABBITS FED DIETARY LEVELS OF *VERNONIA AMYGDALINA*

Adeyemi A. A., Oloyede C. O., Idowu G.A. & Akinlade M. O.
Department of Animal Sciences, Obafemi Awolowo University, PMB 13, Ile-Ife, Nigeria.
Correspondence: nikeadeyemi@oauife.edu.ng

ABSTRACT
The effect of dietary levels of *Vernonia amygdalina* Leaf Meal (VLM) on semen and growth indices in male rabbits was assessed in this study. Dried *Vernonia amygdalina* leaves was milled and included into the experimental diets at 0, 5, 10 and 15 %. The diets were fed to forty male rabbit with ten bucks per group for twelve weeks. Semen was collected from the bucks weekly and assessed for semen volume (ml), spermatozoa motility (%), sperm concentration ($x10^7$/ml) and live sperm cells (%). Body weight gain was monitored weekly using a sensitive weighing scale and morphometric traits were measured once every two weeks using a measuring tape. Five rabbits per group were stunted, slaughtered; the testes were harvested and weighed. Data obtained were analyzed using Analysis of Variance. The result obtained showed that dietary inclusion of VLM had a significant ($P<0.05$) effect on semen volume and live sperm cells (%). The average weekly weight gain of the rabbit bucks was significantly ($P<0.05$) influenced by VLM among the groups. Among the morphometric traits measured, only body length was significantly ($P<0.05$) influenced by the inclusion of VLM in the diets of the animals. The highest testes weight (4.57g) was recorded in bucks fed 10% VLM diets. Inclusion of VLM in the diet of male rabbits had no adverse effect on all the parameters assessed. Improved weight gain was recorded at 10kg/100kg diet. It can be inferred that *Vernonia amygdalina* can be adopted as a component of male rabbits' diet but not for boasting their semen quality.
Keywords: Bitter leaf, Body length, Morphometric Traits, Testes, Weight gain

INTRODUCTION
Rapid growth, efficient reproduction and increased productivity are essential for profitable livestock production. The use of plant for boasting reproductive efficiency in animal production has been on the increase. However, male rabbits with poor body conformation may not be efficient breeders. Changes in the different parts of the body determine the shape, conformation and body proportion of the animal at a given time (Olutogun *et al*., 2003). Morphometric traits can be used as aid to selection in rabbit genetic improvement and live weight prediction (Hassan *et al*., 2012). However, the relationship between nutrition, growth and reproductive efficiency of an animal cannot be over-emphasized. Leaf meals have been identified as suitable replacements for some conventional feedstuff (Oloruntola *et al.,* 2016), many of which may have beneficial or adverse properties. *Vernonia amygdalina* (Bitter leaf) is one of the non-conventional feed resources which are predominantly found in Africa. It is probably the most used medicinal plant in the genus vernonia (Ijeh and Ejike, 2011). It is rich in both nutritional and phytochemical components. *Vernonia amygdalina* contains90.68% dry matter, 22.81% crude protein, 18.17% crude fiber, 16.65% ash, 4.34% crude fat and 38.03% carbohydrate (Usunobun and Okolie, 2016). Bioactive compounds identified in the leaves include oxalate, phylate, tannins, saponins, flavonoid, cyanogenic glycosides, alkaloids, anthraquinone, steroid and phenol (Udochukwu *et al.,* 2015). The modulatory role of *Vernonia amygdalina* extract on spermatogenesis and steriodogenesis have been reported (Saalu *et al.,* 2013); this is attributed to the presence of bioactive substances present in the leaf. The saponin extract of *V. amygdalina* administered to male rats has potential to increase their fertility (Oyeyemi *et al.,* 2015). Olosunde (2016) reported a significantly lower average daily weight gain in West African Dwarf goats fed diets with 30 and 45% bitter leaf inclusion. Despite the various attributes of *Vernonia amygdalina* that has been reported in literature, little is known about its effect on reproductive indices of male rabbits used for breeding purpose. This study therefore aims at assessing the effect of *Vernonia amygdalina* leaf meal on semen indices, weight gain, morphometric traits and weight of testes in rabbit bucks.

MATERIALS AND METHODS
The study was conducted at the Rabbitry unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. Fresh *Vernonia amygdalina* leaves were harvested and air dried until brittle; it was milled to obtain *Vernonia amygdalina* leaf meal (VLM) which was incorporated into the

experimental diets thereafter pelletized. The experimental diets (Table 1) are designated as VLM_0 - diet without VLM (control diet), VLM_5- diet with 5% VLM, VLM_{10}- diet with 10% VLM and VLM_{15}- diet with 15% VLM. Forty rabbit bucks of heterogeneous population with an average weight of 1818.3g were used for this experiment. The rabbits were randomly allocated into four groups with 10 bucks per group in a Completely Randomized Design. The experimental diets were offered to the rabbits daily and feed intake was recorded. The experiment lasted for a period of 12 weeks. Fresh semen samples were assessed for semen volume, spermatozoa motility, sperm concentration and percentage live sperm cells as described in Adeyemi *et al*. (2014). The bucks were weighed weekly using the weighing scale and the body weight gain obtained were recorded in grams. Some morphometric traits of the animals were taken in the morning before feeding the rabbits once every two weeks using a tape rule and the values were recorded in centimeters (Ogbuewu *et al.*, 2011). Traits measured included ear length, head length, body length, abdominal circumference and tail length. Five rabbits per group were stunted, slaughtered; the testes were harvested and weighed using a sensitive scale. All data obtained were subjected to statistical Analysis of Variance procedure using Statistical Analytical System (SAS, 2009). Treatment means were compared using Duncan Multiple Range Test of the same software.

Table 1: Composition of Experimental diets

INGREDIENTS	VA_0	VA_5	VA_{10}	VA_{15}
Maize	9.00	9.00	9.00	9.00
Corn bran	22.50	22.50	22.50	22.50
Rice bran	20.80	20.80	20.80	20.80
Soybean meal	9.90	9.90	9.90	9.90
Palm kernel cake	5.25	5.25	5.25	5.25
Wheat bran	30.80	25.80	20.80	15.80
Vernonia amygdalina	0.00	5.00	10.00	15.00
Others	1.75	1.75	1.75	1.75
TOTAL	100.00	100.00	100.00	100.00
Calculated analysis:				
Crude protein (%)	16.14	16.37	16.60	16.89
Crude fiber (%)	9.04	9.19	9.35	9.30
Digestible energy (kcal/kg)	2468.7	2500	2532.4	2564.2

VLM- *Vernonia amygdalina* leaf meal; VLM_0- diet without VLM (control diet), VLM_5- diet with 5% VLM, VLM_{10}- diet with 10% VLM and VLM_{15}- diet with 15% VLM Others: Bone meal =1.10, Salt = 0.32 and Premix = 0.33

RESULTS AND DISCUSSION

The semen indices of the bucks fed dietary levels of *Vernonia amygdalina* Leaf meal (VLM) is presented in Table 2. Dietary inclusion of VLM had a significant ($P<0.05$) effect on semen volume and live sperm cells (%). The highest semen volume (0.47ml) was recorded in bucks fed 15% VLM diets which was not significantly different from that of bucks fed diet with no VLM (0.43ml). Bucks fed diets VLM_5 and VLM_{10} had lower semen volume (0.34, 0.36 ml) and sperm concentration compare to that of bucks fed VLM_{15}. Sperm motility and concentration were not significantly influenced by the inclusion of VLM in the diets of the bucks. The result from this study corroborate that of Ajala and Owoyemi (2016) who reported no significant effect of VLM levels on milt motility and liveability in African catfish. The effects observed may be attributed to the presence of bioactive substances (Tannin, Saponin) present in VLM that may not enhance spermatogenesis. This may also be influenced by the level of VLM fed and the feeding duration. The weight gained by an animal within a unit of time is an important indicator of its growth. Table 3 shows the body weight gain, testes weight and morphometric traits of male rabbits fed dietary levels of *Vernonia amygdalina* Leaf

Meal (VLM). The average weekly weight gain of the rabbit bucks was significantly different (P<0.05) among treatments. The highest average weekly weight gain (44.04g) was recorded in bucks fed the 10% VLM while the lowest (22.46g) was recorded in those fed 15% inclusion of VLM. The results obtained from this study with rabbit bucks fed diet with 10% VLM having the higher weight gain is in corroborate the findings of Olosunde (2016) who reported reduced weight gain in West African Dwarf goat fed dietary levels of VLM above 15%. However, the value obtained in this study is at variance with the finding from the use of VLM extract which resulted in increased weight gain in broiler chicks (Oleforuh-Okoleh *et. al.* 2015). Among the morphometric traits measured, only body length was significantly (P<0.05) influenced by the inclusion of VLM in the diets of the animals. Bucks on 0%VLM diet recorded the highest value for body and head length (39.88, 11.91 cm respectively). The bucks fed diets with 10% VLM had the highest average weekly weight gain and abdominal circumference. This is at variance with the findings of Ogbuewu *et al*, (2011) who reported no significant difference in body length of pre-pubertal buck rabbits fed different levels of neem leaf meal.

Testes weight was not significantly influenced by the dietary inclusion of VLM in the diets of the bucks. The highest testes weight (4.57g) was recorded in bucks fed 10% VLM diets with the highest weight gain. This corroborates the findings of Raji *et al*., (2008) who reported a linear relationship between age, body weight and the entire testicular dimension within breeds in goats. The result from this study therefore implies that dietary levels of VLM did not have similar effects across the parameters assessed in the bucks; hence its effect on semen quality may not be optimal.

Table 2 : Semen Indices of Rabbit Bucks Fed Dietary Levels of *Vernonia amygdalina*

PARAMETERS	**VLM_0**	**VLM_5**	**VLM_{10}**	**VLM_{15}**	**SEM**	**p value**
Semen Volume (ml)	0.43^a	0.34^b	0.36^b	0.47^a	0.0097	<0.0001
Spermatozoa Motility (%)	79.43	79.82	77.76	77.95	0.66	0.6197
Sperm Concentration ($x10^7$/ml)	47.77	32.42	33.74	39.25	4.80	0.6412
Live Sperm Cells (%)	95.67^{ab}	97.96^a	97.93^a	95.18^b	0.44	0.0401

VLM - *Vernonia amygdalina* Leaf Meal; a, b, c -Means in the same row with different superscript are significantly (P< 0.05) different SEM – standard error of means

Table 3 : Body Weight Gain, Morphometric Traits and Testes Weight of Rabbit Bucks Fed Dietary Levels of *Vernonia amygdalina*

Parameters	VLM_0	VLM_5	VLM_{10}	VLM_{15}	SEM	p value
Avg. Weekly Weight Gain (g)	38.82^{b}	27.29^{bc}	44.04^{a}	22.46^{c}	2.91	0.016
Morphometric Traits:						
Abdominal Circumference (cm)	28.76	28.79	29.01	27.93	0.33	0.451
Body Length (cm)	39.88^{a}	37.10^{b}	38.21^{b}	37.76^{b}	0.32	0.011
Ear Length (cm)	11.16	11.68	11.59	11.11	0.09	0.056
Head Length (cm)	11.91	11.43	11.42	11.47	0.10	0.226
Tail Length (cm)	9.85	8.49	9.72	9.97	0.24	0.106
Testes weight (g)	4.20	4.45	4.57	3.88	0.15	0.419

VLM - *Vernonia amygdalina* Leaf Meal; a, b, c -Means in the same row with different superscript are significantly ($P< 0.05$) different SEM – standard error of means

CONCLUSION

Inclusion of *Vernonia amygdalina* leaf meal (VLM) in the diet of male rabbits had no adverse effect on semen quality, weight gain, morphometric traits and testes weight. Morphometric traits cannot be used to predict weight gain in heterogeneous population of adult bucks fed VLM since the diet had no significant effect on most of the traits assessed. However, improved weight gain was recorded at 10kg VLM/100kg diet. It can be inferred that VLM can be adopted as a component of male rabbits' diet but not for boasting their reproductive efficiency in terms of semen indices.

REFERENCES

Adeyemi A.A. Ewuola E.O. and Tewe O.O. 2014. Testosterone, libido assessment and semen characteristics of rabbits fed supplemental *Moringa oleifera* leaf meal. *Nigerian Journal of Animal Science*, 16(1): 13-19

Ajala, O.O. and Owoyemi, A.O. (2016). Effect of Dietary *Vernonia amygdalina* supplementation on some Biological Parameters of Milt of Male African Catfish *(Clarias gariepinus)*. *Bulgarian Journal of Veterinary Medicine, 1: 30-39.*

Francis O.M., Akinlolu A.A. and Kehinde O.A. (2013) Assessment of bitter leaf (*Vernonia amygdalina*) as fertility enhancer in the giant African Catfish (*Heterobranchus bidorsalis*) broodstock. *Academia Journal of Biotechnology* 1(2): 36-40,

Hassan H. E., Elamin K. M., Yousif I. A., Musa A. M. and Elkhairey M. A. (2012) Evaluation of Body Weight and some Morphometric Traits at Various Ages in Local Rabbits of Sudan. *J. Anim. Sci. Adv.* 2(4): 407-415

Ijeh I. I. and Ejike C.E.C. C. 2011 Current perspectives on the medicinal potentials of *Vernonia amygdalina* Del. *Journal of Medicinal Plants Research* 5(7): 1051-1061

Ogbuewu I.P., Okoro V.M, Okoli I.C and Iloeje M.U. (2011). Evaluation of dried leaf meal of an ethnomedicinal plant-neem on linear growths and reproductive tract morphometry of rabbit does. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 10(4): 2153-2159.

Oleforuh-OkolehV. U., Olorunleke S. O. and Iyakutuye J.N. (2015). Comparative response of Bitter leaf (*Vernonia amygdalina*) Infusion Administration on Performance, Haematology and Serum Biochemistry of Broiler Chicks. *Asian Journal of Animal Sciences*, 9 (5): 217-224.

Olosunde A.O., (2016). Utilization of bitter leaf (*Vernonia amygdalina*) meal as feed for West African Dwarf goats. Ph.D Thesis - Department of Animal Sciences, Obafemi Awolowo University. Ile-Ife Pg141.

Oloruntola O.D, Ayodele S.O, Agbede J.O, Oloruntola D.A. and Omoniyi I.S (2016). Effect of *Alchorneal cordifolia* leaf meal and enzyme supplementation on growth, hematological, immunostimulatory and serum biochemical response of rabbits, *Asian Journal of Biological and Life Sciences*, 5(2), 191-194.

Olutogun O., Abdullah A.R., Raji A.O., Adetoro P.A. and Adeyemi A. (2003). Body conformation characteristics of White Fulani and Gudali (Zebu) cattle breeds of Nigeria. Proceeding of 28th Annual conference, Nigeria Society of Animal Production, Ibadan, Nigeria, 16-20th March, Pp 129-132.

Oyeyemi M.O., Soetan K.O. and Akinpelu O.B. (2015) Sperm characteristics and haemogram of albino rats treated with saponin extract from *Vernonia amygdalina*. *Journal of Cell and Animal Biology* 9 (3), 26-30.

Raji A.O., Igwebuike J.U. and Aliyu J. (2008). Testicular biometry and its relationship with body weight of indigenous goats in a semi-arid region of Nigeria. *ARPN Journal of Agricultural and Biological Science*. 3(4), 6-9.

Saalu L.C, Akunna G.G. and Ajayi J.O. (2013). Modulating role of bitter leaf on spermatogenic and steriodogenic functions of the rat testis. *American Journal of biochemistry and molecular biology*. 3 (3), 314-321

SAS (2009). Statistical analytical system institute, SAS/STAT User's guide statistical, SAS Institute, Cary. North Carolina, USA.

Udochukwu U., Omeje F.I., Uloma I.S. and Oseiwe F.D. (2015). Phytochemical analysis of *Vernonia amygdalina* and *Ocimum gratissimum* extracts and their antibacterial activity on some drug resistant bacteria. *American Journal of Research Communication*, 3(5), 225-235

Usunobun U. and Okolie P. N. (2016) Phytochemical analysis and proximate composition of *Vernonia amygdalina*. *International Journal of Scientific World*, 4 (1), 11-14

CHICKEN GROWTH HORMONE GENE POLYMORPHISM OF SELECTED CHICKEN BREEDS IN NIGERIA

Adigun, U.O., Ojimah, C.O. and Egena, S.S.A.
Department of Animal Production, Federal University of Technology, P.M.B. 65, Minna, Niger State, Nigeria.
Corresponding Author:adigunolagoke@gmail.com

ABSTRACT
The study was carried out to investigate polymorphism at the chicken growth hormone gene of selected chicken breeds (Fulani ecotype, Noiler, FUNAAB Alpha, Frizzled feathered and Cobb 500) in Nigeria. Genomic DNA was extracted from blood samples collected from 49 birds. Amplification of specific DNA fragments at intron 3 of the *cGH* gene yielded a product size of 715bp and this was used to analyze for polymorphism using Polymerase Chain Reaction-Restriction Fragment Length Polymorphism (PCR-RFLP) technique. Banding patterns of the gene investigated, revealed the occurrence of three RFLP variants: TT, CT and CC with genotype frequencies of 0.449, 0.245 and 0.306, respectively. The allele frequencies of the T and C alleles were 0.469 and 0.531, respectively indicating that the C allele was predominant. Chi-square test revealed that the chicken population investigated was in Hardy-Weinberg equilibrium. It was concluded that, the presence of observed genetic variations in the chicken growth hormone gene, could be exploited because of its association with economically important traits.

Keywords: Polymorphism, chicken, growth hormone, gene and RFLP.

INTRODUCTION
Growth hormone affects traits in broiler chickens production such as growth rate, body weight maturation, metabolic rate, egg production, reproduction, appetite control and aging (Harvey, 2013), it also promotes muscle and bone growth and development, as well as regulation of fat content and its metabolism (Zhang *et al.,* 2007). The Chicken Growth Hormone (*cGH*) is a 22-kDa protein, containing 191 amino acid residues and consisting of 4,101bp, having five exons and four introns (Kansaku *et al.,* 2008; Hrabia *et al.,* 2008). A polypeptide, the hormone is produced and secreted by the pituitary gland. Apart from affecting a variety of physiological functions, *cGH* is reported to be one of the most important genes affecting chicken performance traits (Vasilatos-Younken *et al.,* 2000). Its linkage to growth and metabolism, leads to potential correlations between its polymorphisms and economic traits. It is also involved in the processes of sexual differentiation, pubertal maturation and participates actively in gonadal steroidogenesis, gametogenesis and ovulation (Hull and Harvey, 2001). Apart from the above mentioned; it also plays significant roles in a variety of secondary functions such as egg production, aging and reproduction (Kansaku *et al.,* 2008). Accordingly, this study was carried out with the aim of investigating the polymorphism at intron 3 of the *cGH* gene in selected chicken breeds in Nigeria.

MATERIALS AND METHODS
The study was carried out using five chicken breeds commonly reared in Nigerian (Fulani ecotype, Fizzle feathered, Noiler, FUNNAB Alpha broilers, Cobb 500). Blood samples (5mls) were collected from the brachial vein of forty nine chickens using 5ml syringes (separate needles and syringes were used for individual birds to avoid cross contamination). The blood samples were collected into Ethylene Di-amine Tetra-acetic Acid (EDTA) bottles.Samples were stored on ice packs for onward transfer to the laboratory where genomic DNA was extracted. This was done at African Biosciences Ltd., Ibadan, Oyo State, Nigeria. DNA was extracted using gSYNC^{TM} DNA extraction kit (Geneaid) according to the manufacturer's protocol. The quantity and quality of the extracted DNA was checked by spectrophotometer and agarose gel electrophoresis, respectively. The PCR products (2 samples per breed) were sequenced and then aligned against the chicken genome with the BLAST programme to verify their identity. Prior to sequencing, the DNA were cleaned to ensure that the gene is not contaminated with impurities. This was done using DNA clean and concentrator kit according to the manufacturers protocol (ZYMO Research). The primers used for the study was specific to *cGH* gene and was designed using the National Centre for Biotechnology Information (NCBI) website. The *cGH* forward primer 5'TCAGTACGCAGACCTACCCTC3'and 5'TGCACATCATGTCCCACGTTT3' (reverse) were used for the study.The extracted DNA was diluted with autoclaved distilled water to 30ng per µl. A total of 21µl of reaction mixture for the primer was mixed in eppendorf tube. The reaction volume (21µl) containing the *cGH* primers was amplified using PCR-RFLP method; each of

1.5µl, PCR Master Mix (10µl) contained water 2.7µl and 5.3µl (90ng) diluted DNA. The reaction mixture were subjected to an initial denaturation at 95°C for 4 minutes, followed by 50 cycles at 94°C for 25 seconds. Annealing then followed at 56°C for 45 seconds, an extension at 72°C for 40 seconds and a final extension was done for 10 minutes at 72°C. The PCR products were digested with the endonuclease *Taq*1. Restriction enzyme was analyzed on 2.5% agarose gel. For genomic DNA, 1.0% agarose gel was used while for the PCR product, 2.0% agarose gel was used. Electrophoresis was conducted at a constant voltage of 75 volt for 45 minutes at 37°C using 1.0xTAE buffer. The DNA ladder (100 bp) was used for sizing of the DNA bands. The stained (ethidium bromide) DNA fragments were photographed using a Blue Light (BL) transilluminator (Biologix®) to visualize the bands. Genotypic frequencies of the different PCR-RFLP patterns were estimated from the combination of various RFLP alleles generated based on the presence or absence of one or more restriction sites. Different genotypes were identified on the basis of the different patterns observed. The allele frequencies were calculated using standard methods. Chi-square (χ^2) test for goodness of fit was used to test for Hardy-Weinberg equilibrium.

RESULTS AND DISCUSSION

The agarose gel electrophoresis result of isolated genomic DNA of *cGH* of selection chicken breeds in Nigerian is presented in (Figure 1). The isolated genomic DNA of the selected chicken breeds indicated high quality and appeared as single bands without sheared fragments. DNA extraction and quality determination with electrophoresis and spectrophotometer was done for all Chickens and the obtained result was acceptable.



Figure 1: DNA extracted from chicken breeds

The agarose gel electrophoresis results of the PCR amplified *cGH* is presented in Figure 2. Amplification of specific DNA fragments at intron 3 of the *cGH* gene was successfully performed for the total samples using the designed primer pair. The amplified products appeared as clear single bands, and occupied the appropriate position with approximately 715bp of amplicon size, with no variation in sizes between the chicken breeds. The amplified products were consistent with the target fragments and had a good specificity, which could be directly analyzed through PCR-RFLP technique. This finding at intron 3 of the *cGH* gene is in tandem with the results of Muin and Lumatauw (2013) in Indonesia native chickens. However, Shahnaz *et al*. (2008), Thakur *et al.* (2009), Khoa *et al.* (2013), Makhsous *et al*. (2013), Rahmadani *et al.* (2014) and Saikhom *et al.* (2017) reported product sizes of 1200bp, 1216bp, 563bp, 1164bp, 367bp and 713bp, respectively. The differences observed in the bp of the PCR fragments suggest the possibility of insertion/duplication of the sequence. The agarose gel electrophoresis result of the PCR-RFLP analysis amplified *cGH* is presented in Figure 3. The banding pattern revealed three RFLP variants which were arbitrarily assigned as CC, CT and TT genotypes. The CC, CT and TT genotypes were detected by the presence of two bands, three bands and one band, respectively. The frequencies of the different RFLP fragments at intron 3 of the *cGH* gene are presented in Table 1. Out of the 49 chickens studied, 15 had CC (30.6%), 22 had CT (44.9%) and 12 had TT (24.5%) genotype, respectively. This occurrence of three genotypes is in agreement Bingxue *et al*. (2003) who reported three genotypes (AA, AB and BB) in a population of hybrid chickens (broilers x Silky) in China. Also, Tanmankaur *et al.* (2008) analyzed 776bp amplicon of *cGH* gene digested with *Msp*1 with the results revealing three different genotype patterns (AA, AC and CC) created by a combination of polymorphic *Msp*1 cut sites present in exon-1 and intron-1, respectively. The result however, disagrees with the findings of Thakur *et al.* (2009) and Kulibaba (2015) who reported two genotypes AA and AB in Kadaknath chickens and, AB and BB in local chicken breeds of Vietnam.

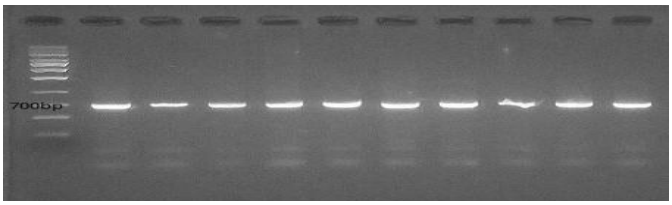


Figure 2: PCR amplified products at intron 3 of *cGH*

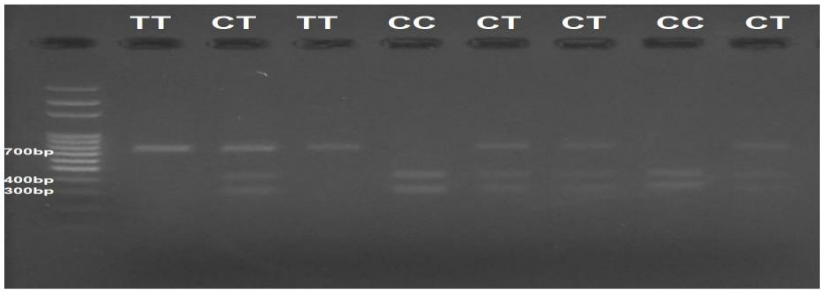


Figure 3: Genotypes amplified products at intron 3 region of *cGH*

Table 1: Frequency of RFLP patterns at intron 3 region of *cGH* gene

Pattern	Genotype	Frequency	Percentage
Two bands	CC	15	30.6
Three bands	CT	22	44.9
One band	TT	12	24.5

The genotype and gene frequencies with respect to intron 3 of the *cGH* gene is depicted in Table 2. The genotype frequencies were 0.306 for CC, 0.449 for CT and 0.245 for TT genotypes, respectively. Bingxue *et al*. (2003) reported three distinct genotypes with genotypic frequencies of 0.759, 0.213 and 0.027, respectively in a population of Chinese hybrid chickens. Thakur *et al.* (2009) and Kulibaba (2015) however, reported two genotypes in Kadaknath and local chicken breeds of Vietnam; the frequencies were 0.4151 and 0.5849, and 0.070 and 0.930, respectively. The results of Makhsous *et al.* (2013) revealed six genotypes (AA, AB, AC, BB, BC, CC) in the native chickens of Iran.

Table 2: Genotype and gene frequencies at intron 3 region of *cGH*

Genotype	Numbers	Frequency
CC	15	0.306
CT	22	0.449
TT	12	0.245
Allele		
C	52	0.531
T	46	0.469

The frequencies of C and T alleles (0.531 and 0.469) indicate that the C allele was predominant. Higher frequency of A allele (0.9028) compared to B allele (0.0972) was reported by Muin and Lumatauw (2013) in Indonesian native chickens. Other authors who also observed preponderance of A allele over B allele include: Bingxue *et al*. (2003) where A allele was 0.8655 and B allele was 0.1335; Thakur *et al.* (2009) where allele A was 0.7075 and B was 0.2925., Makhsous *et al.* (2013) reported allele frequencies as follows: 0.599 (A), 0.102 (B) and 0.299 (C), respectively. However, Kulibaba (2015) observed higher frequency of the B allele (0.964) than the A allele (0.036) in local Vietnamese chicken breeds. The calculated Chi-square value (0.312) showed that the studied population was in Hardy-Weinberg equilibrium with respect to intron 3 of the *cGH* gene (Table 3).

This indicated that evolutionary forces like migration, mutation and selection might have acted on the studied chicken breeds at the locus studied. This is in agreement with earlier observations (Khoa *et al.,* 2013: Makhsous *et al*., 2013; Rahmadani *et al.,* 2014).

Table 3. Hardy-Weinberg equilibrium at intron 3 of *cGH* gene

Genotype	Observed Individuals	Expected individuals	$\frac{(O-E)^2}{E}$	X^2
CC	12	11.028	0.087	0.312
CT	22	23.944	0.158	
CT	15	14.028	0.067	

In conclusion, the presence of observed genetic variants in the *cGH* gene could be exploited as a candidate gene in marker assisted selection to improve the performance of the studied chicken breeds.

REFERENCE

Bingxue, Y., Xuemei, D., Jing, F., Xiaoxiang, H., Changxin, W. and Ning, L. (2003). Single nucleotide polymorphism analysis in chicken growth hormone gene and its associations with growth and carcass traits. *Chinese Science Bulletin* 48(15): 1561-1564.

Harvey, S. **(**2013). Growth hormone and growth? Genetic Comp. *Endocrinology* 190:3–9.

Hrabia, A., Paczoska-Eliasiewicz, H.E., Berghman, L.R., Harvey, S. and Rząsa, J. (2008). Expression and localization of growth hormone and its receptors in the chicken ovary during sexual maturation. *Cell Tissue Res.,* 332: 317-328.

Hull, K.L. and Harvey, S. (2001). Growth hormone roles in female reproduction. *Journal of Endocrinology.* 168:1-23.

Kansaku, N., Hiyama, G., Sasanami, T. and Zadworny, D. (2008). Prolactin and growth hormone in birds: protein structure, gene structure and genetic variation. *Journal of Poultry Science* 45: 1-6.

Khoa, D.V.A., Khang, N.T.K., Ngu, N.T., Matey, J., Thi, H., Loan, H.T.P. and Thuy, N.T.D. (2013). Single nucleotide polymorphisms in Gh, Ghr, Ghsr and insulin candidate genes in chicken breeds of Vietnam. *Greener Journal of Agricultural Science* 3(10): 716-724.

Kulibaba, R.A. (2015). Polymorphism of growth hormone, growth hormone receptor, prolactin and prolactin receptor genes in connection with egg production in Poltava clay chicken. *Agri. Biol.,* 50(2): 198-207.

Makhsous, S.G., Mirhoseini, S.Z., Zamiri, M.J. and Niazi, A. (2013). Polymorphisms of growth hormone gene in a native chicken population: association with egg production. *Bull. Vet. Inst. Pulawy* 57: 73-77.

Muin, M.A. and Lumatauw, S. (2013). Identification of *Msp*I polymorphism in the fourth intron of chicken growth hormone gene and their associations with growth traits in Indonesia native chickens. *Animal Production* 15(1): 1-7.

Rahmadani, R.P., Sumantri, C. and Darwati, S. (2014). Polymorphisms of growth hormone (GH|MspI) gene in Indonesia local chicken and the crossbred using PCR-RFLP. Sustainable livestock production in the perspective of food security, policy, genetic resources and climate change. *Proceedings of the 16th AAAP Animal Science Congress* Vol. II. 10-14th November. Gadjah Mada University, Yogyakarta, Indonesia.

Saikhom, R., Sahoo, A.K., Taraphder, S., Pan, S., Sarkar, U., Ghosh, P.R., Bhattacharya, D. and Baidya, S. (2017). Polymorphisms of growth hormone gene in Haringhata Black chicken. *Explor. Anim. Med. Res.,* 7(1): 42-47.

Shahnaz, S., Shadma, F., Rank, D.N., Khanna, K. and Joshi, C.G. (2008) Growth hormone gene polymorphism and its correlation with different traits in Bantam and White Leghom chicken. *Indian Journal of Poultry Science* 43(2): 123-127.

Thakur, M.S., Parmar. S.N.S., Chaudhari, M.V. and Bhardwaji, J.K. (2009). Growth hormone gene polymorphism and its association with egg production in Kadaknath chicken. *Livestock Research for Rural Development 21 (8)*

Vasilatos-Younken, R., Zhou, Y., Wang, X., McMurtry, J.P, Rosebrough W., Decuypere, E., Buys, N., Darras, M., Geyten, V. and Tomas, F. (2000). Altered chicken thyroid hormone metabolism with chronic *GH* enhancement *in vivo*: consequences for skeletal muscle growth. *Journal of Endocrinology* 166: 609-620.

Zhang, X.L., Jiang, X., Liu, Y.P., Du, H.R. and Zhu, Q. (2007). Identification of AvaI polymorphisms in the third intron of *GH* gene and their associations with abdominal fat in chickens. *Poultry Science*86: 1079–1083.

BREEDING, BIOTECHNOLOGY AND PHYSIOLOGY (ORAL)
SURVIVABILITY OF COCK SEMEN STORED UNDER ROOM TEMPERATURE IN EXTENDERS CONTAINING SOME ANTIOXIDANTS

Amaefule, B.C., Uzochukwu, I. E., Ikeh, N.E., Nnajiofor, N.W., & Eze, E.C.
Department of Animal Science, University of Nigeria, Nsukka
Corresponding author: bright.amaefule@unn.edu.ng Tel: +2348034435785

ABSTRACT
The study was conducted to determine the survivability of cock sperm stored under room temperature in extenders containing some antioxidants. A volume of 2ml of pooled semen collected from four mature Heavy Ecotype cocks was stored in Honey-Ringers solution and three other extenders containing Honey-Ringers solution supplemented with the antioxidant vitamins C and E. The semen samples were observed under a microscope at 0, 6 and 12 hours to determine sperm motility by scoring. Survivability of the sperm cells was taken as the average percentage number of motile spermatozoa in each extender recorded during 0, 6 and 12 hours storage duration. The experimental layout was a completely randomized design. The generated were analysed using one way analysis of variance (ANOVA) in SPSS. The result showed that Average sperm survivability was significantly (P<0.05) higher for semen stored in supplemented with the antioxidant vitamins C and E compared to semen stored in Ringers solution. The proportion of spermatozoa that survived within the 6 hour storage time was highest in the Vit E supplemented extender followed by the Vit C group and lowest in the control group. From the results, it was concluded that extenders supplemented with the antioxidant preserved semen motility and viability.
Key words: survivability,semen extender, antioxidants, Vitamin C, Vitamin E.

INTRODUCTION
The modern day farm animal reproduction is hinged on better reproductive techniques, one of which is artificial insemination (AI) (Akandi *et al.,* 2015). It is an effective and globally accepted method of breeding animals including poultry. Success in AI requires quality spermatozoa which have the capacity to reach the site of fertilization, fertilize the egg and activate embryonic development (Wilson, 2016). Its application is widely based on stored semen for future use. However, the length of storage of undiluted or extended semen is restricted and presents a significant decrease in spermatozoa viability and fertilizing capacity after 24 hours of storage (Donoghue and Wishart, 2000). Lipid peroxidation of sperm membrane lipids is a major cause of decreased motility and fertilizing ability of mammalian spermatozoa (Aurich *et al*., 1997). Avian semen is characterized by high level of unsaturated fatty acid within its phospholipids (Surai *et al.,* 1998c). This makes their semen susceptible to lipid peroxidation and spermatozoa deterioration during storage (Surai *et al.*, 1997; 1998c). Bozhedomov *et al.,* (2009) reported that Oxidative stress occurs when production of potentially destructive reactive oxygen species (ROS) exceeds natural antioxidant defenses thereby resulting in cellular damage. Toxic lipid peroxides are reported to cause impairments of sperm cells and may play a major role in the etiology of infertility in males (Firozeh *et al.*, 2010).
Avian semen contains natural antioxidants including ascorbic acid, tocopherol, catalase, glutathione peroxidase and superoxide dismutase that help to balance lipid peroxidation and prevent excessive peroxide formation (Beconi *et al.*, 1993). However, the endogenous antioxidant activity of seminal plasma and spermatozoa may not be enough to prevent peroxide damage after extension and *in-vitro* storage thus supplementation with antioxidants could improve the semen shelf life (Donoghue and Donoghue, 1997).

MATERIALS AND METHODS
Location of the experiment
The experiment was carried out at the poultry Unit of the Teaching and Research Farm, Department of Animal Science, University of Nigeria, Nsukka in Enugu State, Nigeria.
Experimental diets, animals and management
Thirty (30) mature heavy ecotype cocks with an average weight of 2.4±0-5kg were used for the experiment. The birds were kept in battery cage, one cock per cell to avoid physical contact between

the cocks and to avoid fight. Routine management practices including vaccination and drug administration where necessary were observed with water and feed provided *ad libitum.*

Experimental Design

The experiment was carried out in a completely randomized design (CRD). Ringer's solution + Honey extender was prepared at room temperature, and divided into 3 parts which were supplemented with the antioxidant vitamins C and E, and control corresponding to groups DII, DIII and DI, respectively. No antioxidant was added to the extender in the control group (DI).
The compositions of the different extenders per L are shown in Table 1.

Table 1 Composition of Extenders

Ingredients	DI (Ringer)	DII (Ringer + Vit. C)	DIII (Ringer + Vit. E)
Sodium Chloride (g)	9.5	9.5	9.5
Potassium Chloride (g)	0.2	0.2	0.2
Calcium Chloride (g)	0.26	0.26	0.26
Sodium bicarbonate (g)	0.2	0.2	0.2
Honey (g)	1	1	1
Vitamin C (g)	0	0.4	0
Vitamin E (g)	0	0	0.08
CMC (ml)	0	0	5
Distilled water (L)	1	1	1

Fresh honey used in this research was purchased from local suppliers in Nsukka Main Market, Enugu State. The honey was used as purchased without further processing.

Semen Collection and Evaluation

Semen was collected from the toms using the abdominal manual massage method as described by Al-Daraji, (2007). On the day of semen collection, 2 mL of pooled semen was diluted (1:4) in each of the constituted extenders. Semen samples from the four cocks were pooled to reduce any likely variation in semen quality that may be caused by individual differences in genetic blueprint of the cocks. The determination of the different physical characteristics of the semen was made as described by Peters et al., (2008). The percentage motility of spermatozoa was evaluated immediately after semen collection. For this, a drop of semen was placed on a warm glass slide and covered with a cover slip to evenly spread the semen in the slide. The slide was afterwards viewed in the microscope (400 x magnification). Observations were widely made across different areas on the slide for the various samples. Motility was expressed as percentage of sperm showing normal forward progressive movements.Motility assessment was made by the same person to minimize differences during interpretation. Motility scores taken immediately after dilution were regarded as score for 0 hour storage, while experimental motility scores were recorded for 0, 6 and 12 hours of storage. Sperm concentration was determined by the method of direct cell count using an improved Neubauer hemocytometer. The percentages of live and dead spermatozoa were determined using an eosin–nigrosin stained smear with oil emulsion and observed under a light microscope at 400x magnification. Unstained spermatozoa were regarded as live whereas stained or partially stained spermatozoa were counted as dead. This determination was made over observations of about 200 spermatozoa per slide.

Statistical Analysis

The data generated were analysed using one way analysis of variance (ANOVA) in SPSS software (IBM® version 20.0). Differences found among the treatment means were compared using Duncan's New Multiple Range Test (Duncan, 1955) and accepted at 5% or 1% level of probability.

RESULTS AND DISCUSSION

Table 2: Mean (±SE) effect of diluents and storage duration on sperm survivability of Nigerian ecotype cock

Duration of storage (hrs)	Traits (%)	Ringer solution	Ringer solution + vit C	Ringer solution + vit E	P-value
0	Motility	85.56±3.91	87.22±4.41	87. 22±2.64	0.655
	Live	83.00±6.22	81.78±7.10	81.33±6.54	0.844
	Dead	17.00±6.22	18.22±7.10	18.67±6.54	0.844
6	Motility	70.00±3.54^{c}	75.00±3.54^{b}	80.00±5.00^{a}	0.000
	Live	64.56±5.43^{c}	70.44±7.43^{b}	78.11±6.47^{a}	0.000
	Dead	35.44±5.43^{a}	29.56±7.43^{b}	21.89±6.47^{c}	0.000
12	Motility	62.78±4.41^{c}	70.00±7.07^{b}	75.56±3.91^{a}	0.000
	Live	61.78±4.02	62.56±4.98	65.56±7.40	0.407
	Dead	38.22±4.02	37.44±4.98	34.44±7.40	0.407

^{a,b,c} – Means in the same row with different superscripts are significant at 5 or 1 % (* P < 0.05; ** P<0.01), NS- Not significant, Vit- Vitamin.

The result of the study on the effect of diluents and storage duration on sperm survivability of Nigerian ecotype cock are presented in Table 2.

The result showed that within 0 hour of storage, no significant difference (P > 0.05) was observed in semen progressive motility, percentage live and dead sperm cells among the various treatment groups. All extenders maintained high motility. At 0 hour post semen dilution, spermatozoa motility were 85.56±3.91%, 87.22±4.41%, and 87.22±2.64% for DI, DII, and DIII respectively. The percentage live spermatozoa at 0 hour post dilution were 83.00±6.22%, 81.78±7.10%, and 81.33±6.54% for DI, DII, and DIII respectively while percentage dead sperm cells were 17.00±6.22%, 18.22±7.10%, and 18.67±6.54% for DI, DII, and DIII respectively.

At 6 hours post dilution, significant difference (P < 0.05) was observed in progressive semen motility. Spermatozoa motility reduced to 70.00±3.54%, 75.00±3.54 %, and 80.00±5.00% for DI, DII, and DIII respectively. The same trend was followed for percentage live sperm cells. The percentage live sperm cells for DI, DII, and DIII were 64.56±5.43%, 70.44±7.43 %, and 78.11±6.47% respectively while percentage dead sperm cells recorded 35.44±5.43%, 29.56±7.43%, and 21.89±6.47% for DI, DII, and DIII respectively. The percentage of sperm cells that were motile within the 12th hour of storage was 62.78±4.4 %, 70.00±7.07 %, and 75.56±3.91% for DI, DII, and DIII respectively. There was distinct variation (P<0.05) in the motility of spermatozoa in the extenders. The proportion of spermatozoa that were motile within the 12 hours of storage time was highest in the DIII and lowest in DI. The percentage live sperm cells for DI, DII, and DIII were 61.78±4.02%, 62.56±4.98%, and 65.56±7.40 % respectively while percentage dead sperm cells recorded 38.22±4.02%, 37.44±4.98%, and 34.44±7.40% for DI, DII, and DIII respectively. Although these figures differed numerically, they were statistically similar (P>0.05).

DISCUSSION

Motility, expressed as the percentage of spermatozoa moving through the power of their tail is used as an indicator of fertility. The mean motility value (86.33 ± 3.65) from this study was within the established normal range proposed by Sexton (1981) who reported a mean motility of 80% and above as excellent.

The motility results decreased across the groups with increase in storage time. This drop in motility was witnessed more in the control group compared with the Vit. C and Vit. E treated groups. This is because of the antioxidative properties of Vit. C and Vit. E.

The results from this study showed that antioxidant supplementation of cock semen extenders improved the viability of stored cock semen over the control. The vitamin E supplemented group (DIII) had a better viability followed by vitamin C (DII) while the least values were observed in the control (DI) over the storage period. This finding is supported by the earlier report of Donoghue and Donoghue (1997). Similar results were also reported by Tabatabaei *et al.* (2011) who observed that supplementing semen extender with vitamin E improved spermatozoa quality parameters including motility and viability of cock semen. Al-Daraji (2002) also reported an improvement in semen

quality of roosters supplemented with vitamin C and E. The better viability observed in vitamin E and C group compared to the control could be attributed to the larger distribution of Vit E within the plasma membrane of spermatozoa and its lipid solubility allows it to suppress peroxidative damage across the plasma membrane and the efficiency of ascorbic acid (Vit C) as an antioxidant which scavenges ROS thus protecting sperm membrane against lipid peroxidation.

CONCLUSION

The findings of this study have shown that antioxidant supplementation of cock semen extenders helped to preserve semen motility and viability. Cock semen supplemented with vitamin E performed better, followed by vitamin C supplemented group. These antioxidants hold great prospect in our quest to develop local extenders that are of low cost and environmentally friendly and this is of immense benefit in rural communities in many developing countries, where commercially known extenders are not readily available to farmers for AI.

REFERENCES

Akandi, A., Ugwu, S.O.C and Machebe, N.S. (2015). Survivability of boar sperm stored under room temperature in extenders containing some natural products. Open Access Animal Physiology7: 57–64. doi.org/10.2147/OAAP.S71360.

Al-Daraji, H.J. (2007). Artificial insemination in domestic birds. Ministry of Higher Education and Scientific Research, Univ of Baghdad, College of Agriculture, Baghdad, Iraq

Alvarez, J. G., Touchstone, J. C., Blasco, L. and Storey, B. T. (1987). Spontaneous lipid peroxidation and production of hydrogen peroxide and superoxide in human spermatozoa. *Journal of Andrology*, **8:** 338-348.

Aurich, J.E., Schonherr, U., Hoppe, H. and Aurich, C. (1997). Effects of antioxidants on motility and membrane integrity of chilled-stored stallion semen. *Theriogenology*, **48**: 185-192.

Beconi, M.T., Francia, C.R. and Mora, N.G. (1993). Effect of natural antioxidants in frozen bovine semen preservation. *Theriogenology*; **40:** 841-851.

Bozhedomov, V. A., Gromenko, D. S., Ushakova, I.V., Toroptsova, M. V. and Galimov, S. N. (2009). Oxidative stress of spermatozoa in pathogenesis of male infertility. *Urologia*, **2**: 51 – 56.

Donoghue, A.M. and Donoghue, D.J. (1997). Effects of water and lipid soluble antioxidants on turkey sperm viability, membrane integrity and motility during liquid storage. *Poultry Science,* **76:** 1440-1445.

Donoghue, A.M. and Wishart, G. J. (2000). Storage of poultry semen. *Animal Reproduction Science,* **60:** 213 – 232.

Duncan, D.B. (1955). Multiple range and multiple F tests, Biometrics **11:** 1–42**.**

Firozeh, A., Ebrahim, M., Kobra, H. and Ozra, A. (2010). Relation of serum malondialdehyde and total antioxidant with sperm parameters in fertile men. *American Journal of Immunology*, 6(3): 43 – 49.

Peters, S.O., Shoyebo, O.D., IIori, B.M., Ozoje, M.O., Ikeobi, C.O.N. and Adebambo, O.A. (2008). Semen quality traits of seven strains of chickens raised in the humid tropics. *International Journal of Poultry Science* 7(10): 949-953.

Sexton, T.J. (1981). Evaluation of semen quality and establishment of its correlation with fertility, In: *Reproductive Efficiency in Turkeys*. Western Regional Research Publication, **142**:1-23.

Surai, P.F., Kutz, E., Wishart, G., Noble, R. and Speake, B. (1997). The relationship between the dietary provision of a-tocopherol and the concentration of this vitamin in the semen of chicken: effects on lipid composition and susceptibility to peroxidation. *Journal of Reproduction and Fertility*, 110**:** 47–51.

Surai, P.F., Cerolini, S., Wishart, G.J., Speake, B.K.., Noble, R.C. and Sparks, N.H.C. (1998). Lipid and antioxidant composition of chicken semen and its susceptibility to peroxidation. *Poultry Avian Biology Review,* **9:** 11-23.

Tabatabaei, S., Batavani, R. and Ayen, E. (2011). Effects of vitamin E addition to chicken semen on sperm quality during in vitro storage of semen. *Veterinary Research Forum*, **2:** 103-111.

Wilson, O.E. (2016). Evaluation of the effect of vitamins C and E on Spermiogram and Malondialdehyde concentration in chilled semen of Nigerian indigenous turkey toms (*Meleagris gallopavo*). M.sc research work submitted to Department of Theriogenology and Production, Ahmadu Bello University, Zaria, Nigeria.

HAEMATOLOGICAL PROFILE AND BIOCHEMICAL RESPONSE OF WEANER RABBITS FED GRADED LEVELS OF AFRICAN STAR APPLE *CHRYSOPHYLLUM ALBIDUM* SEED MEAL

Amao, E. A., Adeoti, T. M., Olaogun, Y. A. & Oladokun, A. A.
Department of Animal Production technology, The Oke Ogun Polytechnic, Saki
Corresponding author E-mail: amaoemmanuelayodeleamao@gmail.com

ABSTRACT
This study was carried out to determine the haematological profile and serum biochemical indices of rabbits fed graded level of African star apple (*Chrysophyllum albidum) seed meal*. The study involved forty eight (48) mixed breed weaned rabbits of seven - eight weeks old, with average weight of 186.87±0.03g.The rabbits were allotted into four dietary treatments comprising twelve (12) rabbits per treatment. The dietary treatments were 0%, 5%, 10% and 15% ASASM inclusion levels. The experimental diet contained 15% crude protein and 2488.68 Kcal/Kg metabolizable energy. The feeding trial lasted eight weeks, during which period feed and water were provided *ad – libitum*. Data generated were subjected to analysis of variance. Results obtained from this study revealed that the haematological profile and serum biochemical indices of rabbits recorded no significant ($P > 0.05$) differences among dietary treatments except cholesterol, AST and ALT ($P < 0.05$) . The study concludes that inclusion of graded levels of *C albidum seed meal* up to 15% will not pose any adverse effects on the blood characteristics of rabbits.
KEYWORDS: Weaner rabbits, *C albidum*, haematology, serum biochemistry

INTRODUCTION
Feed scarcity has remained a major limitation to livestock production and productivity (Agbede and Aletor, 2003). The high cost of animal feeds precipitated by the ever increasing cost of feed ingredients has resulted in poor nutrition leading to declining productivity of animals in developing nations like Nigeria (Nodu *etal*., 2014). According to Fetuga (1997) there is a disappointing rate and low level of performance in the Nigerian livestock industry, due to high cost of feeds, poor quality feeds and inefficiency in production and distribution in the feed industry. The low level of livestock production has affected adequate protein intake. However, intensive rabbit production and domestication can help bridge the meat supply gap in Nigeria and ensure animal protein adequacy. Increase in meat production can be achieved through proper nutrition, inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010).

The domestic rabbit (*Oryctolagus cunniculus*) is an important non-ruminant herbivore for meat production. Rabbit meat is a source of healthful food as it is low in cholesterol, but high in protein, 22g/100g (Aduku, and Olukosi 1990). Rabbits can also utilize the available proteins in cellulose rich plants, whereas it is not economical to feed these to chicken and turkeys. Since there is high demand for additional source of food worldwide the exploitation of plants of low economic importance would be a step towards better resource utilization (Telek, and Martin 1983) which is in line with the strategy to achieve sustainable animal production systems by matching them with locally available feed resources (Preston and Sansoucy 1987).

African star apple (*Chrysophyllum albidum)* is a dominant canopy tree of lowland and mixed rainforests, sometimes, riverine (Madubuike and Ogbonnaya, 2003). The plant is propagated by seedlings, wildings and direct sowing. It is a seasonal fruits-bearing tree. The fruit is fleshy and juicy, producing whitish gummy exudates (Adewusi, 1997). It is widely eaten in South Western Nigeria, popular among women and children (Amusa *et al.*, 2003).

The seeds of *C. albidum* are about 1-1.5 x 2 cm, beanlike, shiny when ripe, compressed, with one sharp edge and a star-shaped arrangement in the fruits (Orwa *et al.*, 2009). The seed coat is hard, bony, shiny, and dark brown, and when broken reveal white-colored cotyledons (Amusa *et al.*, 2003).

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajao *et al.*, 2013). Nutritional status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These can be determined by either or combinations of chemical, anthropometric, biochemical or dietary methods (Bamishaiye *et al.*, 2009). Haematology refers to the study of the numbers and morphology of the cellular elements of the blood – erythrocytes, leucocytes, and thrombocytes and the use of these results in the diagnosis and monitoring of disease (Merck Manual,

2012). Haemtological studies are useful in the diagnosis of many diseases as well as investigation of the extent of damage to blood (Onyeyili, *et al.*, 1992; Togun *et al.*, 2007). Haematological parameters are good indicators of the physiological status of animals (Khan and Zafar, 2005). Haematological parameters are those parameters that are related to the blood and blood forming organs (Waugh *et al*., 2001; Bamishaiye *et al*., 2009). Blood act as a pathological reflector of the status of exposed animals to toxicant and other conditions (Olafedehan *et al.*, 2010). As reported by Isaac *et al.* (2013) animals with good blood composition are likely to show good performance.

However, there is no information on the effect of seeds of *C. albidum* on haematology and serum biochemical parameters of rabbits. Therefore, this study was carried out to investigate the effect of feeding graded levels of seeds of *C. albidum* on the haematological and serum biochemical parameters of rabbits.

MATERIALS AND METHODS

The study was carried out at the rabbitary unit of the Oke-Ogun Polytechnic, Saki. Oyo State, Nigeria. African Star Apple seeds were collected from primary and secondary schools in Saki, Oyo State, Nigeria. The seeds were sun dried and further broken to obtain the cotyledons. The cotyledons were sun dried and milled for inclusion in diet mixture of growing rabbits.

Experimental Animals and Management

A total of Forty-eight (48) growing rabbits (7 – 8 weeks of age with average weight 186.87 ±0.03g) of mixed sexes were obtained from a reputable farm in Oyo State, Nigeria for the purpose this study. The animals were housed in wooden cages raised from the ground level. Before the animals were brought into the rabbitary, the cages were thoroughly washed and disinfected and allowed to dry. The floor of each cage was covered with wire mesh to allow for the passage of waste materials. Feed and water troughs were provided in each cage, while feed and water were provided *ad – libitum.* The rabbits were caged individually in clearly marked cells. The feeding trial lasted eight weeks.

Experimental Diet

Four experimental diets were formulated with the inclusion of 0%, 5%, 10% and 15% African Star Apple seed meal (ASASM) as substitute for maize in rabbit diet.

Parameters	0% (ASASM)	5% (ASASM)	10% (ASASM)	15% (ASASM)
Maize	40.00	38.00	36.00	34.00
ASAS	0.00	2.00	4.00	6.00
Maize offal	25.00	25.00	25.00	25.00
Rice offal	18.00	18.00	18.00	18.00
Soybean meal	2.00	2.00	2.00	2.00
Fish meal	1.20	1.20	1.20	1.20
Groundnut cake	10.00	10.00	10.00	10.00
Limestone	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Total	100kg	100kg	100kg	100kg

Blood collection:

Blood collection was done at end of the 8th week of feeding trial from six rabbits per treatment. Blood samples were obtained from the prominent ear vein with the aid of a hypodermic needle and syringe. Two blood samples each were collected per rabbit; one set of the blood samples was collected into plastic bottles containing Ethylene Diamine Tetra acetic acid (EDTA) for haematological studies while the other sample was collected into plain sterile bottles for the serum biochemical indices determination. All haematological parameters were determined by conventional laboratory methods of Baker and Silverton (1982); Bitto and Gemade (2001), while serum biochemical indices were determined by methods described by Ochei and Kolhathar (2007).

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) technique using statistical analysis software.

RESULTS AND DISCUSSION

Table 2: Haematological indices of rabbit fed African Star Apple seed meal.

Parameters	0%ASASM	5%ASASM	10%ASASM	15%ASASM	SEM
PCV (%)	39.00	40.33	40.66	39.33	3.16
Haemoglobin(g/dl)	12.96	13.60	13.60	12.76	1.08
RBC($x10^{12}$/l)	6.33	6.60	6.64	6.44	0.53
WBC($x10^9$/l)	5.93	5.86	5.96	5.77	3.25
Platelet ($x10^9$/l)	128.33	146.00	125.66	115.00	0.83
Lymphocyte (%)	68.33	67.66	69.33	69.33	0.83
Neutrophils (%)	28.66	28.33	28.33	28.00	2.62
Monocyte (%)	2.00	2.00	1.00	2.00	0.43
Eosinphils (%)	1.00	2.00	1.33	0.66	0.41

KEY: Packed cell volume (PCV), White blood cell (WBC), Red blood cell (RBC), African Star Apple Seed Meal (ASASM).

Table 3: B**iochemical indices of rabbit fed African Star Apple Seed Meal.**

Parameters	0%ASASM	5%ASASM	10%ASASM	15%ASASM	SEM
Glucose(mg/dl)	78.39	65.33	66.66	64.18	3.87
Cholesterol(mg/dl)	75.23^b	113.33^a	70.83^b	87.59^b	6.57
AST (IU/L)	51.66^b	97.90^a	55.69^b	43.40^b	4.47
ALT (IU/L)	41.59^a	38.23^a	28.07^b	30.08^a	1.58
Total protein (g/l)	7.14	5.93	5.97	5.28	0.5
Albumin (g/l)	3.14	3.42	3.89	3.49	0.6

Key: Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline Phosphatase (ALP),

RESULTS AND DISCUSSION

It is well established that changes in haematological and biochemical parameters reflect the physiological status of animal. Packed cell volume (PCV) values obtained in this study were not significantly ($p>0.05$) influenced by dietary treatments. The values (39 – 40.66%) were within the reference range of 33 to 50% reported by MediRabbit (2007). The red blood cell (RBC) range of 6.33 – 6.64x106/mm3 and haemoglobin (Hb) range of 12.76 to 13.60 were within standard range of 4 – 8.6 to 7.9 x 106/mm3 for RBC and 10 - 15g/dl for Hb respectively (RAR, 2009). This result indicates that *C. albidum* seed support red blood cell synthesis. The platelet counts recorded in this study ranged from115 to 146 $x10^9$/L for rabbits fed graded levels of *C. albidum* seed. The values were however lower than the normal range (250.00 – 600.00 $x10^9$/L) for rabbits reported by Medirabbit (2011). The white blood cell (WBC) values obtained in this study which were not significant among treatments were within the normal range of $4.5x\ 10^9$ /l to $11\ x\ 10^9$ /l reported (RAR, 2009). The white blood cell differentials namely lymphocytes, neutrophils, monocytes and esonophils were not significantly influenced by dietary treatments.

Biochemical response of rabbits fed *C. albidum* seed was presented in table 3. No significant difference ($p>0.05$) was observed in the values of glucose, total protein and albumin. Values for glucose range from 64.18 to 78.39mg/dl, only animals on control diet falls within the standard range of 75 – 140mg/dl (Medirabbit, 2011) animals placed 5%, 10% and 15% had values below the standard range and this implies hypoglycemia in the rabbits. Values of total protein (5.28 – 7.14g/l) and values of albumin (3.14 – 3.89g/l) were within the standard reference of 5.0 – 7.5g/l and 2.7 – 5.0 g/l respectively (Medirabbit, 2011). This suggests that normal protein metabolism occurred in rabbits, since protein synthesis is related to the amount of protein available in the diet (Iyayi and Tewe, 1998). Cholesterol and Aspartate aminotransferase (AST) followed the same trend with animals placed on

5% having highest values, cholesterol ranged from 70.83 – 113.33 while AST value ranged from 43.40 – 97.90 values for the two parameters falls within the standard range of 10 to 80mg/dl and 10 to 98mg/dl respectively (Medirabbit, 2011). This implies no deleterious influence of ASASM on rabbit biochemical response.

CONCLUSION AND RECOMMENDATION

Results obtained in this study have shown that *C. albidum* seed can be included in weaner rabbits' feed without adverse effects on their haematological profile and serum biochemical indices.

REFERENCES

Adewusi H. A. 1997. The African Star Apple *Chrysophyllum albidum* Indigenous Knowledge from Ibadan, Southwestern Nigeria. *In: Proceedings of a National Workshop on the Potentials of the Satr Apple in Nigeria. (Eds.) Denton OA, Ladipo DO, Adetoro MA, Sarumi MB* pp. 25-33.

Aduku, A. O and Olukosi J. O. 1990. Rabbits Management in the Tropics, *Books Gospel Publication*, Abuja, pp 40.

Agbede, J. O and Aletor, V. A., 2003. Comparative evaluation of weaning food from glycerides and leucaena leaf protein concentrates and some commercial brands in Nigeria. *Journal of Science of Food and Agriculture*, 84: 21 – 34.

Ajao, B. H., Ola, S. I., Adameji, O. V. and Kolawole, R. F. 2013. The relationship of ambient temperature and relative humidity of thermo respiratory function of greater grasscutter. Proc. of the 18th *Annual Conf. of Anim. Sci. Assoc. of Nig*., 92.

Amusa N. A, Ashaye O. A and Oladapo M. O. 2003. Biodeterioration of the African star apple *(Chrysophyllum albidum)* in storage and the effect on its food value. *African Journal of Biotechnology*, 2: 56-59.

Baker, F S and Silverton, R. E., 1982. Introduction to Medical Laboratory Technology, 5th edition, *Butterworth S. C., London*, Pp. 481 – 494.

Bamishaije, E., Muhammad, N. and Bamishaiye, O. 2009. Haematological parameters of albino rats fed on tiger nuts (*Cyperuss esculentus*) tuber oil meat based diet. *The Internet Journal of Nutrition and Wellness*, 10(1): 23-45

Bitto, I. I and Gemade, M., 2001. Preliminary investigations on the effect of pawpaw peel meal on growth, visceral organ and endocrine gland weights, testicular morphometry and haematology of male rabbits. *Global Journal of Pure and Applied Sciences*, 7 (4): 62 – 65.

Etim, N. N. and Oguike, M. A. 2010. Egg production of the domestic fowl (*Gallus gallus*): Implications for food security. *Proc. of the 35th Annual Conf. of the Nig. Soc. for Anim. Prod. (NSAP)*, 660.

Fetuga, B. L., 1997. Animal production in Nigeria and feed supplies. *Nigerian Journal of Animal Production*, 4 (1): 19 – 41.

Isaac, L. J., Abah, G., Akpan, B., & Ekaette, I. U. 2013. *Haematological properties of different breeds and sexes of rabbits* (p.24-27). *Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria.*

Iyayi, E. A and Tewe, O. O., 1998. Serum total protein, urea, creatinine levels as indices in cassava diets for pigs.*Tropical Veterinary*, 8: 11 – 15.

Khan, T. A. and Zafar, F. 2005. Haematological study in response to various doses of estrogen in broiler production. *Int. J. Poult. Sci*., 40(10):748-751.

Madubuike FN, Ogbonnaya O (2003). The Potential Use of White Star Apple seed (*Chrysophyllum albidum*) and Physic Nut (*Jatropha Curcas*) as Feed Ingredients for Rats. *J. Fac. Agric. Vet. Med.* 1: 97-105.

Medirabbit , 2007. www.medirabbit.com/EN/Hematology/blood_chemistry.htm

Medirabbit., 2011. Complete blood count and biochemical reference values in rabbits. Retrieved from www.medirabbit.com

Merck Manual 2012. *Haematologic reference ranges*. Mareck Veterinary Manual. Retrieved from http://www.merckmanuals.com/.

Nodu, M. B., Okpeku, M. and Abezi, A. E., 2014. Haematological characteristics of rabbits fed a mixture of *Alchornea cordifolia*/ Pawpaw leaf meal. *Journal of Agricultural and Veterinary Sciences,* 7 (1): 92 – 96.

Ochei, J and Kolhatkar, A., 2007. Medical Laboratory Science Theory and Practice, 6th edition, *McGraw – Hill Publishing Company Limited, New York, USA,* 1338pp.

Olafedehan, C. O., Obun, A. M., Yusuf, M. K., Adewumi, O. O. Olafedehan, A. O., Awofolaji, A. O. and Adeniji, A. A. 2010. Effects of residual cyanide in processed cassava peel meals on haematological and biochemical indices of growing rabbits. *Proc. of the 35th Annual Conf. of the Nig. Soc. for Anim. Prod., 212.*

Onyeyili, P. A., Egwu, G. O., Jibike, G. I., Pepple, D. J., & Ohaegbulam, J. O. 1992. Seasonal variation in haematological indices in the grey-breasted guinea fowl (*Numida mealagris Gallata pallas*). *Nigerian Journal of Animal Production, 18*(2), 108-110.

Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. 2009. Agroforestree Database: A tree reference and selection guide version 4.0. *World Agroforestry Centre, Kenya*.

Preston, T. R and Sansoucy R. 1987. FAO Animal Production and Health Paper, **1987**, 63: 32-41.

Research Animal Resource [RAR]. 2009. Reference values for laboratory animals: Normal haematological values. RAR Websites, RAR, University of Minnesota. Retrieved from http://www.ahc.umn.edu/rar/refvalues.html.

Telek, L and Martin F. W. 1983. Tropical Plants for leaf protein concentrate*Av 1 Pub. U.S.A.*PP 81-116.

Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., Mustapha, F. 2007. Effects of chronic lead administration on the haematological parameters of rabbits – a preliminary study. *Proceedings of the 41st Conferences of the Agricultural Society of Nigeria.* (p. 341)

Waugh, A., Grant, A. W., & Ross, J. S. 2001. Ross and Wilson Anatomy and Physiology in Health and Illness *Churchill Livingston, an imprint of Elsevier Science Limited*. (9th ed., p. 59-71).

TESTICULAR MORPHOMETRY AND EJACULATE CHARACTERISTICS OF ISA WHITE COCKS FED VARIED LEVELS OF SALT (NaCl) AND SUPPLEMENTAL ACETYLSALICYLIC ACID(ASA)

Aro S. O.
Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria
E-mail: soaro@futa.edu.ng

ABSTRACT
Testicular morphometry and qualitative parameters of the semen of Isa White cocks fed varied supplemental levels of acetyl salicylic acid (ASA) and different inclusion levels of dietary salt (NaCl) were investigated in a-sixteen-week study.. A total of sixteen Isa White cocks were used for the study. The cocks were randomly distributed into four treatment diets and replicated four times where each cock served as a replicate of its treatment diet. The four experimental diets were formulated and designated as: the control (D1) with 0.00% of ASA and 0.25% NaCl while the remaining three (3) diets were labelled as D2, D3 and D4 with 0.05% ASA and 0.50% NaCl, 0.10% ASA and 0.75% NaCl and 0.15% ASA and 1.00% NaCl respectively. The cocks were subjected to semen collection once a week for 9 weeks and qualitative parameters of the ejaculates like semen volume, sperm concentration, spermatocrit, seminal plasma and viability were determined. The birds were sacrificed at the end of the experiment to determine testicular morphometry parameters. The results showed differences ($p<0.05$) in testicular weight, volume and density among the four treatment diets. Cocks fed D3 had the heaviest testicles (13.67±1.67g) and largest testicular volume (11.37±1.75ml) while cocks on D4 had the densest testicles (1.26±0.06gml^{-1}) in comparison with control. The total and average weekly ejaculate volume were best ($p<0.05$)) in D2 (3.35±0.85 and 0.37±0.09ml respectively). Most of the ejaculate parameters like the spermatocrit, sperm concentration, total sperm/ejaculate (TSE) and motility were adversely affected in birds fed D4 when compared with the three other diets. The best combination of dietary salt and ASA was achieved with 0.50 and 0.05% respectively. In conclusion, the use of acetylsalicylic acid (ASA) at 0.05% ASA and 0.50 % Salt (Nacl) could significantly improve semen production potential and viability thus enhancing the reproductive performance of the male domestic chicken.
Keywords: Acetylsalicylic acid, dietary salt, sperm motility, testicular morphometry.

INTRODUCTION
The phenomenon of climate change has put the world on its toes since the famous Rio Earth summit of 1996. Many intervention strategies have been deployed since then to mitigate the problems of climate change on humans, livestock and plants. Livestock agriculture, because of its rate of expansion in recent times, has been fingered as a major culprit in the generation of green house gases (GHG) that are the albatrosses in the depletion of the ozone layer – a protective stratospheric screen that reduces the direct impact of the dangerous ultraviolet rays of the sun on the Earth. Animal agriculture has been predicted to double its production by 2050 as a result of greater demands engendered by increase in global population and standard of living. This increase in reality foretells more generation of these GHG at the detriments of the biosphere. For instance, the contribution of livestock to the generation of the GHG is estimated to be 9% of global CO_2, 35-40% of global CH_4 and 64% of global N_2O emissions (Wikipedia: https://en.m.wikipedia.org/). To tackle this peculiar challenge, livestock practitioners have engaged in series of research channelled towards finding a lasting solution to the climate change problems. Some of such mitigation strategies are dietary manipulation and the use of feed additives, reduction of exposure of manure to water in order to reduce CH_4 emission and use of supplemental feed.

Dietary salt (NaCl) and acetylsalicylic acid (aspirin) have been used as feed additives to mitigate one of the ubiquitous ill effects of climate change in the tropics – heat stress. The ability of these two feed additives to reduce the core body temperature has been documented in the literature (Dai *et al*., 2009; Aro *et al*., 2017). The potentials of NaCl to perfectly play this role is hampered by its predisposition to wet litter in the poultry house thus providing a conducive environment for the proliferation of maggots that produce manure-related GHG like CO_2, N_2O and CH_4. However, a recent study by Aro *et al.* (2018) reported that the use of supplemental levels of acetylsalicylic acid decreased faecal moisture and volume and improved faecal consistency in layers fed high NaCl diets. This experiment was therefore conducted to determine the optimal levels at which these two feed additives could be combined in the diet to achieve the twin effects of decreasing heat stress on livestock and controlling

wet litter in poultry houses. Also, this experiment is intended to unravel any effect such dietary combination of NaCl and ASA could have on the reproductive capacity of the birds.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the livestock section of Teaching and Research Farms of the Federal University of Technology, Akure, Nigeria. Akure is located at an elevation of about 353m above mean sea level, on Latitude $7^{\circ}18^{\prime\prime}$ north of Equator and Longitude $5^{\circ}10^{\prime\prime}$ east of Greenwich meridian. The climate is of hot, wet equatorial type with a bimodal distribution pattern. The mean annual rainfall is about 1,500mm and the mean annual temperature ranges between 26-28ºC while the relative humidity averages about 77% per annum.

Experimental animals and their management: Twenty Isa White cockerels with an average live weight of 1.94kg at 16 weeks of age were purchased from a reliable source. Sixteen of these birds were randomly allotted to four dietary treatments comprising four birds replicated four times at one bird per replicate. Four treatment diets were formulated with four different inclusion levels of dietary salt (NaCl) and four supplemental levels of acetylsalicylic acid (ASA). Diet 1 (D1) which is the control diet had 0.25% NaCl and 0.00% ASA while D2, D3 and D4 had 0.50 and 0.05%, 0.75 and 0.10% and 1.00 and 0.15% of NaCl and ASA respectively. Table 1 below shows the gross composition of the experimental diets.

Table 1: Gross composition (g/100g) of the cocks' diet

Ingredients	D1	D2	D3	D4
Maize	55.10	55.10	55.10	55.10
Fish meal	1.00	1.00	1.00	1.00
Groundnut cake	9.00	9.00	9.00	9.00
Soybean meal	9.00	9.00	9.00	9.00
Wheat offal	21.00	20.75	20.50	20.25
Bone meal	2.75	2.75	2.75	2.75
Limestone	1.50	1.50	1.50	1.50
Salt (NaCl)	0.25	0.50	0.75	1.00
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
ASA	0.00	0.05	0.10	0.15

These diets were fed to the birds throughout the 16-week duration of the experiment at 150g/ day/cock while water was given to the birds *ad libitum*. Routine medication and vaccination were administered as and when due. The birds were trained to respond to the abdominal massage method of semen collection for five weeks before the commencement of semen collection at the 24th week of age. Semen collection continued once weekly at 0700hours for the next 9 weeks or till the 16th week of the experiment. Data were collected on weekly weight change, daily feed intake and weekly seminal volume. The seminal qualitative parameters like the spermatocrit, seminal plasma, sperm concentration, total sperm cells/ejaculate, percentage abnormal sperm cells, sperm motility and viability were determined. All the birds were sacrificed at the end of the trial, dissected and the testes were extracted from which the testicular morphometrics like the testicular weight, volume and density were determined.

Statistical analysis: All data were subjected to a completely randomized design of one way analysis of variance (ANOVA) using SAS (2012 version 9.2 statistical package. Duncan's multiple range test (DMRT) of the same statistical package was used to separate differences among the means where applicable.

RESULTS AND DISCUSSION

The testicular morphometry showing the right and left testis weight, left testicular volume and left testicular density is presented in Table 2 below. Significant ($p<0.05$) treatment effects were observed

in the weight of both the right and left testes between D1 and the other three treatment diets. The high NaCl and ASA supplemented diets had heavier testicular size in comparison with the control ranging from 8.33±1.20g in D1 to 12.33±1.34g in D3 for the right testis and from 10.33±1.20g in D1 to 13.67±1.67g in D3 for the left testis. The same trend observed with the testicular weight was also observed with the left testicular volume where the values ranged ($p<0.05$) from 8.92±1.44ml in D1 to 11.37±1.75ml in D3.

Table 2: Testicular weight, volume and density of Isa White cock fed varied supplementation of acetylsalicylic acid (ASA) and dietary inclusion of Sodium chloride (NaCl).

Diets	Right testis weight (g)	Left testis weight (g)	Left testicular volume (ml)	Left testicular density (gml^{-1})
D1	$8.33±1.20^{c}$	$10.33±1.20^{b}$	$8.92±1.44^{b}$	$1.20±0.67^{ab}$
D2	$10.33±1.67^{b}$	$11.33±2.19^{b}$	$9.69±1.34^{a}$	$1.15±0.08^{b}$
D3	$12.33±1.34^{a}$	$13.67±1.67^{a}$	$11.37±1.75^{a}$	$1.23±0.14^{ab}$
D4	$12.00±1.75^{a}$	$13.33±1.20^{a}$	$10.69±1.35^{a}$	$1.26±0.06^{a}$

$^{a,ab,\ b,\ c}$ *= Means in the same column but with different superscripts are statistically ($p<0.05$) significant; D1= Diet with 0.00% ASA and 0.25% NaCl; D2= Diet with 0.05% ASA and 0.50 % NaCl; D3 = Diet with 0.10% ASA ;and 0.75% NaCl; D4= Diet with 0.15% ASA ;and 1.00% NaCl; ASA = Acetylsalicylic acid; NaCl = Sodium chloride.*

The lightest testicles ($1.15±0.08 gml^{-1}$) were observed in cocks fed D2 while the densest testicles ($1.26±0.06\ gml^{-1}$) were from cocks fed D4. The reproductive capacity of the male animals is closely associated with their testicular size. Males with bigger testes have bigger testicular parenchyma and hence more sperm producing architecture than individuals with smaller testes. The testicular weight in the current study compared with 10-12g obtained by Obidi *et al*. (2008) for Shika Brown breeder cocks. There is also a direct relationship between testicular function and volume. The higher the testicular volume, the more the capacity of the testes to produce sperm cells through increased production of interstitial cell stimulating hormone and testosterone. Feeding ASA in combination with NaCl at 0.10 to 0.75% respectively as used in the current study could improve the reproductive performance of Isa White cocks.

Table 3 shows the ejaculate volumes collected weekly from Isa White cocksfed supplemental levels of acetylsalicylic acid (ASA) and dietary inclusion of sodium chloride (NaCl). The weekly ejaculate volume in D1 ranged from 0.10ml in week 1 to 0.43ml in week 4, 7 and 8. In D2, it ranged from 0.15ml in week 2 to 0.58ml in week 9; it was between 0.18ml in week 2, 4 and 6 and 0.28ml in week 7, 8 and 9 in D3 while it ranged from 0.13ml in week2 to 0.40ml (week 4) in D4. The total ejaculate volume for the entire period of collection ranged ($p<0.05$) from 2.02ml in D4 3.35ml in D2 while the weekly average of the ejaculate were 0.28ml, 0.37ml, 0.25ml and 0.22ml for D1, D2, D3 and D4 respectively.

Table 3: Weekly ejaculate volume (ml) of Isa White cocks fed supplemental levels of acetylsalicylic acid (ASA) and dietary inclusion of Sodium chloride (NaCl).

Weeks	D1	D2	D3	D4
1	$0.10±0.00^{c}$	$0.18±0.03^{b}$	$0.20±0.00^{a}$	$0.15±0.05^{bc}$
2	$0.15±0.03^{ab}$	$0.15±0.03^{ab}$	$0.18±0.03^{a}$	$0.13±0.03^{b}$
3	$0.18±0.08^{b}$	$0.30±0.09^{a}$	$0.28±0.09^{a}$	$0.25±0.05^{a}$
4	0.43±0.06	0.50±0.15	0.35±0.06	0.40±0.06
5	$0.23±0.05^{a}$	$0.28±0.06^{a}$	$0.18±0.05^{b}$	$0.18±0.05^{b}$
6	$0.23±0.05^{a}$	$0.28±0.06^{a}$	$0.18±0.05^{b}$	$0.18±0.05^{b}$
7	$0.43±0.20^{a}$	$0.53±0.17^{a}$	$0.28±0.12^{b}$	$0.15±0.05^{c}$
8	$0.43±0.09^{a}$	$0.55±0.18^{a}$	$0.28±0.10^{b}$	$0.28±0.09^{b}$
9	$0.38±0.09^{b}$	$0.58±0.08^{a}$	$0.28±0.09^{c}$	$0.30±0.07^{bc}$
Total ejaculate volume/diet (ml)	$2.56±0.65^{ab}$	$3.35±0.85^{a}$	$2.21±0.59^{b}$	$2.02±0.50^{b}$
Weekly average volume/diet (ml)	$0.28±0.07^{ab}$	$0.37±0.09^{a}$	$0.25±0.07^{b}$	$0.22±0.06^{b}$

^{a,ab,b,bc,c} *= Means in the same row but with different superscripts are statistically ($p<0.05$) significant; D1=Diet with 0.00% ASA and 0.25% NaCl; D2= Diet with 0.05% ASA and 0.50 % NaCl; D3 = Diet with 0.10% ASA ;and 0.75% NaCl; D4= Diet with 0.15% ASA ;and1.00% NaCl; ASA = Acetylsalicylic acid; NaCl = Sodium chloride.*

The average weekly ejaculate volume, though similar (p>0.05) when compared between the control and the ASA/NaCl treated groups, D2 gave the best statistic as far as this parameter is concerned. It showed that ASA when combined with NaCl at 0.05 and 0.50% of the diet would encourage maximum semen production. Though collected when these roosters were at a relatively young age (24-32 weeks), the figures still fell within the range of 0.2-0.5ml reported by Hafez and Hafez (2000)

The qualitative characteristics of the ejaculates of Isa White cocks fed dietary supplementation of varied levels of acetylsalicylic acid (ASA) and dietary inclusion of sodium chloride (NaCl) are as presented in Table 4.

Table 4: Qualitative characteristics of the ejaculates of Isa White cocks fed dietary supplementation of varied levels of acetylsalicylic acid (ASA) and dietary inclusion of Sodium chloride (NaCl).

Parameters	D1	D2	D3	D4
Seminal volume (ml)	0.30±0.10	0.27±0.07	0.27±0.07	0.20±0.07
Spermatocrit (%)	6.00±0.82^{a}	5.50±0.64^{a}	6.25±1.93^{a}	4.00±2.83^{b}
Seminal Plasma (%)	94.00±0.82	94.50±0.65	93.75±1.93	96.00±2.83
Sperm concentration ($\times10^{9}$)	6.83±0.41^{b}	6.64±0.34^{b}	8.55±0.88^{a}	4.35±2.57^{c}
TSE ($\times10^{9}$)	2.05±0.72^{a}	1.79±0.09^{a}	2.31±0.61^{a}	0.87±0.07^{b}
Sperm motility (%)	100.00±0.00^{a}	100.00±0.00^{a}	62.50±23.93^{b}	50.00±28.89^{b}
Live sperm concentration ($\times10^{9}$)	5.24±0.45^{a}	5.12±0.32^{a}	5.40±1.20^{a}	3.84±2.37^{b}
Dead sperm concentration ($\times10^{9}$)	1.59±0.19^{b}	1.45±0.15^{b}	3.16±1.50^{a}	1.07±0.64^{c}
% live sperm	76.50±3.43^{a}	76.98±1.70^{a}	65.22±14.04^{b}	43.32±25.40^{c}
% dead sperm	23.50±3.43^{b}	23.02±1.70^{b}	34.75±14.00^{b}	56.68±5.87^{a}
% abnormal sperm	18.50±2.40^{a}	17.75±3.84^{a}	20.23±4.18^{a}	13.00±7.90^{b}

^{a,b,c} *= Means in the same row but with different superscripts are statistically (p<0.05) significant; D1=Diet with 0.00% ASA and 0.25% NaCl; D2= Diet with 0.05% ASA and 0.50 % NaCl; D3= Diet with 0.10% ASA ;and 0.75% NaCl; D4= Diet with 0.15% ASA ;and1.00% NaCl; ASA = Acetylsalicylic acid; NaCl = Sodium chloride; TSE = Total sperm/ejaculate.*

All the ejaculate parameters varied significantly among the treatment means with the exception of seminal volume and seminal plasma. The spermatocrit, total sperm cells/ejaculate, live sperm concentration, percentage dead sperm and percentage abnormal sperm cells in D2 and D3 compared statistically (p>0.05) with values obtained in D1 while these values were significantly (p<0.05) depressed in D4. However, D1 and D2 had similar values in terms of sperm concentration, sperm motility, dead sperm concentration and percentage live sperm. The decrease in sperm motility was very obvious in D3 (62.50±23.93%) and D4 (50.00±28.89%) when compared with D1 (100.00±0.00%) and D2 (100.00±0.00%). Sperm motility and more importantly progressive motility is very crucial to the capacity of the sperm to fertilize the ovum. Therefore, using ASA and NaCl in combination above 0.05 and 0.50% of the diet respectively could compromise the reproductive capacity of Isa White roosters.

CONCLUSION AND RECOMMENDATION

The significant depression of most of the reproductive indices in D4 showed that as far as reproduction in male poultry species is concerned, caution should applied not to use ASA and NaCl in combination above 0.10 and 0.75% respectively in the diet.

REFERENCES

Aro, S. O.,Osho, I. B. and Awoneye, O. O. (2017). Comparison of rectal and axillary temperatures of Isa Brown and Harco Black layers fed different levels of dietary acetylsalicylic acid. *Animal Research International*. 14(1): 2691-2696.

Aro, S. O.,Arogbodo, J. O., Faluyi, O. B. and Abere, O. (2018). Faecal bio-physical parameters of two strains of laying chickens fed dietary supplementation of acetylsalicylic acid. Proc. 43rd Annu. Conf. Nig. Soc. for Anim. Prod. (NSAP), held at Federal University of Technology, Owerri, Imo State, Nigeria. 18th – 22nd March, 2018. pp. 682-685

Dai, N. V., Bessei, W. and Quang, N. H. (2009). The effects of sodiumchloride and potassium chloride supplementation in drinking water on performance of broilers under tropical summer conditions. *Archiv fur Geflugelkunde*, 73(1). S. 41-48

Hafez,B. and Hafez, E. S. E. (2000). Reproduction in farm animals. 7th ed. Lippincott Williams and Wikkins, New York, USA.

Obidi, J. A., Onyeanusi, B. I., Ayo, J. O., Rekwot, P. I. and Dzenda, T. (2008). *International Journal of Poultry Science*, 7(12): 1200-1203

Wikipedia: https://en.m.wikipedia.org/ Accessed on 08/01/2020

THE INFLUENCE OF VARIED ACETYLSALICYLIC ACID AND SODIUM CHLORIDE LEVELS ON PERFORMANCE, CLOACAL AND AXILLARY TEMPERATURES OF ISA WHITE COCKS

Aro, S. O. & Onuoha, A. N.
Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria
E-mail: soaro@futa.edu.ng

ABSTRACT
This experiment was conducted to investigate the combined influence of varied inclusion of sodium chloride (NaCl) and supplemental levels of acetylsalicylic acid (ASA) on performance, cloacal and axillary temperatures of Isa White cocks. Four diets with different NaCl and ASA levels of 0.25/0.00% (Diet 1 or D1), 0.50/0.05% (D2), 0.75/0.10% (D3) and 1.00/0.15% (D4) respectively were formulated. The D1 served as the control diet. These diets were fed to the cocks throughout the eight weeks of the experiment during which data on weight change, feed consumption, cloacal and axillary temperatures were taken. The ambient temperature and relative humidity in the mornings (6.00 hour) afternoons (12.00 hour) and evenings (18.00 hour) were recorded from which the respective temperature-humidity indices (THI) were calculated. The results showed significant differences in final live weight, weight change, feed intake and feed conversion ratio (FCR) among the different diets. The best FCR was observed in D3 while weight change was better enhanced in the D2 and D3 diets. The morning, afternoon and evening cloacal and axillary temperatures decreased ($p<0.05$) as the levels of NaCl and ASA increased in the diets. The respective THI for the mornings, afternoons and evenings were 18.36±0.53, 20.79±0.79 and 16.89±0.55. The decrease in the core body temperature of the birds showed that using 0.15% ASA and 1.00% NaCl in combination can help mitigate the harmful effects of high ambient temperature. Also, the combined effect of 0.10% ASA and 0.75% NaCl would optimally enhance feed consumption, feed efficiency and growth in Isa White breeder cocks.
Keywords: Acetylsalicylic acid, ambient temperature, heat stress, relative humidity, sodium chloride.

INTRODUCTION
Livestock production, especially in the tropics is faced with the problem of heat stress engendered by the twin effect of high environmental temperature and relative humidity (Aro *et al.,* 2018). This problem has continued to hamper livestock productivity in this torrid region of the world with its attendant decrease in feed intake, increased morbidity, reduced livability, drop in egg production, decreased milk yield and an overall erosion of the profit margin of the average livestock producer. Heat stress is also known to impart negatively on the physiology of livestock production through its disruption of hormonal balance, causation of heat stroke, heat prostration, respiratory alkalosis, disruption of acid-base homeostasis, impaired fertility, hatchability and general decline in the reproductive performance of livestock.

The urgent need to attenuate the ill effects of heat stress on our livestock to the barest minimum has necessitated series of research in diverse fields of science all with varied rates of success and the search is still on. For instance, the design of livestock houses in the tropics has been modified severally to ensure easy dissipation of heat, allow ample ventilation and reduce solar radiation. Several cooling systems with automation have been deployed towards warding off thermal stress within the animal houses with a view to improving the thermal welfare of livestock. Other intervention strategies that have been deployed against the menace of heat stress include dietary manipulation to help the animals decrease metabolic heat generation under prevailing high environmental temperature, the use of feed additives that will put to check the proliferation of the enteric methanogenic organisms and thus curtail the emission of the greenhouse gases among others. The use of ascorbic acid, potassium chloride, sodium chloride (NaCl), Vitamins A and E and pharmaceutical preparations like the sodium salicylates and acetylsalicylic acid (ASA) or Aspirin have been experimented with as possible antidotes to thermal stress in livestock production (Wu *et al*., 2016).

Currently, there is a renewed awareness in the use of acetylsalicylic acid as a possible elixir for combating thermal stress in livestock. This is predicated on the pharmaceutical importance of ASA as an antipyretic, anti-inflammatory and analgesic agent. The use of NaCl to ameliorate heat stress in livestock has also been reported but its predisposition to wet litter has discouraged its widespread acceptability. Recently, Aro *et al.* (2018) reported on the reduction in faecal moisture and

improvement in faecal consistency of layers fed supplemental levels of ASA. Also, the reduction in rectal and axillary temperatures of two breeds of laying chickens has earlier been reported by Aro *et al.* (2017). It is therefore expedient to experiment with dietary combination of varied levels of ASA and NaCl to unravel their synergistic or antagonistic role on reduction of heat stress, enhancement of growth and change in cloacal and axillary temperatures in Isa White breeder cocks.

MATERIALS AND METHOD

Experimental site: The experiment was carried out in the Student Project Block of the livestock section of Teaching and Research Farm, Federal University of Technology, Akure, Ondo State, Nigeria. Akure is located on Latitude7°1′N and Longitude 5°10”E with a bimodal rainfall pattern characteristic of the hot wet equatorial climate. The mean annual rainfall is about 1,500mm while the mean annual temperature is between 26-28°C.

Experimental birds and their management: Twenty Isa White cockerels with an average initial weight of 1.94kg at 16 weeks of age were purchased from a reliable source. Four experimental diets were formulated to meet the nutrient requirement of the cockerels. Acetylsalicylic acid and NaCl were respectively used at varied supplemental and inclusion levels of 0.00/0.25% (D1), 0.05/0.50% (D2), 0.10/0.75% (D3) and 0.15/1.00% (D4) of the diet. The 0.00/0.25% diet (D1) served as the control and four birds were randomly allotted to each treatment diet which was replicated four times with each bird serving as a replicate of its treatment diet. Table 1 gives the composition of the experimental diets.

Table 1: Gross composition (g/100g) of the experimental diet

Ingredients	D1	D2	D3	D4
Maize	55.10	55.10	55.10	55.10
Fish meal	1.00	1.00	1.00	1.00
Groundnut cake	9.00	9.00	9.00	9.00
Soybean meal	9.00	9.00	9.00	9.00
Wheat offal	21.00	20.75	20.50	20.25
Bone meal	2.75	2.75	2.75	2.75
Limestone	1.50	1.50	1.50	1.50
Salt (NaCl)	0.25	0.50	0.75	1.00
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**	**100.00**
ASA	0.00	0.05	0.10	0.15

DI = Diet with 0.00% of ASA and 0.25% NaCl; D2 = Diet with 0.05% ASA and 0.50% NaCl; D3 = Diet with 0.10% ASA and 0.75% NaCl; D4 = Diet with 0.15% ASA and 1.00% NaCl; ASA = Acetylsalicylic acid.

The experiment was carried out over a period of 8 weeks. The birds were fed with the experimental diets according to their respective treatments until the end of the experiment.

Data collection and analysis: Data were collected on feed intake and weight change from which feed conversion ratio was calculated. The ambient temperature and relative humidity were taken with a combined digital thermometer and hygrometer while the cloacal/rectal and axillary temperatures were taken with a digital thermometer. All these parameters were measured three times weekly (Tuesdays Thursdays and Saturdays at 6am, 12pm and 6pm) for eight weeks thus making a total of 72 observations. From these observations, the respective temperature-humidity indices (THI) for the morning, afternoon and evening readings were calculated according to the model of Marai *et al*. (2001) for non-sweating animals i.e. THI= t – [0.31-0.31 (RH/100)(t-14.4)], where: THI= Temperature humidity index, RH= Relative humidity; t= Dry bulb temperature (ambient temperature). Data collected were subjected to completely randomized design of one-way analysis of variance using SAS (2012), Version 9.2 Significant differences where appropriate were determined using Duncan multiple range test (DMRT) of the same statistical package.

RESULTS AND DISCUSSION

The results of the performance parameters of cockerels fed varied levels of dietary salt (NaCl) and supplemental acetylsalicylic acid (ASA) are as presented in Table 2 below. The final weight was higher ($p<0.05$) in D2 (2.60±0.37kg) and D3 (2.58±0.40kg) than in D1 (2.50±0.25kg) and D4 (2.53±0.37kg). The same trend was observed in the weight change over the entire period where both D2 and D3 recorded the same growth accretion of 0.65kg while D1 and D4 recorded 0.57kg and 0.60kg increase in growth respectively. The feed intake parameters were better ($p<0.05$) in the ASA supplemented and high salt diets than those in the D1 except for the D3 diet. The best feed conversion ratio (FCR) was however recorded in the D3 diet. Neither morbidity nor mortality was recorded during the course of the experiment. The higher growth accretion recorded in the high salt and ASA fed birds supports the report in literature of the role of dietary NaCl and ASA at enhancing the growth rate of livestock (Alagawany *et al*., 2017). This also explains why birds fed diets higher in NaCl and ASA had higher feed intake values than those on the control diet.

Table 2: Performance parameters of Isa White cockerels fed varied levels of dietary salt (NaCl) and supplemental acetylsalicylic acid (ASA)

Parameters	D1	D2	D3	D4
Initial weight (kg)	1.93±0.03	1.95±0.05	1.93±0.03	1.93±0.04
Final weight (kg)	2.50±0.25^{b}	2.60±0.37^{a}	2.58±0.40^{a}	2.53±0.37^{b}
WC (kg)	0.57±0.03^{b}	0.65±0.03^{a}	0.65±0.04^{a}	0.60±0.05^{b}
DFI (g)	94..92±10.55^{b}	102.25±5.37^{a}	95.58±8.49^{b}	112.67±11.13^{a}
WFI (g)	664.44±62.03^{b}	715.75±15.73^{a}	669.06±40.11^{b}	788.67±80.33^{a}
TFI (kg)	5.32±0.67^{b}	5.73±0.87^{a}	5.35±1.13^{b}	6.31±0.97^{a}
FCR	9.33±0.77^{a}	8.81±0.97^{a}	8.23± 0.65^{b}	10.10±1.33^{a}
Mortality	Nil	Nil	Nil	Nil
Morbidity	Nil	Nil	Nil	Nil

a,b = Means in the same row but with different superscripts are statistically ($p<0.05$) significant. DI = Diet with 0.00% of ASA and 0.25% NaCl; D2 = Diet with 0.05% ASA and 0.50% NaCl; D3 = Diet with 0.10% ASA and 0.75% NaCl; D4 = Diet with 0.15% ASA and 1.00% NaCl; ASA = Acetylsalicylic acid.

Table 3 shows the morning, afternoon and evening cloacal and axillary temperatures of Isa White cocks fed dietary supplementation of ASA and inclusion of NaCl under prevailing ambient temperature, relative humidity and their calculated temperature humidity indices. The average ambient temperature recorded in the mornings, afternoons and the evenings in the course of the experiments were 23.83± 0.58^{o}C, 28.27±0.51^{o}C and24.78±0.45^{o}C respectively. Of these three daily readings, only the morning and evening ambient temperatures fell within the 18-24°C thermo-neutral zone proposed for the tropical regions. The relative humidity data recorded for the corresponding periods of the day stood at 87.83±1.52%, 77.21±0.89% and 77.04±1.63% respectively. These are temperature and relative humidity values characteristic of the hot, wet equatorial climatic regions of the world with year-round high temperature and relative humidity - the two climatic variables that are the precursors of thermal stress in this torrid zone. The calculated temperature humidity indices (THI) for the mornings, afternoons and evenings (18.36±0.53, 20.79±0.79 and 16.89±0.55 respectively) showed that the birds were well within the comfort zone in the mornings and evenings but in the borderline of alert and danger zones in the afternoons. The implication of these is that the birds in the current study were only heat-stressed in the afternoons and any intervention strategy to reduce thermal stress on them should be directed at this period of the day.

There are well documented evidences of the decrease in the body temperature of livestock especially with dietary administration of ASA (Alagawany *et al*., 2017; Aro *et al*., 2017). The antipyretic role of ASA is thus evident in the significant reduction in both the cloacal and axillary temperatures of the birds thus helping them to cope better in their effort to maintain homeothermy when physiologically challenged with high air temperature. Furthermore, ASA was able to lower the birds' cloacal and axillary temperatures in the current experiment in combination with dietary increase in the levels of NaCl. This showed that ASA was able to work in synergy with NaCl to achieve this.

Table 3:Morning, afternoon and evening cloacal and axillary temperatures of Isa White cocks fed dietary supplementation of ASA and inclusion of NaCl under prevailing temperature, relative humidity and their calculated temperature humidity indices.

		Morning Data			
Diets	AMT (^oC)	RH (%)	THI	CT (^oC)	AXT (^oC)
D1	23.83± 0.58	87.83±1.52	18.36±0.53	41.54±0.01^a	40.59±0.02^a
D2	23.83± 0.58	87.83±1.52	18.36±0.53	41.39±0.01^b	40.43±0.01^b
D3	23.83± 0.58	87.83±1.52	18.36±0.53	41.30±0.01^c	40.29 ± 0.01^c
D4	23.83± 0.58	87.83±1.52	18.36±0.53	41.16±0.01^d	40.08 ± 0.01^d
Afternoon Data					
Diets	AMT (^oC)	RH (%)	THI	CT (^oC)	AXT (^oC)
D1	28.27±0.51	77.21±0.89	20.79±0.79	41.52±0.01^a	40.61±0.02^a
D2	28.27±0.51	77.21±0.89	20.79±0.79	41.36±0.01^b	40.44±0.01^b
D3	28.27±0.51	77.21±0.89	20.79±0.79	41.27±0.01^c	40.31±0.01^c
D4	28.27±0.51	77.21±0.89	20.79±0.79	41.16±0.01^d	40.01±0.01^d
Evening Data					
Diets	AMT (^oC)	RH (%)	THI	CT (^oC)	AXT (^oC)
D1	24.78±0.45	77.04±1.63	16.89±0.55	41.55±0.01^a	40.54±0.02^a
D2	24.78±0.45	77.04±1.63	16.89±0.55	41.35±0.01^b	40.41±0.01^b
D3	24.78±0.45	77.04±1.63	16.89±0.55	41.11±0.01^c	40.24±0.01^c
D4	24.78±0.45	77.04±1.63	16.89±0.55	41.02±0.01^d	39.95±0.01^d

^{a,b,c,d}=Means in the same column but with different superscripts are statistically ($p<0.05$) significant. DI = Diet with 0.00% of ASA and 0.25% NaCl; D2 = Diet with 0.05% ASA and 0.50% NaCl; D3 = Diet with 0.10% ASA and 0.75% NaCl; D4 = Diet with 0.15% ASA and 1.00% NaCl; ASA = Acetylsalicylic acid; AMT = Ambient temperature; RH = Relative humidity; THI = Temperature humidity index; CT = Cloacal temperature; AXT = Axillary temperature.

CONCLUSION AND RECOMMENDATIONS

The decrease in the core body temperature as revealed by lower cloacal and axillary temperatures with incremental levels of both ASA and NaCl in the diets showed the synergy between these two additives at lowering the body temperature. Also, both ASA and NaCl will work optimally in favour of growth accretion when combined at 0.10 and 0.75% of the diet respectively. The THI as calculated in this study showed that the Isa White cocks were mostly heat-stressed in the afternoons. Therefore, any intervention strategy to mitigate heat stress at this particular location and in similar climes should be directed towards the afternoon period of the day.

REFERENCES

Alagawany, M., Farag, M. R., Abd El-Hach, M. E. and Dhama, K. (2017). Use of acetylsalicylic acid as a feed additive in poultry nutrition. *World's Poultry Science Journal*, 73(3): 633-642.

Aro, S. O.,Arogbodo, J. O., Faluyi, O. B. and Abere, O. (2018). Faecal bio-physical parameters of two strains of laying chickens fed dietary supplementation of acetylsalicylic acid. Proc. 43rdAnnu. Conf. Nig. Soc. for Anim. Prod. (NSAP), held at Federal University of Technology, Owerri, Imo State, Nigeria. 18th – 22nd March, 2018. pp. 682-685

Aro, S. O.,Osho, I. B. and Awoneye, O. O. (2017). Comparison of rectal and axillary temperatures of Isa Brown and Harco Black layers fed different levels of dietary acetylsalicylic acid. *Animal Research International*. 14(1): 2691-2696.

Marai, I. F. M., Ayyat, M. S. and Abd El-Monem,U. M. (2001). Growth performance and reproductive traits at first parity of New Zealand White female rabbits as affected by heat stress and its alleviation under Egyptian conditions. *Tropical Animal Health and Production*, 33(6): 451-462

SAS (2012).Statistical Analytical Systems.SAS Version 9.2 user's guide. Carry, NY: SAS Institute.

Wu, D., Zhang, M., Lu, Y., Tang, S., Kemper, N., Hartung, J. and Bao, E. (2016). Aspirin-induced heat stress in chicken myocardial cells can be suppressed by BAPTA-AM in vitro. *Cell Stress Chaperones*, 21(5): 817-827.

EFFECT OF BODY WEIGHT AT FIRST MATING ON REPRODUCTIVE PERFORMANCE OF RABBIT DOES

***Ayo-Ajasa, O. Y., Egbeyale, L.T., Adewole, F. A., Ekunseitan, D. A. & Babalola, O. A.**
Department of Animal Production and Health, Federal University of Agriculture, Abeokuta
Corresponding author e-mail: olapejuyemisi@yahoo.com; ayo-ajasaoy@funaab.edu.ng

ABSTRACT
Eighteen mature nulliparous rabbit does with initial body weight between 1600g-2500g were used to evaluate the effect of body weight at first mating on reproductive performance of rabbit does. These rabbits were assigned into three treatments, with T1, T2 and T3 weighing (1600-1900), (1901-2200) and (2201-2500) respectively. The study lasted for 5weeks. The does were mated with buck at ratio 1:3. The reproductive parameters evaluated were number of does that kindled, litter size at birth, breeding efficiency, litter size at weaning, pre-weaning loss. All data collected were subjected to descriptive statistical representation. The highest number of kindled does was 5 in T2 and T3; T1 had the lowest number (3). Breeding efficiency of 83.33% was recorded in T1 and T2 while T3 had 50.00%. T3 had highest average birth weight (49.51g) and T2 had the least (41.51g); litter size at birth and weaning ranged from 18 -28kits and 15-24kits respectively.T2 does recorded highest value in both parameters, T3 does recorded same value (28kits) for litter size at birth. Highest pre-weaning loss of 7kits was recorded from does in T3 while T1 and T2 recorded 4kits. It was therefore concluded that does with weight range 1901g – 2200g had better reproductive performance with highest breeding efficiency and lower pre-weaning loss.
Key words: Rabbit does, body weight, reproductive performance

INTRODUCTION
Rabbit farming is becoming more attractive to many animal breeders due to its high fecundity, high mothering ability, adaptability to a wide range of conditions, high genetic variability, high roughage utilization and low cost of production (Das and Yadav, 2007). Reproductive performance is the main factor which assures high productivity on rabbit farms. This requires that the management practices take into account the physiology and behaviour of the animals. For great profit a special attention must be focused on these traits, so studying factors that directly affect them are so important and must be taken into consideration during breeding of any productive species. Rabbit does experience a severe energy deficit during the first lactation; they tend to lose weight after their first litter until the kindling of second litter. This is due to the high energy needs of foetal growth combined with the drop in the feed intake during the last 10 days of gestation. This weight loss by first litter doe accounts for a drop in reproductive performance and a high replacement rate of young does (Rommers *et al*., 2002). Likewise does are often fed to appetite during rearing, and first mating is recommended at approximately 75 to 80% of mature body weight (Lebas *et al*., 1986). In modern management, young does are not mated at a fixed body weight but at a fixed age. Under *ad libitum* feeding conditions during rearing, heavy does can develop according to their growth potential, and body weight differences at first mating will be substantial. At the same age, heavy does can benefit from the extra amount of body weight at the end of rearing to withstand the energy deficit during first lactation. Rommers *et al*. (2002) reported that body weight did affect productive performance in the first parity. Although heavy does were heavier at first mating and remained heavier throughout the reproductive period, they followed a similar body weight curve after weaning the first litter as small and medium does. Hence, this study evaluated the effect of body weight at first mating on reproductive performance of rabbit does.

MATERIALS AND METHODS
Experimental Site
The experiment was carried out at the Rabbitry Unit, Teaching and Research Farm Development (TREFAD), College of Animal Science and Livestock Production Farm, Federal University of Agriculture Abeokuta. It falls within the rainforest vegetation zone of South West Nigeria on the latitude 7◦S 13’49.66’N and longitude 3◦ 26’11.98 E 76m above sea level (Google earth, 2018). The

climate is tropical humid with a mean annual rainfall of 1037mm, a temperature of 43◦C and a relative humidity of 82%.

Experimental Animals and Management

A total of 18 mature nulliparous rabbit does and 6 bucks (mixed breeds) were purchased from a reputable farm in Abeokuta, Ogun State. The does were distributed into three treatments, of six does per treatment. Each treatment was further subdivided into six replicates consisting of one does per replicate. On the arrival of the rabbits, they were given feed and water containing anti-stress (Maxiyield). The rabbits were allowed to acclimatize with the environment for one week (7 days) before the commencement of the experiment. The hutches and equipment that were used were thoroughly washed and disinfected with morigard before stocking the rabbits. The rabbits were kept in hutches equipped with concrete pots of feeders and drinkers. They were supplied with clean water in concrete drinkers and fed on commercial diet (Table 1) in concrete feeders and were also given *Tridax procumbens* twice a week. The droppings were swept off every day, and the rabbit were observed for any sign of illness.

Table 1: Nutrient Composition of the Commercial Feed (As Declared)

Parameter	**Value**
Crude Protein (%)	16.00
Fats and Oil (%)	5.00
Crude Fibre (%)	7.00
Calcium (%)	1.60
Available Phosphorus (%)	0.45
Lysine (%)	0.75
Methionine (%)	0.36
Salt (%)	0.30
Metabolizable Energy (kcal/kg)	2450

Experimental Procedure

The does were mated with a mating ratio of 1:3. The doe were hand mated in the morning and evening; the bucks were allowed to ride 3-4 times before the does were withdrawn. Pregnancy test was carried out on the does by palpating at the 14th and 20th day after mating. Clean and well disinfected kindling boxes were provided for the does to make nest of fur in preparation for birth. The rabbits were weighed on the day of kindling and subsequent weighing was done every week. Gloves were used for handling the kits.

Eexperimental treatments

Treatment 1: Does weighing between 1600 – 1900g
Treatment 2: Does weighing between 1900 – 2200g
Treatment 3: Does weighing between 2200 – 2500g

Data Collection

Data were collected on breeding efficiency (percentage of kindled does), litter size at birth (number of kits per doe at birth), litter size at weaning (number of kits per doe at weaning), average birth weight (weight of kits of a doe at birth divide by the total number of the kits), pre weaning loss (number of kits that died before weaning) and gestation length (difference between conception date and kindling date).

Statistical Analysis

All data obtained was analysed through the use of descriptive statistical tools.

RESULTS

The effect of body weight at first mating on reproductive performance of rabbit does are presented in Figure 1 and Figure 2 below. Figure 1 shows the effect of body weight at first mating on number of kindled does, gestation length and breeding efficiency. The number of does that kindled ranges from 3 to 5 with the does in T2 and T3 recording the highest breeding efficiency (83.33%) and does in T1 recording the lowest breeding efficiency (50.00%) respectively. The gestation length is longer in does in T1 and T3 with duration of 32days while the does in T2 recorded shorter with duration of 31days. The effect of body weight on average birth weight, litter size at birth, litter size at weaning and pre-weaning loss is presented in figure 2. The average birth weight of the kits ranged from 41.57g to 49.57g. Kits from does in T3 had highest (49.57g) while kits from T2 recorded the least (41.57g) average birth weight. Litter size at birth and weaning ranged from 18 to 28 and 15 to 24 respectively with the does from T2 recording the highest values for both parameters while does from T3 also recorded the same value (28) for litter size at birth. The highest pre-weaning loss of 7 was recorded from does in T3 while does in T1 and T2 recorded same pre weaning loss of 4 kits.

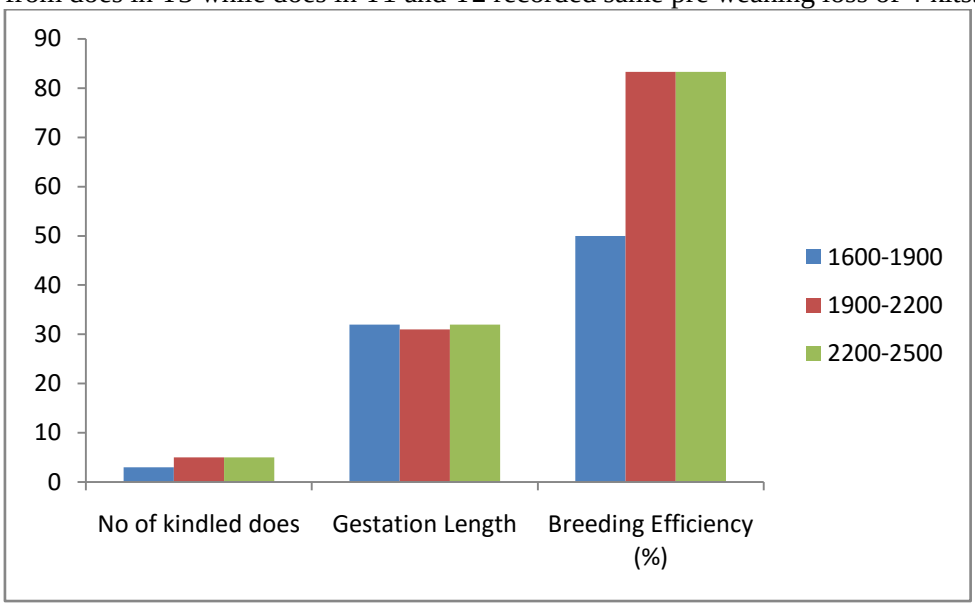


Figure 1: Effect of body weight at first mating on number of kindled does, gestation length and breeding efficiency.

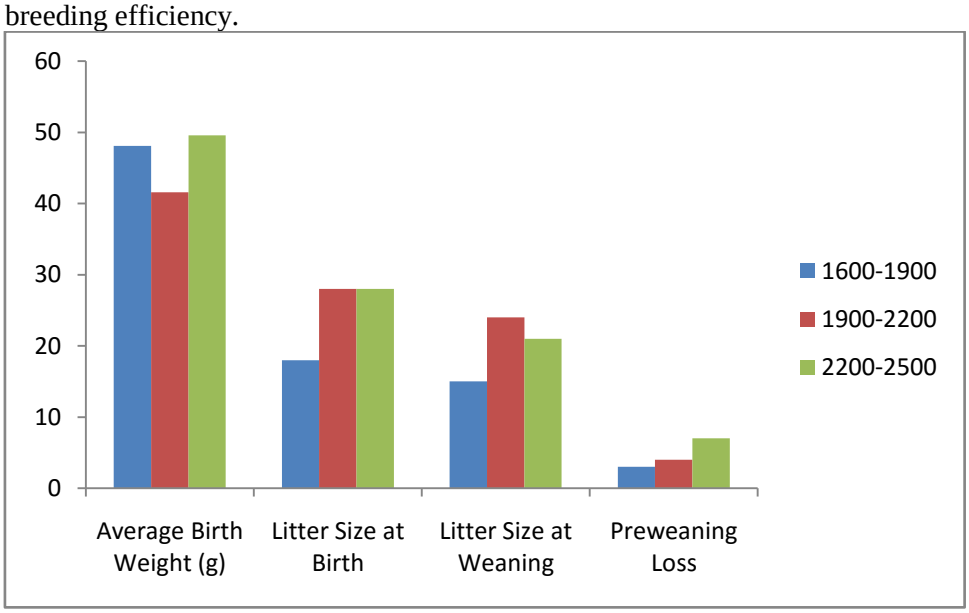


Figure 2: the effect of body weight on average birth weight, litter size at birth, litter size at weaning and pre-weaning loss.

DISCUSSION

The result obtained from does with weight between 1600-1900g having lower breeding efficiency, litter size at birth and litter size at weaning could be as a result of small body size and insufficient body reserve with a possible reduction in the milk production of the does and hence resulting in lower reproductive performance. This result is in line with the report of Szendrő *et al*., (2002) that the insemination of animals with lower body weight has been related to lower fertility and smaller litter size at first parturition (Rommers *et al*., 2001 and 2002). Rabbit does are susceptible to a severe energy deficit during first lactation (Xiccato, 1996), resulting in a decreased reproductive performance. Heavy does are more matured and have more body reserves (protein and fat tissue) which enable them to better resist energy deficit during first lactation, resulting in a better performance (Rommers *et al*., 2004).Gestation duration ranged from 31 to 32days gestation length in rabbit respectively is fixed and only varies within a very narrow gap as observed in this study; similar observation was made by Ajayi *et al*., (2005).The highest numerical value recorded for litter size at birth and weaning by does weighing between 1900 and 2200g shows that increased body weight improved reproductive performance at first parity. According to Inglis (1980), litter size and birth weight vary depending on the breed and size of the dam. Factors that increase litter size include the age at which the does are served and the optimum weight at service, which is an index of breed (Hafez and Hafez, 2000).

CONCLUSION

The study concluded that does with weight range 1901g – 2200g had better reproductive performance with highest breeding efficiency and lower pre-weaning loss.

REFERENCES

Ajayi, F.O., Balogun, O.O., Ovuru, S.S. and Mgbere, O.O. (2005). Reproductive performance of rabbit fed maize milling waste based diet. *African Journal of Biotechnology*, 4: 439-443.

Das, S.K. and Yadav, B.P.S. (2007). Effect of mating system, parity and breed on the reproductive performance of young rabbit does. *Journal of Animal Science.* 79: 1973–1982.

Hafez, E.S.E. and Hafez, B. (2000). Reproductive cycles.In E.S.E. Hafez and B. Hafez (eds). Reproduction in farm Animal. 7th Edition. Balliene Tindal, London, Great Britain.

Inglis J.K. (1980). Introduction to laboratory animal science and Technology, Perganon press, Oxford, 3-4.

Lebas, F., Codert, P., Rouvier, R. and Rochambeau, H. (1986). The rabbit: Husbandry and Healthy. *FAO .Aniimal Production and Health Series*, no.21.202 Pp.

Rommers, J.M., Meijerhof, J.P.. Noordhuizen, T. M and. Kemp. B. (2001). Effect of different feeding levels during rearing and age of first insemination on body develoment, body composition, and puberty characteristics of rabbit does. *World Rabbit Science.* 9:101.-108.

Rommers, J.M., Meijerhof, J.P. Noordhuizen. T.M, and Kemp. B. (2002). Relationships between body weight at first mating and subsequent body development, feed intake reproductive performance of rabbit doe. *Journal of Animal Science* 80:2036-2042.

Rommers, J.M., Meijerhof, J.P. Noordhuizen.,T.M., and Kemp B. (2004). Effect of feeding program during rearing and age at first insemination on performance during subsequent reproduction in young does. *Reproduction Nutrition Den*., 44; 321-332.

Szendro Z.S., Gyarmati T., Maertens L., Biro-Nemeth E., Radnai I., Milisits G and Maotics Z.S. (2002)s. Effect of nursing by two does on the performance of suckling and growing rabbits. *Animal Science*, 74; 117-125.

Xiccato G. (1996) Nutrition of lactating does. In: 6th *World Rabbit Congress* , 1: 29–47.

EFFECT OF NEEM LEAF MEAL ON PERFORMANCE OF PREGNANT WEST AFRICAN DWARF (WAD) DOES

Babatunde, M. O.[1] , Adewumi, O. O.[2], Adelusi, O. O[3], & Aderinboye, R. Y.[3]
[1]Livestock Science and Sustainable Environment, World Bank Centre of Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta, Nigeria.
[2]Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Nigeria
[3]Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Nigeria
Corresponding author:- *mosesolayemi64@gmail.com*, ***Phone number:*** *+234-706-277-5374*
Target Audience*: Smallholder Ruminant Farmers, Modern Intensive Ruminant Animal Producers and Animal Scientists*

ABSTRACT
A 150-day study was conducted to determine the performance and pregnancy rate of intensively managed West African dwarf goats to concentrate supplement containing varying levels of neem leaf meal (NLM). Twelve (12) West African Dwarf does with an average live weight of 11. 15.70 ± 0.81 kg were used in a Completely Randomized Design with animals grouped into three treatments of four replicates each balanced for weight. The animals were fed *Panicum maximum* in the morning with a daily supplementation of 350g concentrate diet containing varying levels of neem leaf meal at 0, 2.5, and 5%. Daily feed intake (1217.11g/day) of goats increased ($P < 0.05$) and daily weight gain (46.14g/day) of goats increased ($P > 0.05$) with inclusion of *A. indica.* However, the feed conversion ratio of the animals fed neem leaf meal increased significantly ($P < 0.05$) compared with the animals in the control. This study, however, concluded that neem leaf supplementation in reproducing traditionally managed WAD goats enhanced pregnancy development. Neem leaf inclusion at 2.5% in West African dwarf goat's diet had effects on the overall performance of the animals with a potential improvement in feed conversion ratio.
Keywords: *Azadirachta indica*, WAD goats, reproduction, performance

INTRODUCTION
Increase in global human population has introduced the challenge of providing quality animal protein for their feeding. In recent years, there has been growing interest in identifying potentially important feedstuffs to supplement the available low nutrient feeds (Tona *et al*., 2014) for ruminant feeding in the tropics. Goats constitute a very important part of the rural economy in Nigeria, with more than 95% of the rural households keeping goats (Ukpabi *et al.*, 2000). Goat rearing has been found equally rewarding under both intensive and semi-intensive systems of management (Shalander, 2007). The major problem being faced by developing countries especially Nigeria is the ever increasing population without a corresponding increase in animal protein production. Animal products contribute only 15 to 20% of the total protein intake of an average Nigerian contrary to 33% recommended by (FAO., 1987). This wide margin between the recommended protein intake and the average consumption rate has resulted in an ever-increasing demand for animal protein by the Nigerian populace. The neem plant (*Azadirachta indica*) is a non-leguminous multi-purpose tree which belongs to the family *Meliceae*. Its common English names include neem tree and margosa tree (Arbonnier, 2002). The neem tree is a drought tolerant plant and is known to do well in areas with long dry seasons, even with rainfall as low as 130mm per annum (Gowda and Sastry, 2000). It is also known to thrive in almost any type of soil and tolerate a wide soil pH range of between 4 and 10 (Arbonnier 2002; Girish and Shankara, 2008). The neem tree is therefore often used in afforestation programmes, especially in semi-arid regions. Neem leaves incorporation into ruminant feeds will help increase the utility of the plant and help alleviate the severe feed inadequacy experienced in the dry tropics during the dry season. Hence, this study was designed to evaluate the effect of neem meal leaf on growth performance of West African Dwarf (WAD) does during pregnancy.

MATERIALS AND METHODS

The experiment was carried out at the small ruminant unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture Abeokuta, Ogun state, Nigeria. Twelve (12) West African Dwarf (WAD) goats does, in their 2nd parity, aged 1-2 years, with an average weight of 11 were used in this study. The goats were housed intensively in well ventilated pens with concrete floors. The experiment was set up as a completely randomized design (CRD) with three levels of Neem Leaf Meal (0%, 2.5%, and 5.0%) added to the concentrate feed (maize (15%), cassava peel (15%), palm kernel cake (32%), wheat offal (24%), groundnut cake (10%), bone meal (3%) premix (0.5%) and salt (0.5%)). Each treatment was having four (4) replicates each. Concentrate was given to the animals at 5% of their body weight and *Panicum maximum* as basal diet, while clean water was provided *ad libitum* intake. The feeding trial lasted for 90days. Each goat was examined sonographically using a portable ultrasound machine with a 3.5 MHz curvilinear transducer (Kaixin KX 2000R, Xuzhou, China) at the Veterinary Teaching Hospital, FUNAAB. The machine was fitted with a 3.5MHz curvilinear and 7.0MHz linear transducers. Each transducer has four windows of frequency range. In addition, the machine was programmed with software for obstetric and cardiac calculations, as well as having a digital imaging and communication in medicine (DICOM) facility for image storage. Basic preparation included clipping of the hairs around the ventral abdomen and application of acoustic gel. Fresh neem leaf was harvested from neem trees found at Directorate of University Farms (DUFARMS). The leaves was separated from their twigs, air-dried and turned regularly for period of 14 days until the leaves was brittle and thoroughly dried. All the leaves were ground in a hammer mill (1-mm screen) to form the Neem Leaf Meal (NLM). The weights of the animals were taken at the commencement of the experiment and weekly for body weight change. Data collected included the following. The weights of the experimental animals were taken before the commencement of the experiment and it was done by using spring balance scale - 20kg capacity and the final weight of the goats were taken at the end of the experimental period of 12 weeks using spring balance scale 20kg capacity. The weight gain was determined by subtracting the initial weight of does from their final weight and the feed consumptionwas determined by taking the weight of total dietary concentrate fed to does daily and weight of concentrate refuse each day by the does throughout the experimental period. The difference between total concentrate refuse from total concentrate given daily gives the feed consume per day. The pregnancy rate was determined by counting the number of does that were confirmed pregnant in each treatment through scanning. Data collected during the experimental period was subjected to one way analysis of variance (ANOVA) in completely randomized design using SAS (1999) and the means separated using Duncan multiple range test of the same software at 5% level of significance.

RESULTS AND DISCUSSION

Approximately two (2) does from each treatment carried their pregnancy. Table 1 shows the performance characteristics of West African dwarf goats fed experimental diet. The initial weight, final weight, weight gain, daily weight gain, concentrate intake, and feed conversion ratio were not significantly ($P>0.05$) different. However, grass intake, total feed intake and daily feed intake were significantly ($P<0.05$) different. The animals showed an improvement in the final weight over the initial weight. The highest value (16.50kg) for weight gain was observed in the control diet and the least value (15.75kg) was observed in the diet with 5% neem leaf inclusion. Likewise, the highest value (46.14g) for daily weight gain was recorded in the treatment with 2.5% neem leaf inclusion and the lowest value (38.69) was observed in the diet with 5.0% neem leaf inclusion. Animal fed with the control diets were superior in their total feed intake and daily feed intake. The feed conversion ration ranged from 28.29-37.65. However, the result showed that T_2 had the best feed utilization of 28.29, while the poorest value (37.65) was observed in T_3.

Table 1: Performance characteristic of West African dwarf does fed experimental diets (%)

Parameters	Levels of inclusion of neem leaf meal g/kg				
	0	**2.5**	**5.0**	**SEM**	**P-VALUE**
Initial Weight (kg)	12.63	12.50	12.50	0.57	0.99
Final Weight (kg)	16.50	16.38	15.75	0.66	0.68
Weight gain (kg)	3.88	3.92	3.25	0.31	0.78
Daily weight gain (gday-1)	46.13	46.14	38.69	4.54	0.78
Concentrate intake (kg)	27.16	27.13	26.36	0.20	0.18
Grass intake (kg)	75.08[a]	74.24[ab]	73.48[b]	0.25	0.01
Total feed intake (kg)	102.24[a]	101.36[ab]	99.85[b]	0.43	0.02
Daily feed intake (gday-1)	1217.11[a]	1206.69[ab]	1188.63[b]	5.13	0.02
Feed Conversion Ratio	28.56	28.29	37.65	3.78	0.37
Pregnancy rate	50.00	50.00	50.00	4.62	0.47

[abc] Means on the same row having different superscripts are significantly different ($p<0.05$); T_1 = 100% concentrate; T_2 = 2.5% *neem leave meal* (NLM) + concentrate; T_3 = 5% *neem leave meal* (NLM). SEM – Standard error of means

The growth performance in this current study showed that the weight gain of the animals were not significantly different. Final weight obtained in this study is higher than the values (8.80 – 11.00kg) recorded by Anaeto *et al*. (2013) but fell within the values (10.42 – 17.25kg) recorded by Bawala *et al.* (2007). The result of this study on weight gain is in agreement with the report of Nkoku and Evbuomwan (2014) that efficient utilization of nutrients in diets that supply adequate energy and protein is required for optimum growth performance of ruminants. Final weight obtained in 2.5% inclusion level of neem leaf meal is higher than the result of (Hossain, 1994) who reported 3.33 and 3.70% for cattle fed neem leaves and neem seeds respectively in 28 days of treatment. The highest daily weight gain (46.14g/day) value recorded for animals fed 2.5% inclusion level of neem meal leave is close to the value of (52.0g/day) recorded by Paengkoum P, *et al*. (2010).

CONCLUSION AND RECOMMENDATIONS

From the results of this study, it can be concluded that the supplement containing up to 2.5% Neem leaf meal can be fed to West African Dwarf goat without any deleterious effect on pregnancy development while resulting in birth of viable kids of higher body weights. Neem leaf meal-based supplement can be used to achieve moderate growth in West African Dwarf goat in the dryseason. I recommend that supplement containing up to 2.50% neem leaf meal may be used to feed pregnant does in the dry season. Further research should be conducted to determine the effect of neem leaf meal on rumen microbial population and intestinal helminthes.

REFERENCES

Alderman, G. 1985. Prediction of the Energy value of Compound Feeds. In: Haresign W, Cole D. J. A. (Eds), Recent Advances in Animal Nutrition. Butterworths, London, UK.

Anaeto, M., Sawyerr A.F., Alli, T.R., Tayo, G.O., Adeyeye, J.A. and Olarinmoye, A.O. (2013). Cassava Leaf Silage and Cassava Peel as Dry Season Feed for West African dwarf Sheep. *Global Journal of Science Frontier Research,* 8 (2), PP. 1-4

AOAC, (2005). Official Methods of Analysis, 18th edition. Association of Official Analytical Chemists, Washington.

Arbonnier, M. 2002. Trees, Shrubs and Lianas of West African Dry Zones. CIRADMargraf Publishers Gmbh, MNHN, Paris, France: 573.

Bawala, T. O., Adegoke, E. O., Ojekunle, A. O., Adu, L. F. and Aina, B. J. (2007). Utilization of cassava peel and rumen epithelial waste diets by West Africa dwarf sheep. ASSET: *An International Journal, 7 (1): 168 – 180.*

Girish, K. and Shankara, B. S. (2008). Neem – A Green Treasure. Electronic Journal of Biology, Volume 4(3): 102-111.

Gowda, S. K. and Sastry, V. R. B. (2000). Neem (Azadirachta indica) Seed Cake in Animal Feeding-Scope and Limitations. Review. Asian-Australasian Journal of Animal Science 13(5): 720-728.

Hossain, M. (1994). Rice-Wheat Production System in Eastern India and Bangladesh: Recent Developments and Economic Constraints. In: Sustainability of Rice-Wheat Production Systems in Asia. RAPA publication, Food and Agriculture Organisation, Bangkok 97-111

Njoku VI, Evbuomwan BO. (2014). Analysis and comparative study of essential oil extracted from Nigerian orange, lemon and lime peels. Greener J Chem Sci Tech. 1(1):6-14

Shalander, K. 2007. Commercial goat farming in India. An emerging Agric-business opportunity. Agricultural Economics Research. Reviews 20: 503-520.

Tona, G. O., Ogunbosoye, D. O. and Bakare, B. A. (2014). Growth performance and nutrient U. S. A. 72110 – 9537

Paengkoum, P. 2010. Effect of neem (*Azadirchta indica*) and leucaena (*Leucaena leucocephala*) fodder on digestibility, rumen fermentation and nitrogen balance of goats fed corn silage. Journal of Animal and Veterinary Advances, 9(5): 883-886.

SAS, (1999). User's Guide: Statistics, version 9.0. SAS Institute, Inc; Cary, NC USA.

Ukpabi, U.H., Emerole, C.O. and Ezeh, C.I., 2000. Comparative study of strategic goat marketing in Umuahia/regional market in Nigeria. Proceeding 25th Annual conference Nigerian Society of Animal Production. pp. 364-365.

STANDARDIZATION OF TWO INTRACELLULAR CRYOPROTECTANTS FOR FREEZING OF PUNJAB-2 ROOSTERS SEMEN DILUTED WITH TRIS COCONUT WATER EXTENDER

Balogun A. S[12]., Narang. R[2].,Cheema Ranjna S[3], Dube P.P [2]., Shantikant D[2]., Keashap N[2].
[1]Department of Animal Health Production and Health Technology, Oyo State College of Agriculture and Technology, Igboora.
[2]Department of Animal genetics and Breeding, [3]Department of Veterinary Gynecology and Obstetrics, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Science University, Punjab, India.

ABSTRACT
Considering the risk of epidemic diseases, *in-vitro* conservation is a strategic tool to secure genetic diversity. The present study is therefore aimed at evaluating the efficacy of different concentrations of glycerol and dimethlysulfoxide (DMSO) for successful cryopreservation of poultry semen extended with Tris coconut-water extender. Tris coconut water extender was prepared, DMSO and Glycerol were supplemented in it at different initial concentrations of; glycerol (4, 5, 6, 7 and 8 V/V) and DMSO (4, 5, 6, 7, 8 amd 9 V/V). Ejaculate Pooled semen from 10 roosters was collected and divided into 5 parts for glycero and 6 parts for DMSO. Semen was diluted with each extenders containing cryoprotectants at dilution ratio of 1:2 (semen:extender). Diluted semen was filled and sealed into 0.25ml straws and equilibrated for 4hrs period and later subjected to vapour freezing and finally immersed in liquid nitrogen container. After a period of 48hrs semen straws samples were brought out of the container for microscopic analysis. A Total of three trials were conducted. Percentage of motile, viable and membrane integrity (M.I) of post-thawed semen was significantly (P>0.05) higher in 7% (51.67±1.6, 62.62±3.8, 50.14±1.2) compared to other treatments although was statistical similar in motility (51.67±1.6) and HOST (45.15±1.1) to 8%. DMSO Post thaw motility, viability and M.I were also significantly (P>0.05) higher in 8% (46.67±9.2, 74.54.±5.9, 51.14±7.6%) and 9% (50.0± 0.0%, 67.81±6.7 %, 54.93±1.1%) than other treatments. Although, both where statistically similar to 7% concentration in motility (40.0±0.0) and M.I (47.38±1.1). It is therefore conclusive that 7-8% glycerol concentration and 8-9% DMSO concentrations is desirable for rooster semen cryopreservation.
Key words: Cryopreservation, Cryoprotectant, Semen, Coconut Water, Rooster

INTRODUCTION
More than 50% of the bird species are under extinction threats all over the world. Assisted reproductive techniques in livestock species have contributed to their conservation and sustainable use. Cryopreservation in -196°C (liquid nitrogen) is a method that makes long term storage of spermatozoa possible (Hammerstedt *et al.*, 1999). However subjecting poultry spermatozoa to ultra low temperature like -196°C usually predispose the sperm to cryopreservation stress which may eventually leads to damage or death of entire spermotozoas contained in the semen, and consequently result into low or zero fertility of inseminated birds and limit is on-farm use. This on the other hand has also limit the effective use of line breeding in poultry breeding farms. An efficient approach for long-term poultry semen storage is thus necessary for future use.
Various semen freezing cryoprotectants and protocols have also been implemented for poultry semen freezing regardless of the physiological differences between species (Awad, 2011; Purdy *et al.*, 2009; Polge *et al.*, 1949). Moreover, there are different types of Cryoprotectants and are usually classified based on their molecular weight, toxicity, temperature and degree of permeability. Glycerol and DMSO cryoprotectants have been formerly used for poultry semen cryopreservation (Tselutin *et al.*, 1995; Polge *et al.*, 1949), but with low and unstable fertility success. It is however deemed that standardizing this two fast permeating cryoprotectants concentration for poultry semen freezing may be an efficient approach. This study therefore aimed at evaluating effects of different glycerol and DMSO concentrations for poultry semen cryopreservation.

MATERIALS AND METHODS
Tris buffer was prepared by adding 3.785g of tris to distilled water, and the pH was adjusted to 7.2. Coconut fruits were purchased from the market, the shell was pierced and water was drained from it into a beaker, it was decanted and filtered. Coconut-water was kept at -20°C for further use. Coconut-water was thawed, added to tris buffer at different concentration of 50%. Different concentrations of

glycerol (4, 5, 6, 7 and 8 V/V) and DMSO (4, 5, 6, 7, 8 and 9 V/V) were prepared in TCWE. Ejaculate of Pooled semen from 10 roosters was collected and divided into 5 parts for glycerol comprising 4% (T1), 5% (T2), 6% (T3), 7% (T4) 8% (T5) and 6 parts for DMSO; 4% (T1), 5% (T2), 6% (T3), 7% (T4) 8% (T5), 9% (T6). Semen and extender was maintained at 37°C before dilution. Semen was diluted with each extenders containing cryoprotectants at dilution ratio of 1:2 (semen : extender), and was processed for chilling in respective extender to get a final concentration of 200 x 10^6 spermatozoa /ml. Extended semen was filled and sealed in 0.25ml straws by manual filling and sealing method. Straws were kept at 4^0C for 4hrs in cold handling cabinet for equilibration. Straws racked in floating rack, equilibrated for 4 hrs were kept in LN_2 vapors in a manual freezer (minitube) for 12 min before plunging into liquid nitrogen. Semen was thawed after 48 hrs at 4°C for 1min and analyzed for motility, viability and membrane integrity. A Total of three trials were conducted, all data collected were subjected to analysis of variance and means were separated with Ducan multiple range test.

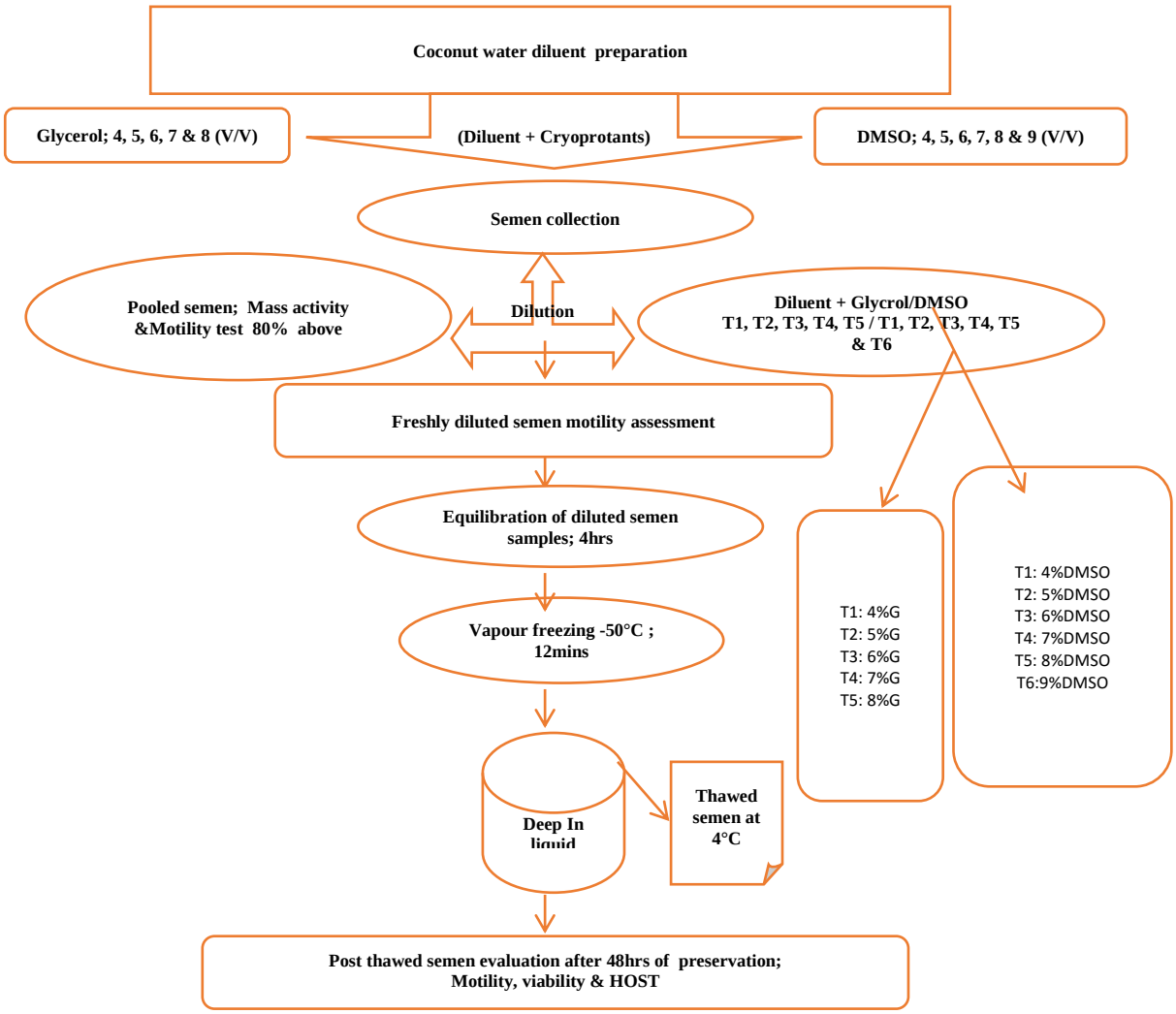


Fig1: Flow Chart of Glycerol and DMSO Concentrations Standardization for Rooster Semen Cryopreservation

RESULT AND DISCUSSION

Effects of different concentrations of glycerol in TCW extender on sperm attributes of post thawed semen are presented in (Table 1). Chickens were the first animals to be produced from frozen sperm using glycerol as a cryoprotectant (Donoghue and Wishart 2000). Percentage of motile, viable and HOS positive spermatozoa in post-thawed semen was significantly (p>0.05) higher in T4 (51.67±1.6, 62.62±3.8 and 50.14±1.2)) than other treatments, T1 (23.33±3.3, 25.08±5.6, 22.70±6.4), T2 (28.33±3.3, 33.50±5.0, 27.47±3.2) and T3 (33.33±3.3, 43.56±1.1, 34.67±4.9) extender. However, Motility and membrane integrity of post thawed semen cryopreserved in T5 (51.67±1.6%, 45.15±4.1%) extender were statistical similar (P>0.05) to T4. Our findings revealed 7% glycerol as optimum concentraton for successful cryopreservation of rooster's semen. In consonance with our observation, (Bearden *et al* 2004) reported that glycerol penetrates the sperm cell and dehydrates the cell partially, thereby reducing the risk of water crystallization. Moreover, motility score of sperm cryopreserved with 7% glycerol is above average. Since motility is one of the many important attributes of a fertile spermatozoon, in agreement with our study (Peña Martinez 2004), also reported 7-8% glycerol is deemed to be sufficient for poultry semen freezing and further reported that the concentration of glycerol to be used is semen diluents dependent. Reda Ibrahim El-Sheshtawy *et al* (2017) reported that CW extender with glycerol 4%, 6% and 8% improved sperm membrane integrity of cooled semen and the superior result was obtained in CW with 4% glycerol. In addition, Silva *et al* (2004) and Cardoso *et al* (2006) also concluded that CW containing glycerol is recommended to achieve satisfactory post freezing quality of boar semen. However, glycerol has a contraceptive effect in poultry (Long and Kulkarin 2004).

Table 1: Effects of different concentrations of glycerol in Tris coconut water extender on post thawed roosters semen

	Glycerol Concentrations				
Parameters	T1 (4%)	T2 (5%)	T3 (6%)	T4 (7%)	T5 (8%)
Motility (%)	23.33^{c}±3.3	28.33^{bc}±3.3	33.33^{b}±3.3	51.67^{a}±1.6	51.67^{a}±1.6
Viability (%)	25.08^{c}±5.6	33.50^{bc}±5.0	43.56^{b}±1.1	62.62^{a}±3.8	43.56^{b}±4.1
Host (%)	22.70^{c}±6.4	27.47^{bc}±3.2	34.67^{ab}±4.9	50.14^{a}±1.2	45.15^{ab}±11.1

Superscripts indicate significant difference at 5 % level with in the columns (a – c)

Effects of different concentrations of DMSO in Tris coconut water extender on post thawed of rooster's semen are presented in (Table 2). Post thaw motility, viability and M.I were also significantly (P>0.05) higher in 8% (46.67±9.2, 74.54.±5.9, 51.14±7.6%) and 9% (50.0± 0.0%, 67.81±6.7 %, 54.93±1.1%) than other treatments. Although, both where statistically similar to 7% concentration in motility (40.0±0.0) and M.I (47.38±1.1). This result revealed that 8%-9% DMSO concentration may be considered as optimum level for cryopreservation of rooster's semen. Moreover, Rosato and Laffaldano (2013) explained that intra-cellular cryoprotective agents are needed to increase membrane fluidity and to prevent dehydrating the cell. Donoghue and Wishart (2000) reported that the DMSO is a standard cryoprotectant for poultry sperm cryopreservation and gives higher sperm motility recovery rate. DMSO has also been proven to be the best cryoprotectant in other avian studies with higher fertility and recovery motility (Sontakke *et al* 2004).

Table 2: Effects of different concentrations of dimethlysulfoxide in Tris Coconut Water extender on post thawed Semen.

	Dimethlysulfoxide Concentrations					
Parameters	T1 (4%)	T2 (5%)	T3 (6%)	T4 (7%)	T5 (8%)	T6 (9%)
Motility (%)	21.67^{c}±1.6	26.67^{c}±1.6	31.67^{bc}±1.6	40.00^{ab}±0.0	46.67^{a}±9.2	50.00^{a}±0.0
Viability (%)	43.36^{c}±0.4	44.73^{c}±0.3	53.25^{bc}±0.3	40.04^{c}±4.3	74.54^{a}±5.9	67.81^{ab}±6.7
Host (%)	20.75^{c}±3.1	26.51^{bc}±1.2	35.76^{b}±2.0	47.38^{a}±1.1	51.14^{a}±7.6	54.93^{a}±1.1

Superscripts indicate significant difference at 5 % level with in the columns (a – c)

CONCLUSION AND RECCOMENDATION

It is therefore conclusive that 7-8% glycerol concentration and 8-9% DMSO concentrations is desirable for rooster semen cryopreservation. However, glycerol usage should not exceed 8% initial concentration while DMSO usage should not exceed 9% concentration when used in poultry. Evaluation of Different freezing, thawing and pre-freezing procedure is also recommended for better post thawed poultry semen quality.

REFERENCES

Awad MM. (2011). Effect of some permeating cryoprotectants on CASA motility results in cryopreserved bull spermatozoa. *Animal Reproduction Science* 123: 157-162.

Bearden H J, Fuquay J W and Willard S T. (2004). Applied Animal Reproduction. Pearson Education, Inc. New Jersey. 6th Edition, Pp.109-27.

Cardoso RCS, Silva AR, da Silva LDM. (2006). Comparison of two dilution rates on canine semen quality after cryopreservation in a coconut water extender. *Animal Reproduction* Science **92:** 384-391.

Donoghue A M and Wishart G J. (2000). Storage of poultry semen. *Animal Reproduction Science***62:** 313-232.

Hammerstedt RH, Graham JK, Nolan JP. (1990). Cryopreservation of mammalian sperm: what we ask them to survive. Journal of Andrology11; 73-88.

Long J A and Kulkarni, G. (2004). An effective method for improving the fertility of glycerol exposed poultry semen. *Poultry Science***83**: 1594-1601.

Peña Martínez A I. (2004). Canine fresh and cryopreserved semen evaluation. *Animal Reproduction Science* 82-83, 209-224.

Polge C, Smith AU, Parkes AS (1949). Revival of spermatozoa after vitrification and dehydration at low temperature. *Nature*; 164: 666-676.

Purdy Y, Song FG, Silversides HD, Blackburn HD. (2009). Evaluation of glycerol removal techniques, cryoprotectants and insemination methods for cryopreserving rooster sperm with implications of regeneration of breed or line or both. *Poultry Science* 88: 2184-2191.

Reda I E, Walid S E, Gamal A D A. (2017). Cryopreservation of cattle semen using coconut water extender with different glycerol concentrations. *Asian Pacific Journal of Reproduction* pg 279-282

Rosato M P and Iaffaldano N. (2013). Cryopreservation of rabbit semen: Comparing the effects of different cryoprotectants, cryoprotectant-free vitrification and the use of albumin plus osmoprotectants on sperm survival and fertility after standard vapor freezing and vitrification. *Theriogenology,***79**: 508-516.

Silva AR, Cardoso RCS, Silva LDM. (2004). Comparison between powder coconut water (PCW106®) and tris buffer as extenders for canine semen cryopreservation. *In*:

Abstracts of 5th International Symposium on Canine and Feline Reproduction, 2004, Embu das Artes, SP, Brazil. Botucatu, SP: UNESP/FMVZ. Pp.98-99.

Sontakke S D, Umapathy G, Sivaram V, Kholkute S D, Shivaji S. (2004). Semen characteristics, cryopreservation, and successful artificial insemination in the Blue rock pigeon (Columba livia). *Theriogenology* **62:**139-153.

Tselutin K, Narubina L, Mavrodina T, Tur B. (1995). Cryopreservation of poultry semen. Brit Poultry Science 36: 805-811.

COMPARATIVE EFFECTS OF TRIS EGG-YOLK ORANGE JUICE EXTENDER ON HEAVY AND LIGHT STRAIN COCKS SEMEN DILUTED AT DIFFERENT RATE

Balogun, A.S, Shobanke, I.A, Akinosun, A.A, Oluwemimo, B.A & Bello I.I
Department of Animal Health Production and Health Technology, Oyo State College of Agriculture and Technology, Igboora.
Corresponding author e-mail: balogunadedeji001@gmail.com

ABSTRACT
Dilution of neat semen is advantageous, as more hens can be inseminated from a single ejaculate semen sample. This study was conducted to evaluate the optimum dilution rate of marshal and Isa brown cocks semen diluted with Tris Egg-yolk Orange Juice extender Preparation of TEY-O extender was done, and maintained at 37°C. Ten marshal and Isa brown of 30-40 weeks of age from Obasanjo farms limited were used. Pooled ejaculates of 10 cocks from each strains were collected into glass funnel per trials. Blood stained and contaminated semen was discarded. Semen was examined for individual progressive motility. The extender and semen were kept at 37°c 5-10 mins before dilution. Pooled semen with motility > 80% was processed for dilution. Ejaculated pooled Semen from each strains were divided into four equal parts consisting of eight treatments and diluted at different ratio with TEY-O extender; undiluted semen, diluted Marshal (1:2, 1:3 and 1:4) and Isa brown (1:2, 1:3 and 1:4) cocks semen. Diluted and undiluted semen samples were evaluated for motility, viability, membrane and acrosome integrity. A total of three trials were conducted. The Freshly diluted semen samples showed no significant difference (P<0.05) in all parameters evaluated. However, in marshal extended semen three folds dilution (1:2) had highest value, while in Isa brown, four folds dilution had highest value in most paramters. It is therefore concluded that semen dilution rate does not have significant influence on strains variability (heavy and light) and that both strains respond similarly to the different dilution rate.
Key words: Extender, Semen, Dilution, Egg-yolk, Strains

INTRODUCTION
The technique of Artificial Insemination is getting popular in other poultry species other than turkey. Since last few decades, more farms in Nigeria now rely on A.I for their broiler breeders. For example, fertility in the broiler breeds continues to decline as males are selected for growth, A.I may become cost effective in broiler breeder management (Reddy, 1995). A.I in poultry expresses better fertility than natural mating (Saeki and Nagomi, 1964). Even when under natural mating 80–85% of eggs are fertile, fertility can be further increase by 5–10% simply through augmentation with A.I to the propagation program (Gee *et al.*, 2004). Semen dilution with an extender for poultry is important because poultry semen is viscous and highly concentrated, containing approximately six to twelve billion spermatozoa per ml for roosters and toms, respectively (Donoghue and Wishart, 2000). Dilution of neat semen irrespective of the strains variability (meat/egg) laying type is therefore advantageous in that more hens can be inseminated from a single ejaculate semen samples. However, Choice of semen extender is an important aspect of semen processing for A.I (Peterson *et al*., 2007).
Several investigators have compared the composition of various diluents and summarized fertility data across studies (Howarth 1983; Bakst 1990; Bootswala and Miles, 1992). But, no standard diluent for poultry semen yet, and studies are so variable in experimental design which includes species and strains response, dilution rate, time of insemination, vaginal depth and frequency of AI, Storage period and number of spermatozoa inseminated and duration of fertility analyzed that discerning the benefits of different diluents is difficult. Glutamic acid is believed to be the most important chemical constituent of avian seminal plasma and it has become a standard component of extenders (Siudzinska and Lukaszewicz, 2008). Egg-yolk known to contain a considerable amount of glutamic acid, and vitamine E, an evident for it antioxidant potentials has been a major component of cattle and some other farm animal species diluent. Moreover, optimizing the potentials of egg-yolk by supplementing it with orange juice as a conjugate antioxidant source has been reported to enhance semen quality *in-vitro* and *in-vivo* and subsequently egg fertility percentage (Balogun, 2019).
Penfold *et al.* (2001) also reported a significant advantage of diluting freshly collected spermatozoa 1:1 in BPSE on sperm motility and progressive status regardless of temperature (24°C versus 4°C) while further dilution in BPSE (1:10 or 1:100) caused a transient increase and a rapid decrease in progressive motility. Thus, maintaining the quality of poultry sperm *in vitro* shortly before and during

insemination has been observed to require suspending it in a solution capable of preserving it fertilizing ability till the sperm is inseminated and probably in the hen oviduct. Thus, identifying the appropriate and optimum dilution ratio ditto strains response is paramount and may be an important step in achieving better diluted semen quality and subsequently good fertility.

MATERIALS AND METHODS

This study was conducted at Oyo State College of Agriculture and Technology, in Collaboration with Obasanjo farm Nigeria limited (OFN) at Igboora. Tris buffer was prepared by adding 3.785g of tris to distilled water, and the pH was adjusted to 7.2. Fresh domestic fowl eggs were collected from the farm and disinfected, the shell was broken and yolk was separated from albumen. 20% egg-yolk was vigorously mixed with Tris buffer in the beaker and finally 10% orange juice was supplemented into it and mixed very well. TEY-O extender was kept in the freezer for further use. Ten Marshal and Isa cock birds were used from Obasanjo Farm Nigeria limited. Pooled semen with motility > 80% from each strains were separately simultaneously processed for dilution. Ejaculated pooled Semen from each strains were divided into four equal parts consisting of eight treatments and diluted at different ratio with TEY-O extender; undiluted semen, diluted Marshal (1:2, 1:3 and 1:4) and Isa brown (1:2, 1:3 and 1:4) cocks semen. The diluted and undiluted semen samples were evaluated for motility, viability, membrane and acrosome integrity. A Total of three trials were conducted, all data collected were subjected to analysis of variance and means were separated with Ducan multiple range test.

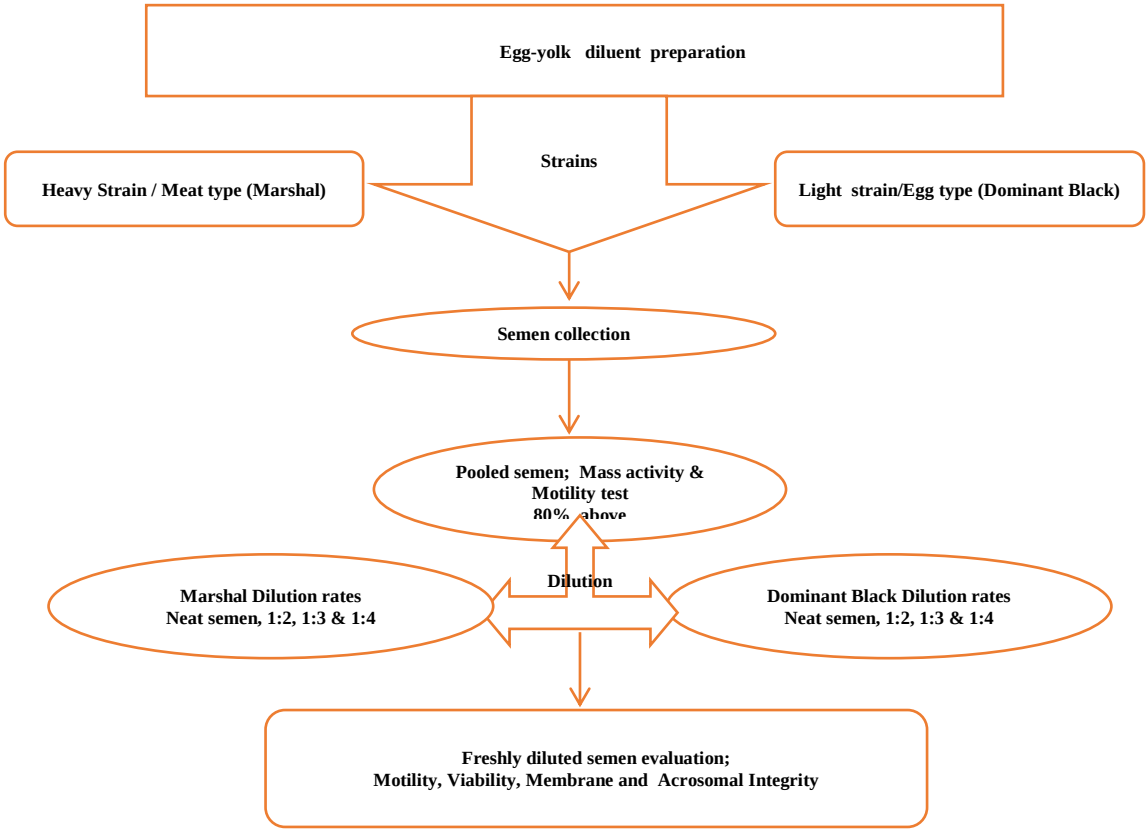


Fig1: Flow Showing Standardization of Semen Dilution Rate of Heavy and Light Strains Domestic Fowl With Tris Egg-Yolk Orange Juice Extender

Result and Discussion

Microscopic semen quality parameters of neat rooster semen extended with Tris egg-yolk orange juice extender is presented in (Table1). Freshly diluted semen samples showed no significant difference ($P<0.05$) in most parameters evaluated such as percentage motility, viability, membrane integrity and acrosome integrity. However, in marshal extended semen, three folds dilution (1:2) had highest value in most parameters such as motility (93.33%), viability (95.00%) and membrane integrity (93.47%) while in Isa brown, four folds dilution (1:3) had highest value in most parameters; motility (91.67%),

viability (94.33%) and membrane integrity (93.33%). This result revealed that most microscopic semen parameters are not significantly affected by dilution rate with TEY-O extender on semen of both heavy and light strain cocks. Moreover, extender do not had adverse effects on immediate dilution with neat semen irrespective of the dilution rate up to four dilution folds.Similar results were reported by (Balogun et al., 2017a, Balogun 2019) on standardization of egg-yolk concentrations for rooster semen dilution and preservation. Also, the result obtained is in agreement with the previous studies in turkey semen (Iaffaldano *et al.,* 2010; Venkatesh 2005).However, Iaffaldano *et al.,* 2010 also reported superior spermatozoa motility with BPSE and IMV diluents at lower dilution (1:2 and 1:3), in which we also recorded highest values in our present experiment. Furthermore,Keerthy *et al.* (2016) buttress the result of our present study by observing that dilution rate did not showed any significant difference even between storage periods irrespective of the extenders and the guinea fowl varieties.

Table1: Effects of Different Dilution Rate on Heavy and Light Strains Cock Semen Extended With Tris Egg-Yolk Orange Juice Extender

Strains									
	Marshal Cock				**Isa Brown**				
Parameters	**T1(neat semen)**	**T2(1:2)**	**T3(1:3)**	**T4(1:4)**	**T5(Neat semen)**	**T6(1:2)**	**T7(1:3)**	**T8(1:4)**	**SEM**
Motility (%)	91.67	93.33	91.67	88.33	91.67	91.67	91.67	90.00	0.54
Viability (%)	92.67	95.00	93.33	91.33	95.00	92.67	94.33	90.33	0.52
Membrane Integrity (%)	93.38	93.47	93.17	90.33	91.50	91.07	93.33	88.33	0.57
Acrosome Integrity (%)	96.17	95.50	95.77	92.80	93.00	94.43	93.67	94.00	0.45

SEM : Standard Error of Mean

CONCLUSION AND RECOMMENDATION

It is therefore concluded that semen dilution rate does not have significant influence on strains variability and that both heavy and light strains cock semen responds similarly to different dilution rate with Tris egg-yolk diluents and can be diluted up to five folds for immediate artificial insemination use without exposing the sperm cells to any deleterious effects.

REFERENCES

Bakst, M.R., (1990). Preservation of avian cells. In: Crawford, R.D. Ed. , *Poultry Breeding*. Elsevier, Amsterdam, Pp. 91–108.

Balogun A S. (2019). Evaluation of antioxidant potentials of tomato & orange juices on extended poultry semen preserved with egg-yolk & coconut water diluents to improve selection intensity Ph.D Dissertation.

Balogun, Adedeji Suleimon., Shivkumar., Mustapha Abdul-Rahman., Fatola, Olabamiji Sunday Gabriel and NidhaImtiyaz (2017a).Spermogram and Fertility Assessment of Cocks Semen, Extended with Coconut-water Extender Supplemented with Garlic Extracts. book of proceedings of IAHA Pre-Conference on Organic Animal Husbandry on the "Role of Livestock in Sustainable Agriculture" 6 - 8 Nov 2017 in Ghaziabad linked to 19th Organic World Congress of IFOAM in India.Pp. 164-169

Bootswala, S.M., Miles, R.D., (1992). Development of diluents for domestic fowl semen. *World's Poultry Science Journal*. 48, 121–128.

Donoghue A M and Wishart G J. (2000). Storage of poultry semen. *Animal Reproduction. Science*, **62:**213–232.

Gee GF, Bertschinger H, Donoghue AM, Blanco JM and Soley J. (2004). Reproduction in non-domestic birds: physiology, semen collection, artificial insemination and cryopreservation. *Avian Poultry Biology Review*. 15: 47–101

Howarth B K. (1983). Comparison of diluents for holding cock semen six hours at 418°C. In *Poultry Science*, **62**:1084-1087.

Iaffaldano N, Rosato MP, Manchisi A, Centoducati G, Meluzzi A (2010) Comparison of different extenders on the quality characteristics of turkey semen during storage. Ital J Anim Sci 4: 513-515.

Keerthy AJ, Omprakash AV, Churchill RR, Hudson GH (2016) Effect of Semen Diluents, Dilution Rates, and Storage Periods on Spermatozoa Motility of Different Varieties of Guinea Fowl. *Journal of Veterinary Science Technology* 7: 378. doi: 10.4172/2157- 7579.1000378

Penfold L, Harnal V, Lynch W, Bird D, Derricson S and Wildt E. (2001). Characterization of northern pintail (Anas acuta) ejaculate and the effect of sperm preservation on fertility. *Reproduction*,**121**: 267–275.

Peterson K, Kappen M A P M, Ursem P J F, Nothling J O, Colenbrander B and Gadella B M. (2007). Microscopic and flow cytometric semen assessment of Dutch AI-bucks: effect of semen processing procedures and their correlation with fertility. *Theriogenology*, **67**: 863-871.

Reddy R P (1995). Artificial insemination of broilers: economic and management implications. In: Bakst, M.R., Wishart, G.J. Eds. , Proc. 1st Int. Symp. on the Artificial Insemination of Poultry. Poultry Science Association, Savoy, IL, Pp. 73–89

Saeki and Y and Nagomi Y (1964). Seasonal differences in fertility and hatchability of eggs produced by the natural mating and artificial insemination methods of chickens. Japan Journal of Animal. Reproduction. 10: 37-43.

Siudzinska A and Lukaszewicz E 2008. Effect of semen extenders and storage time on sperm morphology of four chicken breeds. J. Appl. Poult. Res. 17: 101–108.

FERTILITY AND DURATION OF FERTILE PERIOD IN BROILER BREEDER HENS INSEMINATED WITH VARIED SEMEN DOSES

Bolarinwa, A. O., Adebisi, K. A & Ewuola E. O
Animal Physiology and Bioclimatology unit,
Department of Animal Science, University of Ibadan, Ibadan, Nigeria

ABSTRACT
One hundred and twenty Marshall broiler breeder hens aged 32 weeks were used to assess the effect of varying insemination doses on egg fertility and duration of fertile period. The hens were randomly allotted into five treatments of twenty four hens each in a completely randomized design. Semen was harvested from 10 cocks, using abdominal message technique, pooled and evaluated for semen quality. Hens in T1 were inseminated with 0.02 mL semen (containing $5x10^6$ motile spermatozoa), hens in T2, T3, and T4 were inseminated with 0.04, 0.06 and 0.08 mL of semen, respectively, while hens on T5 were exposed to natural mating at a ratio of one cock to four hens. Both mating processes were repeated for two successive days. Eggs were collected daily and incubated weekly for four weeks to determine egg fertility as influenced by semen doses and oviductal sperm age. Data were analysed using descriptive statistics and ANOVA at $\alpha_{0.05}$. At the first week, fertility in T1 (94.3±1.9%), T2 (94.5±3.2%), T3 (95.2±1.9%) and T4 (97.1±2.9%) were significantly higher than T5 (76.9±3.0%). Fertility up till 7 days of oviductal sperm age in inseminated hens was above 90%, but reduced to 87.0±4.7% and 74.2±9.3% at days 8 and 9, respectively and declined to zero fertility in day 22. It could be concluded in this study that semen insemination dose of 0.02 mL is lease economic dose with optimum fertility in broiler breeder hens. The maximum duration of fertility period in broiler breeder hens was 21days, while efficiency in fertility reduced after 8days.
Keywords: Artificial insemination, fertile period, insemination dosage, egg fertility

INTRODUCTION
Broiler breeder production is one of the profitable business in Nigeria due to the ban in the importation of frozen chickens. This recent development by the government has led to an increase in the demand of day old chicks for production of broiler chickens.

Interestingly, most broiler breeder farms in Nigeria still widely employ the natural mating system in the production of fertile eggs that will yield day old chicks. This system however, is marred with associated problems which includes transfer of disease from male to female, incomplete successful mating leading to reduced fertility due to body weight gain of cocks during natural mating (Attia *et al*., 1993) and higher number of cock to hen ratio. Also, during natural mating a single cock deposit much more semen than what is needed to fertilize an egg which leads to semen wastage and economic loss at large to farmers.

Fertility is of major concern to broiler breeder farmers. To increase fertility in poultry, adoption of artificial insemination (AI) is of paramount importance since AI is attributed with several advantages compared to natural mating (Penfold *et al* 2000). The merit of A.I among others includes increase in number of settable eggs, best overall fertility and hatchability, thus reducing the cost of production of day old chicks (Brillard, 2003). Artificial insemination has been used in poultry industry in the developed countries (Surai and Wishart 1996), However in Nigeria measures have not been put in place in poultry industry to regulate artificial insemination protocol and practices. Artificial insemination technology in poultry has been hypothesized to lengthen insemination interval with lesser semen dose for insemination (froman *et al.*, 2011). Despite the promising of AI in poultry industry in Nigeria, there still indiscriminate use of semen in broiler chicken breeding programs, thus leading to semen wastage.

This is because the management technology and other useful information on insemination dosage in broiler breeder hens are not readily available to the farmers and even the commercial farmers depend on their past experiences.

Researches that have been carried out on A.I in broiler breeders chickens mostly were in temperate regions which may not be directly adoptable by tropical farmers Burrow and Quinn (1937) reported insemination dose of 0.05 mL of undiluted semen; Dose containing 5.5 $x10^6$ spermatozoa have been reported to increase fertility (Lake and Ravie, 1988). There is therefore dearth of information on

insemination schedule in broiler breeder chickens in Nigeria. Also, proper documentation on insemination schedule particularly on least viable semen dose for optimum fertility under Nigeria condition is lacking. Therefore, this study was aimed at investigating the appropriate semen dosage, for optimal fertility in broiler breeder hens.

MATERIALS AND METHODS

Experimental location

The experiment was conducted at the poultry unit of the Teaching and Research farm and the Animal Physiology Laboratory of the Department of Animal Science, University of Ibadan, Nigeria.

Experimental animal management and semen collection

One hundred and twenty Marshall broiler breeder hens aged 32 weeks were randomly allotted into five treatments (T1-T5) of twenty- four hens each in a completely randomized design. Semen was harvested from 10 cocks, using abdominal message technique (Burrow and Quinn 1937), pooled and evaluated for semen quality.

Insemination, data collection and analysis

Hens in T1 were inseminated with 0.02 mL semen (containing $5x10^6$ motile spermatozoa). Hens in T2, T3, and T4 were inseminated with 0.04, 0.06 and 0.08 mL semen, respectively while hens on T5 were exposed to supervised natural mating at a ratio of one cock to four hens and each hen was allowed to be mated once per day. Both mating processes were repeated for two successive days. Eggs were collected daily and incubated weekly for four weeks to determine egg fertility and duration of fertile period as affected by semen doses and oviductal sperm storage. Analysis was done on square root transformed data using general linear model of SAS (2003) while means where significant were separated using Duncan's Multiple Range Test of the same software.

RESULTS

Spermatozoa characteristics in pooled semen inseminated for the two days are shown in Table 1. Average sperm concentration, liveability and sperm motility were 0.28 $x10^9$ cells/ml, 96.8% and 90%, respectively.

Table 1: Characteristics of pooled semen administered to the hens

Semen parameters	Mean values (± Standard deviation)
Sperm concentration (x 10^9 cells/mL)	0.28±0.13
Liveability (%)	96.8±3.7
Sperm motility (%)	90.0±0.0

Table 2. Shows the effect of different semen insemination dosage and natural mating on fertility of hens. Fertility result for the first week ranges from 94.29±1.91% to 95.17±1.91% in the inseminated groups and was significantly ($p<0.05$) higher than that of the natural mating groups (76.89±2.95%). Fertility in week two and three was not significantly different ($p<0.05$) among the treatments. Though drops to zero in all the treatments at weeks four.

Table 2: Egg fertility (%) in broiler breeder hens inseminated with varied semen doses for four weeks

Weeks after insemination	Semen dose inseminated (mL)				
	0.02 (T1)	0.04 (T2)	0.06 (T3)	0.08 (T4)	Natural mating (T5)
1	94.29±1.91[a]	94.53±3.23[a]	95.17±1.91[a]	95.17±1.91[a]	76.89±2.95[b]
2	66.60±9.01	56.03±4.41	55.17±7.54	47.01±9.32	41.89±8.52
3	15.50±6.32	12.89±4.50	9.37±4.40	10.42±3.79	6.22±2.17
4	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

[ab] Means of treatments along a row with different superscripts differed significantly ($p<0.05$). SE-standard error.

The duration of fertile period and oviductal spermatozoa age effect on fertility of the inseminated groups of hens are presented in Fig 1. Fertility was at maximum at the first week after insemination with 95.3% but there was a steady and significant drop in fertility on a daily basis to about 25% at 14th day, after which it declined till it finally reached 0% at 22 days.

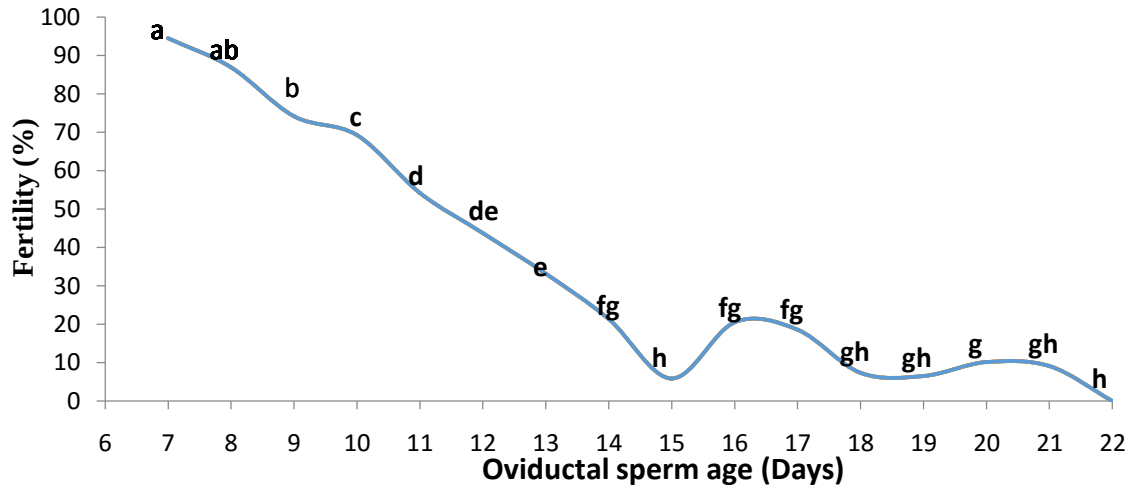


Figure 1: Duration of fertile period in inseminated broiler breeder hens

DISCUSSION

The mean values of sperm concentration observed was 0.28±0.13 ($x10^9$ /ml). The values for sperm concentration was $5.5x10^6$ /ml reported by Lake and Ravie (1988) for breeder cocks. This suggests that the concentration of sperm cells in the semen was high and thus sufficient for the intended purpose. Liu *et al.* (2009) noted that semen quality parameters such as concentration, liveability and morphology are good predictors of the fertilizing ability of sperm cells.

The result of the semen evaluation for 0.02, 0.04, 0.06 and 0.08mL of raw semen contained approximately, 5 $x10^6$, 10 $x10^6$, 15 $x10^6$ and 20 $x10^6$ motile sperm cell respectively. Brillard and Bakst (1990) reported that the length of fertile period in chickens is determined by the number of spermatozoa that enters the sperm storage tubules (SST). This Suggest that an increase in the number of spermatozoa inseminated may maintain a high level of fertility for an extended period. Contrarily, Campton and van krey (1979) suggest that only a finite number of sperm cells are capable of entering the sperm storage tubules within a given period. The suggestion supports the observation from this

study as increasing administration of semen dose across treatment groups did not translate to increase in fertility. Thus, suggesting that insemination dose above 0.02mL (approximately 5 $x10^6$ motile sperm cell) is in excess of the maximum number of spermatozoa which can be accommodated by the SST at a given period.Also, by inseminating a semen dose of 0.02mL would mean that more hens will be inseminated. Semen wastage will be reduced and cost of production will be lowered. The fertility rate of hens on natural mating was observed to be lower throughout the trail compared to the inseminated groups. This could probably be that the volume of semen ejaculated for the two consecutive mating days did not contain enough sperm cells that was sufficient to fill the sperm SST probably due to wastage as a result of inadequate contact during natural mating.

Fertility significantly decreases with increasing oviductal sperm age up to 21 days. However, optimum fertility level was observed in inseminated groups which was obtained within first 7days post-insemination. At days 8 and 9 fertility ranged from 86.98 to 74.1% and slightly decreased to 69.2% at day 10. There was a sharp reduction on day 15 (5.83%) which later increased to (20.52%) at day 16 and subsequently 0% fertility was attained at day 22 post - insemination. This observation was in line with the work of Tabatabaei *et al.,* (2009) where optimum fertility was obtained at days 1 to 7, while fertility drops to zero at day 19 in indigenous chickens and day 17 for Ross chickens. The duration of fertile period in chicken was reported as 21days by Brillard (1993); while Bramwell (2002) reported 22 days for broiler breeder hens which corroborated this finding in the tropics.

CONCLUSION AND RECOMMENDATION

In the adoption of artificial insemination in broiler breeder hen, Semen insemination dose of 0.02mL containing $5x10^6$ motile spermatozoa is recommended as an economic dose using undiluted semen. The duration of fertile period in broiler breeder hens is 21days while efficiency in fertility reduces after 8 days.

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REFERENCES

Attia, J. Hicks, L. Oikawa, K. Kay, C.M. and Dunn, R.J. 1993. Structural properties of the myelin-associated glycoprotein ectodomain. J. Neurochem.61 (2):718-26.

Brillard, J.P., 1993. Sperm storage and transport following natural mating and artificial insemination. *Poult.Sci*.71:923-928.

Brillard, J.P., 2003. Practical aspects of fertility in poultry. *World's Poult. Sci*. J., 59: 441- 446.

Brillard, J.P. and Bakst, M.R. 1990. Quantification of Spermatozoa in the sperm-storage tubulesof turkey hens and the relation to sperm numbers in the periviteline layer of eggs. *Biology of Reproduction* 43: 271-275.

Bramwell, R. K. 2002. Fertility and embryonic mortality in breeders. Avian Advice 4:2. https://poultry-science.uark.edu.

Burrows, W.H. and Quinn, J.P. 1937. The collection of spermatozoa from domestic fowl and turkey. *Poultry Science* 26 (1): 19-24.

Campton, M.M. and Van krey, H.P. 1979. A histological examination of the uterovaginal sperm storage glands in the domestic hens following insemination with variable semen doses. *Poult Sci*.58:478-480.

Froman, D.P. Feltmann, K. Pendavis, A.M. Cooksey. S.C. Burgess and Rhoads D. D. 2011. Physiology and endocrinology symposium: A proteome- base model for sperm mobility phenotype J. *Anim. Sci*. 89:1330-1337

Lake, P. E and Ravie, O. 1988. Effect of trypsin and neuraminaidae on fowl spermatozoa and their retention in the oviduct.. 9th Conference *Proceeding of the World Poultry Congress* 593-594

Liu, S. J. Zheng, J. X. and Yang, N. 2009. Semen quality factor as an indicator of Fertilizing capacity for geese-http://ps:fass,org/cgi/content/full/87/1/155.

Penfold, L.M., wildt, D.E., Herzog, T. L., Lynch, L., Ware, S. E. Derrickson and S.L Monfort, 2000. Seasonal patterns of LH, testosterone and semen quality in the Northern pintail duck. Reproduction, fertility Development, 12:229-235.

Statistical Analytical System, SAS., 2003. SAS/STAT User's Guide. Version 8 for Windows. SAS institute Inc., SAS Campus Drive, Cary, North Carolina, USA.

Surai, P. F. and Wishart, G. J. 1996. Poultry artificial insemination technology in the countries of the former USSR. Worlds *Poultry Science Jounrna*l 52:27-43.

Tabatabaei, S. R.; Batvani, A. R. 2009. Composition of semen quality of in indigenous and Ross Broiler breeder Rooster-J*ournal of Animal and Veterinary Advance*, 8(1) 90-93.

EFFECTS OF SUPPLEMENTAL BIOTIN ON YOLK, ALBUMEN AND EXTERNAL QUALITY PARAMETERS OF NOILER HEN EGGS

***S.B Atsen., Y.P Mancha & D.J.U Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: atsensamuelbulus@gmail.com mobile No: 08022802930*

ABSTRACT

The study was carried out to evaluate the effects of supplemental biotin on yolk, albumen and external quality parameters of Noiler hen eggs. A total of one hundred and twenty Noiler hens were purchased from the bauchi state agricultural development project, they were housed in the poultry unit of Abubakar Tafawa Balewa University Teaching and Research Farm and were further designated into five treatments with each treatment having 24 hens. Five graded levels of supplemental biotin (0.00, 0.50, 1.00, 1.50, 2.00g) were administered to each treatment in drinking water. The results for yolk quality parameters indicate that there was significant difference ($p<0.05$) among different levels of biotin tested, it was also deduced that treatment 4 with biotin level of 2.0g performed best, which was closely followed by treatment three with biotin level of 1.5g. The results also shows that albumen quality was significantly affected ($p<0.05$) by treatment 4 (2.0g) which had the highest influence on the parameters. Results for effects of biotin on external egg quality parameters indicates that there was significant difference ($p<0.05$) among the treatments with treatment 4 (2.0g) showing superior performance. From the results of this research it was concluded that biotin improved the performance of Noiler hens in all parameters studied. Therefore it is recommended that supplemental biotin should be administered at either 1.5g or 2.0g. Further research is also recommended so as to widen the use of biotin in poultry science.

Keywords: Biotin, Noiler, Albumen, Yolk.

INTRODUCTION

The chicken egg is naturally designed for reproduction, it is a veritable source of protein affordable to all classes of people. In addition to protein, the chicken egg also contains carbohydrate, vitamins and other nutrients. Among the economically important traits in egg production enterprise are egg size, shell thickness and internal qualities of egg as well as hatchability. The quality of chicken egg is influenced by age, breed and strain of the chicken, as well as nutrition. Thus, the internal and external egg quality traits are of major importance to the egg industry worldwide (Ahmadi and Rahimi, 2011). It has been reported that the quality of the chicken egg is influenced by genetic and non-genetic factors such as season, environment and feed intake (Ahmadi and Rahimi, 2011; Ojedapo, 2013; Burra, 2014). Egg quality traits had been reported to influence embryo development, hatchability, and growth performance of chicks (Khan et al., 2004; Onagbesan et al., 2007; Huwaida et al., 2015). The Noiler chicken breed is a hybrid developed in Nigeria which is rugged and can adapt to harsh conditions like local chickens, they have an excellent survival rate that matches that of local chicken they also grow faster and have better egg laying performance. Management practices, high stocking density and harsh climatic conditions result in poor egg quality such as thin egg shell, shell-less egg, low albumen and yolk quality which impacts negatively on the poultry industry. Biotin (vitamin H) which is also called vitamin B7 or B8 is a water soluble B-vitamin and an essential coenzyme that contributes an integral part of embryonic development. Its physiologically active form is linked to biotin-dependent enzymes (Chen *et al.*, 1994). Thus, it contributes to growth, bone development, reproduction, improving feed conversion in animals (McMahon, 2002) and improving the performance of breeder hens and chicks (Arends *et al.*, 1971; Watkins andKratzer, 1987; Kruger and Brown, 1987and Robel, 1989 & 1991). Birds do not have the capability to synthesize biotin, which is provided, under physiological conditions, by microbial synthesis of gut flora. Egg biotin is positively related to dietary biotin. Egg biotin content increases with incremental dietary biotin levels (Frigg *et al.*, 1984 andRobel, 1991). Hence the objective of the research was to determine the effects of biotin on yolk, albumen and external quality parameters of Noiler hen eggs.

MATERIALS AND METHODS

The study was conducted at Abubakar Tafawa Balewa University Teaching and Research Farm Bauchi, Bauchi state it is located in the north eastern part of Nigeria and has a tropical climate. One hundred and twenty Noiler hens were purchased from the Bauchi State Agricultural Development Project, they were designated to five treatments in a complete randomized design with each treatment having 24 hens. Biotin was administered orally in drinking water. The research work lasted a period of twelve weeks.

Treatment layout

Control (0.00)
Treatment 1 (0.5g)
Treatment 2 (1.0g)
Treatment 3 (1.5g)
Treatment 4 (2.0g)

Egg and shell weight

The eggs were collected within four hours of lay and weighted using a digital weighing scale and weights were recorded to the nearest 0.1mm.

Egg length and width

The egg length and width were measured with a vernier calliper to the nearest 0.1mm.

Egg shell thickness

The thickness of the shell with intact membrane were measured at three different points and the average of the broad, sharp and middle parts of the egg shell were obtained using micro screw gauge.

Albumen length, width and height

Albumen length, width and height were measured using vernier calliper to the nearest 0.1mm.

Yolk length, width and height

Yolk length, width and height were measured using vernier calliper to the nearest 0.1mm

Yolk colour

Yolk colour was measured using Roche Colour Chart.

Yolk and albumen weight

Yolk and albumen weight were measured using a digital weighing scale

Data analysis

Data obtained were analysed using General Linear Model Procedure of SAS (2015) and significant ($p<0.05$) means differences among treatment means were compared using Duncan's Multiple Range Test (Duncan, 1995) of the SAS package.

RESULTS AND DISCUSSION

Table 1: Effects of Biotin on yolk quality parameters

Parameters	Yolk Length (mm)	Yolk Width (mm)	Yolk Height (mm)	Yolk Weight (g)	Yolk Colour
Treatments					
CC (0.0g)	3.98^{b}	3.98^{ab}	1.51^{c}	14.96^{c}	4.62^{b}
T1 (0.5g)	3.98^{b}	3.10^{c}	1.52^{bc}	15.02^{c}	4.71^{a}
T2 (1.0g)	4.04^{b}	4.02^{a}	1.54^{b}	15.56^{b}	4.74^{a}
T3 (1.5g)	4.06^{a}	4.05^{a}	1.55^{b}	15.78^{b}	4.47^{c}
T4 (2.0g)	4.05^{a}	4.05^{a}	1.71^{a}	16.47^{a}	4.76^{a}

Means within columns having different superscript are significantly different ($P<0.05$)

The results for effects of biotin on yolk quality parameters are shown in table 1. The results shows that there exist significant difference ($p<0.05$) among the treatments in all the parameters studied. It was also deduced that treatment 4 with biotin level of 2.0g performed best, which was closely followed by treatment three with biotin level of 1.5g.

Table 2: Effects of Biotin on albumen quality parameters

Parameters	Albumen Length (mm)	Albumen Width (mm)	Albumen Height (mm)	Albumen Weight (g)
Treatments				
Cc (0.0)	6.48^{bc}	4.42^{d}	0.60^{c}	22.44^{d}
T1 (0.5g)	6.38^{c}	4.72^{c}	0.60^{c}	23.84^{c}
T2 (1.0g)	6.59^{b}	4.75^{c}	0.66^{b}	24.76^{bc}
T3 (1.5g)	7.08^{a}	5.21^{b}	0.66^{b}	25.27^{b}
T4 (2.0g)	7.38^{a}	5.30^{a}	0.72^{a}	27.83^{a}

Means within columns having different superscript are significantly different ($P<0.05$)

The results for effects of biotin on albumen quality parameters are shown in table 2. The results shows that there was significant difference ($p<0.05$) among the treatments with treatment 1(0.5g) having the lowest influence on the parameters while treatment 4 (2.0g) having the highest influence on the parameters.

Table 3: Effects of biotin on external egg quality parameters

Parameters	Egg Weight (g)	Egg Length (mm)	Egg Width (mm)	Shell Weight (g)	Shell Thickness (mm)
Treatments					
CC (0.0)	50.24^{d}	5.27^{d}	4.07^{c}	5.73^{b}	0.37^{b}
T1 (0.5g)	51.40^{cd}	5.24^{e}	4.11^{bc}	5.84^{b}	0.38^{ab}
T2 (1.0g)	52.51^{c}	5.42^{c}	4.13^{ab}	5.79^{b}	0.38^{ab}
T3 (1.5g)	56.63^{b}	5.83^{b}	4.14^{ab}	5.89^{b}	0.38^{ab}
T4 (2.0g)	58.88^{a}	6.04^{a}	4.18^{a}	6.40^{a}	0.40^{a}

Means within column having different superscript are significantly different ($P<0.05$)

The results for effects of biotin on external egg quality parameters are shown in table 2. The results indicates that there was significant difference ($p<0.05$) among the treatments with treatment 4 (2.0g) showing superior performance.

CONCLUSION AND RECOMMENDATIONS

From the results of this research it was concluded that biotin improved the performance of Noiler hens in all parameters studied. Therefore it is recommended that supplemental biotin should be administered at either 1.5g or 2.0g, further research is also recommended so as to widen the use of biotin in poultry science.

REFERENCES

Ahmadi, F., & Rahimi, F. (2011). Factors affecting quality and quantity of egg production in layers: a review. *World Applied Science Journal*, **12**(3), 372-384

Arends, L. G.; E. W. Kienholz.; J. V. Shultze and D. D Taylor, (1971). Effect of supplemental biotin on reproductive performance of turkey breeder hens and its effect on the subsequent progeny's performance. *Poultry Science*., **50**: 208-214.

Burra, A. (2014). Egg size and shell quality: an overview. Amo Farm Hatchery Ltd Bulletin. www.afshltd.com/egg-size-andshell-quality-an-over-view. Retrieved on 7th April, 2017.

Chen, F.; S. L. Noll and P. E. Waibel, (1994). Dietary biotin and turkey breeder performance. *Poultry Science.,***73**: 682-686.

Frigg M.; J. Broz and F. Streiff (1984). Studies on biotin deposition in hens' eggs. Proc XVII *World's Poultry Congress*, Aug 8-12, Helsinki, Finland.

Huwaida, E. E. M., Ahmed, I. Y. S., Hind, A. A. E., Bakhiet, M. D., & Khalid, M. E. (2015). Effect of Egg Weight and egg Shell Thickness on Hatchability and Embryonic Mortality of Cobb Broiler Breeder Eggs. *Global Journal of Animal Scientific Research*, 3(1), 186-190.

Khan, M., Khatun, M., & Kibria, A. (2004). Study on the quality of eggs of different genotypes of chicken under scavenging system at Bangladesh. *Pakistan Journal of Biological Science*, 7(**12**), 2163-2166.

Kruger, W. F. and B. Brown, (1987). Effect of added biotin, vitamin E and bacitracin on hatch and early chick livability in broiler breeders. *Poultry Science*., **66** (supplementary 1): 129 (Abstract.).

McMahon, R. J., (2002). Biotin in metabolism and molecular biology. *Annual Review of Nutrition.,***22**: 221-239.

Ojedapo, L. O. (2013). Effect of age and season on egg quality traits of Isa Brown layer strain reared in derived Savannah zone of Nigeria. *Transnational Journal of Science & Technology*, **3**(7), 48-60.

Robel, E. J., (1989). Increasing hatchability with biotin Int. *Hatchery Practice***4**: 47-51.

Robel, E. J., (1991). The value of supplemental biotin for increasing hatchability of turkey eggs. *Poultry Science.,***70**: 1716-1722.

Watkins, B. A. and H. F. Kratzer, (1987). Effects of dietary biotin and linoleate on polyunsaturated fatty acids in tissue phospholipids. *Poultry Science.,***66**: 2024-2031.

EFFECTS OF NOILER HEN STRAINS ON YOLK, ALBUMEN AND EXTERNAL EGG QUALITY PARAMETERS

***S.B Atsen., Y.P Mancha & D.J.U Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: atsensamuelbulus@gmail.com mobile No: 08022802930*

ABSTRACT

A study was conducted to determine the effects of Noiler hen strains on yolk, albumen and external egg quality parameters. A total of one hundred and twenty Noiler hens were divided into three treatments at the Bauchi State Agricultural Development Project. The hens were housed in a two tier battery cage, they were further divided into three treatments of forty hens each comprising three strains namely Brown, Black and Spotted. The results obtained from the study shows that strains did not significantly affect ($p<0.05$) yolk lenght, yolk width, youlk height, yolk weight and yolk colour. The results also indicates that ($p<0.05$) there were no significant difference in albumen length, albumen width and albumen height but it was observed that there was significant difference in albumen weight with Black (25.46g) and Spotted (25.40g) performing better than Brown (23.92g). Furthermore the results for external egg quality parameters showed that there was no significant difference ($p<0.05$) among the strains tested, this implies that strains did not affect egg weight, egg lenght, egg width, shell weigth and shell thickness. From the finding of this research it was therefore concluded that the strains studied did not influence yolk quality parameters and external egg quality parameters but significantly influenced albumen weight. It is recomended that either black, spotted or a combination of the two strains should be used by local farmer.

Keywords: Noiler, Strain, Yolk, Albumen

INTRODUCTION

Noiler chicken breed is one of the breeds of poultry birds with with a great prospect, raising Noiler hens is comparatively cheaper than other chickens. The demand for animal protein has globally increased, in the last five years meat consumption has gone up sactifactorily, with Noiler chiken breed, the production of animal protein is cheaper and sustainable. The Noiler chiken is a dual-purpose breed of chicken developed in Nigeria.Noilers are suitable for rural communities and smallholder farmers and can address the challenges of animal food insecurity (justagric.com, 2019). Noiler hens come in different strains such as black, brown, spotted etc, these strains affect the quality of the eggs produced by the hens such as yolk, albumen and external quality parameters which in turn influence the marketability of the eggs and also the quality of chiks obtained from the eggs after hatching. This research was therefore conducted to evaluate the effects of some selected Noiler strains (brown, black and spotted) on yolk, albumen and external egg quality parameters of eggs.

MATERIALS AND METHODS

The study was conducted at the Bauchi State Agricultural Development Project (BSADP) Bauchi State, Nigeria. It lies between latitude 9.30° and 12.3° North of the equator, and Latitude 8.48° and 11° East of the Greenwich meridian. One hundred and twenty Noiler hens were purchased from the bauchi state agricultural development project and housed in two tier battery cages, they were allotted to three treatments in a complete randomized design with each treatment having 40 hens. The research work lasted a period of twelve weeks.

Egg and shell weight

The eggs were collected within four hours of lay and weighted using a digital weighing scale and weights were recorded to the nearest 0.1mm.

Egg lenth And width

The egg lenght and width were measred with a vernier calliper to the nearest 0.1mm.

Egg shell thickness

The thicness of the shell with intact membrane were measured at three different points and the average of the broad, sharp and middle parts of the egg shell were obtained using micro srew guage.

Albumen lenght, width and height

Albumen lenght, width and height were measued using vernier calliper to the nearest 0.1mm.

Yolk lenght, width and height

Yolk lenght, width and height were measued using vernier calliper to the nearest 0.1mm

Yolk colour

Yolk colour was measured using Roche Colour Chart.

Yolk and albumen weight

Yolk and albumen weight were measured using a digital weighing scale

Data analysis

Data obtained were analysed using General Linear Model Precedure of SAS (2015) and significant ($p<0.05$) means differences among treatment means were compared using Duncan's Multiple Range Test (Duncan, 1995) of the SAS package.

RESULTS AND DISCUSSION

Table 1: Effects of strain on yolk quality parameters

Parameters	Yolk Length (mm)	Yolk Width (mm)	Yolk Height (mm)	Yolk Weight (g)	Yolk Colour
Strains					
Brown	4.02[a]	4.01 [a]	1.56 [a]	15.61 [a]	4.59 [a]
Black	4.03 [a]	4.03 [a]	1.59 [a]	15.53 [a]	4.71 [a]
Spotted	4.03 [a]	4.03 [a]	1.56 [a]	15.50 [a]	4.70 [a]

Means within column having different superscript are significantly different ($P<0.05$)

The results for effects of strain on yolk quality parameters is outlined in table 1. The results showed that ($p<0.05$) there was no significant difference in all the parameters tested, this implies that the strains did not influence the out come of yolk lenght, yolk width, youlk height, yolk weight and yolk colour.

Table 2: Effects of strain on albumen quality parameters

Parameters	Albumen Length (mm)	Albumen Width (mm)	Albumen Height (mm)	Albumen Weight (g)
Strains				
Brown	6.80 [a]	4.88 [a]	0.63 [a]	23.92[b]
Black	6.80 [a]	4.92 [a]	0.65 [a]	25.46[a]
Spotted	6.72 [a]	4.82 [a]	0.63 [a]	25.40[a]

Means within column having different superscript are significantly different ($P<0.05$)

The results for effects of strain on albumen quality parameters is outlined in table 2. The results obtained in table two indicates that ($p<0.05$) there were no significant difference in albumen length, albumen width and albumen height but it was also observed that there was significant difference in albumen weight with Black (25.46g) and Spotted (25.40g) performing better than Brown (23.92g).

Table 3: Effects of strain on external egg quality parameters

Parameters	Egg Weight (g)	Egg Length (mm)	Egg Width (mm)	Shell Weight (g)	Shell Thickness (mm)
Strains					
Brown	54.43[a]	5.59[a]	4.12[a]	6.09 [a]	0.38 [a]
Black	53.74[a]	5.56 [a]	4.13 [a]	5.84[a]	0.38 [a]
Spotted	53.31[a]	5.51 [a]	4.12 [a]	5.80[a]	0.38 [a]

Means within column having the same superscript are not significantly different ($P<0.05$)

The results for external egg quality parameters are outlined in table 3. The results indicates that there was no significant difference among the parameters tested, this shows that strains did not affect egg weight, egg lenght, egg width, shell weigth and shell thickness.

CONCLUSION AND RECOMMENDATIONS

From the finding of this research it was therefore concluded that the strains studied did not influence yolk quality parameters and external egg quality parameters but significantly influenced albumen weight. It is recomended that either black, spotted or a combination of the two strains should be used by local farmers.

REFERENCES

Duncan, D.B. (1955). Multiple Range and Multiple F-tests. Biometric, **11**:1-42

Haugh, R. R., (1937). The Haugh unit for measuring egg quality. U.S. Egg Poultry Magazine, **43**: 552-553 and 572-573.

Hosseinzadeh, M.H., Ebrahimnezhad, Y., Janmommadi, H. Ahmadazadeh, A.R. and Sariikhan, M. (2010). Poultry by Product meal: influence on performance and egg quality traits of layers. International journal of Agricultural Biology, **12**: 547-550.

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UNILATERAL TESTICULAR DEGENERATION IN DOGS ADVERSELY AFFECTS SPERMATOZOA CHARACTERISTICS IN THE TESTIS AND EPIDIDYMIS

[1*]Chike F. Oguejiofor, [1]Kenneth O. Anya, [2]Clifford N. Abiaezute, [1]Nnaemeka K. Ogbanya
[1]Department of Veterinary Obstetrics and Reproductive Diseases
[2]Department of Veterinary Anatomy
Faculty of Veterinary Medicine, University of Nigeria, Nsukka
**Corresponding author: E-mail: chike.oguejiofor@unn.edu.ng; Phone: +2348038993103*

ABSTRACT
Testicular degeneration (TD) is associated with poor fertility in affected dogs. The study investigated the specific effects of unilateral testicular degeneration (UTD) on spermatozoal parameters in the testes and epididymides of dogs. Ten sexually mature (7-12 months old) Nigerian indigenous breed of dogs comprising 5 normal dogs (N; both testes normal and present in the scrotum) and 5 dogs with UTD (one normal scrotal testis and one degenerated scrotal testis) were used for the study.The testes and epididymides were removed via orchidectomy and sperm analyses (total and progressive motility, vitality, total abnormalities and concentration) were performed. The samples were grouped as N1 (right normal testis); N2 (left normal testis); UTD-N (normal testis in dogs with UTD); UTD-D (degenerated testis in dogs with UTD). Data were analysed using one-way ANOVA. The UTD-D group had significantly lower ($p<0.001$) epididymal sperm total and progressive motility, vitality and concentration, higher total sperm abnormalities ($p<0.001$) and lower testicular sperm concentration ($p<0.01$) compared to the contralateral UTD-N and the N testes. The UTD-N group also had significantly lower epididymal sperm total motility ($p<0.01$) and progressive motility ($p < 0.05$), and higher total abnormalities ($p<0.05$) compared to the N groups. Our study demonstrated that UTD in dogs adversely affected spermatozoa in the affected testis and epididymis. There was also evidence of compromised spermatozoa in the testis and epididymis contralateral to the degenerated testis. Taken together, these sperm abnormalities are likely to have adverse effect on the fertility of affected dogs.
Keywords: testicular degeneration, sperm characteristics, spermiogram, canine

INTRODUCTION
Dogs are mainly bred for companionship, security and hunting, and to provide valuable source of income for breeders. In addition, the slaughter and consumption of dog meat is popular in many countries worldwide including Nigeria (Podberscek, 2009; Ehimiyein *et al*., 2014). Therefore, infertility is likely to cause significant economic losses in canine breeding.

The testis is the primary organ of reproduction in male animals and functions in spermatogenesis (sperm production) and steroidogenesis (testosterone production). Testicular degeneration (TD) is considered as one of the most common causes of poor semen quality and acquired infertility in male dogs (Fontbonne, 2011; Domingos and Salomão, 2011) with a prevalence of 15-58% in dogs (Ortega-Pacheco *et al.*, 2006; Câmara *et al*., 2014). TD involves deterioration in the structure of the testis with a consequent loss of testicular function (Turner, 2007). It may affect one (unilateral) or both (bilateral) testes, involving parts of the testis or the whole testis. Acute TD can result secondary to a known insult such as exposure of the testes to toxins, radiation, extreme scrotal temperature, scrotal trauma, autoimmune disease, certain nutritional deficiencies, and infection with pathogenic organisms (Turner, 2007; Obi *et al*., 2013). Idiopathic TD has no identifiable underlying cause and has also been reported in dogs (Rehm, 2000; Fontbonne, 2011).

Spermatozoa can be recovered from the cauda epididymides of dogs by percutaneous epididymal aspiration, following castration or at post mortem, for use in the investigation of sperm quality and spermatozoal characteristics (Varesi *et al*, 2013; Chima *et al*., 2017; Bhanmeechao *et al*., 2018) and for artificial breeding of bitches (Wydooghe *et al*., 2016). Ejaculated semen comprises sperm from both testes and also secretions of the accessory sex glands. Thus while evaluation of the ejaculate is used to assess semen for fertility potential, it precludes the investigation of specific effects of testicular disorders and their impact on spermatozoa. Moreover, there is little available information on the effect of TD on epididymal or testicular spermatozoa in dogs. Therefore, the aim of the study was to investigate the specific effects of unilateral testicular degeneration (UTD) on spermatozoal parameters in the testes and epididymides of affected dogs. The specific objectives were to evaluate the effects of UTD on epididymal sperm motility, vitality, morphological abnormalities and concentration, and testicular sperm concentration.

MATERIALS AND METHODS

Animals

Ten sexually mature (7-12 months old) apparently healthy Nigerian indigenous breed of dogs comprising 5 normal dogs (N; both testes normal and present in the scrotum) and 5 dogs with UTD (one normal scrotal testis and one degenerated scrotal testis) were used for the study. Only dogs with a history of progressive unilateral scrotal testicular atrophy were selected and UTD was confirmed retrospectively following testicular histopathology. Animal welfare was observed in accordance with the National Research Council's Guide for the Care and Use of Laboratory Animals (2011) and the protocol was approved by the Research Ethics Committee of the Faculty of Veterinary Medicine (2016/10-173537). Orchidectomy (open castration) was performed following standard surgical procedure as previously described (Hassan and Hassan, 2003) and the testes and epididymides were dissected, and then used for sperm analyses.

Epididymal and testicular sperm analyses

Sperm evaluation was performed as previously described (Seed *et al*., 1996; Cooper, 2010). Sperm motility was determined using the sperm diffusion in phosphate buffered saline (PBS; pH 7.4, 37 °C) from sectioned cauda epididymis. Sperm motility (%) was determined at ×400 using a phase-contrast microscope (Motic B3; Motic, Carlsbad, CA, USA) equipped with a stage slide warmer (TCS-100; Amscope, Ivrine, CA, USA) set at 37 °C. Sperm vitality (%) was evaluated using eosin-nigrosin vital staining method. Sperm morphological abnormalities were evaluated using eosin-nigrosin staining and phase-contrast microscopy. All values in percentage were determined by examining 200 sperm cells in duplicates. Cauda epididymal and testicular sperm concentrations were determined following cauda epididymal/testicular tissue homogenization in PBS and sperm cells were counted using a haemocytometer (Weber, England). Total sperm count was expressed as number of sperm per gram cauda epididymis and per gram testis, respectively.

Data analysis

Data were analyzed using One-way analysis of variance (ANOVA) built in SPSS, version 20 (IBM Corp, Armonk, NY, USA). Significant differences between means were confirmed using Tukey's honestly significant difference post hoc test. Results were considered significant when $p < 0.05$.

RESULTS

The results of the sperm analysis in normal dogs and dogs with UTD are shown in Table 1. There were no significant differences ($p > 0.05$) in all the spermiogram parameters between the two normal testes (N1 and N2) in the normal dogs. Both N groups also did not differ from the normal testes (UTD-N) in dogs with UTD with respect to epididymal sperm vitality and concentration and testicular sperm concentration. However, UTD-N group had significantly lower epididymal sperm total motility ($p < 0.01$) and progressive motility ($p < 0.05$) and higher total abnormalities ($p < 0.05$) compared to the N groups. The predominant sperm abnormalities observed included presence of cytoplasmic droplets, bent tails and coiled tails. On the other hand, there were significant differences in all the spermiogram parameters in the degenerated testes (UTD-D) when compared to the contralateral normal testes (UTD-N) in dogs with UTD and also when compared to the two normal testes (N1 and N2) in the normal dogs. The UTD-D group had significantly lower epididymal sperm total and progressive motility, vitality and concentration ($p < 0.001$) and higher total abnormalities ($p < 0.001$) compared to the contralateral UTD-N and the N testes. The predominant sperm abnormalities observed included presence of detached head, bent midpiece, coiled midpiece (dag defect) and coiled tails. Moreover, testicular sperm concentration was significantly decreased in the UTD-D testes when compared to the contralateral UTD-N testes ($p < 0.01$) and the N testes in normal dogs ($p < 0.001$).

Table 1. Epididymal and testicular spermatozoal parameters in dogs with normal testes and unilateral testicular degeneration

Sperm parameters	N1	N2	UTD-N	UTD-D
Epididymal sperm total motility (%)	83.6 ± 2.7^a	84.8 ± 3.0^a	71.2 ± 5.8^b	8.4 ± 5.1^c
Epididymal sperm progressive motility (%)	74.4 ± 4.7^a	71.2 ± 5.0^a	60.2 ± 7.8^b	3.6 ± 4.2^c
Epididymal sperm vitality (%)	94.6 ± 2.3^a	94.2 ± 2.8^a	87.6 ± 4.8^a	27.2 ± 8.3^b
Epididymal sperm total abnormalities (%)	28.0 ± 2.7^a	27.2 ± 3.1^a	39.0 ± 3.2^b	66.4 ± 8.7^c
Epididymal sperm concentration ($x10^6$/g epididymis)	926.0 ± 23.9^a	912.4 ± 19.1^a	874.0 ± 78.7^a	3.29 ± 2.1^b
Testicular sperm concentration ($x10^6$/g testis)	31.6 ± 5.7^a	29.3 ± 4.8^a	23.2 ± 9.3^a	5.81 ± 2.9^b

N1 (right normal testis); N2 (left normal testis); UTD-N (normal testis in dogs with UTD); UTD-D (degenerated testis in dogs with UTD). Values represent mean ± SD. Rows with different superscripts indicate significant differences ($p < 0.05$).

DISCUSSION

The study provided evidence that UTD adversely affected spermatozoa parameters in the testes and epididymides of dogs. UTD decreased epididymal sperm total and progressive motility. A low % of progressively motile sperm has also been reported in the semen of stallions with TD (Blanchard *et al*., 2000). Decreased sperm motility may be related to abnormal sperm formation and the observed increase in dead sperm and sperm with morphologic abnormalities. There was also increased % of dead epididymal sperm (decreased sperm vitality) in dogs with UTD. This may be related to a disruption of the normal processes in spermatogenesis and sperm epididymal maturation consequent upon the testicular insult. A significantly higher percentage of morphologically abnormal sperm was observed herein in the dogs with UTD. Câmara *et al*. (2014) similarly reported high sperm abnormality in dogs with severe TD. Interestingly, our study observed a higher % of sperm total abnormalities in dogs with UTD compared to the previous study. This may be due to differences in the source of sperm sample. Herein, sperm was harvested from the cauda epididymis whereas the previous study utilized sperm from the vas deferens. In addition, a higher % of detached head, bent midpiece and dag defect were observed in the UTD-D group, which are known to have significant negative effect on fertility (Kolster, 2018).

In this study, TD also decreased the testicular and epididymal sperm concentration. This may be a consequence of atrophy of the testicular parenchyma, degeneration of seminiferous tubules and decreased spermatogenesis (spermatogenic arrest). Since the cauda epididymis is site of sperm storage, the lowered epididymal sperm concentration may reflect a decrease in sperm production in the testis. Similarly, there was lowered daily sperm production per milliliter of testis and decreased sperm concentration in stallions with TD (Blanchard *et al*., 2001). Azoospermia has also been reported in the semen and vas deferens fluid of dogs with TD (Fontbonne, 2011; Câmara *et al*., 2014). Moreover, the findings suggest that TD in one testis can impair spermatozoa in the contralateral testis and epididymis. However, the mechanism for this effect (whether direct or indirect) was unclear due to the unknown underlying aetiology of UTD in the affected dogs. Some spermatozoal parameters (vitality and concentration) were not significantly different between the testes in normal dogs and the contralateral testes in UTD dogs. However, it is likely that the overall fertility outcome in dogs with UTD will depend on the progression and severity of TD. Taken together, lowered epididymal sperm motility, vitality and concentration, increased epididymal sperm abnormalities, and decreased testicular sperm concentration can have adverse effect on the fertility of affected dogs (Johnston *et al*., 2001; Robert *et al*., 2016; Kolster, 2018).

In summary, our study demonstrated that UTD in dogs adversely affected spermatozoa in the testis and epididymis and also showed evidence of compromised spermatozoa in the contralateral testis and epididymis. Our findings provide more information on alterations in sperm quality in relation to UTD. Although sperm cells may be recovered from the cauda epididymides of affected dogs for application in assisted reproductive technologies, further studies could investigate the functional capacity and fertilizing potential of such recovered spermatozoa.

REFERENCES

Podberscek, A.L. 2009. Good to pet and eat: the keeping and consuming of dogs and cats in South Korea. *J Soc. Issues*. 65: 615-632.

Bhanmeechao, C., Srisuwatanasagul, S., Prapaiwan, N., Ponglowhapan, S. 2018. Reproductive aging in male dogs: the epididymal sperm defects and expression of androgen receptor in reproductive tissues. *Theriogenology.*108: 74-80.

Blanchard, T., Johnson, L., Roser, A.J. 2000. Increased germ cell loss rates and poor semen quality in stallions with idiopathic testicular degeneration. *J Equine Vet. Sci.* 20: 263-265.

Blanchard, T.L., Johnson, L., Varner, D.D., Rigby, S.L., Brinsko, S.P., Love, C.C., Miller, C. 2001. Low daily sperm output per ml of testis as a diagnostic criteria for testicular degeneration in stallions. *J Equine Vet. Sci*. 21: 11, 33-35.

Câmara, L.B.R.M., Câmara, D.R., Maiorino, F.C., Silva Júnior, V.A., Guerra, M.M.P. 2014. Canine testicular disorders and their influence on sperm morphology. *Anim. Reprod*. 11: 32-36

Chima, U., Abu, A., Dawuda, P., Kisani, A., Ahemen, T. 2017. Effect of storage time on cauda epididymal sperm parameters of Nigerian local dogs. *Open J Vet. Med*. **7:** 151-161.

Cooper, T.G. Editor. WHO laboratory manual for the examination and processing of human semen. 5th edn. World Health Organization Geneva, Switzerland: WHO Press; 2010.

Domingos, T.C.S., Salomão, M.C. 2011. Diagnostic tools of testicular disorders in dogs: review. *Rev. Bras. Reprod. Anim*. 35: 393-399.

Ehimiyein, A., Audu, S., Ehimiyein, I. 2014. The role of dog trading and slaughter for meat in rabies epidemiology with special reference to Nigeria- a review. *J Exp. Biol. Agric. Sci*. 2: 130-136.

Fontbonne, A. 2011. Infertility in male dogs: recent advances. *Rev. Bras. Reprod. Anim*. 35: 266-273.

Hassan, A.Z., Hassan, F.B. 2003. An introduction to veterinary practice. Zaria, Nigeria: Ahmadu Bello University Press Ltd. p. 288.

Johnston, S.D., Kustritz, M.V.R., Olson, P.N.S. Semen collection, evaluation, and preservation. In: Johnston SD, Kustritz MVR, Olson PNS, editors.Canine and FelineTheriogenology, 1st edn. Philadelphia: W.B. Saunders; 2001. p. 287-306.

Kolster, K.A. 2018. Evaluation of Canine Sperm and Management of Semen Disorders.*Vet Clin Small Anim*. 48: 533-545.

National Research Council: Institute for Laboratory Animal Research. The guide for the care and use of laboratory animals. 8th ed. Washington DC: The National Academies Press; 2011.

Obi, C.F., Obidike, R.I., Ezeh, I.O., Omoja, V.U., Iheagwam, C.N., Idika, I.K., Ezeokonkwo, R.C. 2013. Effects of Trypanosoma brucei infection and diminazene aceturate therapy on testicular morphology and function of Nigerian local dogs. *Vet. Parasitol*. 196: 283-288.

Ortega-Pacheco, A., Rodríguez-Buenfil, J.C., Segura-Correa, J.C., Bolio-Gonzalez, M.E., Jiménez-Coello, M., Linde Fosberg, C. 2006. Pathological conditions of the reproductive organs of male stray dogs in the tropics: prevalence, risk factors, morphological findings and testosterone concentration. *Reprod. Domest. Anim.* 41: 429-437.

Rehm, S. 2000. Spontaneous testicular lesions in purpose-bred Beagle dogs. *Toxicol. Pathol*. 28: 782-787.

Robert, M.A., Jayaprakash, G., Pawshe, M., Tamilmani, T., Sathiyabarathi, M. 2016. Collection and evaluation of canine semen- a review. *Int. J Sci. Environ. Tech*. 5: 1586-95.

Seed, J., Chapin, R.E., Clegg, E.D., Dostal, L.A., Foote, R.H., Hurtt, M.E. 1996. Methods for assessing sperm motility, morphology, and counts in the rat, rabbit, and dog: A consensus report. *Reprod Toxicol*. 10: 237-44.

Turner, R.M.O. 2007. Pathogenesis, diagnosis, and management of testicular degeneration in stallions. *Clin. Tech. Equine Pract*. 6: 278-284.

Varesi, S., Vernocchi, V., Faustini, M., Luvoni, G.C. 2013. Quality of canine spermatozoa retrieved by percutaneous epididymal sperm aspiration. *J Small Anim. Pract*. 54: 87-91.

Wydooghe, E., Snoeck, F., Van Soom, A. 2016. Establishment of live birth following intravaginal artificial insemination with chilled epididymal dog semen collected post mortem: case report. Proceedings of the International Symposium on Canine and Feline Reproduction (ISCFR), June 2016, Paris, France. p. 231.

BREED AND SEX INFLUENCE ON BODY CONDITION SCORE (BCS) OF SHEEP

Dafur, B. S*., Mbap, S. T., Ibrahim, T+. & Mancha, Y. P+
*Department of Animal Production, University of Jos
+Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
***Corresponding author**: bdafur70@gmail.com, 08036085311*

ABSTRACT
This study was conducted to assess the effect of breed and sex on body condition score (BCS) of some sheep raised at Federal College of Education, Pankshin Research Farm in Plateau state. The BCS data were obtained from two hundred and twenty (220) sheep comprising 46 Balami (26 females: 20 males), 44 Uda (21 females: 23 males), 63 WAD (33 females: 30 males) and 67 Yankasa (32 females: 35 males) at the age of 1 year based on the BCS scale of 0 - 5. Data were analyzed with statistical package for social science version 22.0. Results indicated that WAD and Yankasa had higher ($p<0.05$) BCS than Balami and Uda, while males were superior ($p<0.05$) to females. It is concluded that breed and sex influence BCS of sheep.
Keywords: Sheep, Breed, Sex, BCS, Nigeria

INTRODUCTION
Body condition score (BCS), an estimate of the muscle and fat cover of an animal by palpation of different regions of the body, was originally described by Jefferies (1961) in Scotland sheep. It consists of a scale of six scores, from 0 to 5, based on the concept that subjectively assessed condition score is closely related to the amount of chemically determined fat in sheep (Russel *et al.,* 1969). It is an estimate of body reserves (Edea, 2008). The BCS method has been applied on various sheep breeds such as Avagonesa (Purroy, 1997), Bermagasia (Susmel *et al.,* 1995), Awassi (Treacher and Filo, 1995), Sarda (Ligios *et al.,* 1995) and Lacaune (Bocquier *et al.,* 1999). Body condition scores have been widely adopted for managing the nutrition of flock, especially on grazing, and for selecting lambs for purchase and slaughter (Jalilian and Moeini, 2007). In most studies, BCS provides a better prediction of body composition than live weight (Russel *et al.,* 1969; Sanson *et al.,* 1993).
Stockmen in several countries usually appraise animal condition in verbal terms such as "fair, bad, good, lean, fat" which are often ambiguous (Woldemariam, 2005). Over the years, several attempts have been made to formalize body condition scores using numerical values. A system based on six points scale was described by Boden (1991).Russel *et al.* (1969) showed that subjective body condition scores were closely related to the amount of chemically determined fat in sheep and could provide acceptable and useful means of estimating the proportion of fat in the body. In recent years, the system has been improved with better guidelines. According to Boden (1991);

i. An assessment is made of the prominence (the degree of sharpness or roundness) of the spinous process of the lumbar vertebrae.
ii. The prominence and the degree of fat cover of the transverse process of the vertebrae were also assessed.
iii. The extent of the muscular and fatty tissues below the transverse process were judged by the ease with which the fingers pass under the ends of the bones.
iv. The fullness of the muscle area and degree of fat cover in the angle between the spinous and transverse process estimated.

The purpose of this study is to determine the effect of breed and sex on body condition score of some Nigerian sheep.

MATERIALS AND METHOD
Location and climate
The research was carried out in Pankshin town, Jos Plateau. The Jos Plateau has been described by PADP (2000), WWF (2001) and Plateau State Government Organization (2004). It is a pear-shaped upland located in the middle of Nigeria between latitude $8^{o}$and 10^{0}north and longitudes 7^{0} and 11^{0} east, at an average attitude of 1,200m above sea level and reaches the highest peak in the Shere Hills where it stands at 1,766m.

Sheep used and management

The study sheep comprised 220 sheep (46 Balami, 44 Uda, 63 West African Dwarf sheep and 67 Yankasa) reared at Federal College of Education, Pankshin Research Farm. sheep were managed under the traditional free-range in the dry season. In the rainy season when arable crops were growing, animals were kept under semi-intensive management. Under this system, sheep were taken out for grazing by a shepherd from late morning till evening. Sometimes supplementary feeds (hay and household waste) were fed.

Body condition scores

The body condition scores (BCS) were assessed by combining palpation of the sheep in the lumber region and around the backbone in the loin area immediately behind the last rib, as suggested by Boden (1991) and the guidelines (Figure 1). The scores used in the study were 1.0, 2.0, 3.0, 4.0 and 5.0 for emaciated, thin, average, fat and obese respectively. Cases which did not fit these categories properly, i.e fell between whole numbers were assigned half scores as recommended by Thompson and Meyer (1994) and additional scores of 1.5, 2.5 and 3.5 were therefore used.

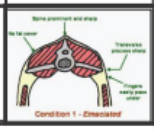
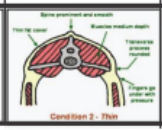
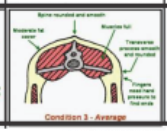
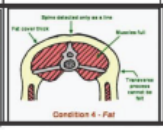
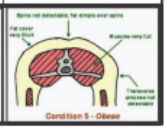
Spines	Individually clearly felt, sharp, obvious	Forms a smooth line with smooth undulations	Only slightly detectable undulations	Only detectable with firm pressure	Not detectable
Transverse Process	Fingers easily pass underneath	Smooth round edges	Well covered, have to push firmly to get fingers underneath	Cannot be felt at all	
Muscle	Very little concave	Concave	Not concave, Not convex	Minimally developed convex	
Fat Layer	No	Very thin	Moderate	Thick	very thick to form a dp along top midline
Condition score					

Figure 1: Body condition scoring of sheep Source: Woldemariam, 2005.

Statistical analysis

Data generated were analyzed using the General Linear Model (GLM) of SPSS (Statistical Packages for Social Sciences, 2013) version 22.0, differences between breed and sex in BCS were determined. Ryan-Einot-Gabriel-Welsch post hoc-test was performed to separate means of breeds that were statistically different. The final model used is as follows

$$Y_{ij} = \mu + B_i + S_j + E_{ij}$$

Where:

Y_{ij} = individual observation on the animal for the ith breed and j^{th} sex

μ=overall mean

B_i=effect of the ith breed (i=1,2,3,4)

S_j = effect of the jth sex (j=1,2)

$$E_{IJ} = random\ error$$

RESULTS AND DISCUSSION

Table 1 shows BCS of sheep by breed and sex. Breed had significant ($p<0.01$) effect on BCS. West African Dwarf Sheep (WAD) and Yankasa with respective mean BCS of 3.21 and 3.20 did not significantly differ but were superior to Balami and Uda which had BCS of 2.67 and 2.79, respectively. However, Balami and Uda did not differ in BCS. Male sheep had mean BCS of 3.56 which was significantly ($p<0.01$) higher than the 2.56 in females.

In the present study, WAD and Yankasa had higher BCS's than the larger breeds (Uda and Balami). This is similar to some previous reports. Edea (2008) recorded higher BCS (3.23) in Horro than (2.71) in Bonga. Frutos *et al*. (1995) found higher internal fats and BCS in Churra than Merino. They further stated that the distribution of internal fat varied between the two breeds; the Churra breed had higher omental but lower mesenteric fat. Similarly, in a comparison between Sarda and Lacaune breeds to using BCS scores between 1 and 3.5, Ronchi *et al.* (1993) found that 60% of the former had BCS higher than 2.3 while only 40% of the latter had values higher than 2.3. Gizau *et al.* (2013) found higher overall mean BCS (2.04±0.04) in Afar than Menz breed (1.9±0.03). Laxta breed had also been found to have lower BCS (2.66) than Gallega (2.76) (Osoro *et al.,* 2002). Olthoff and Dickerson (1989) asserted that genetic differences exist in distribution of body scores in sheep. Purroy (1997) also observed that the range of BCS variation depends on the breed, due to difference in skeletal proportion, rating among muscle and fat and, the type of deposits.

In the present study, male sheep had higher BCS than female. This corroborates the report of Gizau *et al.* (2013) in each of Afar and Menz breeds. However, Ma'aruf *et al.* (2018) reported non-significant effect of sex on BCS of Yankasa sheep in Kano. The higher BCS in WAD and Yankasa despite higher than Uda and Balami, is an indication that these breeds are better adapted to the environment.

CONCLUSION

It is concluded that West African Dwarf and Yankasa sheep have similar BCS which were higher than those of Balami and Uda sheep. Male sheep have higher BCS than females.

Table 1: Body condition scores of sheep by breed and sex

	Body condition score **Means ± standard error**
Breed	
Balami	2.67 ± 1.73^{a}
Uda	2.79 ± 1.69^{a}
WAD	$3.21+1.23^{b}$
Yankasa	3.20 ± 1.41^{b}
Sex	
Male	3.56 ± 1.20^{a}
Female	2.56 ± 1.62^{b}

Means in the same column with different superscripts differ significantly, ($p<0.01$)

REFERENCES

Bocquier, F., Guillouet, P., Barillet, F., and Chilliard, Y. (1999). Comparison of three methods for the in vivo estimation of body composition in dairy ewes. *Annales de Zootechnie***48**: 297-308.

Boden, E. (1991). *Sheep and Goat Practice*. Bailliere Tindall, Philadelphia.

Edea, Z. (2008). Characterization of Bonga and Horro Indigenous sheep breeds of small holders for designing community based breeding strategies in Ehiopia. Msc Thesis, Haramaya University.

Frutos, P., Mantecon, A. R., Revesado, P. R., Gonzalez, J. S. (1995). Body fat depots and body condition score relationship: a comparison of two Spanish sheep breed (Churra vs Merina). *Options Mediterraneennes-Series Seminaires*, **27**: 19-23

Gizau, S., Gatachew, T., Edea, Z., Mirkena, T., Duguma, G., Tibbo Rischkowsky, B., Mwal, O., Dessie, T., Wurzinga, M., Solkner, J. and Haile, A. (2013). Characterization of indigenous breeding strategies of the sheep farming communities of Ethiopia: A basis for a community based breeding program. *INCARD working paper,* Aleppo, Syria. 47p.

Jalilian, M. T. and Moeini, M. M. (2007). The effect of body condition score of Morghoz goats on reproductive parameters were studied. 5th congress of Animal Science Association, Isfehan University, 1-3 September. (Abstract book).

Jefferies, B. C (1961). Body Condition Scoring and its use in Management. *Tasmanian Journal of Agriculture,***32**: 19-21.

Ligios, S., Molle, G., Casu, S., and Nuvoli, G. (1995). Validation de la méthode de l' eau lourde pour estimer la composition corporelle des brebis au pâturage. *Options Méditerranéennes. Série A: séminaires méditerranéennes. Numero***27**: 75-84.

Ma'aruf, B.S., Ibrahim, I., Umar, H.A., Shuaibu, A. and Okoh, J.J. (2018). Effect of age and sex and body weight, body condition score and biometrics traits of Yankasa sheep. Nigerian Journal of Science and Technology, 1(2): 39-46

Olthoff, J. C., and Dickerson, G. E. (1989). Composition of the whole body fractions in mature ewes from seven breeds. *Journal of Animal Science*, **67**: 2565-2575.

Osoro, K., Martinez, A. and Celaya, R. (2002). Effect of breed and sward height in sheep performance and production per hectare during the spring and autumn in Northern Spain. *Grass and forage Science*, **57**: 137-146.

PADP. (2000). Plateau Agricultural Development Programme. HouseJournal, p13.

Plateau State Government Organisation (2004). Visit Plateau. Plateau state Gov. org. 2pp

Purroy, U. A. (1997). Metodo de la nota de la condicion corporal (Universidad Publica de Navarra, Pamplona. Escuela Tecnica Superior de Ingenieros Agronomos).

Ronchi, B., Bernabucci, U., and Bertoni, G. (1993). Valutazione comparata del metodo body condition score (BCS) nelle razze ovine Sarda e Lacune. *Proc. XLVII congress S.I.S.VET (Italy)***88**: 1985-1989.

Russel, A. J. F., Doney, J. M. and Gunn, R. G. (1969). Subjective assessment of fat in live sheep. *Journal of Agricultural Science*, **72**: 451-454.

Russel, A. J. F., Doney, J. M. and Gunn, R. G. (1969). Subjective assessment of fat in live sheep. *Journal of Agricultural Science*, **72**: 451-454.

Sanson, D. W., West, T. R., Tatman, W. R., Riley, M. L., Judkins, M. B., and Moss, G. E. (1993). Relationship of body composition of mature ewes with condition score and body weight. *Journal of Animal Science*, **71**:1112-1116

Susmel, P., Canavese, B., Filacorda, S., and Piasentier, E. 1995. Prediction of body fat in lactating ewes using the diameter of subcutaneous adipocyte cells or body condition score. *Options Méditerranéennes-Série Séminaires,***27**: 59-66.

Thompson, J. and Meyer, H. I. (1994). Body condition scoring of sheep. Oregon State University Extension Service, U.S.A.

Treacher, T. T., and Filo, S. 1995. Relationship between fat depots and body condition score or live weight in Awassi ewes. *Options Méditerranéennes-Série Séminaires,***27**: 13-17.

Woldemariam, D. L. (2005). Nematode prevalence, helminths management practices and anthelmintic resistance in small ruminants in the mid-rift valley of Ethiopia. Doctoral Thesis, University of Pretoria.

World Wildlife Fund (WWF) (2001). Plateau forest Grassland Mosaic (AT1010). World Wildlife Fund Scientific Report. 2 pp.

HAEMOGLOBIN GENOTYPE OF SOME NIGERIAN SHEEP

Dafur, B. S[*]., Mbap, S. T., Ibrahim, T[+]. , Mancha, Y. P[+] & Okoh, J. J[#].
[*]*Department of Animal Production, University of Jos, Plateau State*
[+]*Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi State*
[#]*Department of Animal Sciece, Federal University, Kashere, Gombe State*
***Corresponding author**: bdafur70@gmail.com, 08036085311*

ABSTRACT
This study investigated the haemoglobin genotype of Nigerian sheep. Two hundred animals comprising 46 Balami (20 males vs 26 females), 44 Uda (23 males vs 21 females), 63 West African Dwarf (30 males vs 33 females) and 67 Yankasa (35 males vs 32 females) reared at the Teaching and Research Farm of Federal College of Education, Pankshin were used for this study. Five millilitres of blood was obtained from each animals by jugular venipuncture and dispensed into bottles containing Ethylene Diamine Tetra Acetic Acid and analysed using cellulose acetate paper electrophoresis. Only a single band was observed and designated as AA based on the comparison with existing control giving rise to HbAA genotype and HbA gene frequency of 1.0 each. It is concluded that all the sheep breeds studied were homozygous for haemoglobin allele Hb A. The haemoglobin phenotype could therefore not be used as basis for selection.
Keywords: Sheep, breed, sex, haemoglobin, genotype

INTRODUCTION
Haemoglobin polymorphism in sheep was first described in 1955 (Cabannes and Serain, 1955; Harris and Warren, 1955). The characteristics of blood groups and biochemical polymorphism of blood protein in farm animals have been attracting geneticists interest in obtaining data for analysing genetic differences between gene pools (Darcan and Guney, 2001). Subsequent studies of Tucker (1971) and Agar *et al.* (1972) confirmed the different variants. Electrophoretic study of sheep haemoglobin showed that there are three main genotypes; HbAA, HbBB and HbAB (Miresan, 2003; Tapio *et al.*, 2003: Salako *et al*., 2007; Akinyemi, 2010). Haemoglobin types are genetically determined in a simple Mendelian manner, none being dominant (Evans *et al.,* 1958).
The alleles vary with breed (Harris and Warren, 1955; Evans *et al.,* 1958; Stormont *et al*., 1968). The Hb C appeared in anaemic sheep (Van Vliet and Huisman, 1964). A fourth allele, Hb D with electrophoretic mobility faster than Hb A, B and C was found to be characteristic of some Yugoslavian sheep (Vaskov and Efremov. 1967). Specific foetal haemoglobins, designated as Hb F have also been identified (Helm *et al*., 1958).
Akinyemi (2010) obtained a high frequency of Hb A in populations of Balami, Uda and Yankasa reared in the Northern Guinea Savannah zone of Nigeria, while Salako *et al*. (2007) reported a higher value of HbB in population of West African Dwarf sheep at low altitude in South-West Nigeria.
The discovery of genetic polymorphism demonstrated by proteins that differ electrophoretically furnishes information for the study of the genetics of the organism at all levels, i. e. molecular, cellular, or the entire organism. The knowledge obtained from the determination of genetic polymorphism from protein differences permits the study of protein evolution and thus the evolution of the organism. Qualitative genetic traits enable man to examine the effects of breeding systems on the frequencies of alleles where inbreeding and selection are practiced. It is assumed that the genes for quantitative traits behave in the same manner as the qualitative genes and thereby allow a monitoring of the shifts in gene frequencies of all genes where various breeding systems are used. The discovery of a qualitative gene trait that may serve as a genetic marker for a desirable combination of quantitative genes which will make for better animal production is possible as well as desirable. The objective of this study is to validate or otherwise previous findings (Salako *et al.,* 2007; Agaviezor *et al.*, 2013; Dafur *et al*., 2019) on Nigerian sheep haemoglobin as demonstrated by electrophorentic pattern. Study like this may not only add to store of knowledge but may provoke further studies on sheep selection and breeding.

MATERIALS AND METHOD

Location and climate

The research was carried out in Pankshin town (Figure 9), Jos Plateau. The Jos Plateau has been described by PADP (2000), WWF (2001) and Plateau State Government Organization (2004). It is a pear-shaped upland located in the middle of Nigeria between latitude $8^{o}$and 10^{0}north and longitudes 7^{0} and 11^{0} east, at an average attitude of 1,200m above sea level and reaches the highest peak in the Shere Hills where it stands at 1,766m.

Sheep used and management

The study sheep comprised 220 sheep (46 Balami, 44 Uda, 63 West African Dwarf sheep and 67 Yankasa) reared at Federal College of Education, Pankshin Research Farm. sheep were managed under the traditional free-range in the dry season. In the rainy season when arable crops were growing, animals were kept under semi-intensive management. Under this system, sheep were taken out for grazing by a shepherd from late morning till evening. Sometimes supplementary feeds (hay and household waste) were fed. In both systems, extensive and semi-intensive, no specialized form of housing was provided but their owner's compound or homestead and veterinary care was generally not provided.

Blood sample collection and analysis

Blood (5ml) was collected from each sheep by jugular venipuncture and dispensed into each of the sample bottles with ethylene diamine tetra-acetic acid (EDTA) for electrophoresis to determine haemoglobin genotype. Electrophoresis was carried out at the Central diagnostic laboratory of NVRI Vom. Two millilitres of blood sample were placed into a clean test tube, 5ml of cold saline was added and the diluents centrifuged at 4000 rpm for 10 – 15 minutes. The supernatant was discarded and the sample washed again three times. The sediment was re-suspended using 2ml of cold distilled water. When the lysate was well separated after standing, it was stored at refrigeration temperature until electrophoresis. The red cell lysate was then impregnated on a cellulose acetate paper which was placed in the electrophoresis tank using forceps and subjected to electrophoresis according to standard procedure described by Evans (1971). The tank was powered with the lid closed and sampled allowed to separate for about 10 – 15 minutes. The identification of the haemoglobin type was achieved by the position of bands along the electrophoretic substratum using Ponceau-S which was later washed with glacial acetic acid.

Data Analysis

Because only one allele (A) was detected, the haemoglobin genotype and gene frequencies was estimated thus; the genotype frequency AA = number of AA/total number x 100, while gene frequency = number of AA x 2/100.

RESULTS AND DISCUSSION

Table 1 depicts the genotype and gene frequency of sheep by breed and sex. At electrophoresis, only a single band was observed and designated as AA by comparison with existing control. This implied that all the sheep breeds (Balami, Uda, West African Dwarf and Yankasa) studied were homozygous for haemoglobin allele HbA. This gave rise to Hb AA genotype and HbA gene frequency of 1.0 each.

Only HbAA genotype was observed in sheep used for this study. This is in agreement with the report of Chuku and Uwakwe (2012) who also found only HbAA genotype in sheep in Port Harcourt, Nigeria and Dafur *et al.* (2019) who similarly reported only the Hb AA in all sheep breeds on the Jos Plateau. However, these findings contradict that of Salako *et al* (2007) who showed that HbBB predominates followed by HbAA and HbAB in both male and female sheep. The existence of only HbAA in this study could be an adaptive survivability feature. Different genotypes have been reported to exhibit selective advantages in different geographical regions (Ndamukong, 1995). This might have led to the fixation of HbAA in sheep of present study. FAO (1988) reported that carriers of HbAA demonstrated significant resistance against helminth infections. According to Distasio (1997), this could be due to better functional properties such as greater affinity to oxygen, higher Hb concentration and packed cell volume. Conversely, Mwacharo *et al.* (2002) found HbBB alleles fixed in Kwale, Makueni and Siaya sheep breeds of Kenya. Agaviezor *et al.* (2013) stated that there is indication that vegetation or climate changes affect Hb type. With homozygosity at the Hb locus, selection for improvement cannot be based on sheep genotype.

Table 1: Haemoglobin types and gene frequencies of four Nigerian Sheep Breed

Breed	N	Genotype frequency			Gene frequency	
		AA	AB	BB	A	B
Balami	46	46(1.00)	0(0)	0(0)	92(1.00)	0(0)
Female	26	26(1.00)	0(0)	0(0)	52(1.00)	0(0)
Male	20	20(1.00)	0(0)	0(0)	40 (1.00)	0(0)
Uda	44	44(1.00)	0(0)	0(0)	88(1.00)	0(0)
Female	21	21(1.00)	0(0)	0(0)	42(1.00)	0(0)
Male	23	23(1.00)	0(0)	0(0)	46(1.00)	0(0)
West African Dwarf	63	63(1.00)	0(0)	0(0)	126(1.00)	0(0)
Female	33	33(1.00)	0(0)	0(0)	66(1.00)	0(0)
Male	30	30(1.00)	0(0)	0(0)	60(1.00)	0(0)
Yankasa	67	67(1.00)	0(0)	0(0)	134(1.00)	0(0)
Female	32	22(1.00)	0(0)	0(0)	44(1.00)	0(0)
Male	35	35(1.00)	0(0)	0(0)	70(1.00)	0(0)

CONCLUSION AND APPLICATIONS

It is concluded that on the Hb AA genotype is exhibited in the Nigerian sheep used for the study, therefore, haemoglobin genotype cannot be used as the basis for selection of sheep for improvement.

REFERENCES

Akinyemi, M. O. (2010). Morphological and biochemical diversity in Balami, Uda and Yankasa sheep of Nigeria. Unpublished Ph.D Thesis, Faculty of Agriculture and Forestry, University of Ibadan, Nigeria. 174pp.

Agar, N. S., Evans, J. V. and Robert, J. (1972). Red blood cell potassium and haemoglobin polymorphism in sheep. A review. *Animal Breeding Abstracts,40: 407-436.*

Agaviezor, B. O., Gunn, H. H., Amusan, S. A. and Imumorin, I. G. (2013). Gene flow in Nigerian Sheep breeds as revealed by microsatellite DNA markers. *Journal of Animal Production Advances*,**3** (2): 35-39.

Cabannes, R. and Serain, C. (1955). Etude electrophoretique des hemoglobines des maniferes domestique d'Algerie. *Comptes Rendus des Séances et Mémoires dela Société de Biologie*(Paris), **149**: 1193.

Chuku, L. C. and Uwakwe, A. A. (2012). Analysis of M. and Rognoni, G. (1980) Immunogenetic and population hematological and biochemical parameters, to study the genetic analyses of Iberian cattle. Animal Blood Groups ecological relationship on selected species of vertebrates biochemistry and genetics. *Indian Journal of Drugs Dispensary*, **1**(9): 208 -212.11: 21-38.

Dafur, B.S., Dafur, G.S. and Anwo, O.J. (2019). Haemoglobin polymorphism in Nigerian breeds of sheep. *Nigerian Journal of Animal Science,* 21(1): 30-36

Darcan, N. and Guney, K. (2001). Effect of Haemoglobin and transferring polymorphism on the performance of Awasi and crossbred ewes under tropic environment. *Journal of Applied Animal Research*, 19:187-192

Distasio, L.(1997)**.** Biochemical genetics. **In**: **Genetics of sheep**. Piper, L. and Runvisky, A. (Eds.). Oxon, CAB International. Pp.133-48.

Evans, D. I. (1971). Haemoglobin electrophorensis on cellulose acetate using whole blood samples. *Journal of Clinical Pathology*, **24**: (9): 877-878.

Evans, J. V., Harris, H. and Warren, F. L. (1958). The distribution of haemoglobin and blood potassium type in British breeds of sheep. *Proceedings of Royal Society London*, **149**: 249-262.

FAO(1988)**.***Animal genetic resources conservation by management, data banks and Training.* FAO Animal production and health paper 44/1. Rome. P.186.

Harris, H. And Warren, F. L. (1955). Occurence of electrophoretically distinct haemoglobins in ruminants. *Biochemical Journal*, **60**: 29-34.

Helm, H. J., va der Vliet, G. V. and Huisman, T. H. J. (1958). Some investigations dealing with animal haemoglobins. *Clinca Chimica Acta*, **3**: 114-119.

Mireşan, V. (2003). Evolution of the main blood indices in Tsigai fattening sheep. *Journal of Central European Agriculture (Online)*, **4**(4): 405-410.

Mwacharo, J. M., Otieno, C. J. and Okeyo, A. M. (2002). Genetic variations between indigenous fat-tailed sheep populations in Kenya. *Small Ruminant Research*, **44**: 173–178.

Ndamukong, K. J. N. (1995). Haemoglobin polymorphism in grassland dwarf sheep and goats of the north west province of Cameroon. *Bulletin of Animal Health and Production in Africa, **43**: 53-56*

Plateau Agricultural Development Programme, PADP. (2000). Plateau Agricultural Development Programme. HouseJournal, p13.

Plateau State Government Organisation (2004). Visit Plateau. Plateau state Gov. org. 2pp

Salako, A. E., Ijadunola, T. O. and Agbesola, Y. O. (2007). Hemoglobin polymorphism in Nigerian indigenous small ruminant populations - preliminary investigation. *African Journal of Biotechnology***, 6**(22): 2636-2638.

Stormont, C., Suzuki, Y., Bradford, G. E. and King, P. (1968). A survey of haemoglobins, tranferrins and certain red cell antigens in nine breeds of sheep. *Genetics*, **60**: 363-371.

Tapio, M., Miceikiené, I., Vilkki, J. and Kantanen, J. (2003). Comparison of microsatellite and blood protein diversity in sheep: Inconsistencies in fragmented breeds. *Molecular Ecology*, 12: 2045–2056.

Tucker, E. M. (1971). Genetic variation in the sheep red blood cell. *Biological Review*, 46: 341-386.

Van Vliet, G. and Huisman, T. H. J. (1964). Changes in the haemoglobin types of sheep as a response to anaemia. *Biochemical Journal*, 93: 401-409.

Vaskov, B. and Efremov, G. (1967). Fourth haemoglobin type in sheep. *Nature*, **216**: 593-594.

World Wildlife Fund (WWF) (2001). Plateau forest Grassland Mosaic (AT1010). World Wildlife Fund Scientific Report. 2 pp.

INFLUENCE OF PERIOD EGG PRODUCTION PERFORMANCE OF NOILER CHICKENS

[1]Dogara, M. U., [1]Kalla, D. J. U., [1]Mancha, Y. P.

[1]Department of Animal Production Faculty of Agriculture anad Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria

[2]Department of Animal Science Faculty of Agriculture, Federal University of Kashere, Gombe State, Nigeria

ABSTRACT

The study was conducted at Poultry unit of Bauchi State Agricultural Programme (BSADP) from July to September, 2018 to determine the influence of period on egg production performance of noiler chickens. A total of 135 adult noiler hens were used for the study out of which 63 were black strain, 52 brown and 20 spotted. Specifically, egg weight, egg mass, hen day production (HDP) and hen house production (HHP) were assessed. Data generated were subjected to analysis of variance using SPSS version 22. Period had significant effect on all the variable recorded and that these traits increases with increment in production cycle. Thus, selective improvement of these birds on these traits should be emphasised at peak laying.

Keywords: Noiler chicken, egg production and period

INRODUCTION

Poultry eggs constitute one of the most valuable sources of animal protein recommended for human consumption and offer means of solving the problems of animal protein shortage (Olawoyin, 2006). The need to produce more animal protein in the country has become increasingly urgent in view of the ever rising population. The human population in Nigeria is projected to grow at an annual rate of 2-5% to the year 2025 (Adebambo, 1999). Population growth has surpassed food production and at the moment it is estimated that about one quarter of the population are already facing chronic food insecurity. Poultry meat and eggs have been recommended among the livestock to bridge this protein gap, because of short generation interval, high rate of productivity, quick turnover rate, higher feed efficiency and low labour and land requirement (Ojedapo *et al.,* 2008). Adequate information on growth potentials of existing commercial layers in the country is essential to poultry farmers so as to guide or assist in the choice of stock. However, because these commercial layers vary in production indices, it is therefore imperative to assess them as a measure of their performance in the environment (Piper and Latter, 1974). Most commercial laying birds are bred in developed countries of Europe and America by International breeding companies and supplied to enfranchised companies locally from whom many farmers purchase their chicks (Oluyemi, 1978).

MATERIALS AND METHODS

Location of the study area

The experiment was conducted at the poultry unit of Bauchi State Agricultural Development Programme (BSADP) Headquarters Bauchi, Bauchi State, Nigeria. Bauchi State is located between latitudes 9° 3' and 12° 3' north, longititudes 8° 50' and 11° east of the equator, at an elevation of 537 meters above sea level. The land area is 49,119 km^2 representing 5.3% of Nigeria's total land mass. The area is primarily agrarian contributing 75% to the State's economy. The climate is characterized by two well defined seasons: The rainy season (May to October) and the dry season (November to April). The mean annual rainfall and temperature range are 905.33 mm and 11 - 41 ^{o}C, respectively (IAR/BSADP, 1996).

Experimental Design

A total of 135 noiler chickens of 8 weeks purchased from Bauchi State Agricultural Development Programme (BSADP) were used for the present study. It comprises of 63 Black, 52 Brown and 20 Spotted noiler chickens. The experimental design employed was (CRD) and the experiment lasted for three (3) months.

Experimental diets

From time of purchase to commencement of laying, the birds were fedwithcommercial growers' feed (CP = 14 %, Fat = 7 %, Crude Fibre = 10 %, Calcium=1.0 % and Available Phosphorous = 0.35 %). At 5% of laying, the feed was changed to commercial layers ration (CP = 16.5 %, Fat = 5 %, Crude Fibre = 10 %, Calcium = 3.50 % and Available Phosphorous = 0.40 %) feed. feed and water was supplied *ad-libitum*.

Data Collection

Data on egg weight, hen day egg production (HDEP), hen housed production (HHP) and average egg mass (AEM) was recorded in three strains of chicken. Egg weights were recorded individually to the nearest gramme using an electronic scale (Professional scale), while HDEP, HHP and AEM were obtained using the following formulas.

$$\text{HDEP} = \frac{Total\ number\ of\ eggs\ produced\ in\ a\ day}{Total\ number\ of\ hens\ present} \times 100$$

$$\text{HHP} = \frac{Total\ number\ of\ eggs\ produced\ in\ a\ day}{Total\ number\ of\ hens\ at\ begining\ of\ laying} \times 100$$

Average egg mass = per cent HDEP × Average egg weight (g)

Data Analysis

The data generated were subjected to analysis of variance (ANOVA) using the General Linear Procedure (GLM) of SPSS, version 22 (2014). Significantly different means were compared using the Least Significant Difference (LSD). The model utilized was as follows:

$\mathbf{Y}_i = \mathbf{U} + \mathbf{W}_i + \mathbf{e}_i$

Where:

$\mathbf{Y}_i$ = Dependent variable (egg production performance)

$\mathbf{U}$ = Overall mean

$\mathbf{W}_i$ = Effect of ith week of lay

$\mathbf{e}_i$ = Residual error

Table 1: Weekly Egg production of noiler birds

Week of production	Age of bird in days	Age of bird in weeks	Hen day production (%)	Egg weight (g)	Egg mass
1	154	22	2.82^{e}	44.15^{c}	1.25^{d}
2	161	23	17.15^{d}	43.48^{c}	7.46^{c}
3	168	24	32.30^{c}	46.17^{b}	14.91^{bc}
4	175	25	69.30^{b}	49.94^{b}	34.61^{b}
5	182	26	62.23^{b}	53.13^{a}	36.78^{b}
6	189	27	82.91^{ab}	53.59^{a}	44.43^{a}
7	196	28	86.99^{ab}	52.91^{a}	46.03^{a}
8	203	29	89.21^{a}	54.31^{a}	48.45^{a}
9	210	30	87.94^{a}	54.76^{a}	48.16^{a}
10	217	31	88.47^{a}	53.90^{a}	47.69^{a}
11	224	32	88.79^{a}	55.70^{a}	49.46^{a}
12	231	33	91.12^{a}	54.26^{a}	49.44^{a}
Overall mean	-	-	59.37	51.36	35.72

Means in the same column with different superscript are significant ($P<0.05$)

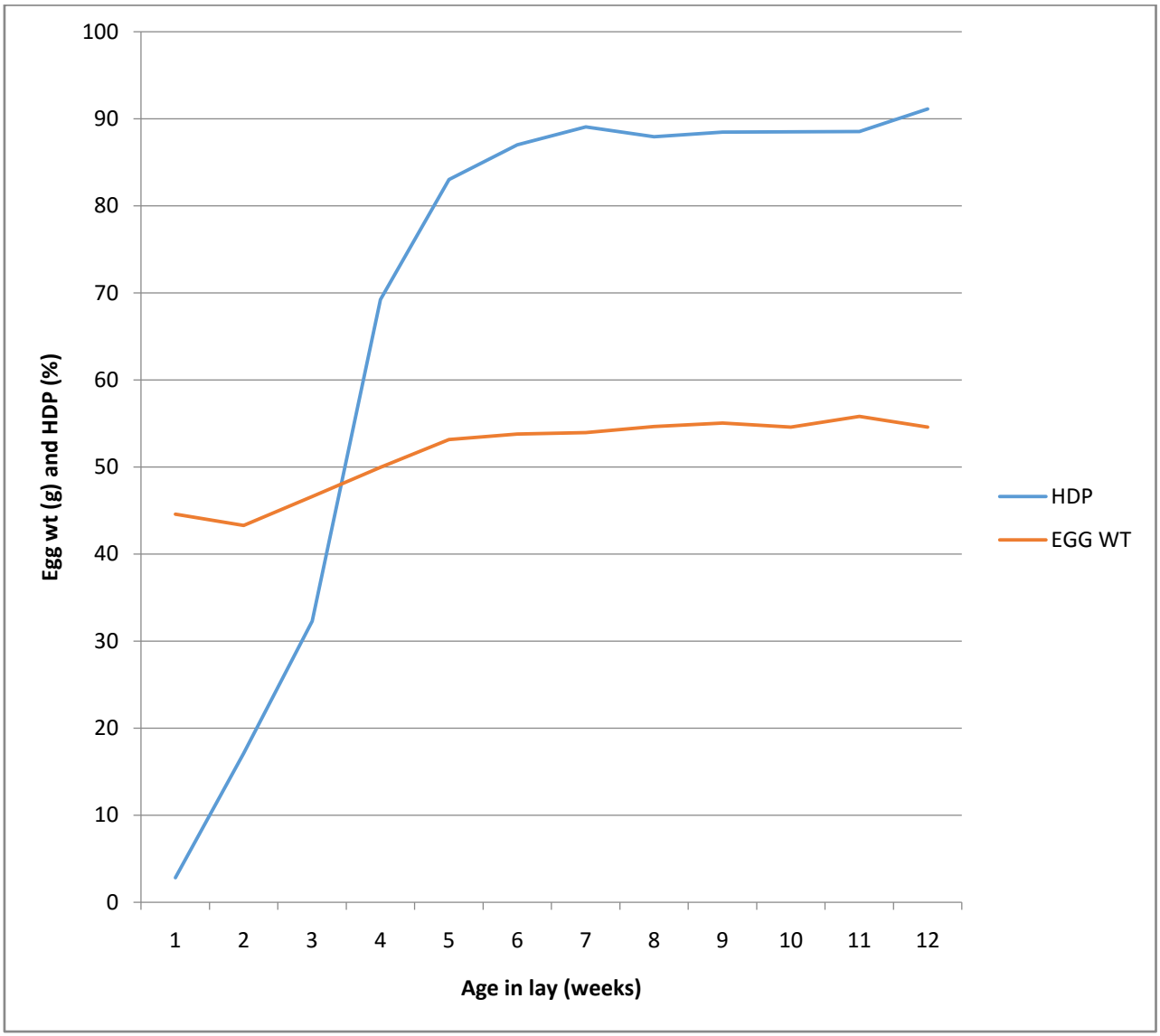


Figure 1: Egg production pattern of Noiler chicken

RESULTS AND DISCUSSION

Averages of hen day production (HDP), egg weight and egg mass according to week of production are presented in Table 1. Significant influence ($P<0.05$) of week of production was observed in these traits. This is line with the work of Padhi *et al*. (2013) who observed that egg quality traits of commercial layer bird increases significantly from 28 weeks of age to 72. However, the authors revealed that egg weight at 52, 64 and 72 weeks of age did not differ significantly indicating that in early period there was gain in this trait and thereafter, it remain static. Similar observation was reported by Suk and Park (2001). Tumova and Gous (2012) also reported non-significant effect of age on egg shape index in broiler breeder and laying hen. Usman *et al*. (2017) reported significantly higher egg production in first laying cycle than second and third among Aseel chicken native to Pakistan and attributed it to low level of fat deposition on the reproductive organs in the younger birds. They further explained that fat deposition on the ovary increases with increasing age. Usman *et al*. (2013) also stressed that egg production of commercial layer birds decreased with age advancement. Regarding egg mass, chicken in the first cycle production had significantly larger egg mass which could be as a result higher number of egg produced compared to the second and third cycles (Usman *et al*., 2013). Similar to the present result, the earlier work of Haq *et al*. (1997) showed that feed conversion ratio (FCR) values of layers during the first production cycle were better than in the second production cycle. However, Vargas *et al*. (2009) reported that FCR is not influenced by

age. Regarding egg parameters, Vargas *et al*. (2009) reported higher mean in third laying cycle compared to second and first and could be due to the weight and size of egg laid by birds of this age group. In another study, higher egg breadth in older birds has been reported which is positively correlated to the size of the oviduct (Johnston and Gouys, 2007). Contradictory statement has been reported by Sohail *et al.* (2013) who observed non-significant effect of age on egg surface area. In figure 1, HDP and egg are presented. The result revealed that HDP increases with age advancement and peaked at 6 to 7 weeks of production. Thereafter, the production is maintained. For egg weight, the deviation from the initial weight was insignificant.

CONCLUSION

The study therefore revealed that both egg mass and HDP increases with increase in weeks of production, while the changes observed in egg weight was insignificant.

REFERENCES

Adebambo, O. A. (1999). Improving the potentials of Nigerian livestock genetic resources in the new millennium. In: Genetics and food security in Nigeria in the twenty – first Century. Genetics Society of Nigeria. pp: 175-186.

IAR/BSADP (1996). Diagnostic survey on Agriculture in Bauchi State, Executive Summar, BSADP (Bauchi State Agricultural Development Program), Bauchi. Pp: 180.

Ojedapo, L. O., Akinokun, O., Adedeji, T. A., Olayeni, T. B., Ameen, S. A., Ige, A. O. and Amao, S. R. (2008). Evaluation of growth traits and short-tem laying performance of three strains of chicken in Derived Savannah Zone of Nigeria. *International Journal of poultry science,* **7**(1):92-96

Olawoyin, O. O. (2006). Evaluation of performance and adaptability of the local Nigerian and exotic Harco cockerels in the humid tropical zone. *Tropical Journal of Animal Science,* **9** (1): 63-71.

Oluyemi, J. A. (1978). A comparison of five laying commercial strains of fowl in a tropical environment. *Nigerian Journal of Genetics*, **2**: 91-96.

Piper, L. R. and Latter, B. D. H. (1974). Proceedings of the Australian Society of Animal Production, **10**: 8.

Sohail, A., Muhammad, A., Hussain, J., Iqbal, A., Usman, M. and Rehman, A. (2013).Comparative study on production performance, egg quality, egg geometry and hatching traits of three age groups of indigenous Peshawari Aseel chicken. *Scientific Journal of Veterinary Advances*, **2**: 21-5.

Haq, A., Ahmad, R. S. and Shah, T. (1997). Effect of light and feed restriction during rearing on production performance of egg strain layers. Asian-Australian Journal of Animal Science, **10**: 57-64.

Vargas, F., Baratto, T., Magalhães, F., Maiorka, A. and Santin, E. (2009). Influences of breeder age and fasting after hatching on the performance of broilers. *Journal of Applied Poultry Research*, **18**: 8-14.

Usman, M., Ahmad, Z., Akram, M., Hussain, J., Mehmood, S. and Shafiq, M. (2013). Pre and Post moult Productive performance of three age groups in four varieties of Aseel Chicken. Abstracts of 33rd Pakistan Congress Of Zoology (International) Pakistan; 355.

Johnston, S. and Gous, R. (2017). Modeling the changes in the proportions of the egg components during a laying cycle. British Poultry Science, **48**: 347-53.

Suk, Y.O. and Park, C. (2001). Effect of breed and age of hen on the yolk to albumen ratio in two different genetic stocks. *PoultryScience*, **80**: 855-58.

Tumova, E. and Gous, R.M. 2012. Interaction of hen production type, age and temperature on laying pattern and egg quality. *PoultryScience*, **91**: 1269-75.

Padhi, M. K., Chatterjee, R. N., Haunshi, S. ans Rajkumar, U. (2013). Effect of age on egg quality in chicken. *Indian Journal of Poultry Science,***48**(1): 122-125

AGE BASED CLASSIFICATION OF MORPHOMETRIC TRAITS OF DIFFERENT NIGERIA GOAT BREEDS

P.F. Abolusoro[*1]., A.J. Shoyombo[2],O.O. Alabi[2], J. Izebere[2], R.A Animashahun[2], S.O Olawoye[2] H. Yakubu[3], A. A Musa[4] & M.Wheto[5]

[1]Department of Agric Education, Kogi State College of Education Technical, Egbeda, kabba, Kogi State, Nigeria

[2]Department of Animal Science, College of Agricultural Sciences, Landmark University Omu-Aran, Kwara State, Nigeria

[3]Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

[4]Department of Animal Science, Faculty of Agriculture, Kogi State University, Anyigba, Kogi State, Nigeria

[5]Department of Animal breeding and Genetics, Federal university of Agriculture Abeokuta, Ogun State, Nigeria

ABSTRACT

A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age. The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test. The result of this study indicated that the Sahelian breed was superior to other breeds across all age groups in body weight, while the red Sokoto was intermediate followed by the West African Dwarf.

INTRODUCTION

Goats are the largest in number among ruminant livestock in Nigeria totaling about 58.3 million (FAOSTAT, 2008). Goats, predominantly are kept by the rural household and ownership is spread across all human age groups and sexes (Akpa,1999).The importance of goat stem from its ability to convert forages and household by-product into high quality human food and their role as locally available source of food, fibre, power and other products to suit local community needs. The indigenous breeds found in Nigeria are, Red Sokoto, Sahel, and West African Dwarf (WAD) goat (Adu and Ngere, 1979). These differ considerably in size, coat colour, horn length, etc. Their broad genetic variability enables them to survive under stressful environmental condition including high disease incidence, poor nutrition which may increase animal susceptibility to disease, high temperature, and traditional husbandry system.

MATERIALS AND METHODS

The study was carried out in Borno, Sokoto and Ogun States. These states were selected because they are locations having close to pure breeds of the goats. Animals used for this study were sampled in the abattoir, of Borno, Sokoto and Ogun states when brought for slaughter either by the owner or by the slaughter man. It is believed that all animals find their way into the abattoir from villages and local markets, where they are kept in small numbers by local farmers; they are raised under the extensive system of management. A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age.

The following metric characters were measured on each animal: Body Weight (BW), Age, Horn Length (HL), Ear length (EL), Shoulder width (SW), Neck circumference (NC), body length (BL), Withers Height (WH), Heart Girth (HG), Pouch Girth (PG), Tail Length (TL) and Scrotal circumference (SC). Weights of the animals were taken using a spring balance and Walk-in weighing scale. Flexible measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by two assistants in such a way that their heads,

necks, and chest were stretched almost in a straight line. Each measurement was taken at least three times and the mean recorded to the nearest centimeter or kilogram. Reference marks used for body measurement according to the method of and Salako and Ngere (2002).

Data analysis

The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software (SAS, 1990) package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test.

RESULTS AND DISCUSSIONS

Mean body weight in Red Sokoto, Sahel and West African Dwarf goats less than one year are presented in Table 1. The Sahel breed is superior to the other breeds with a body weight of 13.56±0.56Kg and 14.94±0.52Kg in does and bucks respectively. Within the Red Sokoto population, body weight in doe and buck was 13.73±0.51Kg and 12.86±0.42Kg respectively while in West African Dwarf, 10.44Kg±0.22 and 10.62±0.21Kg for does and bucks. Coefficient of variation ranges between 13.98% and 29.40% suggesting the influence of major genes on this trait.

Summarized in Table 2 are Sahel goats had a mean weight of 17.13±0.43Kg and 16.86±0.49Kg followed by West African Dwarf goats with 15.45Kg±0.54 and 17.65±0.44Kg for does and bucks respectively. Red Sokoto goats weighed 13.60±0.46Kg (does) and 13.51±0.43Kg (bucks).

Live weight is important for assessing the condition of the animal and represents a criterion of selection. Mean live weight of 13.73 Kg, 13.56 Kg, 10.44 Kg and 12.86 Kg, 14.94 Kg and 10.44 Kg for does and bucks for the three breeds respectively for age less than one year are within the range of 12-18 Kg reported by Katongole *et al*. (1996) for indigenous goats in Kenya. Mean live weight of 13.60 Kg, 17.13 Kg, 15.45 Kg and 13.51 Kg, 16.84 Kg and 17.65 Kg for does and bucks between the age one through two years are lower than values of 20-40kg reported by several authors (Akpa *et al*., 1998, Otoikhan *et al*., 2008 and Salako *et al*., 2006) in different breeds of goat. Mean live weight of 18.95 Kg, 23.60 Kg, 19.13 Kg and 19.21, 25.12 Kg and 19.35 Kg for does and bucks above two years are closer to the range reported by several authors (Akpa *et al*., 1998, Osuhor *et al*., 2002 and Otoikhan *et al*., 2008), with Sahel breed fell within the specified range of 20-40 Kg. The average body weight at different ages fell within the range of 16-30 Kg specified by Hassan and Ciroma (1990) for both does and bucks from age 1-5 years in different breeds of goats.

CONCLUSION

Present results showed that age has strong influence, as there were consistent increases in all the traits studied as the animals aged. The scenario is however not surprising since the size and shape of the animal is expected to increase as the animal is growing with age. There was wide variability as the age of the animals increased most particularly in the bodyweight. This was in consonance with the report of Orheruata and Olutogun, (1984) in cattle.

REFERENCES

Adu, I.F., and Ngere, L.O. (1979). The indigenous Sheep of Nigeria. World *Review of Animal Production*. 15(3); 52 – 62.

Akpa, G.N. (1999). Evaluation of Dairy Characteristics and lactation curves of small holder Red Sokoto (Maradi) Goats. Ph.D Thesis.Ahmadu Bello University, Zaria pp 64-68.

Akpa, G.N., Ambali, A.L. and Suleiman, I.O. (2013).Body Conformation, Testicular and Semen Characteristics as Influenced by Age, Hair Type and Body Condition of Red Sokoto Goat. N Y Sci J 6(7):44-58]. (ISSN:1554-0200).

Akpa, G.N., Duru, S. and Amos, I.T. (1998). Influence of strain and Sex on estimation of within age-group body weight of Nigerian Maradi goats from hair linear body measurements. *Tropical Agriculture (Trinidad) 74:462-467*

Banerjee, A.K., Animat, G., and Ermias, E. (2000).Selection and Breeding Strategies for increased production of goats in Ethiopia. In: Merkel, R.G., and Goetsch, A.L, (ed). The opportunities and challenges of enhancing goat production in east Africa, PP. 70 – 79. Debub University, Awassa, Ethiopia 10 – 12 November 2000.

Bunge, R., Thomas, D.L., and Stookey, J.M. (1990) Factors Affecting the Productivity of Ram bottle ewes mated to ram Lambs. *J. Anim. Sci*. (68). 2253 – 2262.

Dettmers, A. (1983). Performance of Hair Sheep in Nigerian. In Fitzhugh, H. E. and Bradford, G.E. (eds). Hair Sheep of West Africa and the Americas. Boulder, Col., West View Press pp 201 – 218.

Devendra, C., and Burns, M. (1983).Goat |Production in the Tropics. 2nd ed. Farham Royal, Commonwealth Agricultural Bureau, pp 1 – 60.

Hall, S.J.G. (1991). Body Dimensions of Nigerian Cattle, Sheep and Goats. Anim. Prod. 53:61-69

Hassan, A. and A. Ciroma. 1990. Bodyweight measurements relationship in Nigerian Red Sokoto goats. Department of Animal Science, Usmanu Danfodiyo University, Sokoto, Nigeria http://www.fao.org/wairdocs/ilri/x5 520b/x5520b1d.htm.

Katongole J B D, Sebolai B and Madimabe M J 1996 Morphological characteristics of the Tswana goat. In S H B Lebbie and E Kagwini (eds). Proceedings of the Third Biennial Conference

Morphological traits among Red Sokoto, Sahel and WAD goat (< 1 year)

		RED SOKOTO			SAHEL			WAD		
Parameter		Doe	Buck	Total	Doe	Buck	Total	Doe	Buck	Total
BW	N	50	50	100	50	50	100	50	50	100
	X	13.73	12.86	13.30	13.56	14.94	14.25	10.44	10.62	10.53
	SD	3.62	3.00	3.33	3.90	3.70	3.89	1.53	1.49	1.50
	CV	26.38	23.36	25.12	29.40	24.78	27.30	14.65	13.98	14.27
EL	N	50	50	100	50	50	100	50	50	100
	X	10.22	9.86	10.04	11.52	11.06	11.29	9.56	9.43	9.49
	SD	1.17	1.07	1.13	1.79	1.88	1.83	1.08	1.20	1.13
	CV	11.46	10.81	11.24	15.53	16.96	16.28	11.27	12.70	11.95
SW	N	50	50	100	50	50	100	50	50	100
	X	13.34	13.83	13.59	18.18	18.59	18.39	12.75	12.99	12.87
	SD	3.94	3.40	3.68	3.02	2.57	2.79	3.02	3.40	3.20
	CV	29.57	24.65	27.06	16.60	13.80	15.20	23.70	26.21	24.90
NC	N	50	50	100	50	50	100	50	50	100
	X	22.69	23.43	23.06	21.02	23.31	22.17	23.47	24.39	23.93
	SD	5.10	4.30	4.71	3.67	4.53	4.26	4.16	4.16	4.16
	CV	22.48	18.35	20.41	17.47	19.43	19.22	17.73	17.04	17.40
BL	N	50	50	100	50	50	100	50	50	100
	X	41.92	41.97	41.95	35.36	39.56	37.46	42.04	41.88	41.96
	SD	4.70	3.99	4.33	7.16	9.25	8.50	5.85	5.13	5.48
	CV	11.20	9.50	10.33	20.25	23.39	22.68	13.92	12.27	13.06
WH	N	50	50	100	50	50	100	50	50	100
	X	52.06	51.63	51.85	42.47	45.80	44.13	47.93	48.07	48.00
	SD	6.13	5.69	5.89	10.04	9.44	9.84	7.98	7.53	5.33
	CV	11.78	11.03	11.36	23.64	20.62	22.30	16.65	15.67	16.08
HG	N	50	50	100	50	50	100	50	50	100
	X	53.33	57.53	55.43	49.90	48.77	49.33	50.15	49.71	49.93
	SD	9.24	8.29	8.98	3.46	4.68	4.14	5.51	5.18	5.33
	CV	17.33	14.40	16.21	6.74	9.60	8.39	10.98	10.43	10.67
PG	N	50	50	100	50	50	100	50	50	100
	X	55.37	59.61	57.49	52.20	50.63	51.41	51.42	50.99	51.19
	SD	9.32	8.40	9.08	3.50	4.68	4.18	5.48	5.05	5.25
	CV	16.83	14.09	15.79	6.70	9.24	8.14	10.65	9.91	10.25
TL	N	50	50	100	50	50	100	50	50	100
	X	12.08	11.71	11.807	11.62	11.97	11.79	10.29	10.27	10.28
	SD	1.84	2.13	1.99	2.27	2.28	2.27	1.33	1.46	1.39
	CV	15.24	18.17	16.71	19.52	19.06	19.25	12.90	14.24	13.52

Horn Length (HL), Ear Length (EL) Shoulder Width (SW) Neck Circumference (NC) Body Length (BL) Wither Height (WH) Heart Girth (HG), Pouch Girth (PG), tail length (TL), scrotal circumference (SC) and Body Weight (BW)

INFLUENCE OF ROAD TRANSPORT STRESS ON CATTLE HEART RATE AND BEEF QUALITY: A REVIEW

***Ebule K., D.J.U Kalla., Mai H.M., Y.P Mancha., Mai H.M & Igila T.T**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: ebulekenneth@gmail.com mobile No: 08024263740*

ABSTRACT

This paper discusses the influence of road transport stress on cattle heart rate and beef quality. The demand for beef and beef products has resulted in increased road transport of cattle which is the predominant means of cattle transport especially in developing parts of the world. Stress due to road transport exposes cattle to physical, psychological, and climatic factors that affect the animals with different intensities and duration. The most dominant stress factors associated with road transport of cattle include loading and unloading, bad handling, inappropriate driving, poor road conditions, too hot or too cold climate, insufficient ventilation, high stocking densities, mixing of unfamiliar groups, water and food deprivation, vibration, vehicle motion and length of the journey. These stress factors result in an increased heart rate which distort homeostatic balance of the animal, thus leading to induced changes in the secretion of pituitary hormones, altered metabolism, immune competence and behaviour which result in Dark Firm Dry (DFD) and Pale Soft Exudative (PSE) beef products which are unattractive and unpalatable to consumers. It is concluded that road transport is a source of stress for cattle. Road transport conditions are very essential factors which affect heart rate of the animal, this directly impacts the physiological wellbeing of the animal with direct influence on the quality of beef produced. Therefore it is recommended that all stake holders in the road transport sector should be trained on the techniques of handling cattle during transport. Specialized vehicles should be designed for road transport of cattle.

Keywords: Transport, Heart Rate, Stress, Road, Cattle, Beef, Cortisol

INTRODUCTION

Stress can be defined as a biological response elicited when an animal perceives threat to its homeostasis (Mob erg, 2000). There is increasing transport of livestock through long distances, as demand for meat products increases freight opportunities grow and trade barriers are reduced (Phillips, 2015). Most of this transport is by road. The physiological responses of animals to adverse conditions such as those which they may encounter during handling and transport will be affected by the anatomical and physiological constitution of the animal. Cattle transport produces physical, psychological, and climatic stressors that affect animals with different intensities and duration (Earley, 2010). There is no doubt that long transport is an unknown procedure for cattle which can be irritating and aversive (Hartung, 2003). This will lead to a persistent increase in heart rate of the animal which will cause an increased level of cortisol and other stress hormones that will affect beef quality. Warriss (2000) defined meat quality on the basis of their functional or conformational qualities. Functional qualities were referred to as the desirable attributes in a product while conformance qualities encompass producing a product that meets consumer's specification exactly. Yield and gross composition, palatability, wholesomeness and ethical quality are the components of meat quality (Warriss, 1996). Therefore this review elaborates the influence of road transport stress on cattle heart rate and beef quality.

Factors Causing Transport Stress

The most pervasive factors with cattle transport include loading and unloading, bad handling, inappropriate driving, poor road conditions, too hot or too cold climate, insufficient ventilation, high stocking densities, mixing of unfamiliar groups, deck height, water and food deprivation, vibration, vehicle motion and length of the journey (Hartung, 2003). The duration of the journey has a greater impact than the distance (Von Borell, 2005). The main critical issues resulting in stress during transport are due to factors like inadequate road vehicles, illegal route plan and non-compliance with travelling speed limit, negligence and poor handling of animals, transport of unfit cattle, inadequate ventilation, over loading and difficulty in checking that vehicles were authorized to transport cattle (Singh, 2012). Some other stress inducing factors during transport are the attitudes of stakeholders and their driving skills, laws and codes of practice, genetic differences between breeds, design of vehicle for transport and design of equipments used for loading, payment of persons working with animals (Broom, 2003).

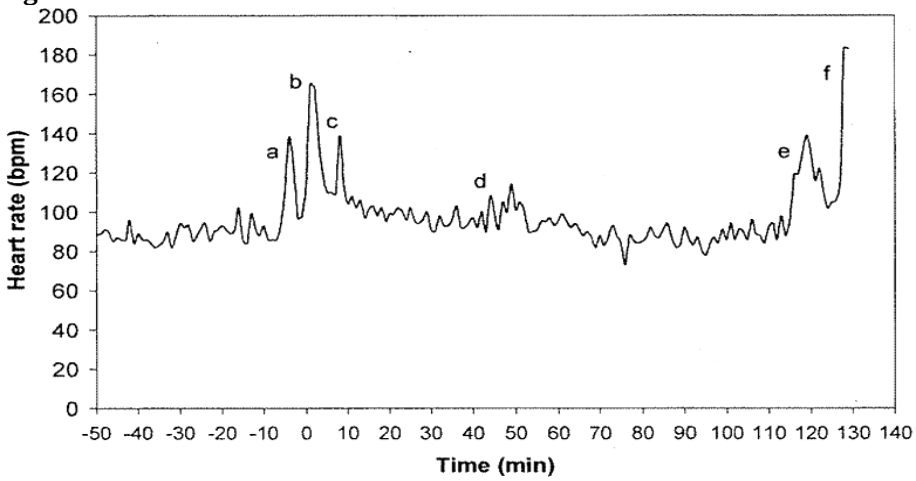
Table 1: Stressors in cattle transportation

Stress	Stressor	Effect
Behavioural	Novelty, restraint, noise	Fear
	Mixing, overcrowding	Aggressive interaction
Nutritional	Fasting	Dehydration and hunger
Physical	Mixing & overcrowding	Bruising and injury
	road conditions	Bruising and injury
	driving technique& horns	Bruising and injury
	Weather extremes	Hyper/hypothermia
Infectious	Dust exposure	Respiratory disease

(Ashenafi, 2018)

Influence of road transport stress on cattle heart rate

Figure 1. Curve of measured heart rate from a bull.



(Gebresenbet, 2005)

a) Animal near experimental animal is loaded
b) Loading
c) The vehicle starts to drive
d) Loading of new animals
e) Unloading at abattoir
f) In the stunning box

X-axis represents time in minutes where 0 represent loading, negative time is before loading and positive after loading.

A typical heart rate curve is shown in figure 1. The first peak occurred when an animal near the experimental animal was loaded, the second peak at loading, the third peak when the vehicle started to drive, the forth small peak occurred when new animal was loaded to the vehicle, and the fifth and sixth peak when the bull was unloaded and then forced to go into the stunning box (Gebresenbet, 2005).

Effects of increased heart rate on hormones

Increased heart rate as a result of transport stress triggers an increase in activity of thyroid and adrenal function in cattle which continues to increase after long distance transport (Fazio, 2005). Physiological changes encountered during road transport induced heart rate increase include plasma cortisol levels, breathing rate, extent of muscle tremor, foaming at the mouth, changes in adrenaline and noradrenaline (i.e., epinephrine and nor epinephrine), plasma or saliva glucocorticoid levels, saliva cortical levels, increases/decreases in body temperature, physical signs of nausea or motion

sickness, plasma vasopressin levels, plasma ß-endorphin levels, plasma Adrenocorticotropic hormone (ACTH) levels, plasma creatinine levels, plasma lactate dehydrogenate levels (Ashenafi, 2018). Cortical concentrations are used extensively as an indicator of stress because cortisol is released during the activation of the Hypothalamus, Pituitary and Adrenal glands (HPA) axis in response to stressful stimuli (Swanson, 2001). It has been widely documented that increased heart rate in response to transportation in the bull, cow and calf elicit an elevation in plasma cortisol levels which result in high levels of plasma urea and glucose (Guardia, 2009; Averos, 2008).

Effects of increased heart rate on beef quality

Elevated heart rate levels have a direct impact on cortisol. This influences other blood physiological parameters such as depletion of glycogen reserves which lead to a decrease in post-mortem lactic acid production (Coldit *et al*.2006; Mounier *et al*. 2006). This lead to two major conditions namely Pale Soft Exudative (PSE) and Dark Firm Dry (DFD) beef. Pale soft exudative and dark firm dry beef are very important beef quality problems that continuous to bedevil the beef industry, PSE and DFD beef are unattractive and more likely to face discrimination by consumers (Viljoena *et al*., 2002). Pale soft exudative beef looks pale, lean, has soft texture and low water holding capacity and poor functional attributes. Dark firm dry beef looks dark, variations in tenderness, poor functional attributes and prone to spoilage. Detailed description of pale soft exudative and dark firm dry beef can be found in Adzitey and Nurul (2010).

CONCLUSIONS

There is clear indication that road transport represent a source of stress for cattle. Transport conditions are very essential factors which affect heart rate of the animal. This directly impacts the physiological wellbeing of the animal which has direct influence on the quality of beef produced.

Transport stress ⟶ Elevated heart rate ⟶ physiological changes ⟶ PSE & DFD Beef

RECOMMENDATIONS

All stake holders in the road transport sector should be trained on the techniques of handling cattle during transport. Specialized vehicles should be designed for road transport of cattle. Private investors should be encouraged to invest in modular abattoirs so as to reduce distance and duration of road transport for cattle.

REFERENCES

Adzitey, F. and Nurul, H. (2010). Pale Soft Exudative (PSE) and Dark Firm Dry (DFD) Meats: Causes and measures to reduce these incidences. *International Food Research Journal*.

Ashenafi D.,Yidersal E., Hussen E., Solomon, Tand Desiye, M. (2018). The Effect of long Distance TransportationStress on Cattle. *Biomedical Journal of Scientific and Technical Research.* DOI: 10.26717

Averos X, Martin S, Riu M, Serratosa J, Gosalvez LF. (2008). Stress response of extensively reared young bulls being transported to growing-finishing farm under Spanish summer commercial conditions. *Life Science* 119**(1-3)**: 174-182.

Broom DM. (2003). Causes of poor welfare in large animal during transport. *Vetirinary Research Communications*. 27**(1)**: 515-518.

Colditz I. G., D. L. Watson, R. Kilgour, D. M. Ferguson, C.Prideaux,J. Ruby, P. D. Kirkland, & K. Sullivan. (2006). Impact of animal health and welfare research within the CRC for Catte and Beef Quality on Australian beef production. *Australian Journal of Experimental Agriculture*. **46**:233-244.

Earley B, Murray M, Prendiville DJ. (2010). Effect of road transport for up to 24 hours followed by twenty-four hour recovery on live weight and physiological responses of bulls. *BioMedicalCentral Veterinary Research.* **6**: 38

Fazio E, Medica P, Alberghina D, Cavaleri S, Ferlazzo A. (2005). Effect of long-distance road transport on thyroid and adrenal function and hematocrits values in Limousin cattle: influence of body weight decrease. *Veterinary Research Communications* 29**(8)**: 713-719.

Gebresenbet, G., Wikner, I., Ladberg, E., Holm, P., Nilsson, C., Svensson, L. (2005). Effect of transport time on cattle welfare and meat quality. *Researchgate.net*/publication/28610288

Guardia MD, Estany J, Balasch S, Oliver MA, Gispert M. (2009). Risk assessment of skin damage due to pre-slaughter conditions and RYRI gene in cattle. *Meat Science***81**: 745-751.

Hartung J, Marahrens M, Holleben KV. (2003). Recommendations for future development in cattle transport in Europe. *Dtsch tierärztl Wochenschr journal* 110**(3)**: 128-130.

Mob erg. (2000). Biological response to stress: Implications for Animal Welfare. **In**: Moberg GP, Mendy JA (Eds.), The Biology of Animal Stress, Oxon OX108DE, CAB International, Walling for, UK, p. 1-21.

Mounier, L., H. Dubroeucq, S. Andanson, & I. Veissier. (2006). Variations in meat pH of beef bulls in relation to conditions of transfer to slaughter and previous history of the animals. *Journal of Animal Science*. **84**:1567-1576.

Phillips, C.J.C. (2015). The Animal Trade; *Centre for Agriculture and Biosciences International Publishing*. Wallingford, UK.

Singh SK (2012) Animal health. *Bio green books*, New Delhi, India.

Swanson JC, Morrow Tesch J. (2001). Cattle transport: Historical, research, and future perspectives. *Journal of Animal Science* 79**(1)**: 102-109.

Viljoena, H. F., de Kocka, H.L. and Webbb, E.C. (2002). Consumer acceptability of dark, firm and dry (DFD) and normal pH beef steaks. *Meat Science***61**: 181–185

Von Borell E, Schaffer D. (2005). Legal requirements and assessment of stress and welfare during transportation and slaughter handling of pigs. *Livestock Production Science* 97**(2-3)**: 81-87.

Warriss, P. D. (2000). Meat science: an introductory text. Wallingford, Oxon, UK: *Centre for Agriculture and Biosciences InternationalPublishing*.

Warriss, P.D.,Taylor, S.A., Raimundo, A., Severini, M and F.J.M. (1996). Meat Quality and Meat Packaging. *International food research journal*, Belgium: Utrecht p 3-10.

EFFECTS OF TOMATO LYCOPENE ON SEMEN CHARACTERISTICS AND LIBIDO OF RABBIT BUCKS

***Ebule K., D.J.U Kalla & Y.P Mancha**

Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: ebulekenneth@gmail.com Mobile No: 08024263740*

ABSTRACT

A total of 15 mature mongrel rabbit Bucks were randomly divided into five treatments at the Abubakar Tafawa Balewa University Farm, Bauchi, Nigeria. The experiment lasted for a period of 16 weeks. The Bucks were allowed 4 weeks for stabilization and acclimatization, 4 weeks for training with a teaser doe and 8 weeks for oral administration of graded levels of tomato lycopene (0.00g, 0.25g, 0.50g, 0.75g, and 1.00g). Semen was collected once a week from all 15 Bucks and analyzed. The result showed that while lycopene doses at 0.75g and 1.00g significantly reduced ($P<0.01$) reaction time (seconds) it also resulted in greater ($P<0.01$) semen volume (ml), sperm cell concentration/ml ($n\times10^7$), total sperm Count ($n\times10^7$) and libido score (mounts/minute) while live sperm cells (%) was not significantly affected by all doses of lycopene administered. The result also showed significant improvement ($P<0.05$) for Sperm motility (%)of Bucks administered 0.50g and 0.75g lycopene. From the finding of this study it was concluded that lycopene significantly influenced semen characteristics and libido of rabbit bucks. This study therefore recommends that lycopene at 0.75 grams per day for eight weeks should be used to improve the semen quality and libido of rabbit Bucks used for breeding. Further research should be carried out so as to widen the scope and utilization of lycopene in animal science.

Keywords: Lycopene, Tomato, Semen, Sperm, Libido

INTRODUCTION

Rabbit farming is becoming more attractive to many animal breeders due to its high fecundity, high mothering ability, adaptability to a wide range of conditions, high genetic variability, high roughage utilization and low cost of production (Das, S.K *et al.*,2007; Zarrouki, N *et al.*,2004). The economic efficiency of a rabbitry depends mainly upon the reproductive performance of the doe, which in turn is affected by fertility of the buck (Castellini C *et al.*,2003). Male rabbits are undoubtedly the basis of reproductive success, given that farm profitability depends not only on the female's fertility but also upon the buck. Male fertility is also an interesting trait in rabbit breeding, because together with the doe it determines reproductive and productive success. Moreover, due to the fertilising capacity of semen, the male can influence not only fertility and conception but also the productivity of the does (Berchiche *et al.*, 2000; Zerrouki *et al.*, 2005a). Lycopene has antioxidant properties and imparts the red-coloured pigment in both fruits and vegetables. Poor semen production is a factor that hinders efficient reproductive performance in rabbit Bucks. In the tropics, male rabbits are used for breeding purposes from about 6 months of age and expected to produce semen consistently from this age (Wang *et al*., 2010). This is not so in many tropical breeds and their crosses as a result of the extreme conditions in the tropics which causes oxidative stress even in period of abundant feed supply. Antioxidants, especially lycopene which is an antioxidant carotenoid compound have not been widely used to improve rabbit semen. This study was therefore designed to evaluate the influence of lycopene on semen characteristics of rabbit Bucks.

MATERIALS AND METHODS

This study was carried out at Abubakar Tafawa Balewa University Teaching and Research Farm, Bauchi, Bauchi state, Nigeria. It is located in the north eastern part of the country and has a tropical climate. Lycopene used for this experiment was obtained by extraction from tomato. Fifteen Mature mongrel rabbit Bucks of breeding status were randomly assigned to different treatments in a complete randomized design. The experiment lasted for a period of 16 weeks comprising 4 weeks of stabilization and acclimatization, 4 weeks of training with a teaser doe and 8 weeks for oral administration of graded levels of tomato lycopene.

Reaction Time

A teaser doe was introduced to each buck every week to measure reaction time. This was the time it takes the rabbit buck to sniff, groom and mount the doe and it was recorded with a stop watch.

Libido Score

A teaser doe was introduced every week to measure sex drive, this was the number of time each buck attempted to mount the doe in a minute.

Semen Collection

Semen was collected from the Bucks with the aid of an artificial vagina (AV) as described by Herbert and Adejumo (1995). Prior to semen collection the AV was warmed for a few minutes in warm water at a temperature slightly above body temperature and thereafter drained. The semen was collected between 8:00am and 9:00 am, this was to ensure that good quality semen was obtained.

Semen Colour and Semen Volume

Semen colour was noted visually immediately after collection. The volume of semen collected was measured using graduated collection tube.

Sperm Motility

To determine the motility of the sperm cells, a drop of undiluted semen mixed with a drop of slightly warmed diluents (sodium citrate) was placed on a sterile slide, covered with a cover slip and observed under the microscope at ×400 magnification and scored within a rating of 0-100% as described by Ewuola and Egbunike (2010).

Sperm Cell Concentration (per ml)

Sperm cell concentration per ml of semen was evaluated by visual count under the microscope using the improved Neubauer haemocytometer. A mixture of sodium bicarbonate (5g), formalin (1ml) and distilled water (100ml) was used as diluents to arrest the activity of sperm cells in the sample. The mixture was uniformly mixed and through capillary action allowed to run under the cover slide placed on the haemocytometer. After few minutes the sperm cells were counted within the five smaller squares. The total count was obtained by adding the counts from the five smaller squares multiplied by the dilution factor and the multiplication factor.

Live Sperm Cells Count

Live sperm cells determination was done by placing a drop of semen on a glass slide, mixed with one drop of eosin negrosin, smeared and observed under the microscope. The unstained cells represented the live cells while the stained cells are the dead ones.

Total Sperm Count

The total sperm count was obtained by multiplying the sperm concentration by the volume of semen per ejaculate.

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA). Treatment means were separated and compared with the control using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

Results for semen characteristics and libido score are elaborated in table 1

Reaction Time

From the result of this study it can be observed that animals in treatment 4 (0.75g) and 5 (1.00g) had lower reaction time (3.62 and 3.65 seconds) this implies that for Bucks in this group it will only take 3.62 or 3.65 seconds to realize that a doe has been brought to them and attempt to mount.

Libido score

The result from this study indicate that animals in treatment 4 (0.75g) and 5 (1.00g) attempted to mount the doe more times in a minute than animals in treatment 2 (0.25g), 3 (0.50g) and the control (0.00g). It is also noteworthy to state that from the results obtained it was noticed that reaction time and libido score are inversely related, the lower the reaction time the higher the libido score.

Semen colour and Semen Volume

Semen colour for all the treatments and the control were observed to be milky. Semen volume was significantly influenced by lycopene in treatment 4 (0.87ml) and 5 (0.90ml) this was a significant improvement when compared with the control in treatment 1 (0.47ml). With this improvement it is therefore safe to say that lycopene at 0.75g and 1g will improve semen volume significantly.

Sperm Motility

Motility which is best described as the progressive forward movement of sperm cells is important for the transport of spermatozoa in the reproductive tract and oocyte penetration (Holt and Van Look, 2004). The result obtained from this study indicates that the most motile sperm cells were observed in treatment 3 (79.50%) and treatment 4 (78.63%), it is therefore note worthy to mention that as the level of lycopene increased in treatment 5 (1.00g) the motility of sperm cells reduced.

Sperm Cell Concentration (per ml) and Total Sperm Count

The high percentage of live sperm cells observed in this study is an indication of the viability of sperm cells with possibly higher fertilizing capacity. Sperm concentration was significantly influenced by lycopene in treatment 4 (38.88×10^7 /ml) and 5 (48.13×10^7 /ml). Although testosterone was not a parameter in this study, the result of this study suggests that lycopene has a positive influence on testosterone since it increased sperm concentration. The total sperm count was also observed to be significantly affected by treatment 4 (31.54×10^7 /ml) and 5 (46.30×10^7 /ml) which were the highest observed in this study. ***Live Sperm Cells***

The result from this study revealed that lycopene did not affect or influence the percentage of live sperm cells in the semen, this also indicate that the volume of semen did not influence the percentage of live sperm cells but influenced the total number of sperm cells as semen of higher volume resulted in higher sperm cells, this is further authenticated by the fact that all semen collected demonstrated a consistent colour.

Table 1: Semen characteristics and libido score of rabbit Bucks administered graded levels of lycopene

	Lycopene						
Parameters	T1 (0.00)	T2 (0.25)	T3 (0.50)	T4 (0.75)	T5 (1.00)	LSD	LOS
Reaction time (seconds)	9.30±0.85	9.35±1.03	10.23±0.13	3.62±0.48**	3.65±0.40**	3.31	P<0.01
Semen colour	Milky	Milky	Milky	Milky	Milky		
Semen volume (ml)	0.47±0.03	0.49±0.05	0.47±0.10	0.87±0.17**	0.90±0.16**	0.24	P<0.01
Sperm motility (%)	73.00±3.72	76.58±1.56	79.50±4.30*	78.63±1.65*	77.04±1.75	4.72	P<0.05
Sperm cell Conc/ml ($\times10^7$)	17.75±1.28	18.25±1.39	18.13±1.46	38.88±4.94**	48.13±11.69**	12.85	P<0.01
Total sperm Count ($\times10^7$)	8.66±1.67	9.60±1.92	9.00±1.43	31.54±11.89**	46.30±15.72**	19.82	P<0.01
Live sperm cells(%)	71.46±3.72	72.96±2.07	75.54±4.09	74.50±1.49	73.63±1.81	4.71	P<0.05
Libido score (mounts/minutes)	3.10±0.90	5.04±1.29	8.96±3.26	15.29±7.41**	16.50±7.67**	11.20	P<0.01

Treatment 2 to 5 within each row were compared with treatment 1 which is the control using LSD

± (standard deviation)

**Significant at (P<0.01)

* Significant at (P<0.05)

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study Lycopene up to 0.75g and 1.00g improved semen quality and libido of rabbit Bucks. Lycopene up to 0.75g administered every day for eight weeks (56 days) should be used to boost semen quality and libido of rabbit Bucks used for breeding. Further research should be carried out so as to widen the scope and utilization of lycopene in animal science.

REFERENCES

Berchiche M., Zerrouki N., Lebas F. (2000). Reproductive performances of local Algerian does raised in rational conditions. *In Proceedings: 7th World Rabbit Congress, July 4-7, 2000.Valencia, Spain, 43-49.*

Castellini C. Dal Bosco A., and Mugnai C (2003). Comparison of different reproductive protocol for rabbit does: effect of litter size and mating interval. *Livestock production science*.**83**:131-139.

Das, S.K. and B.P.S Yadav (2007). Effect of mating system, parity and breed on the reproductive performance of broiler rabbits under the agro-climatic condition of Meghalaya. *Livestock research for rural development.***19 (2).**

Ewuola E and Egbunike GN. (2010). Gonadal and extra-gonadal sperm reserves and sperm production of pubertal rabbits fed dietary fumonisin B. *Animal Reproduction Science*. **119**: 282–286.

Herbert, U. And Adejumo, D. O. (1995). Construction and evaluation of an artificial vagina for collection rabbit semen. *Delta agriculture.* **2**: 99-108.

Holt WV and Van Look KJW. (2004). Concepts in sperm heterogeneity, sperm selection and sperm competition as biological foundations for laboratory tests of semen quality. *Reproduction*. **127**: 527–535.

Wang, Y., J. Tang, W. Ma and J. Feng (2010). Dietary zinc glycine chelate on growth performance, tissue mineral concentrations, and serum enzyme activity in weanling piglets. *Biological Trace Element Research*. **133**: 325-334.

Zarrouki, N., G. Bolet, M.Berchiche and F. Lebas.(2004). Breeding performance of local Kabylian rabbits in Algeria . *Proceedings of the 8th world rabbit congress*, September 7-10 pueblo, Mexico.

Zerrouki N., Bolet G., Berchiche M., Lebas F. (2005a). Evaluation of breeding performance of a local Algerian rabbit population raised in the Tizi-Ouzou area (Kabylia). *World Rabbit Science.***13**:29-37.

EXTRACTION OF TOMATO LYCOPENE AND ITS EFFECTS ON ELECTROLYTE BALANCE, KIDNEY AND LIVER FUNCTION OF RABBIT BUCKS

***Ebule K., D.J.U Kalla & Y.P Mancha**
Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria
**Corresponding author:ebulekenneth@gmail.com Mobile No: 08024263740*

ABSTRACT
Lycopene is an antioxidant carotenoid compound occurring in plants and is responsible for the red coloured pigment of tomato, watermelon and other fruits mostly red coloured. In this study lycopene was extracted from tomato using acetone and dichloromethane as extraction solvents. Identification of lycopene was carried out using UV-Visible spectrophotometer. It was further fed to 15 mongrel rabbit Bucks in five graded levels at 0.00, 0.25, 0.50, 0.75 and 1 gram using a completely randomized design for a period of 8 weeks (56days) to determine its effects on electrolyte balance (sodium, potassium, chloride and bicarbonate), kidney function (uric acid, urea nitrogen and creatinine) and liverfunction (total protein, albumin, total bilirubin, alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase). The results showed that the peaks of lycopene in UV-Visible spectrophotometer were found at 475nm and 470.5nm in chloroform and hexane respectively. Also, all parameters tested for electrolyte balance, kidney and liver function were within the normal range. From the results of this study it was concluded that lycopene did not have any adverse effects on electrolyte balance, kidney and liver function but it was well tolerated by these delicate organs. This study therefore recommends that lycopene can be used an antioxidant in rabbit Bucks to reduce oxidative stress.
Keywords: Lycopene, Tomato, Antioxidant, Electrolyte, Kidney, Liver

INTRODUCTION
Rabbits have an important role in the supply of animal protein for humans. Rabbit occupies a vital midway position between ruminants and non-ruminant animals and can effectively utilise feed in rations containing less than 20% grain (Saleh *et al.*, 2010). Male rabbits are undoubtedly the basis of reproductive success, given that farm profiability depends not only on the female's fertility but also upon the welfare of the buck which is subject to stress factors such as oxidative stress. Reactive oxygen species (ROS) are the major cause of oxidative stress and are continuously produced during metabolism.Indeed, when produced in excess and not tightly kept under control by the antioxidant "detoxifying" systems, ROS can potentially damage all components of the cell (Jean, 2012). Lycopene is a carotenoid that has antioxidant properties and imparts the red-colored pigment in both fruits and vegetables, it is a fat soluble substance. Epidemiological research studies have demonstrated positive benefits in consuming lycopene. Fruits and vegetables that are high in lycopene include tomatoes, watermelon, pink guava and red pepper. The lycopene in tomato is considered to possess the highest antioxidant activity. The antioxidant property of lycopene is highlighted by its capacity to sequester and its ability to trap reactive oxygen species (ROS) (Amany *et al.*, 2009). This study was therefore designed to determine the safety of lycopene administered to rabbit Bucks by evaluating its effects on electrolytes balance, kidney and liver function.

MATERIALS AND METHODS
This study was carried out at Abubakar Tafawa Balewa University Teaching and Research Farm, Bauchi, Bauchi state, Nigeria. It is located in the north eastern part of the country and has a tropical climate. Lycopene used for this experiment was obtained by extraction from tomato which was procured from an established market in Bauchi metropolis. Fifteen mature mongrel rabbit Buckswere randomly assigned to different treatments in a complete randomized design. The experiment lasted for a period of 12 weeks comprising 4 weeks of stabilization and acclimatization and 8 weeks for oral administration of graded levels of tomato lycopene.

Extraction and packaging of Lycopene from Tomato
Lycopene was extracted using Acetone and Methylene chloride (Dichloromethane) following the method of Gordon *et al* (2007) with some slight modifications.
The following steps were followed:-

- Tomato was washed in a basket with running water only
- It was milled into paste with the aid of a petrol powered 5.5 horse power grinding mill, it was heated and allowed to simmer for five minutes.

- After simmering for five minutes it was poured into a cheese cloth which was suspended above ground level and allowed to drain until 10 percent of the initial weight was attained.
- Tomato paste was processed in batches of 1kg at a time in 1.4 litre of acetone (This was done to dehydrate the tomato paste)
- It was stirred until no longer gummy and then Filtered using a cheese cloth
- The resultant solid material was Placed in 1 litre of Methylene Chloride and then
- Filtered with the aid of 110mmØ whatman paper
- The filtrate was allowed to evaporate at room temperature leaving behind lycopene at the base of the beaker.
- It was then subjected to light spectrophotometric authentication in selected solvents such as Hexane and chloroform
- It was further graded into 0.25gram, 0.50gram, 0.75gram and 1gram
- Wheat flour was used as excipient which was mixed thoroughly with lycopene and finally packaged in capsules.

Blood Collection

Blood was collected from each buck through the marginal ear vein (ear veinipuncture) every fortnight (two weeks) to examine major electrolytes, liver and kidney function.

RESULTS AND DISCUSSION

Figure1 and 2 below shows that the maximum absorbance of lycopene in chloroform and hexane was at 475nm and 470.5nm respectively, this very closely coincides with the three peaks characteristics of Lycopene at λ = 446nm, 472nm and 505nm (Monica, 2011).

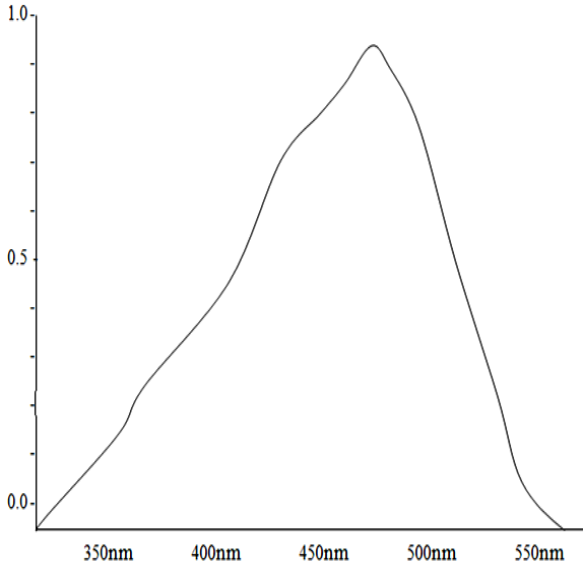


Fig1: Absorbance Spectrum of Lycopene in Chloroform

nm (nanometre)

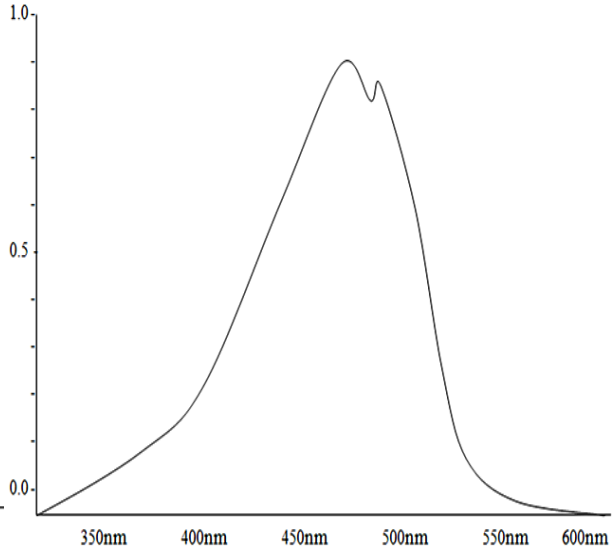


Fig2: Absorbance Spectrum of Lycopene in Hexane

nm (nanometre)

Electrolytes Balance

The role of balanced electrolytes in male animals cannot be overemphasised. In this study sodium, potassium, chloride and bicarbonate were tested. The results in table 1 shows that all the electrolytes were within the normal range except for bicarbonate in treatment one (T1) which is the control group with no lycopene administered. This indicates that lycopene helped to maintain electrolytes balance.

Table 1: Electrolyte balance of rabbit Bucks administered graded levels of lycopene

Parameters	T1(0.00)	T2(0.25)	T3(0.50)	T4(0.75)	T5(1.00)
	Lycopene				
Sodium (140-160 mmol/L)	153.91±0.88	152.67±3.06	155.58±5.78	154.92±3.79	152.17±2.31
Potassium (4.3-5.8 mmol/L)	4.88±0.06	5.15±0.1	4.9±0.53	4.87±0.32	4.91±0.68
Chloride (90-110 mmol/L)	105±0.47	101.42±1.73	97.67±8.50	98.83±6.24	105.67±4.73
Bicarbonate (16-32 mmol/L)	33.66±3.95#	24.67±5.03	22.33±5.29	27.83±4.04	20.00±2.08

Means that it is outside the normal range

(mmol/L) Millimoles Per Litre

Liver Function

A loss of liver function will result in retaining waste metabolites in the body, there by affecting performance, in view of this, total protein, albumin, total bilirubin, alkaline phosphatase (ALP), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were examined to determine the effect of lycopene on the functionality of the liver. The result in table 2 showed that lycopene did not affect liver function as all the parameters tested were within the normal range. This is also an indication that lycopene was well tolerated and metabolised by the liver without affecting its functionality.

Kidney Function

The kidneys are responsible for maintenance of homeostasis which directly impacts performance of rabbit Bucks, in this study parameters such as uric acid, urea nitrogen and creatinine were examined. Table 3 shows that all parameters tested were within the normal range at all lycopene levels. From the results therefore, it can be deduced that lycopene did not adversely affect the kidneys but rather maintained the functionality of the kidneys.

Table 2: Liver function of rabbit Bucks administered graded levels of lycopene

Parameters	T1(0.00)	T2(0.25)	T3(0.50)	T4(0.75)	T5(1.00)
	lycopene				
Total Protein (5.4-7.3g/dl)	6.12±0.75	5.77±0.26	6.34±0.29	6.14±0.15	6.40±0.60
Albumin (2.4-4.5g/dl)	3.98±0.21	3.71±0.29	3.52±0.50	3.52±0.38	3.48±0.70
Total Bilirubin (up to1.0 mg/dl)	0.48±0.10	0.61±0.17	0.56±0.06	0.53±0.23	0.59±0.17
ALP (4-20 U/L)	13.42±1.00	11.83±6.66	14.00±0.58	12.25±6.24	13.67±4.04
AST (10-120 U/L)	60.50±28.43	55.17±14.84	49.50±13.28	66.25±9.45	90.08±26.16
ALT (10-45 U/L)	25.50±2.89	24.03±5.51	22.67±16.00	32.42±12.70	22.75±11.06

(mg/dl) milligrams per deciliter (ALP) Alkaline phosphatase
(g/dl) grams per deciliter (AST) Aspartate aminotransferase
(ALT) Alanine aminotransferase

Table 3: Kidney function of rabbit Bucks administered graded levels of lycopene

	Lycopene				
Parameters	T1(0.00)	T2(0.25)	T3(0.50)	T4(0.75)	T5(1.00)
Uric Acid (1.0-4.3 mg/dl)	2.50±0.52	3.55±0.31	3.68±0.76	2.98±0.66	3.13±0.84
Urea Nitrogen (10-33 mg/dl)	22.33±6.66	22.00±6.24	25.08±7.94	21.42±10.82	21.92±6.00
Creatinine (0.5-2.2 mg/dl)	1.24±0.56	1.63±0.15	1.73±0.26	1.51±0.61	1.35±0.31

(mg/dl) milligrams per decilitre

CONCLUSION AND RECOMMENDATIONS

This study has shown that lycopene does not have any adverse effect on the electrolyte balance, kidney and liver function of rabbit Bucks. This is an indication that lycopene up to 1gram is safe to use as an antioxidant to combat oxidative stress and improve overall performance of rabbit Bucks.

REFERENCES

Amany M. Basuny, Ahmed M. Gaafar and Shaker M. Arafat. (2009). Tomato lycopene is a natural antioxidant and can alleviate hypercholesterolemia. *African Journal of Biotechnology***8**(23), 6627-6633.

Gordon Anthon and Diane M. Barrett. (2007). Standardization of a Rapid Spectrophotometric Method for Lycopene Analysis Proc. Xth IS on the Processing Tomato Eds.: A. B'Chir and S. Colvine. *Acta Horticulturae*. 758.

Jean CP. (2012). Oxidative Stress.*Journal of Parenteral and Enteral Nutrition.* **20:** 10

Monica V B and Camilia V G. (2011) The use of some nanoemulssion based on aqueous propolis and lycopene extract in the skin's protective mechanisms against UV radiation. *Journal of Nanobiotechnology*. **9**: 3.

Saleh S.Y., Attia K.A., Fouad M., Nassar M.M. (2010). Effcts of Multi-enzyme Feed Additive "Kemzyme" or/and Sodium Bentonite "as a Feed Binder"on Sexual Activity and Some Fertility Parameters of Rabbit Bucks. *Journal of Agricultural Science.***2**: 89-99.

EFFECT OF STORAGE AND SPECIES ON THE PERCENTAGE YOLK INDEX AND HAUGH UNIT OF VARIOUS POULTRY SPECIES

*** Ezeoke F. C., & ** N. J Okeudo**
**Department of Animal Science, Chukwuemeka Odumegwu Ojukwu University Igbariam Campus,P.M.B 6059,Awka Anambra State Nigeria.*
***Department of Animal Science and Technology, Federal University of Technology Owerri P.M.B 1526, Owerri, Imo State, Nigeria*
**Corresponding author: richfrank101@gmail.com 08067182660*

ABSTRACT
This study was designed to compare the egg quality of three poultry species (turkey, chicken and guinea fowl) under two storage methods (refrigeration and room temperature) over 28 days storage period. A total of 72 eggs comprising 24 eggs from each species, were assessed for exterior and interior quality at 0, 7, 14, 21 and 28 days of storage as well as the determination of chemical composition at 0 day of age using the 3 x 2 factorial design. Results obtained showed that the average weight of fresh turkey eggs was 69.13 g; chicken eggs, 60.13 g and guinea fowl eggs, 38.50 g .However, there was significant decline in haugh unit due to species and method of storage, but the decline in guinea fowl eggs was relatively faster from 21st day of storage. These are important issues in egg handling, transportation, processing and consumption.
Keywords: Storage; Percentage yolk index; Haugh unit; three species of poultry eggs.

INRODUCTION
All living organisms need protein because it is the basic structural material from which all body tissues are formed such as muscles, skin, nerves, blood cells, hair, hooves, bone, etc. (Esonu, 2006) No other nutrient can replace protein in the ration, because, in addition to its importance as a structural component, all enzymes and many hormones are proteins (Esonu, 2006). Because of the animal's numerous needs for protein and its irreplaceable nature, there is a certain minimum dietary level recommended for each class of animal, depending on physiological age and type of production (Esonu, 2000). Animal products being one of the most important constituents of human diet which aid in proper development of the body are in short or limited supply. The husbandry system coupled with the hot and humid tropical climate adversely affect product quality. Although eggs are less perishable compared with meat and milk, evidence exist nonetheless showing that chicken egg quality depreciates significantly after one week of storage under ambient condition. Presently, there is scare information on the effect of storage on the quality of poultry eggs of various species and storage temperatures. Turkey eggs and more importantly guinea fowl eggs are consumed in large numbers in Nigeria, and interestingly little are known about changes in exterior, interior and chemical quality parameters during handling and storage. Research in this area is justified because of the immense importance of poultry eggs in human diet, and losses that may be incurred during storage.

MATERIAL AND METHOD
A total of 72 eggs comprising 24 eggs each from turkey, chicken and guinea fowl were used in this study. Fresh turkey and chicken eggs were obtained from a commercial farm at Isuofia in Aguata Local Government Area of Anambra State. Fresh guinea fowl eggs were obtained from dealers in Awka, Anambra State because of wild nature of guinea fowl.
The 24 eggs from each species were divided into two groups of 12 eggs and kept in the refrigerator at 4° C while the second 12 eggs were kept under the ambient temperature of 26 ^{0}C - 30 ^{0}C (room temperature) on a plastic egg crate respectively. The 12 eggs from each group were further sub divided into four of three eggs for each sub groups. Three eggs from each group were cracked for interior and exterior quality measurement at seven days intervals. The albumen height and width were measured using venier caliper. The egg was broken out on a flat plate, and readings were taken in millimeters. Then the albumen was separated from the yolk and poured in a petri dish. The albumen weight was taken. The yolk was separated from the albumen using a spoon and the weight measured on the sensitive electronic balance. The yolk height and width were measured with the pin end of venier caliper. The haugh unit was calculated using the formula derived by Haugh (1937):

$$HU = 100Log (H+7.57 – 1.7W^{0.37})$$

Where H = Observed albumen height (mm) and

W = Observed weight of eggs (g)

The ratio of yolk height to average of the width was taken as the yolk index while the ratio of the albumen height to average albumen width was also taken as the albumen index.

Statistical analyses were carried out using the 3 x 2 factorial designs. Factors were 3 poultry species (turkey, chicken and guinea fowl) and 2 storage methods (refrigeration and room storage). Data analysis was executed using the analysis of variance for completely randomized design. Egg quality parameters were regressed on shell thickness / percentage weight loss, and the correlation coefficients tested for significance. Means having significant differences were separated using the least significant difference (LSD) method as describe by Snedecor and Cochram (1983). Statistical analysis was performed using SAS (1999) computer application software.

RESULTS AND DISCUSSION

The effect of species by storage method interaction is shown in table 4.8. Generally and in few exceptions yolk index was highest in guinea fowl eggs throughout the four storage periods in both refrigerated and room temperature stored eggs (P>0.05). After the 7th day of storage, yolk indices of guinea fowl and chicken eggs stored under refrigeration were similar to yolk indices of counterparts stored under room temperature, whereas for turkey eggs room temperature stored eggs were significantly lower in yolk index than those stored under refrigeration (P<0.05). After the 28th day of storage, species related differences in yolk index among eggs stored under refrigeration were not significant (P>0.05) whereas under room temperature storage, guinea fowl and turkey eggs were similar in yolk index, while chicken eggs were significantly lower in yolk index than eggs from the other two species (P<0.05).

These results suggests that based on the yolk index, guinea fowl eggs would have longer shelf life than turkey or chicken eggs. This observation is supported by the lower weight loss suffered by guinea fowl eggs during storage compared with turkey and chicken eggs (Tables 4.2 and 4.3). However, this is contradicted by the higher haugh unit value recorded by turkey eggs during storage compared with guinea fowl eggs (Table 4.4). Although the haugh unit and yolk index are considered to be the best indicators of interior egg quality (Ogunwole *et al.,2017*), the yolk index may be better than the haugh unit when comparisons across different species are undertaken.

The effect of length of storage on haugh unit of turkey, chicken and guinea fowl eggs are presented in Table 4.4. Although, fresh guinea fowl eggs were significantly higher (P<0.05) in haugh unit than turkey and chicken eggs, this was not the case during storage. By the 7th and 28th days of storage, turkey eggs were significantly higher (P<0.05) in haugh unit than chicken and guinea fowl eggs, whereas chicken eggs were higher (P < 0.05) in haugh unit than the eggs from the other two species by the 21st day of storage. Differences in haugh unit between the three poultry species were not significant (P>0.05) by the 14th day of storage. These results indicate that no clear trend could be established in the differences in haugh unit between these species during a storage period of 28 days. However, in all the poultry species and for all the storage periods, eggs stored in the refrigerator were consistently higher in haugh unit (P<0.05) than eggs stored under room temperature. This was in support with Akinola, and Iyomo,(2018). Species by storage interaction effect was not significant (P>0.05) in any of the storage period.

Table 1: Effect of storage and species on the haugh unit of various poultry species

Days	**7**	**14**	**21**	**28**
Species				
Turkey	63.86[a]	50.99	39.7[b]	32.68[a]
Chicken	55.28[b]	49.41	43.17[a]	25.15[c]
Guinea fowl	56.06[b]	48.69	36.04[c]	29.56[b]
SEM	1.18	0.73	0.58	0.36
Storage				
RM	45.53[b]	35.16[b]	26.01[b]	19.06[b]
RG	71.27[a]	64.23[a]	53.29[a]	39.19[a]
SEM	0.964	0.595	0.476	0.292
Interaction				
(Species x Storage)	NS	NS	NS	NS

[a, b, c,] Means in the same column bearing different superscript(s) are significantly different (P< 0.05)
RM = Eggs stored under room temperature
RG = Refrigerated eggs
SEM= Standard error of the mean

Table 2: Effect of storage and species on the yolk index of various poultry species

Days	**7**	**14**	**21**	**28**
Species				
Turkey	0.27[b]	0.31[b]	0.33[ab]	0.29[ab]
Chicken	0.49[a]	0.38[b]	0.32[b]	0.24[b]
Guinea fowl	0.48[a]	0.52[a]	0.40[a]	0.39[a]
SEM	0.029	0.023	0.023	0.35
Storage				
RM	0.40[a]	0.37[a]	0.27[b]	0.19[b]
RG	0.42[a]	0.44[a]	0.42[a]	0.43[a]
SEM	0.029	0.023	0.023	0.35
Interaction				
(Species x Storage)	**	**	**	**

[a, b, c,] Means in the same column bearing different superscript(s) are significantly different (P< 0.05)
RM = Eggs stored under room temperature
RG = Refrigerated eggs
SEM= Standard error of the mean

Table 3: Interaction means on the percentage yolk index between turkey, chicken, and guinea fowl egg stored in room temperature verses refrigeration temperature.

Species	RM	RG 7 days storage
Turkey	0.21^{c}	0.32^{b}
Chicken	0.56^{a}	0.41^{ab}
Guinea fowl	0.42^{ab}	0.54^{a}
SEM		0.054
14 days storage		
Turkey	0.28^{c}	0.34^{bc}
Chicken	0.35^{b}	0.41^{b}
Guinea fowl	0.47^{ab}	0.57^{a}
SEM		0.043
21 days storage		
Turkey	0.30^{bc}	0.35^{bc}
Chicken	0.23^{c}	0.40^{ab}
Guinea fowl	0.27^{c}	0.52^{a}
SEM		0.043
28 days storage		
Turkey	0.24^{b}	0.34^{ab}
Chicken	0.07^{c}	0.41^{a}
Guinea fowl	0.25^{b}	0.53^{a}
SEM		0.065

$^{a, b, c,}$ Means in the same column bearing different superscript(s) are significantly different ($P< 0.05$)
RM = Eggs stored under room temperature
RG = Refrigerated eggs
SEM= Standard error of the mean

REFERENCES

Akinola, I. A.F. and Iyomo, E. 2018. Egg quality analysis and performance of laying hens fed different levels of calicium. Nigeria Jounal Animal Production, 45(1): 172-182.

Esonu, B.O. (2000). Animal Nutrition and Feeding A Function Apporach, (1st Ed). Rukzeal& Sukson Associate, Owerri . 199 p

Esonu, B.O, R.O. Izukanne, O. O Emenalom, E.B. Etuk, O.A. Iyang, S.Samuel, F. Ezeoke and B. Mere (2006) Evaluation and economics of enzyme supplementation on the performance of broiler finishers fed soybean hull meal based diets.Nigeria Journal of Animal Production 33(2) 215-221.

Ogunwole, O.A. Adesope A.I., Raji, A.A and Oshibanjo, O.D (2017) .Effect of partial replacement of dietary maize with cassava peel meal on egg quality characteristics of chicken during storage . Nigeria J. Anim Sci 2017(2): 140-152.

SAS (1999). SAS Institute INC. CARY, NC, USA.

Snedecor, G W. and Cochran, W.C. (1983). Statistical Methods (7th ed.). The Iowa State University Press, Ames, Iowa.

GROWTH PERFORMANCE AND GHRELIN GENOTYPES OF THREE YORUBA ECOTYPE CHICKEN STRAINS

Bolarinwa M.O.[1] , Adeyemo, G.O., Awodele O.A.[1] & Popoola M.A.[1]
[1]Federal College of Animal Health and Production Tech., Moor Plantation, Ibadan.
Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria
**Corresponding author: polymeragro@gmail.com.*

ABSTRACT
Growth performance and haemoglobin polymorphisms in relation to the Ghrelin Genotypes present in three Yoruba ecotype chicken strains were evaluated. Blood sample was collected from 45 Yoruba Ecotype chicken strains: Frizzled Feathered (FF), Naked Neck (NN) and Normal Feathered (NF) for ghrelin genotyping via electrophoresis using standard procedures. Growth performance data were generated for 18 weeks: Initial and Final Body Weight, Body weight gain, Feed Intake, Feed conversion Ratio (FCR) and the mortality rate. Data were subjected to ANOVA and means were separated using the Duncan Multiple Range Test. Ghrelin genotyping of the three Yoruba ecotype chicken strains for 18 weeks showed that genotypes AA and AB were observed, while genotype BB was absent among the chicken strains. Results revealed that ghrelin genotypes had significant effects ($p<0.05$) on Final Weight, Body weight gain, Feed Intake, FCR and the mortality rate. The highest final body weight was recorded in the NN genotype (888.08±0.12g), while the lowest final weight gain was recorded in the NF genotype with (805.10±0.12g). The highest body weight gain was also recorded in the NN genotype with (858.61±0.14g) and the least body weight gain was recorded in the NF genotype (775.67±0.14g).The lowest feed intake was recorded in the NN genotype (5538.46±7.09g) while the highest feed intake was recorded in the NF genotype (5752.46±7.09g).The highest FCR was recorded in the NF genotype (7.42±0.01g) while the lowest FCR was recorded in the NN genotype (6.45±0.01g). The picture of the ghrelin genotypes during electrophoresis showed the genotypes A and B. The base pairs (bp) of 300 and 400 indicated the genotype AA while the base pairs (bp) of 300,400,500,700,900 up to 1000 indicated the BBgenotypes. It was concluded that Naked Neck chicken with the ghrelin genotypes AA and AB had the lowest feed intake and FCR, which indicated that Naked Neck ghrelin genotypes AA and AB favoured better growth performance.

INTRODUCTION
The indigenous chickens or native chicken populations was about 103 million in Nigeria (RIM, 1992), with the largest percentage in the Northern part. These birds among others inherent advantages over their exotic counterparts are hardy can adapt to rural environment, survive on little inputs and is better in both fertility and hatchability of egg (Ige *et al*., 2012). Nevertheless, these birds are important reservoirs of useful (major) genes and possess a number of adaptive traits. Among the major genes that have been found potentially useful to the tropical environment are Naked neck (*Na*) and Frizzle (*f*) genes. These genes have been associated with heat stress (Horst, 1989). Thus, they serve as a good pool for genetic improvements (Mengesha and Tsega, 2011).

Variation in haemoglobin has been reported to cause depression in percentage egg production in mutant haemoglobin type compared with normal or heterozygous haemoglobin (Lowe and Washburn, 2007).

Haemoglobin polymorphism is a term used in genetics to describe the multiple forms of a single gene that exists in an individual or among a group of individuals. (Williams *et al*.,1990).

In animal industry, growth traits of animals are always of primary concern during breeding for its determinant economic value (Zhang *et al.,* 2008).

The growth traits are complex traits involving multiple genes, loci and interactions (Hua *et al.,* 2009).

Ghrelin is a circulatory hormone produced by the entero endocrine cell of the gastro intestinal tract especially the stomach and it is often called a "Hunger Hormone" because it increases food intake. (kojima *et al.,* 1999). Ghrelin is a 28- amino acid peptide in a monogastric species (Dickin*et al.,* 2004).

It is primarily produced by oxyntic cells in the stomach or abomasum with smaller amounts produced by the intestine and pancreas (Hosoda *et al.,* 2006). Ghrelin stimulates the secretion of GH, increases

food intake and in turn produces gain in weight (Solomis *et al.*, 2014) . Ghrelin is the only known peripherally produced and centrally active orexigenic hormone that is considered to be an important gut-brain signal for appetite control and energy balance (Solomis *et al.*, 2014).

The objectives of these investigations were therefore to evaluate the growth performance of three Yoruba ecotype chicken strains in relation to ghrelin genotypes. And also to determine ghrelin haemoglobin polymorphisms among three Yoruba ecotype chicken strains.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of the Federal College of Animal Health, I.A.R&T, Ibadan, Nigeria and the experiment lasted for 18weeks

Data Collection

From day one, growth performance indices were recorded for the Yoruba ecotype chickens (FF, NN and NF) and at the eighteenth week, 2-5 mLs of blood was sampled through the jugular vein into EDTA bottles. The blood samples were then placed in a cooler containing iced block to maintain the stability of the blood and then taken to Biotechnology Laboratory, Abeokuta, Ogun state for genotyping.

DNA Extraction and Electrophoresis

DNA Extraction is a routine procedure used to isolate DNA from the nucleus of cells. The extraction was carried out using Blood-Plant Animal DNA preparation kit following standard procedures.

Data Analysis

Data were subjected to analysis of variance (ANOVA) according to SAS (2004) and means were separated using Duncan multiple range test.

RESULTS

Table 2: Growth performance and Ghrelin genotypes of three Yoruba ecotype chicken strains at week 18

	Strains			
Parameters	FF	NF	NN	SEM±
Ghrelin Genotypes	(AA, AB)	(AA, AB)	(AA, AB)	
Initial Weight(g/b)	29.38	29.43	29.48	0.05
Final Weight(g/b)	839.42^{b}	805.10^{c}	888.08^{a}	0.12
BWG (g/b)	810.05^{b}	775.67^{c}	858.61^{a}	0.14
Feed Intake (g/b)	5590.44^{b}	5752.06^{a}	5538.46^{c}	7.09
FCR	6.90^{b}	7.42^{a}	6.45^{c}	0.01
Mortality (%)	1.92^{b}	2.25^{a}	1.91^{c}	0.00

^{a,b,c}means along the same row with different superscripts are significantly different ($p<0.05$). Feed intake (FI), Body weight gain (BWG), Feed conversion ratio (FCR).

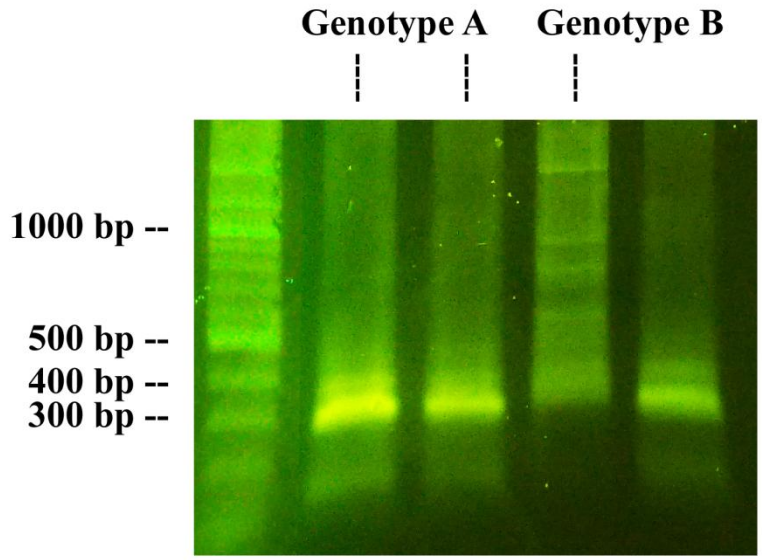


Figure 1: Shows the picture of Ghrelin genotype bands during Electrophoresis. Bp (base pairs)

DISCUSSION

The Growth performance and Ghrelin genotypes of the three Yoruba Ecotype chicken strains at 18 weeks showed that the Naked Neck with Ghrelin genotypes AA and AB had highest value for body weight gain (858.61±0.14g) with the lowest feed intake (5538.46±7.09g) and the lowest Feed conversion ratio (6.45±0.01g). This corroborates the findings of Nakazeto *et al.,* 2001, which states that Ghrelin influences energy metabolism and body composition. The result of the Ghrelin haemoglobin polymorphisms of the three Yoruba ecotype chicken strains showed that there was remarkable variation in the Yoruba ecotype chicken as two haemoglobin variants AA and AB alleles were identified with corresponding detectable genotype HbAA and HbAB. This showed that the population of this Yoruba ecotype chicken is Homozygous. This does not agree with the findings of (Ibe, 1990) who observed three haemoglobin variants AA, AB and BB alleles with corresponding detectable genotypes HbAA, HbAB and HbBB which showed that the population of the indigenous chicken is Heterozygous, which may be as a result of crossbreeding of indigenous chicken with the exotic strains or may be due to the larger sample size used. The report of (Washburn *et al.,* 1971) showed that chicken of the homozygous haemoglobin genotypes as observed in this study are approximately 20% less susceptible to Marek's disease. The Homozygous genotypes observed in this study could be an added advantage in conferring resistance to this disease. The picture of the Ghrelin Genotype bands during Electrophoresis showed the Genotypes A and B. The first band which is the ladder serves as a guide to measure the Ghrelin levels and Genotypes. Genotype AA had a base pair of 300 and 400 while genotype AB had the base pair of 300,400,500,700,900 up to 1000. The more the bands, the more the variations among the ghrelin genotypes which is an indication of wider heterozygosity. From the results of this study, chicken strains with the Ghrelin genotypes A and B are more distant from one another as a result of variation among the population samples

CONCLUSION AND RECOMMENDATION

It is concluded that Naked neck strains with ghrelin genotypes AA and AB had a better Feed Conversion Ratio with a consequential enhanced growth performance.

It is also concluded that proper evaluation of ghrelin genotypes and other genes in chicken genome as they affect feed intake, weight gains and overall animal protein food security is important.

RECOMMENDATION

Also, since the Naked Neck strain has the highest final and body weight gains, therefore naked neck chicken should be selected and improved upon for their growth performance as this will contribute to availability and affordability of meat and its products for the masses**,** particularly in the rural communities.

REFERENCES

Dickin, J. C., Thue, T. D., Buchanan, F. C. (2004).An alternative splice site in ghrelin is missing in ruminants. *Anim. Genet.* 35, 411–412.

Horst, P. (1989). Native fowls as reservoir for genomes and major genes with direct and indirect effect on adaptability and their potential for tropically oriented breeding plans.Arch. Geflugel 53(3):93-101.

Hosoda, H., Kojima, M., Kangawa, K. (2006). Biological, physiological and pharmacological aspects of ghrelin. *Sci,*100(5): 398-410.

Hua, G. H., S. L. Chen, J. N. Yu, K. L. Cai and C. J. Wu et al., (2009). Polymorphism of the growth hormone gene and its association with growth traits in Boer goat bucks. *Meat Sci.,* 81: 391-395.

Ibe, S. N. (1993). Growth performances of normal, frizzle and naked neck chicken in a tropical environment. *Nigerian Journal of Animal Production* 20(1- 2): 25-29.

Ige, A. O., Salako, A. E., Yakubu, A., Ojedapo, L. O., Adedeji, T. A. and Adeoti, T. M. (2012).Comparison and prediction of morphological characteristics of frizzled feathered and naked neck chicken in Derived Savannah zone. *Production Agriculture and Technology*8(2):68-75.

Kojima, M., Hosoda, H., Date, Y., Nakazeto, Matsuo, H., Kangawa, K. (1999). "Ghrelin is a growth hormone releasing acylated peptide from the stomach" Nature.402(6762): 656-60.

Lowe, R.H. and Washburn, K.W. (2007). A pleitropic effect of a mutant haemoglobin type in chicken 1. *British Poultry Science* 12 (2): 235-244.

Mengesha, M. and Tsega, W. (2011).Phenotypic and genotypic characteristics of indigenous chickens in Ethopia: A review. *African Journal of Agricultural Research* 6(24):5398- 5404.

RIM (1992).Nigerian Livestock Resources. II. National Synthetic Annex Publication Resources Inventory Management Ltd.

SAS. (2004). Statistical Analysis Institutes User's Guide. SAS Insti. inc.Car N.C.,10th edition.Pp.100

Solomis, S., Korbonits, M. (2014). The role of ghrelin in weight-regulation disorders: Implications in clinical practice. *Hormones*, 13(4): 458-475.

Williams, J. K., Kubelik A. R., Livak K. J., Rafalski J. A and Tingey S. V. (1990).DNA polymorphisms amplified by arbitrary primers are useful as genetic markers. Nucleic acids Res., 18:6531-6535.

Zhang, W. (2008). Ghrelin, a Gastric Hormone with Diverse Functions, Chemical Biology, Deniz Ekinci (Ed.), ISBN: 978-95351- 0049-2.

A STUDY ON SOME MORPHOMETRIC TRAITS OF RED SOKOTO AND SAHEL GOATS IN MAIGATARI LOCAL GOVERNMENT AREA OF JIGAWA STATE

Adamu, H., Ma'aruf, B. S., Shuaibu, A. & Umar, H. A
Department of Animal Science, Faculty of Agriculture, Federal University of Kashere, Gombe P.M.B 0182 Gombe State
Corresponding author email: *habibuadamu2016@gmail.com*

ABSTRACT

The study was conducted in Maigatari Local Government Area of Jigawa State. A total of 250 goats (187 Red Sokoto and 63 Sahel) of mixed sex and age were used to obtain the following parameters; body weight (BW), body condition score (BCS), body length (BL), heart girth (HG), wither height (WH), udder length (UL), udder circumference (UC), testicular length (TL) and testicular circumference (TC). The animals were sampled from Maigatari main livestock market. Data generated were subjected to analysis of variance, Pearson's correlation analysis and stepwise linear regression. Red Sokoto had mean BW, BCS, BL, HG, WH, UL, UC, TL and TC of 20.58 kg, 3.20, 22.45 cm, 25.28 cm, 22.93 cm, 3.48 cm, 5.99 cm, 4.97 cm and 7.88 cm, respectively. The corresponding values for Sahel were 22.91 kg, 3.00, 23.58 cm, 25.07 cm, 24.55 cm, 4.14 cm, 7.06 cm, 4.75 cm and 7.52 cm. Sahel goats had significantly higher BL (P<0.01) and WH (P<0.001). Female goats were heavier than male and had longer body, wider chest and higher height at wither. Except TC, goats of 36 - 48 months had the highest for all the significantly affected traits (BW, BCS, BL, HG and WH; P<0.001). The correlation coefficients observed among the morphometric traits were in general high, positive and significant, while the accuracy of the predictive equation when HG and in combination with BL were used to predict live weight was also high. This study indicated that breed had no effect on most body characters and that live weight can best be predicted using HG.

Key words: Morphometrics traits, breed, sex, age, goat.

INTRODUCTION

Small ruminants are important genetic resources and play apredominant role in the sustenance of the livelihoods of impoverished families especially inthe rural areas of tropical countries. Caprine species specifically goats play animportant role in the social life of many Africans and supply human population withmeat, milk, skin, manure and other products. The Red Sokoto goat (RSG) or Maradi is the most predominant breed and accountsfor about 70% of Nigeria's total goat population (Ademosun, 1994). It is commonly found with the agro pastoralist mainly within thenorthern sub-humid and semi-arid zones of the country (Akpa *et al.,* 2001). The Sahel goat is an extant meat and milk type goat in Nigeria (Otoikhian and Orheruata, 2010). It is large in size, predominantly white colour, pied with black or white and brown spots around the ear, nose and udder. This breed is found alongthe northern border of Nigeria, particularly Borno State, where it is often known as"Balami, although this name has not been adopted as it would lead to confusion with thebetter known sheep breed Balami. Morphometric characteristics are important in breed identification and classification. Gizaw *et al.* (2007) stated that morphostructural description of traits remained essential component of characterization that can be used to physically identify, describe and recognize a breed. It also helps in the classification of livestock breeds. The knowledge of morphometric traits aids in appropriate breeding design, feeding and health management (Thiruvenkadan, 2005).

MATERIALS AND METHODS

Study Location

The study was conducted at Maigatari Local Area of Jigawa State. Maigatari is located between longitude 48.26^0 12' N and latitude 25.50^0 9'E and is 352m above sea level (Encarta Encyclopedia, 2009 PC version). It has an average annual rainfall of 418 mm per annum, which starts from late April or early May and ends in mid-October.

Experimental Animal and Management

A total of 250 goats (180 Red Sokoto and 70 Sahel) of mixed sexes and ages(1 year = 1PPI, 2 years = 2PPI, < 2-3 years = 3PPI and 3.5-4 years above = 4PPI) were used for the study. The animals were randomly selected from Maigatari main livestock market.

Data Collection

Body weight and seven linear body measurements were recorded. They include; body length (BL), heart girth (HG), wither height (WH), testicular length (TL), testicular circumference (TC), udder length (UL) and udder circumference (UC). The measurement was done using a flexible tailors tape, while the wither height was accessed with a measuring stick.

Body Condition Score

Body condition score (BCS) was achieved through palpation of visible bone structure. Animals were palpated over the back bone, loin and rump. Fat condition was smooth to palpate while bone structure with little or no fat cover felt rough to touch. These general assessments were used to place each goat in a category of body condition (very thin = 1, thin = 2, moderate = 3, fat = 4 and obese = 5).

Data Analysis

Data generated were subjected to general linear model (GLM) procedure of SPSS, version 22 (2013). Significantly different means were compared using the least significant differences (LSD). The model utilized was as follow:

$Y_{ijk} = \mathbf{U} + \mathbf{B}_i + \mathbf{S}_j + A_k + \mathbf{e}_{ijk}$

$\mathbf{Y}_{ijk}$ = Observation on dependent variables

U = Common Mean

$\mathbf{B}_i$ = effect of ith breed (1, 2)

$\mathbf{S}_j$ = effect of jth sex (1, 2)

$\mathbf{A}_k$ = effect of kth age (1, 2, 3, 4)

$\mathbf{e}_{ijk}$ = random error term

The relationships among the linear body measurements and body weight were estimated using Pearson's correlation analysis. Stepwise regression procedure was used to find the best linear combination of morphometric traits that can predict body weight. This was performed for male, female and the pooled data. The following linear and multiple regression models were applied:

$Y_1 = a + bx$ - - - - - - (2) simple regression model

$Y_1 = a + b_1x_1 + b_2x_2 + \ldots + b_kx_k$ - - - -(3) multiple regression model

Where Y = dependent variable

a = the Intercept, bs = the slopes and x = independent variable.

RESULTS

Average morphometric traits according to breed, sex and age are presented in Table 1. There was significant effect of breed on BL ($P<0.001$) and WH ($P<0.01$). Sahel goats had lengthier body and higher wither height than Red Sokoto (23.88±0.43 and 24.55±0.41 cm vs 22.45±0.50 and 22.93±0.44 cm). However, non-significant effect of breed on BW, BCS, HG, UL, UC, TL and TC was observed. Significant effect of sex on BW, BL, HG ($P<0.001$) and HG ($P<0.05$) was observed. Females were heavier and had longer body, wider chest and higher wither height than males (25.28±1.00 kg, 24.54±0.41 cm, 26.48±0.40 cm and 24.25±0.38 cm vs 18.51±1.34 kg, 21.80±0.55 cm, 24.47±0.53 cm and 23.24±0.50 cm). Non-significant influence of sex on BSC was however evident. Significant influence of age on BW, BCS, BL, HG, WH ($P<0.001$) and TC ($P<0.01$) was observed. Except TC, goats of 36 - 48 months had the highest for all the significantly affected traits. The correlation coefficients for separate and both sexes are presented in Table 2, 3 and 4. The coefficients observed were in general high, positive and significant except between WH and TL in male and between BW and UC, BCS and BL, WH, UL and UC in females.

Predictive equations of body weight from linear body measurements are shown in Table 5. Of all the body traits recorded, heart girth was observed to have the highest coefficient of determination, while subsequent inclusion of body length in females and pooled data of both sexes yielded better result.

Table 1: Average morphometric traits according to breed, sex and age

		Morphometric traits							
Factor	BW	BSC	BL	HG	WH	UL	UC	TL	TC
Overall mean±S.E.	21.90±1.08	3.14±0.16	23.17±0.42	25.47±0.41	23.74±0.38	3.81±0.48	6.52±1.10	4.86±0.23	7.70±0.23
Breed	NS	NS	**	NS	***	NS	NS	NS	NS
Sahel	22.91±1.11	3.00±0.17	23.88±0.45	25.67±0.44	24.55±0.41	4.14±0.53	7.06±1.19	4.75±0.31	7.52±0.31
Red Sokoto	20.88±1.21	3.20±0.19	22.45±0.50	25.28±0.48	22.93±0.44	3.48±0.60	5.99±1.32	4.97±0.34	7.88±0.33
Sex	***	NS	***	***	*				
Male	18.51±1.34	3.07±0.21	21.80±0.55	24.47±0.53	23.24±0.50	-	-	-	-
Female	25.28±1.00	3.21±0.16	24.54±0.41	26.48±0.40	24.25±0.38	-	-	-	-
Age	***	***	***	***	***	NS	NS	NS	**
Yearlings	17.76±1.25^{b}	2.88±0.20^{c}	20.85±0.51^{b}	23.57±0.49^{b}	22.02±0.46^{b}	3.78±0.71	5.95±1.58	4.44±0.50	7.16±0.50^{b}
12-24 months	19.54±0.90^{b}	2.72±0.14^{c}	21.93±0.37^{b}	24.61±0.36^{b}	23.40±0.33^{b}	3.08±0.58	4.94±1.30	5.95±0.31	6.91±0.31^{b}
24-36 months	27.71±0.86^{a}	3.65±0.14^{b}	25.27±0.35^{a}	27.79±0.34^{a}	25.61±0.32^{a}	4.42±0.44	8.47±0.97	5.53±0.39	9.04±0.38^{a}
36-48 months	27.87±2.67^{a}	3.43±0.42^{a}	25.38±1.10^{a}	28.29±1.10^{a}	25.79±0.98^{a}	5.80±1.23	7.70±2.74	-	-

BW = Bodyweight, BCS = Body condition score, BL= Body length, HG = heart girth, WH= Wither height, TL= Testicular length, TC= Testicular circumference, UL= Udder length and UC= Udder circumference. * = P<0.05, ** = P<0.01, *** = P<0.001, NS = Non-significant and S.E = Standard error

Table 2: Phenotypic correlation coefficients among morphometric traits in male goats

Variable	1	2	3	4	5	6	7
BW (1)	1	0.913**	0.919**	0.983**	0.871**	0.523*	0.791**
BCS (2)		1	0.870**	0.885**	0.830**	0.627**	0.833**
BL (3)			1	0.922**	0.834**	0.445**	0.752**
HG (4)				1	0.872**	0.507**	0.752**
WH (5)					1	0.346^{NS}	0.539*
TL (6)						1	0.774**
TC (7)							1

BW = Bodyweight, BCS = Body condition score, BL= Body length, HG = heart girth, WH= Wither height, TL= Testicular length, TC= Testicular circumference. * = P<0.05, ** = P<0.01 and NS = Non-significant.

Table 3: Phenotypic correlation coefficients among morphometric traits in female goats

Variable	1	2	3	4	5	6	7
BW (1)	1	0.395*	0.818**	0.839**	0.720**	0.371*	0.318NS
BCS (2)		1	0.336NS	0.505**	0.194NS	0.154NS	0.152NS
BL (3)			1	0.754**	0.748**	0.509**	0.436*
HG (4)				1	0.650**	0.487**	0.439*
WH (5)					1	0.419*	0.418*
UL (6)						1	0.847**
UC (7)							1

BW = Bodyweight, BCS = Body condition score, BL= Body length, HG = heart girth, WH= Wither height, UL= Udder length and UC= Udder circumference. * = P<0.05, ** = P<0.01 and NS = Non-significant.

Table 4: Phenotypic correlation coefficients among morphometric traits in both sexes goats

	1	2	3	4	5
BW (1)	1	0.600**	0.898**	0.917**	0.781**
BCS (2)		1	0.598**	0.681**	0.465**
BL (3)			1	0.867**	0.785**
HG (4)				1	0.758**
WH (5)					1

BW = Bodyweight, BCS = Body condition score, BL= Body length, HG = heart girth and WH= Wither height. ** = P<0.01.

Table 5: Prediction equation of body weight from heart girth and body length

Sex	Prediction equation	Coefficient of determination (R^2)
Male	BW = -33.54 + 2.13HG	0.96
Female	BW = -35.04 + 2.28HG	0.69
	BW = -39.50 + 1.40HG + 1.15BL	0.77
Pooled	BW = -39.86 + 2.44HG	0.84
	BW = - 37.81 + 1.50HG + 0.96BL	0.88

BW = Bodyweight, BL= Body length, HG = heart girth. R^2 = Coefficient of determination

DISCUSSION

The facts that breed had effect on BL and WH as observed in the present study agrees with the findings of Guifen *et al*. (2014) who reported a significant variation in morphometric and carcass traits of different genotypes of goats. Similarly, the work of Sanni *et al*. (2018) on different breeds of goats (Kalahari and Sokoto reds, Sahel and WAD) native to Africa also detected a significant variation on morphostructural traits and it has been suggested that the wide variation observed between Sahel and WAD goats could lead to heterotic gain (Zaharaddeen *et al*., 2008). Some authors (Gizaw *et al*., 2007; Agaviezor *et al*., 2012) attributed this variation to inherent genetic potential of each breed, geographical isolation and ecological variation. The significantly higher BSC observed in Red Sokoto goats contradicts the work of Brown and Swan (2012). The results obtained in the present study indicated that morphometric characteristic of Red Sokoto goats was sexually dimorphic in favour of females. This agrees with the work of Ma'aruf *et al*. (2018) in Yankasa sheep breed. Contrary to the present observation, Sowande *et al*. (2008) showed that male sheep were superior to female in live weight and most body measurements. They attributed this differences to genes linked with sex chromosomes. Shuaibu *et al*. (2018 and 2019) also made similar assertion in Yankasa sheep that males had higher values for morphometric traits than females.

The effect of age on live weight and linear body measurements observed in this study agrees with the work of some investigators (Afolayan *et al*., 2006; Mavoule *et al*., 2013) who reported that adult sheep were heavier than the younger ones and had higher values for linear body measurements. Similarly, Mekuriawa *et al*. (2013) reported higher values for morphometric traits in adult sheep compared to the younger and yearling ones and suggested that selective improvement of body weight and conformation traits should be emphasized at this stage (adult). The correlation coefficients observed among the morphometric traits were high, positive and significant. This is in line with the work of Afolayan *et al*. (2006) who reported that live weight was highly correlated with body dimensional traits. The finding of Shuaibu *et al*. (2018) on Yankasa sheep also indicated that the relationship between live weight and linear body measurements were mostly moderate to high which shows that they can predict each other. Working on dairy goat (Saneen), Pesmen and Yerminci (2008) however reported low to moderate relationships among these traits. The highest R^2 observed in this study when BW is predicted from HG conform the report of Tsegaye *et al*. (2013) that this trait (HG) is positively correlated with live weight (LW) and can indicate it with high precision (R^2 = 0.94). Similar report by Tadesse and Gebremariam (2010) in sheep also showed that heart girth predicted LW with higher accuracy of 0.69. Yakubu (2010) attributed this relationship to pleiotropic gene action that exist between the two traits. In the present finding, subsequent inclusion of body length in females and in pooled data of both sexes yielded better values, this agrees with the report of Tadesse and Gebremariam (2010) who observed higher R^2 when BL and WH are included in the predictive equation of BW from HG.

CONCLUSION

I. The results of this study showed that breed had no influence on body weight and most linear body measurements, however, significant effect of sex and age was observed.
II. The correlation coefficients observed among the morphometric traits were in general high, positive and significant.
III. The coefficient of determination observed in the prediction of body weight from height girth was high, but subsequent inclusion of body length in female and the pooled data of sexes yielded better result.
IV. Heart girth predicted body weight with highest precision.

REFERENCES

Ademosun, A. A. (1994). Constraints and prospects for small ruminant research and development in Africa. In: Small Ruminant Research and Development in Africa. *Proceedings of the 2nd Biennial Conference of the African Small Ruminant Research Network, Arcc, Arusha, Tanzania*. 7th – 11th December: 1 - 6.

Agaviezor, B. O., Peters, S. O., Adefenwa, M. A., Yakubu, A., Adebambo, O. A., Ozoje, M. O., Ikeobi, C. O. N., Wheto, M. Ajayi, O. O., Amusan, S. A., Ekundayo, J. O., Sanni, M. T., Okpeku, M., Onasanya, G. O., De Donato, M., Ilori, B. M., Kizikaya, K. and Imumorin I. G. (2012): Morphological and microsatellite DNA diversity of Nigerian indigenous sheep. *Journal of Animal Science and Biotechnology*, **3**: 38 – 44.

Akpa, G. N., Asiribo, O. E., Oni, O. O. and Alawa, J. P. (2001).The influence of non-genetic factors on the shape of lactation curves in Red Sokoto goats. *Nigerian Journal ofAnimal Science*, **72**: 233 - 239.

Afolayan, R. A., Adeyinka, I. A. and Lakpini, C. A. M. (2006). Estimation of live weight from body measurements in Yankasa sheep. *CezchJournal of Animal Science*, **51**(8): 343 – 348.

Brown, D. and Swan, A. (2012). Genetic analysis of adult body weight and condition score in Merino Sheep. *Proceedings, 10th World Congress of Genetics Applied to Livestock Production. Animal Genetics and Breeding Unit, University of New England, Armidale, NSW, Australia*.

Ijomanta, E.O. (2012). Genetic Profile of Morphological Traits and their Association with Production Capacity of Red Sokoto Goat in Katsina State. M.Sc. Thesis, A.B.U, Zaria. Pp: 22 - 26.

Gefu, J. O. (1992). Analysis of factors associated with management of goat in Kano state. *Journal Animal Production Research*, **12** (1): 31 – 39.

Gizaw, S., van Arendonk, J. A. M., Komen, H., Windig, J. J. and Hanotte, O. (2007). Population structure, genetic variation and morphological diversity in indigenous sheep of Ethiopia. *Animal Genetics*, **38**: 621– 628.

Guifen L., Fachun, W., Enliang, S., Xiaomu, L., Xiuwen, T. and Haijian, C. (2014): SNP identification and analysis in part of exon 3 of beef cattle MSTN gene and variation among breeds. *Journal of Animal and Veterinary Advances*, **13**: 174 – 177.

Ma'aruf, B. S., Ibrahim, T., Umar, H. A., Shu'aibu, A. and Okoh, J. J. (2018). Effects of age and sex on body weight, body condition score and biometric traits of Yankasa Sheep. *Nigerian Journal of . Animal Science and Technology***1**(2): 39 – 46.

Mavule, B., Muchenje, V., Bezuidenhout, C. and Kunene, N. (2013). Morphological structure of Zulu sheep based on principal component analysis of body measurements. *Small Ruminant Research*, **111**(1): 23 - 30.

Mekuriawa, S., Mekuriawb, Z., Tayeb, M., Mekuriawb, G., Amanea, A., T. Bimrewa, T. and Haile, A. (2013). Growth performance and linear body measurements of Washera, Farta and their crosses under farmers' management system in Western Highland of Amhara Region. *Scientific Journal of Veterinary Advances*, **2**(9): 132-143.

Otoikhian, C. S. O. and Orheruata, A. M. (2010). The white Bornu goats: Untapped meat-breed in Nigerian small ruminant industry. Klobex Academic Publishers. Bioscience Research Communications 22: 6.

Peacock, C. (2005). Goat: A pathway out of poverty. *Small Ruminant Research*, **60**: 179 - 185.

Pesmen, G. and Yardimci, M. (2008). Estimating the live weight using some body Measurements in Saanen goats. *Archivos de Zootecnica*, **11**: 30 - 40.

Sanni, M. T., Okpeku, M., Onasanya, G. O., Adeleke, M. A., Wheto, M., Adenaike, A. S., Oluwatosin, B. O., Adebambo, O. A. and Ikeobi, C. O. N. (2018). Genetic morphometry in Nigerian and South African Kalahari Red goat breeds. *Agricultura Tropica Et Subtropica*, **51**(2): 51 – 61.

Sownade, O. S. and Sobola, O. S. (2008). Body measurements of West African Dwarf sheep as parameters for estimation of live weight. *Tropical Animal Health and Production*, **40**: 433-439.

Shuaibu, A., Umar, H. A., Ja'afar, A. M., Mujitaba, M. A. and Almajiri, I. (2019). Morphometric characterization of Yankasa sheep in Bauchi South of Bauchi State, Nigeria. *International Journal of Advances in Scientific Research and Engineering,* **5**(2): 34 - 43.

Shuaibu, A., Aliyu, A., Ja'afar, A. M., Ma'aruf, B. S. and Mujitaba, M. A. (2018). Phenotypic characterization of Yankasa sheep in Northern Agricultural Zone of Bauchi State, Nigeria. *Nigerian Journal of Animal Science and Technology*, **1** (2): 36 - 45.

Tadesse, A. and Gebremariam, T. (2010). Application of linear body measurements for live body weight estimation of high sheep in Tigray region, North-Ethipia. *Journal of the Dry land*, **3**(2): 203-207.

Thiruvenkadam, A. K. (2005). Determination of best fitted regression model for estimation of body weight in Kanni Adu kids under farmers' management system. *Livestock Research for Rural Development*, **17** (7): 1-11.

Yakubu, A. (2010). Path coefficients and Path analysis of body weight and biometric traits in Yankasa lambs. *Slovak Journal of Animal Science*,**43**(1): 17-25.

Yakubu, A., Salako, A. E., Imumorin, I. G., Ige, A. O. and Akinyemi, M. O. (2010). Discriminant analysis of morphometric differentiation in the West African Dwarf and Red Sokoto goats. *South African Journal of Animal Science*, **40** (4): 381-387.

Zahraddeen, D., Butswat I. S. R. and Mbap S. T. (2008). Evaluation of some factors influencing growth performance of local goats in Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, **8**: 464 – 479.

EFFECTS OF SEX ON HAEMATOLOGICAL VALUES, BLOOD CHEMISTRY AND CARCASS CHARACTERISTICS OF NOILER CHICKEN

***Ibrahim M., Y.P Mancha & D.J.U. Kalla**
Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria
**Corresponding author: kwala_laras@yahoo.com mobile No: 08038079331*

ABSTRACT
The experiment was conducted to determine the effects of sex on haematological values, blood chemistry and carcass characteristics of Noiler chicken. A total of one hundred and thirty-six (136) eight weeks old Noilers birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system. The experiment lasted for three months. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum. The result showed that cocks and hens haemoglobin (Hb) and packed cell volume (pcv) values were significantly the same ($P<0.05$). The result of PCV (Packed Cell Volume) showed that the PCV values were ($P<0.05$) significantly the same (32.00 and 32.60) for the cocks and hens respectively. This shows that Hb and PCV were not influenced by androgen, which is a hormone that plays a major role in male traits and reproductive activities. The percentage of lymphocytes, neutrophyl, basophyl and eosinophyl were also not significantly different between cocks and hens. The result for biochemical values shows that that there was no significant difference between Noiler cocks and hens in all the parameters tested. From the result it was deduced that dressing percentage was affected by sex, which showed that cocks had higher dressing percentage (77.54) than hens (69.65). From the finding of this study it was concluded that there were no significant differences in haematological and biochemical values between sexes, however cocks showed superior dressing percentage.
Keywords: Sex, Carcass, Noiler, Haematological

INTRODUCTION
Globally, animal protein consumption has steadily increased in the last five years, this is as a result of increased beef consumption. Pork is the number one animal protein consumed around the world, however, the Food and Agriculture Organization (FAO, 2011) predicts chicken will overtake pork as the most consumed animal protein by the year 2020. Consumption is driven by poultry's lower cost and demographic interest that fit with their meat. Inadequate consumption of animal protein by an average Nigerian is on the increase due to the increase in population which has resulted in the demand for protein of animal origin to surpass its supply. Food and Agricultural Organization (2006) reported that an average Nigerian takes about 5.5g of animal protein per day which is very low compared to the recommended 77g per day. The solution to the problem of inadequate consumption of animal protein by an average Nigerian is to increase the production of highly productive animals with short generation interval such as rabbits, pigs and poultry (Ani and Adiegwu, 2005). The development of indigenous breeds with improved meat and egg production is also a solution to the problem of poor consumption of animal protein. Recently the development of NOILER chicken by Amofarm Siebere Hatchery in Nigeria is a step in the right direction becausese Noiler chicken is a natural cross breed between broilers, layers and indigenous local chicken. There is little information about the bird focusing on the haematological and carcass characteristics of Noiler chicken. This research is expected to generate information on the Carcass yield, Gut and Organ characteristics and haematological values of male and female Noiler chicken.

MATERIALS AND METHODS
The experiment was conducted at the poultry section of the Bauchi State Agricultural Development Programme (BSADP) along Yelwan Makaranta Dass Road, Bauchi State. A total of one hundred and thirty-six (136) eight weeks old Noilers birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system and were randomly distributed into 3 treatment groups based on strain using a Completely Randomized Design (CRD). The experiment lasted for three months. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum.

Data Collection and Analysis

At 34 weeks, twenty four (24) birds were randomly selected from each of the three strains with each strain having twelve (12) cocks and hens respectively for haematology and biochemical analysis. 3ml of blood samples were collected from the basillic vein of the birds into a well labelled sterile bottle containing anticoagulants. These were used to determine packed cell volume, hemoglobin (hb), white blood cell count (WBC), and the differential counts which are Neutrophils, lymphocites, monocites, Eosinophil and Basophils. Another 3ml sample of blood was collected into sterile labelled bottles without anticoagulants to determine the serum biochemical metabolites as follows: total protein, cholesterol, Glucose, Albumin, calcium, phosphorus, uric acid.

Hematological technique

Total red blood cell count and Total white blood cell count were determined by a manual method using hematocytometer (Campbell, 1995). Differential counts were made on monolayer blood films, fixed and stained with leishman – stain. Packed cell volume was measured by a standard manual technique using micro hematocrit capillary tubes and hematocrit reader. Haemoglobin concentration was measured by cyanhemoglobin method (Ritchie *et al.,* 1994).

Biochemical technique

Total protein, glucose, calcium, phosphorus, cholesterol, and uric acid, were determined by automatic analyzer.

Gut and Carcass Analysis

At the end of the experiment, nineteen (19) birds were randomly selected from each of the three strains with each strain having ten (10) hens and nine (9) cocks. They were deprived of feed for twelve hours but provided with drinking water. The chickens were weighed and slaughtered. Slaughtered birds were scalded in hot water (about 50^0c) for 1 minute and plucked manually, offal were then eviscerated for carcass yield and organ weight determination. The carcass yield and organ weight were calculated as percentage of the live weight. Dressing percentage was calculated using the relationships: -

$$\text{Dressing percentage} = \frac{\text{carcass weight}}{\text{live weight}} \times 100$$

Statistical Analysis

Analysis of variance was carried out on data collected using the general linear model of SPSS (2011). Where means differed, Duncan multiple range test (DMRT) was used to separate them (Duncan, 1955).

RESULTS AND DISCUSSION

The result for the effects of sex on haematological values of Noiler chickens is shown in Table 1.The result showed that cocks and hens haemoglobin (Hb) and packed cell volume (pcv) values were ($P<0.05$) significantly the same. The result disagrees with the study conducted by Addass et al., (2012) on indigenous chickens where they observed that cocks generally have higher hb value than the hens. PCV values were ($P<0.05$) significantly the same (32.00 and 32.60) for the cocks and hens respectively. The percentage of lymphocytes, neutrophyl, basophyl and eosinophyl were also not significantly different ($P<0.05$) between cocks and hens.

The result for the effects of sex on biochemical values of Noiler chicken is shown in Table 2. The result obtained indicates that there was no significant difference between Noiler cocks and hens in all the parameters tested.

Table 1: Effects of Sex on Haematological Values of Noiler Chickens

	Sex		
Parameters	**Cocks**	**Hens**	**SEM**
Heamoglobin (gldl)	11.47	10.90	0.39NS
Parked cell volume %	32.00	32.60	1.19NS
White blood cell %	3.62	4.54	0.54NS
Neutrophil %	39.04	38.28	0.73NS
Lymphocytes%	50.80	55.94	0.87NS
Monocytes%	2.23	3.66	0.17NS
Basophils%	0.00	0.00	0.00NS
Eosinophils%	0.00	0.20	0.00NS

SEM=standard error of mean, NS= Not significant

Table2: Effects of Sex on Biochemical Values Noiler Chicken

	Sex		
Parameters	**Cocks**	**Hens**	**SEM**
Total protein(gl)	63.92	57.98	1.19NS
Albumin (mmol/l)	22.61	23.94	0.46NS
Glucose (mmol/l)	4.29	1.38	0.23NS
Cholesterol (mmol/l)	2.46	5.41	1.74NS
Calcium (mmol/l)	3.31	2.36	0.59NS
Phosphorus (mmol/l)	1.23	2.58	1.01NS

SEM-standard error of mean, NS= Not significant

The result for effects of sex on effects of sex on carcass and gut characteristics Noiler chickens is shown in Table 3. From the result it was deduced that only dressing percentage was affected by sex. The cocks have higher dressing percentage (77.54) than the hens (69.65). Dressing percentage is the proportion of live weight that is obtained as a carcass. The dressing percentage indicates the quantity of meat that could be obtained from the animal. Report by Jones et al. (1994), who reported a higher dressing percentage for cocks agrees with the finding of this research. However the dressing percentage of the Noiler hen indicated that it can also be used as a meat animal thereby qualifying the Noiler as a dual purpose breed.

Table 3: Effects of Sex on Carcass and Gut characteristics Noiler Chickens

Parameters	Sex			
	Cocks	**Hens**	**SEM**	**LS**
Live weight	2.48	3.61	0.108	NS
Plucked weight	2.2	3.36	0.104	NS
Eviscerated weight	1.94	3.12	0.102	NS
Carcass weight	1.74	2.81	0.98	NS
Dressing percentage	77.54^{a}	69.65^{b}	1.24	*
Head	6.8	7.21	7.194	NS
Leg	6.8	7.28	4.192	NS
Gizzard	3.9	3.12	1.24	NS
Liver	3.9	3.12	41.18	NS
Kidney	0.3	0.35	0.083	NS
Small intestine	9.6	5.26	4.39	NS
Large intestine	0.9	0.82	0.22	NS
Pancrease	0.3	0.35	3.13	NS
Abdominal fat	9.07	5.9	6.94	NS
Spleen	0.17	0.2.	1.65	NS
Ceacum	1.7	1.6	16.7	NS
Lungs	1.1	1.2	10.35	NS
Heart	1.2	1.2	12.61	NS

SEM – Standard error of mean, LS= Level of significant, * = Significant (P<0.05)
NS- Non significant

CONCLUSION

From the finding of this study it was concluded that there were no significant differences in haematological and biochemical values between sexes, however cocks showed superior dressing percentage.

REFERENCES

Addass, P.A., David, D.L., Edward, A., Zira, K. E., & Midau, A. (2012). Effect of Age, sex and management of system on some Haermological parameters of intensively and semi–intensively kept chicken in Mubi, Adamawa state, Nigeria. Iranian journal of applied Animal science, (3), 277-282.

Ani, A.O and Adiegwu, L.I (2005). The Feeding value of velvet beans (mucuna pruriens) to weaner rabbits in procvcedings 30th Annual conference of Nigeria society for annual production, march 20th – 24th 2005, university of Nigeria, NSUKKA Nigeria 186 -189.

Campbel, T.W (1995). *Avian Hematology and Cytology, IOWA state university press Ames, IOWA.*

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics 11:1-42.

FAO (2011). World Livestock 2011 – Livestock in food security. Rome, Fap. Pp. 115

Food and Agricultural organization (2006). Official statistics, Rome

Jones M.P (2015). Avian Hematology Clin lab med sep; 35(3):649-59.

Ritchie, B.W. Harrisson, J.G. and Harrison, R.L. (1994). *Avian Medicine wingers publishing inc. Florida.*

SPSS (2011) SPPSS Statistics for windows, version 20.0 Armonk, NY.IBM Corp.

INFLUENCE OF TEASER HENS ON SASSO SEMEN COLLECTION, QUALITY AND SPERMATOZOA CHARACTERISTICS

Idahor K.O.
Department of Animal Science, Nasarawa State University, Keffi, Shabu-Lafia Campus
Email address: koidahor@nsuk.edu.ng

ABSTRACT
In poultry, body weight is an important trait when selecting for breeding flock performance, hence Sasso cock could be notable in any breeding program. But the size may not be convenient for massage technique during semen collection. As a result, this study was aimed at using teaser hens to ease semen collection in Sasso cocks without massaging. Twelve Sasso cocks with 4 each in Control (T1): massage technique, use of Sasso hen as a teaser (T2) and use of local hen as a teaser (T3). Another set of 4 each of Sasso hens and local hens were used as teasers in T2 and T3, respectively. In T1, gentle massage on the back and the abdominal regions of the cocks was done to collect semen. While in T2 and T3, Sasso and local hens were used as teasers for semen collection (without massage). Capillary tubes were used in the collection of semen that was promptly processed for semen quality and spermatozoa characteristics determinations. It was observed that only a cock (representing 25%) responded to semen collection when local hen was used as a teaser, whereas all the cocks (100%) responded to massage technique and use of Sasso hen as a teaser. The semen volume ranged from 0.12ml (T3) to 0.22ml (Control) and the total spermatozoa count was similar (405 – 459 x 10^6/ml) across the treatments. Since the Sasso cocks responded to use of teaser hens in semen collection and the semen quality as well as spermatozoa characteristics were apparently not compromised, use of teasers in semen collection could be an alternative technique in poultry.
Keywords: ACGG-Nigeria, artificial insemination, poultry species, spermatozoa quality

INTRODUCTION
It has been established that assessment of semen quality in poultry species, gives an excellent indication of the reproductive potential and it was stated to be a major determinant of fertility and hatchability of eggs, which in turn determines hatchery enterprise profitability (Islam *et al*., 2002). Poultry semen quality as reported by Tarif *et al.* (2013) includes semen volume, glucose level and pH as well as spermatozoa concentration and motility.
According to Ganpule (2018), Sasso is the premium quality coloured broiler breeder that was exclusively bred from original parent breeding stocks in France. It was stated that it has been proven to be hardy, easy to manage and was regarded to as a multipurpose bird, hence its international popularity. These attributes make Sasso cock a reputable strain and may be a suitable research bird for demonstration of artificial insemination technique in breeding programs.
Unfortunately, the weight may not be convenient for the usual massage method of semen collection, as a result of possible injuries and discomfort during massage for semen collection in large poultry species. This has often times resulted in frequent administration of antibiotics and anti-stress medications, which could be detrimental. Therefore, use of teasers as being practiced to collect semen in rabbits, swine and ruminants (Barszcz *et al*., 2012; Dominiek *et al*., 2011; Naughton *et al*., 2003), could be a veritable alternative to the usual massage technique in poultry species.

MATERIALS AND METHODS
Experimental birds and welfare
From a large stock of Sasso birds reared in deep litter system, by African Chicken Genetic Gains Research Group at the Teaching and Research Farm, Nasarawa State University, Keffi, Shabu-Lafia Campus. Twelve cocks at 24 weeks old were randomly selected, weighed, housed individually and acclimatized for two weeks. Breeders' mash as well as cool clean drinking water was offered *ad libitum.* The twelve Sasso cocks were distributed 4 each to Control (T1): massage technique, use of Sasso hen as a teaser (T2) and use of local hen as a teaser (T3). Another set of 4 each of Sasso hens and local hens were kept separately and used as teasers to arouse the Sasso cocks in T2 and T3, to ease semen collection without massage. During the acclimatization period, teasers were introduced only to the cocks in T2 and T3 twice daily, but were not allowed to mount.

Semen collection techniques

Massage technique

Gentle "to and fro" stroke on the back feather using one hand accompanied with abdominal massage toward the tail with the other hand to stimulate the copulatory appendage was done to cause the ejaculatory papillae to swell. Upon eventual secretion of semen on the swollen ejaculatory papillae, capillary tube was used in the semen collection as described by Burrows and Quinn (1937).

Use of teaser technique

A teaser hen was introduced one at a time to the Sasso cocks individually. Immediately the cock advances to mount the teaser, it was allowed a short time and then picked up at the point of ejaculation. Without any massage, semen was secreted on the swollen ejaculatory papillae and capillary tube was used in the collection as described by Burrows and Quinn (1937).

Data collection and statistical analysis

Body weight of the Sasso cocks, number of cocks that responded to semen collection technique, response time to semen collection, semen volume and pH were recorded. Also, semen glucose, motile spermatozoa, sluggish spermatozoa, alive spermatozoa, dead spermatozoa and total spermatozoa count were determined, following the guide of Bakst and Long (2010). Data were subjected to analysis of variance at $\alpha_{0.05}$ using SPSS (2010).

RESULTS AND DISCUSSION

Table 1 shows the influence of teaser hens on Sasso cocks' semen collection, quality and spermatozoa characteristics. There were no statistical variations (P<0.05) in all the parameters measured, except in response time to semen collection and semen volume.

Table 1: Influence of teaser hens on Sasso cocks' semen collection, quality and spermatozoa characteristics

	Semen collection techniques (±STD)		
	Control	Teaser	
Parameters	T1	T2	T3
Number of cocks	4	4	4
Body weight (kg)	4.19±0.17	3.77±0.56	3.82±0.33
NCRSC	4 (100%)	4 (100%)	1 (25%)
Response time (minutes)	5.25±1.26^{c}	9.75±3.86^{b}	30.0±0.00^{a}
Semen volume (mL)	0.22±0.03^{a}	0.17±0.03^{b}	0.12±0.00^{c}
Semen pH	7.50±1.0	7.25±0.96	7.80±0.00
Semen glucose (mol/L)	5.28±0.26	5.20±0.22	5.0±0.00
Motile spermatozoa (%)	68.75±12.48	64.25±13.68	62.00±14.88
Sluggish spermatozoa (%)	31.25±13.20	35.75±13.68	38.00±14.06
Alive spermatozoa (%)	50.00±33.66	63.75±29.26	40.00±0.00
Dead spermatozoa (%)	50.00±33.66	36.25±29.26	60.00±0.00
Total spermatozoa count ($\times 10^6$/mL)	459.10±231.5	455.50±.266.08	405.48±235.8

a,b,c: Mean values on the same row with different superscript differ statistically at 5% probability test; NCRSC: Number of cocks that responded to semen collection technique; STD: Standard deviation; T1 (Control): Massage technique; T2: Use of Sasso hen as a teaser; T3: Use of local hen as a teaser.

This observation probably indicated that irrespective of collection technique, semen quality and spermatozoa characteristics may not be compromised. It was observed that only a cock (25%) responded to semen collection when local hen was used as a teaser. This probably suggested that Sasso cocks were reluctant to mate with the local hens, resulting in delay response time of 30 minutes compared to massage technique and use of Sasso hen as a teaser, where all the cocks (100%) responded between 5 and 10 minutes. This could be largely due to the size of the local hen that was relatively very small compared to that of a Sasso hen. The observed Sasso cocks' responses to teaser hens perhaps, suggested that a teaser could be used in poultry breeder semen collection as established in cattle (Barszcz *et al.*, 2012), pigs (Dominiek *et al.*, 2011) and rabbits (Naughton *et al.*, 2003).

The superiority (P<0.05) of semen volume recorded in T1 over T2 and T3, may be a mere coincidence and probably due to only a cock that gave 0.12ml in T3, unlike in T1 and T2 where the values were obtained from 4 hens. However, it possibly indicated that massage technique may be better than the use of teasers. Generally, it has been reported that semen volume of poultry species are low but very high in spermatozoa concentration (Hafez and Hafez, 2000). Meanwhile, the semen volume, pH and glucose values were similar to what was reported in poultry species (García-Herreros, 2016; AL Mahdi *et al.,* 2014). Therefore, collecting semen from Sasso cocks using teasers without massaging, may not down grade semen quality.

There were more dead spermatozoa (60%) in semen collected with a local hen as a teaser, slightly followed by massage technique (50%) compared to 36% recorded when Sasso hen was used as a teaser. This observation could be a mere coincidence and not possibly due to the treatment. The quantum of motile spermatozoa recorded was similar to a range reported in birds by Froman (2007).

The spermatozoa concentration was within the values given as normal in poultry breeder cocks (Latif *et al.,* 2005; Nwagu *et al.,* 1996). Therefore, use of teasers in Sasso cocks' semen collection may not influence semen quality and spermatozoa characteristics.

CONCLUSION AND RECOMMENDATION

Sasso cocks apparently responded to teaser hens in semen collection yet, the semen quality and spermatozoa characteristics were seemingly not affected. Thus, use of teasers in collecting semen in poultry species could be adopted, as already being practiced in some mammals. However, in depth research investigations, on the use of different teasers in order to develop avian research and improve poultry production may be required.

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REFERENCES

AL Mahdi A.B., Ondho Y. S. and Sutopo O. 2014. Comparative studies of semen quality on different breed of chicken in Poultry Breeding Center Temanggung-Central Java. *Intl. R. J. Engineer. Sci*. 3(2): 94 – 103.

Bakst M. R. and Long J. A. 2010. Techniques for semen evaluation. Semen storage and fertility determination. St. Paul, Minnesota, the Midwest Poultry Federation. Pp. 113.

Barszcz K., Wiesetek D., Wąsowicz M. and Kupczyńska M. 2012. Bull semen collection and analysis for artificial insemination. *J. Agric. Sci*. 4(3): 1 – 10.

Burrows W.H. and J.P. Quinn 1937. The collection of spermatozoa from the domestic fowl and turkey. *Poult. Sci*. 16: 19 – 24.

Dominiek M., Alfonso L. R., Tom R., Philip V. and Ann V. S. 2011. Artificial Insemination in Pigs, Artificial Insemination in Farm Animals. ISBN: 978-953-307-312-5,

Froman D.P. 2007. Sperm motility in birds: insights from fowl sperm. Soc. *Reprod. Fertil. Suppl*. 65: 293 – 308.

Ganpule S. 2018. Farmer's guide to Sasso coloured broiler management. SASSO Country Manager, India. Pp. 9 Accessed in January, 2020 at: www.poultryproducer.com.

García-Herreros M. 2016. Sperm subpopulations in avian species: a comparative study between the rooster (*Gallus domesticus*) and Guinea fowl (*Numida meleagris*). *Asian J. Androl*. 18: 889 – 894.

Hafez, B. and Hafez, E.S.E. (2000). Reproduction in Farm Animals. 7th Ed. New York. Lippincott Williams and Wilkins, USA.

Islam M.S., Howlider M.A.R., Kabir F. and Alam J. 2002. Comparative assessment of fertility and hatchability of barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock hens. *Intl. J. Poult. Sci.* 1(4): 85 – 90.

Latif A., Ijaz A., Aleem M. and Mahmud A. 2005. Effect of osmotic pressure and pH on the short-term storage and fertility of broiler breeder sperm. *Pak. Vet. J*. 25: 179 – 183.

Naughton C.K., Nelson D.R. and Thomas A.J. 2003. Development of an inexpensive artificial vagina for semen collection from rabbits. *J. Androl*. 24(5): 712 – 715.

Nwagu B.I., Reroot P.I., Abubakar B.Y., Oni O.O., Adeyinka I.A. and Egbuedo U.C. 1996. Semen characteristics of Rhode Island Red and White breeder cocks. *Nig. J. Anim. Prod*. 23: 1 – 4.

SPSS 2010. Statistical package for Social Sciences, SPSS Inc., 444. Michigan Avenue, Chicago, IL 60611.

Tarif A.M., Bhuiyan M.M.U., Ferdousy R.N., Juyena N.S. and Mollah M.B.R. 2013. Evaluation of semen quality among four chicken lines. *J. Agric. Vet. Sci*. 6: 7 – 13.

INFLUENCE OF MILKING HYGIENE ON PREVALENCE OF MASTITIS IN DROMEDARY CAMEL (*Camelus dromedarius*) IN AZARE, BAUCHI STATE, NIGERIA

Idi, Y[1]; Kalla, D J U[1]; Sanusi, M[1]

[1]Department of Animal Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria.

[2]Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria.

Correspondence E-mail: idiyusuf5@gmail.com +2348038488924

ABSTRACT

The study aimed at assessing the influence of milking hygiene on prevalence of mastitis in dromedary camel (*Camelus dromedarius*) in Azare, Bauchi State, Nigeria.A cross-sectional survey was carried out on 189 lactating dromedary camels in pastoral herds in Azare. Questionnaire and oral interview were used to generate data on pre milking udder preparation and hygiene, vaccination/medication, tick control, parity and stage of lactation. California Mastitis Test was carried out to evaluate the prevalence of mastitis in the pastoral herds.The results obtained showed only 10% of the herders wash their hands before milking and none washed hands between milking lactating camel. Only 10% of the herders practice tick control, while all herders cover/tie the udder/teat as anti-suckling device. Mastitis prevalence rate of 17.17% was recorded. Significant ($p<0.05$) association was observed between parity and mastitis prevalence. General herd management and hygiene during milking should be improved to avoid transfer of pathogen from among animals.

Key word: Udder,Hygiene, Management, Mastitis, Camel

INTRODUCTION

Camel milk is one of the main components of diet of the nomads in semi-arid and arid zones and is an essential food for livelihood of people and it may be the only milk available in places where other milking animals cannot be maintained (Abdurahman 2006). Despite the environmental constraints, camel is known to meets the demands of the pastoralist in terms of milk. Wernery (2003) reported that a good milker produce 20-30 litres of milk daily. Average daily milk yield of the Somali breed camels was reported to range from 5-8 litres (Bekele *et al.,* 2002). Estimates of lactation periods vary from 9-18 months (Ramet 2001; Bekele *et al* 2002).

Mastitis, an inflammation of the mammary gland caused by bacterial infection, trauma, or injury to the udder, remains the most common and most expensive disease affecting the dairy industries throughout the world. Micro-organisms invading the mammary gland via the teat cause 90-95% of mastitis problems in cows, while 5-10% of mastitis problems were due to injury (NebGuide 2003). Factors that predispose animals to mastitis include poor hygiene, poor animal husbandry, the malfunction of milking machines, and poor milking techniques.

Management plays a major role in the level of mastitis, which is evident on many dairy farms. Higher levels of mastitis usually occur on farms with a low level of sanitation, suboptimal teat dip application, inadequate dry cow antibiotic procedures, poor milking techniques, or inadequate machine maintenance (Costello 1998).

Improper milking practices may cause production of diseases of mastitis pathogen. Mastitis bacteria are spread from cow-to-cow at milking time by whatever touches the udder and teats, be it hands, udder cloths and teat cups (Billet 1995). Therefore, the aim of the study were to determine the influence of milking hygiene on prevalence of mastitis in dromedary camel in Azare

MATERIALS AND METHODS

Study area

This study was carried out in Azare, Katagum Local Government area of Bauchi State. Katagum lies between latitude 9.3^0 and 12.3^0N and longitude 8.5^0 and 11.0^0E (BASGD 2006). The research area lies within the Sahelian region, characterized by low rainfall (700mm in the extreme north). The rainfall in the area begins around June/July and lasted for 4-5 months. The vegetation of the area

consist of mainly short grasses, with shrubs and scanty trees. Ambient temperature fluctuates throughout the year and it reaches its peak around April/May.

Study animals

Lactating camels in pastoral herd of Arab under traditional management in Katagum Local Government area were used for the study. A total of 189 lactating camels were selected for this study accordingly.

Study design, Sampling and sample size

A cross-sectional epidemiological survey was conducted on 189 lactating camels, in which case study animals were visited once for data collection. Purposive sampling was adopted.

The desired sample size for the study was calculated using the formula given by Dahoo *et al.* (2003) for veterinary epidemiological research with 95% confidence interval and 5% desired absolute precision.

California Mastitis Test (CMT)

Sub-clinical mastitis was diagnosed based on California Mastitis Test (CMT) results and the nature of coagulation (milk and CMT) showed the presence of the infection. A squirt of milk sample was placed in each well on CMT paddle and an equal amount of 3% CMT reagent was added to each well and mixed (Quinn *et al* 1999).

Data analysis

Data were recorded in Microsoft excel spread sheet for statistical analysis using Statistical Package for Social Sciences (SPSS) Version 21. Descriptive statistic using a simple percentage was used to evaluate the prevalence of mastitis and management technique while Chi-square test was carried to evaluate the strength of association between the potential risk factors with occurrence of mastitis in camel.

RESULTS

Characterization of camel management practices

Table (1) revealed the herd management practices. Based on observation while interacting with the herdsmen in their herds early morning before milking, the results showed that, only (10%) of the herds visited washed/prepare the udder before milking the camels. They believed that the calf would clean the udder by suckling. So also none (0%) among the milkers washed their hands between milking the lactating camel. All (100%) the herders practiced the habit of covering/tying the teat while on grazing in order to prevent the calf from suckling the dam while on grazing. Only 40% of the herd visited vaccinate their camels annually. 40% of the herds visited during the study gave medication to their camels whenever their camels are sick and these happened to be the owners who give annual vaccination to their camel, while the remaining 60% do not care to treat camel with conventional drugs rather traditional or none at all. On tick control, the outcome of the research indicated that (90%) the herds visited do not practice any form of tick control. All (100%) herders around Azare gave mineral supplement (potash) to their camel, while none (0%) among the herders gives feed supplement to the camels.

Table 1: Camel Herd Management Practice**s** Azare, Katagum Local Government Area, Bauchi State

	Camel Herders Responses (%)	
Household Practices	**Yes**	**No**
Washing udder before milking	10	90
Washing hand between milking	0	100
Cover/tie udder while on grazing	100	0
Vaccination	40	60
Medication	40	60
Tick control	10	90
Mineral supplementation	100	0
Feed supplementation	0	100

Prevalence of mastitis and its risk factors

Table (2) showed the distribution of CMT results in various locations in the study area. Of the 198 camels examine for sub-clinical mastitis through CMT, 34 (17.17%) showed positive reactions.

Among many mastitis potential risk explanatory variables, two were considered as potential risk factors for the occurrence of sub clinical mastitis in the study area. These were stage of lactation and parity of the lactating camels. Tables 3 showed that there was $p<0.05$ association between parity and sub-clinical mastitis. While non significant $p>0.05$ relationship were observed between occurrence of mastitis and stage of lactation.

Table 2: Overall Prevalence of Mastitis in Dromedary Herds in Azare, Katagum Local Government Area, Bauchi State

	California Mastitis Test			
Location	**Negative**	**Positive**	**Total**	**Prevalence rate (%)**
Katanaga	49	15	64	23.4
Ragwam	42	9	51	17.6
Buskuri	47	6	53	11.3
Magonshi	16	4	20	20
Barkeji	10	0	10	0
Total	**164**	**34**	**198**	**17.17**

Table 3: Association Between the Occurrence of Mastitis and Parity of Lactating Camels in Azare, Katagum Local Government Area, Bauchi State

Parity	**Number**	**Positive**	**Negative**	**Prevalence (%)**	**p-value**
1	36	1	35	2.8	0.011
2	46	9	37	19.6	
3	34	3	31	8.8	
4 and above	82	21	61	25.6	
Total	**198**	**34**	**164**	**17.2**	

P<0.05

Table 4: Association Between the Occurrence of Mastitis and Stage of Lactating Camels in Azare, Katagum Local Government Area, Bauchi State

		Mastitis			
Stage of lactation	**No. of Camel**	**No. Positive**	**No. Negative**	**Prevalence (%)**	**p-value**
≤2 month	88	15	73	44.12	0.933
>2 month	110	19	91	55.88	
Total	**198**	**34**	**164**		

P>0.05

DISCUSSION

It was observed that majority of the herders do not wash hands before and between milking time of the lactating camels, the results indicated poor hygiene practices during milking of lactating camel. This practice may have spread of mastitis pathogen between camels in the camel herds. Agab and Abas (1999) reported that lesions due to ticks infestation and poor udder hygiene were serious problem to udder health, and recommended that milk hygiene should be improved. Hygiene during milking process, and presence of lesion on udder or teats were reported to be significant with the prevalence of mastitis in lactating camel (Husein *et al*., 2013).

Furthermore, herders do not practice any form of tick control in their herds The ticks colonized mostly areas around the udder, particularly the teats, and this created lesions which may have probably given mastitis pathogen access to infect the udder. Amena *et al.* (2011) attributed the high prevalence of mastitis in camel to heavy tick infestation in Ethiopia. Megersa (2010) and Husein *et al.* (2013) reported that one of the factors that predisposed camels to mastitis was the lesions caused by ticks, which facilitate bacterial entry and cause permanent tissue damage, exerxabated by poor udder hygiene.

In this study, all herds visited practiced the tradition of covering the udder to protect the calves from suckling the dam. Similar outcome was reported by Abeer *et al.* (2016) which found out that all udders under his investigation showed marks of faulty anti-suckling devices. A studies carried out in Sudan by Abdurahman (2006) also explained that the use of device to prevent the calves from sucking their dams, together with heavy tick infestation of the udder was considered as the predisposing factor for camel mastitis.

In the present study the overall prevalence of mastitis in dromedary camel was 17.17%, which was significant to affect economic and public health in the study area. The overall prevalence rate reported in the present study was slightly above the values reported by Kalla *et al.* (2008) that the incidence of lactating camels having mastitis was 14.4% in Komodugu-Yobe River Basin, Nigeria. The prevalence rate observed in the present study was consistent with the findings of Al-Jaboori *et al.* (2013) which reported a prevalence rate of 18.5% in Abu-Dhabi, UAE. However, the findings was lower when compared with the findings of other authors in other countries like: Husein *et al.* (2013) 30.2% Ethiopia, Obeid *et al.* (1996) 66.8% Sudan and 29% by Osman *et al.* (1991) in Somali.

The differences in prevalence rate of mastitis in the present study and other reports could be attributed to unhygienic milking procedures and generally poor traditional management practices observed. Earlier work (Mungube *et al* 2004) showed that animals were much more infected by mastitis causing pathogens, mainly in areas where hygienic conditions were poor and treatment of mastitis cases was not well pursued. So also differences in the methods and material employed by the investigators might have been contributed in the wide variation of the prevalence rate reported by different authors.

There were high occurrence of mastitis in dromedary camel with >4 calves than those with 1-3 calves. This is in accordance with the findings of Abera *et al.* (2010) who reported that the risk of clinical and sub clinical mastitis increases with advancing age or parity of the camel. Husein *et al.* (2013) also reported that incidence of mastitis is influenced by age and parity number of the camel. While prevalence of mastitis found to be non significantly ($p>0.05$) associated with the lactation stage of dromedary camel.

CONCLUSION

It could be concluded that mastitis was prevalent in camel pastoral herds in Azare and it environs, and there was poor general herd management and hygiene during milking in the herds. General herd management should be improved to checkmate the prevalence of mastitis in camel pastoral herds in Azare.

REFERENCES

Abdurahman, O.A.S. (2006). Udder health and milk quality among camels in the Errer valley of eastern Ethiopia. *Livestock Research for Rural Development* **18** (8):3-11. https://irrd.cipav.org.co/lrrd18/8/abdu18110.htm

Abeer, A. M., Zakia, A. M., Muna, E. A. and Sabiel, Y. A. (2016). Bacteriological and pathological studies of mammary glands affections in camels *(camelus dromedarius)* at Tumbool abbatoir, Sudan. *British Microbiology Research Journal*. **15**(5): 1-8

Abera, M., Demie, B., Aragaw, K., Regassa, F. and Regassa, A. (2010) Isolation and identification of *Staphylococcus aureus* from mastitic milk and their drug resistance patterns in Adama town, Ethiopia. *Journal of Veterinary Medicine and Animal Health.***2**(3): 29-34

Agab, H. and Abbas, B. (1999) Epidemiological studies on camel diseases in the Eastern Sudan. *World Animal Review* 92:42.

Al-Juboori, A. A., Kamat, N. K. and Sindhu, J. I. (2013) Prevalence of some mastitis causes in dromedary camels in Abu Dhabi, United Arab Emirates. *Iraqi Journal of Veterinary Sciences*, **27**(1): 9-14. http://www.vetmedmosul.org/ijvs

Amena, M. I., Al-Humiany, A. A., Ahmed, M. A. M. and Hoda, M. Z. (2011) Epidemiological and microbiological studies on mastitis in she-camels. *International Journal of Microbiology Research*. **2**:18-27.

BASGD (2006). Bauchi State Government diary Published by (BREPOL) *www.brepols.com.*77

Bekele, T., Zekele, M. and Baars, R. M. K. (2002). Milk production performance of the one humped camel (*Camelus dromedarius*) under pastoral management in semi-arid Eastern Ethiopia. *Livestock Production Science,* **76***:* 37-44.

Billet, R. (1995). Combat mastitis losses. In: *Farmer's Weekly*, 85044, pp 44- 49.

Costello, S. (1998). The role of trace minerals and vitamins in bolstering resistance to mastitis. In: *Dairy Feed Facts*. 18 March, pp 20-23.

Dahoo I., Martin W., and Stryhn H. (2003). Veterinary Epidemiology research; AVC.

Husein, A.,Haftu1, B., Hunde A. and Tesfaye, A. (2013).Prevalence of camel (*Camelus dromedarius*) mastitis inJijiga Town, Ethiopia. *African Journal of AgriculturalResearch*,**8**(24):3113-3120, http://wwwacademicjournals.org/AJAR

Kalla, D. J. U., Zahraddeen, D. and Yerima, J. (2008). Reproductive performance of one-humped camel (*Camelus dromedarius)* at the Komodugu-Yobe River Basin, Nigeria. WBC / ICAR 2008 satellite meeting on camelid reproduction, Budapest, Hungary

Megersa B (2010). An epidemiological study of major camel diseases in the Borana Lowland, Southern Ethiopia. Dry lands Coordination Group Report No. 58, 09, 2010. pp. 32-33.

Mungube, E.O., Tenhagen, B.A., Kassa, T., Regassa, F., Kyule, M.N., Greiner, M. and Baumann, M.P.O. (2004).Risk factors for dairy cow mastitis in the central highlands of Ethiopia. *Tropical animal health and Production***36**(5); 463-472.

NeGguide. (2003). *Basic principles of mastitis control*. [online] University of Nebraska. Available from: http://www.ianr.unl.edu/pubs/dairy/g1253.htm>

Obeid, A. I., Bagadi, H. O. and Mukhtar, M. M. (1996). Mastitis in *Camelus dromedarius* and the somatic cell content of camels' milk. *Research in VeterinarySci*ence **61**:55-58.

Osman, K. H., Abdi A. M., Abdurahman, O., Bornstein, S., Zakrisson, G. (1991). Prevalence of mastitis among camels in Southern Somalia: A pilot study. Camel forum, working paper 37:1-9.

Quinn, P. J., Carter, M. E., Markey, B. and Carter, G. R. (1994). Clinical Veterinary Microbiology, (Wolf publishing, London, England). P. 327.

Ramet, J. P. (2001). The technology of making cheese from camel milk (*Camelus dromedarius*), FAO Animal Production and Health Paper 113. Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy.62p.

Wernery, U., Juhasz, J., Johnson, B. and Nagy P., (2006). Milk production of dromedaries milked with an automatic milking machine: milk yield, quality control and udder hygiene. In: Proceedings of the International Scientific Conference on Camels, Qassim, K.S.A., 2006, Part 2, 833–842.

REVIEW OF CANDIDATE GENES TOWARDS SELECTIVE BREEDING AGAINST SOME MAJOR DISEASES AFFECTING CATTLE, SHEEP AND GOATS IN NIGERIA

[1]Iyiola-Tunji, A.O., [2]John, P.A. & [3]Galadima, M.A.
[1]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria.
[2]Department of Animal Science, Ahmadu Bello University, Zaria.
[3]Department of Biology, Faculty of Life Science, Ahmadu Bello University, Zaria.
Corresponding author: tunjiyiola@naerls.gov.ng

ABSTRACT
Compilation and review of some candidate genes that can be employed in characterization of indigenous livestock in Nigeria for resistance to common diseases were undertaken in this study. The diseases that affected livestock (cattle, sheep and goats) in 2018 and 2019 were presented.
Keywords: Candidate gene, resistance to disease, cattle, sheep and goats

INTRODUCTION
Genetic variation of resistance to internal parasites has been demonstrated in numerous species, including humans and several livestock species (Kloosterman *et al.*, 1992 and Quinnell, 2003). However, the genetic architecture underlying such traits is poorly understood (Kemper *et al*., 2011). Livestock diseases adversely affect animal production throughout the world. Livestock keepers and other stakeholders involved in promoting animal health can draw on a number of approaches to reducing these negative effects (http://www.fao.org/3/a1250e/a1250e05.pdf). Some of the strategies being used to reduce the negative effects of diseases on productivity of farm animals include vaccination, elimination of disease vectors and appropriate management methods. These approaches are sometimes constrained and become less sustainable. Identification of animal genetic resources (AnGR) for resistance to some major diseases of livestock (cattle, sheep and goats) is one of the high end solutions that can provide sustainable reduction to economic losses due to diseases. For many livestock diseases, evidence has been found for genetic variation in the extent to which host animals are susceptible. This paper was aimed at reviewing some candidate genes that can be employed in characterization of indigenous livestock in Nigeria for resistance to common diseases.

Major livestock diseases reported in Nigeria by 2018 and 2019
Reported cases of livestock diseases were shown in Table 1. These reports were documented through the Agricultural Performance Survey (APS) of NAERLS (NAERLS, 2018 and 2019). Contagious bovine pleuropneumonia (CBPP) was reported in six (6) States in 2018 and 2019. Foot and mouth disease was reported among cattle populations in many States of Nigeria. Foot and mouth disease (FMD) is a severe, highly contagious viral disease of cattle. It also affects sheep and goats. Other diseases and pests that affect cattle in Nigeria in 2018 and 2019 were babeiosis, fasciolasis, foot rot, helmithiasis, rinderpest., tick infestation and tuberculosis.
Peste des petits ruminants (PPR) affected sheep and goats in all the agro-ecological zones in Nigeria. The disease was reported to have affected sheep and goats in 16 States in 2018. Plate I showed the estimated loss of sheep and goats to PPR disease in 2018. Other pests and disease that affected sheep and goats in 2018 and 2019 were fleas, foot rot, helminth worms and mange.

Candidate gene for resistance to foot and mouth Disease
Integrin subunit Beta 6 (ITB6) gene was reported to be associated with resistant to foot and mouth disease in cattle (Gowane *et al*., 2013). This gene encodes a protein that is a member of the integrin superfamily. Members of this family are adhesion receptors that function in signaling from the extracellular matrix to the cell. Integrins are heterodimeric integral membrane proteins composed of an alpha chain and a beta chain. Integrin alpha-V: beta-6 (ITGAV: ITB6) is a receptor for fibronectin and cytotactin. It recognizes the sequence R-G-D in its ligands. Internalization of integrin Alpha-V/ beta-6 via clathrin-mediated endocytosis promotes carcinoma cell invasion. It acts as a receptor for fibrillin-I (FBNI) and mediates R-G-D-dependent cell adhesion to FBNI.
The Major Histocompatibility Complex (MHC) gene is a candidate gene considered important for the immune system and disease resistance traits. MHC is a cell surface molecule involved in antigen presentation by glycoprotein receptors (Dukkipati *et al*., 2006). The MHC involves a series of highly

polymorphic genes which are responsible for the initiation of the immune response when an animal is challenged by pathogens or parasite (Santucci *et al*., 2007). The major histocompatibility complex (MHC) is a cluster of tightly linked genes that play an important role in the immune system (Klein, 1986). The products of these genes are involved in the induction and regulation of immune response. The MHC spans approximately 4Mb of human genome, 1.5Mb in mice and approximately 2.5Mb of cattle genome (Lewin, 1996). In cattle, it is located on chromosome 23. The structure and organization of MHC genes of cattle, known as the bovine leukocyte antigen (BoLA) complex, are very similar to those of the human MHC.

Table 1: Reported cases of major diseases affecting cattle, sheep and goats in Nigeria

		Reported cases by States	
Species	**Diseases**	**2018**	**2019**
Cattle	CBPP	Adamawa, Anambra, Gombe, Lagos, Nasarawa, Plateau, Taraba	Bauchi, Borno, Kogi, Kwara, Taraba, Zamfara
	Helminthiasis	Adamawa, Benue, Kano, Niger, Rivers	Benue, Edo, Kwara, Rivers
	FMD	Adamawa, Bayelsa, Gombe, Kano, Katsina, Taraba, Osun, Oyo, Rivers, Sokoto	Borno, Kano, Kogi, Oyo, Rivers, Taraba, Zamfara
	Babeiosis	Niger	Kwara
	Foot rot	Edo	Edo
	Mastitis	Nil	Osun
	Tuberculosis	Nil	Benue, Kano, Ogun
Sheep/Goats	PPR	Abia, Adamawa, Anambra, Benue, Ebonyi, Edo, Gombe, Kano, Katsina, Nasarawa, Niger, Osun, Oyo, Plateau, Rivers, Taraba	Anambra, Benue, Borno, Cross River, Ebonyi, Edo, Ekiti, FCT, Imo, Kogi, Osun, Oyo, Plateau, Rivers, Taraba, Zamfara
	Helminthiasis	Adamawa, Benue, Edo, Kano, Plateau, Rivers, Taraba	Bayelsa, Benue, Cross River, Edo, Kwara, Plateau
	Babeiosis	Imo	Ebonyi
	Foot rot	Bayelsa	Akwa-Ibom
Sheep	Brucellosis	Nil	Zamfara
Goat	Leptospirosis	Nil	Zamfara

CBPP: Contagious bovine pleuropneumonia; PPR: Peste des petits ruminants
Source: NAERLS APS Report 2018 and 2019.

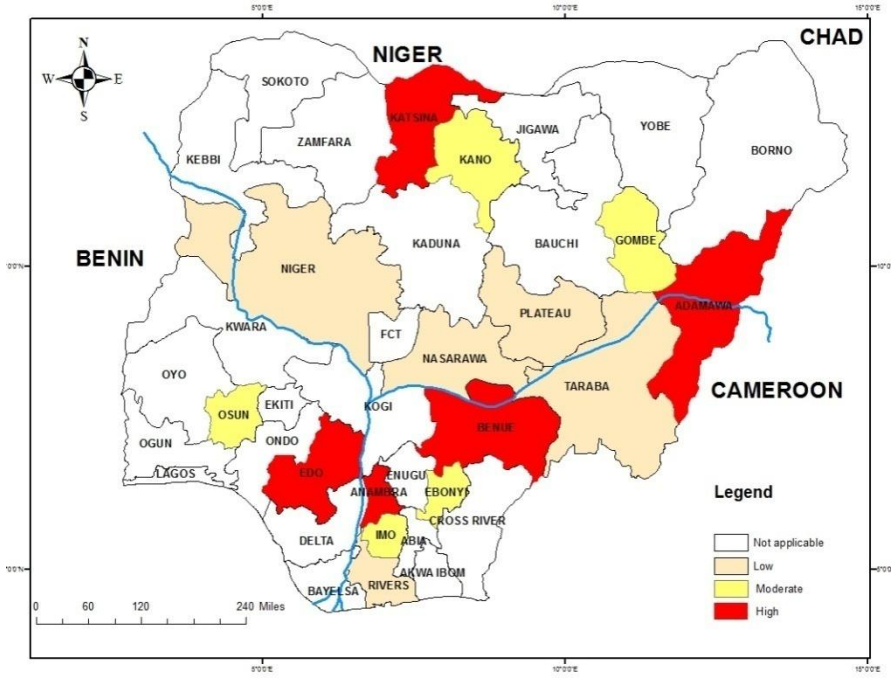


Plate I: Estimated loss of sheep and goats to peste des petitis ruminant disease in 2018 (Source: NAERLS, 2018)

Candidate gene for resistance to peste des petits ruminants

Toll-like receptor (TLR) gene are vital for the detection of invading pathogens and are commonly expressed in antigen presenting cells and other immune cells (O'Neill, 2006). Toll-like receptorsare type 1 transmembrane protein expressed in almost all cell types and activate the innate immune system upon sensing pathogen associated molecular patterns ($PAMP_S$). Intracellular TLR that sense viral nucleic acids include TLR3 (double stranded RNA), TLR7 and TLR8 (single stranded RNA and TLR9 (CPG motifs in DNA) (Prajapati *et al*., 2017). The cell specific location and basal expression levels of TLR mRNA could indicate the natural pathogen-associated molecular patterns (PAMPs) load of that tissue as well as the innate host resistance to pathogens. In addition to the differential expression profiles of Tousled-like kinase (TLK), ligand induced downstream cytokine profiles and/or levels could also play a role in the innate disease resistance (Manaswini *et al*., 2018).

Candidate gene for resistance to mastitis

Toll-like receptor gene 4 (TLR4) plays an important role in bovine mastitis resistance (Wang *et al*., 2015). The protein encoded by TLR4 gene is a member of the toll-like (TLR) family which plays a fundamental role in pathogen recognition and activation of innate immunity (TLR immunity). TLR_S are highly conserved from drosophila to humans and share structural and functional similarities. They recognize pathogen-associated molecular patterns that are expressed on infectious agents, and mediate the production of cytokines necessary for the development of effective immunity.

Candidate gene for resistance to tuberculosis

Caspase recruitment domin 15 (CARD15) gene in cattle plays an important role in tuberculosis (TB) resistance (Prajapati *et al*., 2017). CARD15 gene encodes for a cytosolic protein implicated in bacterial recognition during innate immunity. Para tuberculosis represents a major problem in farmed ruminants and at the present is considered a potential zoonosis. The disease is caused by *Mycobacterium avium* subspecies (Pinedo *et al*., 2009).

Candidate gene for resistance to other types of livestock diseases

The Natural Resistance Associated Macrophage Protein 1 (NRAMP1) gene, also known as Solute Carrier family11 member A1 (SLC11A1) gene is a member of large family of metal ion-transport proteins and it was the first positional cloned gene related to infectious disease susceptibility in mouse (Vidal *et al*., 1993). Since SLC11A1 is associated with pH dependant transport of divalent cations (like Fe^{2+}, Mg^{2+}, etc.) through the phagosome membranes, are essential for many cellular functions.

Under normal physiological conditions, SLC11A1 gene delivers bivalent metal cations from the cytosol into acidic endosomal and lysosomal compartments where the Fenton and Haber-Weiss reaction generate toxic antimicrobial radicals for direct antimicrobial activity against phagocytosed microorganisms (Goswami *et al.*, 2001). SLC11A1 gene have pleiotropic effects on macrophage function, that include increased chemokine KC, tumour necrosis factor-α, interleukin-1β, inducible nitric oxide synthase and major histocompatibility complex class II expression; all are important in resistance to intracellular pathogens (Awomoyi, 2007).

There are so many experimental evidences regarding the association of SLC11A1 gene polymorphisms with resistance to infectious diseases in human beings as well as animals. In mouse SLC11A1 gene confers resistance to intracellular pathogens like *Mycobacterium spp*., *Salmonella spp*. and *Leishmania spp.* (Vidal *et al*., 1995)

Toll-like receptors (TRL-2 gene)initiate inflammatory responses following the recognition of a wide repertoire of pathogens including bacteria, fungi, protozoa and viruses. They are composed of an extracellular leucine-rich repeat domain responsible for detecting pathogen-associated molecular patterns, a membrane spanning region and an intracellular Toll/Interleukin 1 receptor domain which invokes signal transduction. Toll-like receptor 2 is the most diverse of these receptors as it recognizes infectious agents from a range of pathogenic groups.

Bovine leukocyte antigen (BoLA-DRB3) complex are very similar to those of human MHC. BoLA complex is found in two separate regions of the chromosome rather than a single cluster of genes seen in most mammals. The larger gene cluster is located at BTA23 band 22 and apparently contains all of the bovine class I and class III sequences and gene encoding both subunits of the classical class II proteins DQ and DR. The remaining BoLA class III loci (DIB, DNA, DOB, DYA, DYA, TCPI, LMP2, LMP7 and TAP2) are located in a cluster near the centromere at BTA23 band 12-13 (Rothschild *et al*., 2000). The DRB3 locus and its gene products are among the best defined in cattle. The associations between BoLA alleles and disease class I association include resistant to mastitis (Mejdell *et al*., 1994).

REFERENCES

Awomoyi, A.A. (2007). The human carrier family 11 member 1 protein (SLC11A1): linking infections, autoimmunity and cancer? *FEMS Immunol. Medical Microbiology*, 49(3): 324-329.

Dukkipati, V.S.R., Blair, H.T., Garrick, D.J. and Murray, A. (2006). Ovar-Mhr-Ovine major histocompatibility complex: Role in genetic resistance to diseases. *New Zealand of Veterinary Journal*, 5(4): 153-160.

Gowane, G.R., Sharma, A.K., Sankar, M., Narayanan, K., Das, B., Subramanian, S. and Pattnaik, B. (2013). Association of BoLA DRB3 alleles with variability in immune response among the crossbred cattle vaccinated for foot-and –mounth disease (FMD). *Research Veterinary Science*, 9: 156-163.

Goswami, T., Bhattacharjee, A., Babal, P., Searle, S., Moore, E., Li, M. and Blackwell, J.M. (2001). Natural resistance-associated macrophage protein I is an H^+/bivalent cation antiporter. *Biochemical Journal,* 354: 511-519.

Kemper, K.E., Emery, D.L., Bishop, S.C, Oddy, H., Hayes, B.J., Dominik, S., Henshall, J.M. and Goddard, M.E. (2011). The distribution of SNP marker effects for faecal worm egg count in sheep, and the feasibility of using these markers to predict genetic merit for resistance to worm infections. *Genetic Research*, 93: 203-219.

Klein, J. (1986). *Natural History of the Major Histocompatibility Complex*. John Wiley, New York, USA.

Kloosterman, A., Parmentier, H.K. and Ploeger, H.W. (1992). Breeding cattle and sheep for resistance to gastrointestinal nematodes. *Parasitology Today*, 8: 330–335.

Lewin, H.A. (1996). "Genetic organization, polymorphism and function of the bovine major histocompatibility complex", in *The Major Histocompatibility Complex Region of Domestic Animal Species*, Schook, L.B and Lamont, S.J, Eds., CRC Press, Roton, Fla, USA. Pp 65-98.

Manaswini, M., Chinmoy, M., Sushant, K.D., Priyanka, P., Siddharth, S.S., Lipilekha, S. and Madhumita, S. (2018). Genomic insight to the disease resistance in goat. *The Pharma Innovation Journal*, 7(2): 98-103.

NAERLS (National Agricultural Extension and Research Liaison Services)(2018). Agricultural Performance Survey. https://naerls.gov.ng/wp-content/uploads/2019/05/Agricultural-Performance-Survey-of-2018-Wet-Season-in-Nigeria-1.pdf

NAERLS (National Agricultural Extension and Research Liaison Services)(2019). Agricultural Performance Survey. www.naerls.gov.ng/publication

Mejdell, C.M., Lie, O., Solbu, H., Arnet, E.F. and Spooner, R.L. (1994). 'Association of major histocompatibility complex antigens (BoLA-A) with AI bull progeny to test results for mastitis, ketosis and fertility in Norwegian Cattle'', *Animal Genetics*, 25(2): 99-104.

O'Neill, L.A.J. (2006). What we know and what we don't know. *Current Opinion in Immunology*, 2006: 3-9. doi: https://doi.org/10.1016/j.coi.2005.11.012.

Pinedo, P.J., Buergett, C.D., Donovan, G.A., Melendez, P., Morel, L., Wu, R., Langaee, T.Y and Rae, D.O. (2009). (Association between CARD15/NOD2). Gene polymorphisms and para tuberculosis infection in cattle. *Veterinary Microbiology*, 134(3-4): 346-52

Prajapati, B.M., Gupta., J.P., Pandey, D.P., Parmar, G.A., Chaudhari, J.D. (2017). Molecular markers for resistance against infectious diseases of economic importance. V*eterinary World*, 10(1): 112-120.

Quinnell, R.J. (2003). Genetics of susceptibility to human helminth infection. *International Journal for Parasitology*, 33, 1219–1231.

Rothschild, M.F., Skow, L. and Lamont, S.J. (2000). '*The major histocompatibility complex and its role in disease resistance and immune responsiveness*,'' in Breeding for Disease Resistance in Farm Animals, Oxford, R.F.E., Bishop, S.C, Nicholas, F.W. and Owen, J.B, Eds., Pp 243-252, CAB International, Wallingord, Wash, U.S.A.

Santucci, F., Ibrahim, K.M. and Hewit, G.M. (2007). Selection on MHC-linked microsatellite loci in sheep populations. *Hereditary*, 99: 340-348.

Vidal, S., Malo, D., Vogan, K., Skamene, E. and Gros, P. (1993). Natural resistance to infection with intracellular parasites: isolation of a candidate for *Bcg. cell*, 73: 469-485.

Vidal, S., Tremblay, M.L., Govoni, G., Gauthier, S., Sebastiani, G., Malo, D., Skamere, E., Olivier, M., Jothy, S. and Gros, P. (1995). The Ity/Lsh/ Bcg locus: natural resistance to infection with intracellular parasites is abrogated by distribution of the NrampI gene. *Journal of Experimental Medicine*, 182: 655-666.

Wang, Y., Wang, S., Liu, Tu, W. and Dong, G. (2015). CARD15 gene polymorphisms are associated with tuberculosis susceptibility in Chinese Holstein cows. *PloS One*, 10(8): 1-10.

HAEMOGLOBIN POLYMORPHISM OF GOATS IN SOUTHERN KADUNA

***[1]Yayi, J., **Barje, P.P., *Makama, R.S.**
**Department of Animal Science, Kaduna State University, Kafanchan Campus.*
***National Animal Production Research Institute, Shika-Zaria.*
**[1]Corresponding author: kyuukyayi@gmail.comPhone: 08129235498*

ABSTRACT
Blood samples were collected in heparinized test tubes from 100 smallholder goats in four local government areas (Jema'a, Kaura, Jaba, and Kachia) of Southern Kaduna. The blood samples were collected and analysed by electrophoresis to study the haemoglobin polymorphism and its frequency in indigenous smallholder goats found in Southern Kaduna. The electrophoretic test showed the presence of two co-dominant alleles HbA and HbB which produced two haemoglobin phenotypes: A homozygote HbAA and heterozygote HbAB; HbBB was not detected in this study. HbAA (61%) had the highest frequency over HbAB (39%). The gene frequency of HbA (0.805) exceeded HbB (0.195) significantly. The high preponderance of HbA allele is seen as an adaptation due to several environmental factors such as height above sea level (altitude) for oxygen utilization, temperature extremes, and presence of parasitic helminthes. The chi-square test showed high significant differences between observed and expected genotype frequencies ($P<0.01$). Thus, indicating that the flock was not in Hardy-Weinberg's equilibrium.
Key words: Goat, haemoglobin, haemoglobin polymorphism, electrophoresis, and adaptation.

INTRODUCTION
The domestic goat or simply goat (Capraaegagrushircus) is a subspecies of Capraaegagrus domesticated from the wild goat of South Asia and Eastern Europe. They are a valuable source of animal protein for humans when their meat or milk is consumed. Indigenous goats in Nigeria belong to three distinct breeds: the long-legged Sahel/desert goat found in the arid and Sahel regions; the relatively small body-sized red Sokoto goat found in the savannah zone; and the hardy, short-legged West African Dwarf (WAD) found mostly in the South. Although goat breeding is a very old tradition among indigenous farmers, no purposeful breeding programme has ever been organized for the species in Nigeria. Goat breeds have been previously evaluated for genetic variation based on morphological, physiological, pathological, productive, reproductive and behavioural features (Pourlis and Christodoulous 2008; Salako *et al*., 2007). However, these characters underestimate the true level of genetic variation. The amount of genetic variation detectable in an animal population is related to the magnitude of genetic improvement achievable within the species (Salako *et al*., 2007; Akpa *et al*., 2011). Therefore, the polymorphic variants of different proteins, enzymes, and mineral element or blood group factors represent more accurate procedure for better measurement of genetic variation in goat species. One of the important blood proteins is haemoglobin because of its biochemical, biophysical and physiological properties, having relevance to selection phenomenon of animals (Menrad *et al*., 2002). Haemoglobin have been previously reported to have variants (polymorphism) and these variants have been reported to be associated with environmental adaptability as well as being clinically important as causes of a variety of genetic disorders of blood (Peter *et al*,. 2004).
The objectives of this study were: to assess haemoglobin polymorphism which exists in goats found in Southern Kaduna; to assess the frequencies of the haemoglobin variants of goats found in Southern Kaduna; and to relate the predominant haemoglobin polymorphic form to the type of environment the goats thrive in.

MATERIALS AND METHODS
Study area
The study was carried out in four local government areas in the Southern part of Kaduna state: Kachia, Jaba, Jema'a, and Kaura local government area.
Data collection
Blood samples (5ml) were collected from 100 goats (25 goats from each local government) in four local governments of Kaduna state: Kachia, Jaba, Jema'a, and Kaura local government area. 5ml of blood was collected from each of the sampled animals by jugular venipuncture using needle and syringe and into sample bottles containing Ethylene Diamine Tetra Acetic acid (EDTA) as

anticoagulant, properly labelled with respect to the different breeds and local governments and preserved in a fridge from whence it is transported to the laboratory for analysis.

Electrophoresis

The red cell lysate was impregnated on a cellulose acetate paper with a control, placed on the electrophoresis tank and subjected to electrophoresis according to the standard procedure described by Smithies (1955) that was later modified using the procedure of Boyer and Hiner (1963). By electrophoresis, the haemoglobin fractions were separated. The identification of the haemoglobin types in the samples was achieved in accordance with the migration speed of the light spots on the electrophoretical substratum, detected from the start line towards the cathodal zone. The haemoglobin polymorphism was pointed out by detection of three migration zones coded as follows: A single faster band designated as AA homozygote, a single slower band designated as BB homozygote, and the presence of both bands designated as AB heterozygote.

RESULTS AND DISCUSSION

Table 1: Genotypic frequencies of the indigenous goats in the sampled local governments

Local govt	N	AA%	AB%	BB%	Total
Jema'a	25	68.00	32.00	0.00	100.00
Kaura	25	60.00	40.00	0.00	100.00
Jaba	25	84.00	16.00	0.00	100.00
Kachia	25	32.00	68.00	0.00	100.00
Polled	100	61.00	39.00	0.00	100.00

Result on genotypic frequencies of the indigenous goats in the sampled local governments is presented in Table 1. The results obtained revealed that AA genotype had the highest frequency across all sampled local governments areas (Jema'a: 68%, Kaura: 60% and Jaba: 84% respectively) except for Kachia local government where AB has the highest genotypic frequency of 68%. The AB genotype had the second highest frequency across the local government areas (32%, 40%, and 16% for Jema'a, Kaura, and Jaba, local government area respectively) except in Kachia local government where it had the highest frequency of 68%.The BB genotype had the lowest genotypic frequency of 0%.

Table 2: Gene frequencies of the indigenous goats in the sampled local government

Local govt	N	A (P)	B (Q)	Total (P+Q)
Jema'a	25	0.84	0.16	1.00
Kaura	25	0.80	0.20	1.00
Jaba	25	0.92	0.08	1.00
Kachia	25	0.66	0.34	1.00
Polled	100	0.805	0.195	1.00

Result on gene frequencies of the indigenous goats in the sampled local governments is presented in Table 2. The result showed that the HbA gene had the highest gene frequency across the four local governments (Jema'a: 0.84, Kaura: 0.8, Jaba: 0.92, and Kachia: 0.66 while the B gene had the lowest gene frequency in all four local government areas (Jema'a: 0.16, Kaura: 0.2, Jaba: 0.08, and Kachia: 0.34).

Result from chi-square analysis showed that there was high significant difference between observed data and expected data.

Relationship between genotype and environment

In this study, two haemoglobin genotypes were detected: homozygote (AA) and heterozygote (AB). No homozygote BB was detected in this study. The genotypic frequency of AA (61%) genotype was significantly higher than AB (39%) when polled together, from table 1. The results of this study is similar to the works of Agaviezor *et al* 2013 in which they recorded significantly higher frequency of AA genotype (75%) over AB genotype (21.67%) and BB genotype (3.33%) of indigenous goat breeds living in areas of dense vegetation. Buvanendran *et al* 1981 did not find the BB phenotype in red

sokoto breeds. Johnson *et al* 2002 reported that the BB genotype is not widely distributed. Agaviezor *et al* 2013 suggested that the AA genotype may have selective advantages against helminthic infections.

Hrinca (2010) explains that extreme temperature (acute cold or sultry heats), the extreme forms of relief (dessert or mountain) and precarious nutrition conditions favour the fixing of the allele HbA, and the temperature situated in the biological comfort zone, the moderate forms of relief (forest steppe, hill, etc) or the optimal breeding technologies are correlated with a more emphasized fixing of the allele HbB. The present study was done in the northwest of Nigeria where the temperature could be as high as 38^0C. This high temperature could probably favour the fixing of HbA over HbB. Salako *et al*. (2007) reported that Red Sokoto goats sampled in the South West of Nigeria (Rain forest zone) had a higher frequency of HbB to HbA, suggesting that they best fit in zones of moderate temperature. Evans and Warren (1958), explained that HbA genes are favoured in environment of high altitudes, while HbB are favoured by lower altitudes. The population sampled in this study came from high altitude areas of 2021ft (616m) above sea level. This may explain the higher frequency of HbA than HbB. Salako *et al.* (2007) reported higher frequency of HbB than HbA in their study; they sampled animals from a lower altitude (Ibadan is 780ft above sea level; Falling Rain Genomics Inc. 1996-2006). Das *et al.* (2004) also reported a higher frequency of HbB in Kolkata, West Bengal India (altitude 42ft). Alphonsus *et al.* 2012 also reported a high preponderance of HbA alleles (0.60) over the HbB alleles (0.335) of indigenous goats found in the in the Northern region of Nigeria. Likewise, Akpa *et al*. (2011) reported a high preponderance of HbA alleles in the indigenous goats of Northern Nigeria. These findings suggest that the natural habitat of Northern Nigeria favour goats with HbA alleles than HbB alleles. However, some studies by Das *et al.* (2004) and Salako *et al*. (2007) in goats of southern Nigeria revealed high preponderance of HbB alleles than HbA. This variation is probably due to differences in the geographical locations especially with regard to their altitudes. The southern part where Salako *et al.* 2007 and Das *et al.* 2004 conducted their study was in a relatively lower altitude (750ft and 42ft respectively); while the study of Alphonsus *et al.* (2012) and Akpa *et al.* (2011) were conducted in a relatively high altitude (2552ft) of the Northern part.

CONCLUSION

Haemoglobin polymorphism is defined by the expression of different variant (polymorphic) forms of haemoglobin. Two types of haemoglobin genotypes were found in this study, HbAA and HbAB; generally 61% of the goats had HbAA genotype while 39% had HbAB genotype. The allelic (gene) frequency for HbA was 0.805 while the allelic frequency for HbB was 0.195. This suggests that goats possessing the HbA allele had a higher chance of survival and reproduction as they might be better at utilizing oxygen, more tolerant to extreme weather conditions, and have higher resistance to helminths.

The chi-square test revealed high significant differences between observed data and expected data which show that the goat population were not in Hardy Weinberg's equilibrium suggesting differential mortality and preferential selection for particular genotypes which are more suited to the environment.

RECOMMENDATION

1. Haemoglobin variants should be put into consideration in goat's selection and breeding programs.
2. Environmental factors should always be assessed before goats are being introduced so that the goats with the most suitable genotype can be chosen.
3. Larger scale studies needs to be done to give a better understanding of how environmental factors interact with Haemoglobin forms and how these polymorphic forms interact with other biochemical factors in the animal.

REFERENCES

Agaviezor, B.O. (2013). Haemoglobin polymorphism in Nigerian indigenous goats in the Niger Delta region, Nigeria. *International Journal for Science and Nature, I.J.S.N*., VOL.4(3)2013:415-419.

Akpa, G.N., Ibrahim, O.A., Yakubu, H. and Kabir, M. (2011). Sexual dimorphism, haemoglobin polymorphism and body mensuration characteristics of Red Sokoto goats. *Proceedings of the 35th Annual conference of genetic Society of Nigeria* 10th -14th October, 2011, Ahmadu Bello University, Zaria. Pp. 2-7.

Boyer, S. H. and Hiner, R. (1963) Modified apparatus for starch gel electrophoresis. Journal of Laboratory and Clinical Medicine, 61:879-81.

Buvanendran, V., Sooriyamoorthy, T., Ogunsusi, R.A., and Adu, I.F. (1981). Haemoglobin polymorphism and resistance to helminthes in Red Sokoto goats. Tropical animal health and production. 13: 217–221.

Dally, M.R., Hohenboken, W., Thomas D.L. and Craig, M.C. (1980). Relationship between haemoglobin type and reproduction, lamb wool and milk production and health related traits in crossbred ewes. *Journal Animal Science*, 50: 418-427.

Das, D.K., Sinha, R., Dattagupta, R. and Senapti, P.K. (2004). Association of Haemoglobin types with some menstruation and reproductive characteristics in Garole sheep. *Indian Journal of Animal Sciences*, 74(4): 382-384.

Evans, J.V., King, W.B., Cohen, B.L., Harris, H. and Warren, F.L. (1958) Genetics of haemoglobin and blood potassium differences in sheep. Nature, 182: 320-321

Hrinca, G.H. (2010). Haemoglobin types in the Carpathian breed and their relevance for goat adaptation. Universitation de Stiinte Agricolesi Medicina veterinara lasi. *Lucrari Stiintifice. Seria Zootehnie,* 53: 310-314.

Johnson, E.H., Nam, D., Al-Busaidy, R. (2002). Observations on haemoglobin types in three breeds of Omani goats. Veterinary Research Communication, 26(5): 353-359.

Menrad, M., Muller, E., Stier, C.H., Galderman, H. and Gall, C.F. (2002). Analysis of blood protein polymorphisms and genetic variability within and between the populations, Small Ruminants. Research, 43(1): 3-14.

Peters, S.O., Ozoje, M.C., Nwagbo, N.E. and Ikeobi, C.O.N. (2004) Haemoglobin polymorphism and phenotypic variation in coat and wattle incidence among West African Dwarf (WAD) goats. *Proceedings of the 29th Annual Conference of the Genetics Society of Nigeria*, Oct. 11-14 Abeokuta, Nigeria, pp: 84-87.

Pourlis, A.F. and Christodoulous, G. (2008). Morphology of the hairs in the goat breed *Capra prisca, Journal of Animal Veterinary Advances*, 7(9): 1142-1145.

Salako, A.E., Ijadunola, T.O. and Agbesola, Y.O. (2007). Haemoglobin polymorphism in Nigerian indigenous small ruminant population – preliminary investigation. *African Journal of Biotehnology*, 6(22): 2636-263.

Smithies, O. (1955) Zone electrophoresis in starch gels; group variation in serum proteins of normal human adults. Biochemical Journal, 61:629-41.

CLASSIFICATION OF DONKEY STRAINS IN NORTHWESTERN NIGERIA THROUGH EUCLIDEAN DISTANCE MEASUREMENTS

[*1]John, P.A, [2]Iyiola-Tunji, A.O., [3]Millam, J.J., [3]Abbaya, H.Y., [4]Iriso, B.V. & [1]Bello, S.S.
[1]Department of Animal Science, Ahmadu Bello University, Zaria.
[2]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria.
[3]Department of Animal Production, Adamawa State University, Mubi.
[4]Department of Animal Science, University of Port Harcourt, Choba.
[*]Corresponding author: johnpaulapagu@gmail.com

ABSTRACT
Proper knowledge of variations and diversities between, among and within the populations of animals helps in classifying animals into their various genetic groups, which helps in identification and conservation of important alleles. A total of seven hundred (700) donkeys consisting of (280) adult, (210) young and (210) weaner donkeys were sampled from Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States of Nigeria using a random sampling techniques. Biometric traits measured among sampled donkeys were body weight, head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and tail length. Data obtained were subjected to statistical analysis to determine the genetic distance estimate across the strains. The classification of Black (Duni), White (Fari), Brown (Idabari), Red (Auraki) and Brown-white (Idabari-fari) donkeys (by using Euclidean as the distance measurement, Single Linkage, Average Linkage, and Complete Linkage were applied, and the obtained results were compared. The simple discriminant analysis procedure was used to classify the strains using the R 2.13.0 (R Development Core Team) package. Homogeneous genetic distance was observed for head width (16, 16) and shoulder width (21, 21) in male red donkeys. Female donkeys showed similar and closed genetic distances for ear length in red (26, 21), black (21, 26) and brown (26, 21) and male Red (26,22), Black (22, 25), White (26, 22) and Brown (22, 25) across the strains. Heart girth, body length and height at wither showed high level of genetic variability among the strains. Heaviest body weight was recorded in male red (141.90kg) donkey strain with a distance of 6.75cm compared to other strains of donkeys. Further classification of donkeys into various genetic groups should employ heart girth, body length and height at wither.
Keywords: Donkey, genetic distance, classification, strain, Nigeria.

INTRODUCTION
Knowledge of morphometric characteristics marks the first step in classification of Farm animal genetic resources (FAnGR) (Delgado *et al*., 2001). Genetic distance is a measure of the genetic divergence between species or between populations within a species, whether the distance measures time from common ancestor or degree of differentiation (Nei, 1987). Populations with many similar alleles have small genetic distances. This indicates that they are closely related and have a recent common ancestor. Genetic distance is useful for reconstructing the history of populations. For example, evidence from genetic distance suggests that Sub-Saharan Africa and Eurasian people diverged about 100,000 years ago (Nei, 1974). Genetic distance is also used for understanding the origin of biodiversity. For example, the genetic distances between different breeds of domesticated animals are often investigated in order to determine which breeds should be protected to maintain genetic diversity (Ruane, 1999). Since donkey population has suffered substantial decline in its size, it is expected that the levels of inbreeding and risk of extinction may be high which necessitates a genetic study to assess variability among donkey populations for their conservation along with their breed assignment, better utilization, production and management practices. This study aimed at determining the genetic clustering, extent of genetic diversity and classification of donkeys into various genetic groups using biometric traits.

MATERIALS AND METHODS
Seven hundred donkeys (700) donkeys comprising 280 adults, 210 young and 210 weaner donkeys were used. The study was carried out in the North West of Nigeria. The States where donkeys were sampled were Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States of Nigeria using random sampling techniques. These States in North West Nigeria were selected for this study because of existence of high population of donkeys. The age of the donkeys was determine using teeth count in combination with the information provided by donkey owners. Biometric traits measured were

body weight, head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and tail length using a flexible tailor's tape. The classification of Black (Duni), White (Fari), Brown (Idabari), Red (Auraki) and Brown-White (Idabari-fari) donkeys (by using Euclidean as the distance measurement; Single Linkage, Average Linkage, and Complete Linkage were applied, and the obtained results were compared. The cluster analysis procedure was used to classify the strains using the R 2.13.0 (R Development Core Team, 2015) package. DISCRIM procedure was used to calculate the probabilities of including an animal in determining the strain, taking into account the error made in classification of the strain. Stepwise discriminant procedure (STEPDISC) was applied to determine, which performance traits were used in the final clustering analysis.

RESULTS AND DISCUSSION

The classification by the application of Euclidean to measure distance among biometric traits of male and female donkeys are shown in Table 1. In male black donkey, homogeneous genetic relationships were observed for head width (16, 16), between cluster 1 and 2, and shoulder width (21, 21) in male red donkey. Similar genetic relationships were observed between cluster 1 and 2 for ear length in male red (26, 22), Black (22, 25), White (26, 22), and Brown (22, 25). In female donkeys, the genetic distance between cluster 1 and 2 for ear length in Red (26, 21), Black (21, 26), Brown (26, 21) and Brown-white were similar for neck length (38, 36) and head length (38, 35). Closer and similar genetic distances were also observed for head width in female Black (11, 14) and White (11, 14). Heart girth, body length and height at wither showed high level of genetic variability across the strains. Similar report was observed in the findings of Nei, 1987 who reported genetic divergence among animal populations with many similar alleles having small genetic distances. This indicates that they are closely related and have a common ancestor.

The classification by the application of single, average and complete linkage are shown in Table 2. The heaviest body weight was recorded in male red (141.90kg) donkey strain with a distance of 6.75cm compared to other strains of donkeys. Male donkey with the smallest body weight was recorded in white (123.55kg) with a distance of 12.01cm.

Female donkey with the heaviest body weight was recorded in brown donkey strains (123.07kg) with a distance of 16.78cm while the female donkey with the smallest body weight was recorded in brown-white (52.25kg). The high level of genetic variability observed among strains of donkeys signifies that the higher the genetic distance estimates among the strains, the further the genetic distances and the more or better the chances for selection in the population. The result of this study is similar with the findings of John *et al*. (2017) who reported similar and closed genetic distance estimates in the qualitative traits of donkeys.

Table 1: Classification by the application of euclidean to measure distance among biometric traits of male and female donkeys

Red cluster				Black cluster				White cluster				Brown cluster				Brown-white cluster			
Sex	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**
Female	HG(cm)	118	92	Male	HW(cm)	110	105	Male	HG(cm)	111	82	Female	HG(cm)	114	73	Female	HW(cm)	89	84
Male	HG(cm)	114	104	Male	BL(cm)	109	100	Male	BL(cm)	109	87	Female	BL(cm)	106	70	Female	HG(cm)	88	79
Male	BL(cm)	109	99	Male	HG(cm)	108	101	Male	HW(cm)	105	80	Female	HW(cm)	104	79	Female	BL(cm)	84	76
Female	BL(cm)	109	89	Female	BL(cm)	87	107	Female	HW(cm)	86	105	Male	HW(cm)	77	99	Female	NC(cm)	49	42
Female	HW(cm)	108	85	Female	HG(cm)	82	115	Female	HG(cm)	84	112	Male	BL(cm)	73	101	Female	TL(cm)	49	42
Male	HW(cm)	107	97	Female	HW(cm)	80	106	Female	BL(cm)	84	112	Male	HG(cm)	69	108	Female	NL(cm)	38	36
Female	NC(cm)	71	35	Male	NC(cm)	62	50	Male	TL(cm)	64	35	Female	TL(cm)	65	39	Female	HL(cm)	38	35
Male	NC(cm)	65	51	Male	HL(cm)	48	46	Male	NC(cm)	60	50	Female	NC(cm)	60	38	Female	EL(cm)	24	22
Female	TL(cm)	63	22	Male	NL(cm)	47	43	Female	NC(cm)	47	61	Female	HL(cm)	49	34	Female	SW(cm)	14	16
Male	TL(cm)	60	49	Male	TL(cm)	46	68	Male	HL(cm)	47	36	Female	NL(cm)	47	33	Female	HWD(cm)	11	10
Male	NL(cm)	49	35	Female	TL(cm)	45	61	Male	NL(cm)	45	35	Male	NC(cm)	39	47				
Female	HL(cm)	49	28	Female	NC(cm)	40	65	Female	TL(cm)	38	68	Male	TL(cm)	33	53				
Male	HL(cm)	48	39	Female	NL(cm)	33	46	Female	NL(cm)	38	46	Male	NL(cm)	32	47				
Female	NL(cm)	47	27	Female	HL(cm)	32	48	Female	HL(cm)	36	48	Male	HL(cm)	28	48				
Male	EL(cm)	26	22	Male	SW(cm)	24	22	Male	EL(cm)	26	22	Female	EL(cm)	26	21				
Female	EL(cm)	26	21	Male	EL(cm)	22	25	Female	EL(cm)	23	26	Male	EL(cm)	22	25				
Female	SW(cm)	24	14	Female	EL(cm)	21	26	Male	SW(cm)	20	17	Female	SW(cm)	20	12				
Male	SW(cm)	21	21	Male	HWD(cm)	16	16	Female	SW(cm)	15	25	Female	HWD(cm)	17	11				
Male	HWD(cm)	16	12	Female	SW(cm)	15	19	Male	HWD(cm)	13	11	Male	SW(cm)	13	23				
Female	HWD(cm)	15	11	Female	HWD(cm)	11	14	Female	HWD(cm)	11	14	Male	HWD(cm)	11	15				

HL: Head length; HWD: Head width; EL: Ear length; NL: Neck length; NC: Neck circumference; SW: Shoulder width; HW: Height at withers; HG: Heart girth; BL: Body length; TL: Tail length. The values for each of the five groups were ranked; the first level of ranking was cluster 1 while the second level was cluster 2.

Table 2. Classification by the application of single, average and complete linkage

Sex	Strain	Body weight (kg)	Distance
Male	Brown	130.29	16.64
	Red	141.90	6.75
	Black	137.87	9.32
	White	123.55	12.01
Female	Brown	123.07	16.78
	Red	115.90	10.91
	Black	109.60	11.40
	White	113.45	12.09
	Brown-white	52.25	0.00

CONCLUSION AND RECOMMENDATION

High level of genetic distance estimates were recorded for heart girth, body length and height at wither among donkey strains in the studied populations. Further classification of donkeys into various genetic groups should employ heart girth, body length and height at wither.

REFERENCES

Delgado, J.V., Barba, C., Camacho, M.E., Sereno, F.TP.S., Martinez, A. and Vega-Pla, J.L (2001). Livestock characterization in Spain. *Agricultural Research Institute*, 2: 7-18.

John, P.A., Akpa, G.N., Iyiola-Tunji, A.O. and Abbaya, H.Y. (2017). Phylogenetic analysis of qualitative traits of donkey in North West Nigeria. *In: Proceedings of 6th ASAN-NIAS Joint Meeting* (Editors: Ososanya, T.O., Bawa, G.S., Yashim, S.M. and Owosibo, A.O.). September, 10-14th 2017. NAF Conference Centre, Plot 496, Ahmadu Bello Way, Kado, Abuja. Pp 292-295.

Nei, M. (1987). Molecular Evolutionary Genetics. (Chapter 9). New York: Columbia University Press.

Nei, M. and Roychoudhury, A.K. (1974). "Genetic variation within and between the three major races of man, Caucasoids, Negroids, and Mongoloids*". The American Journal of Human Genetics, 26: 421–443.*

R Development Core Team. (2015). *A Language and Environment for Statistical Computing. R Foundation for Statistical Computing*, Vienna, Austria. URL http://www. R-Project.org/.

Ruane, J. (1999). A critical review of the value of genetic distance studies in conservation of animal genetic resources. *Journal of Animal Breeding and Genetics*, 116(5): 317-323.

EFFECTS OF SODIUM BICARBONATE SALT AND TURMERIC POWDER ON PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF ISA BROWN HENS

*** Hirdima L.D., Y.P Mancha & D.J.U. Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: ihirdima@gmail.com mobile No: 07032892843*

ABSTRACT

The study was carried out to determine the effects of sodium bicarbonate salt and turmeric powder on performance and haematological parameters of Isa brown hens. The experiment was conducted at the poultry unit of the Department of Animal Production Abubukar Tafawa Balewa University located in Gubi, Bauchi. A total of one hundred and eighty four (184) Isa Brown layers at 51 weeks of age were used for the study, which was conducted during the rainy season (July-October). The hens were kept in deep litter system during the experiment. The control birds were administered feed without sodium bicarbonate salt and turmeric powder while the other treatments received diet supplemented with bicarbonate salt supplemented at the level of 0.30 g and 0.70 g, turmeric powder at the level of 0.30g and 0.70g, and the combinations S30T30, S30T70, S70T30 and S70T70. During lay, the birds were fed once daily with compounded ration containing 16% crude protein, other constituents of the feed includes vitamins, minerals and amino acid. Water was ad libitum. The result revealed that the supplementation of sodium bicarbonate salt and turmeric powder did not affect the feed conversion ratio (FCR). However, significant ($P< 0.001$) differences were in feed per egg and the hen day production (%HDP). It was observed that birds on inclusion level of 0.70g sodium bicarbonate salt (116.74±0.05) increased feed per egg while the least values was obtained on birds fed with 0.30g sodium bicarbonate salt inclusion which decreased feed per egg. It was also observed that sodium bicarbonate salt and turmeric powder did not affect haematological parameters thereby making it safe for the birds. From the finding of this research it is concluded that sodium bicarbonate salt and turmeric powder significantly improved performance and is therefore recommended for Isa brown hens.

Keywords: Isa Brown, Turmeric, Sodium Bicarbonate

INTRODUCTION

Domestic poultry is an important sector of livestock keeping worldwide, the production of meat and egg being the major contribution to human nutrition. Taking into account the economic, social and cultural aspect of poultry keeping underlines the huge significance of this sector. There are about 17 billion domestic chickens worldwide (Defra, 2010). Poultry production is one of the best available sources for the production of high biological value animal protein in terms of egg and meat. Commercial hybrids both broilers and layers are being propagated for egg and meat production throughout the world (Ahmad *et al.,* 2010). However there is need to improve the output of the poultry industry through improved performance of the birds. Supplementation of sodium bicarbonate may help to maintain proper pH balance, eliminate acidosis and facilitate metabolic process, ensuring maximum growth and productivity (Abbas *et al*., 2017; Naseem *et al.*, 2005). Moreover, its use as dietary supplement may help rise in blood bicarbonate ion concentration, which can favour better performance of birds (Kaya *et al.,* 2004; Naseem *et al.,* 2005).Turmeric (*Curcuma longa*) is found to be one of such perennial herbs that are used as alternatives to antibiotics and is also found to have anti-oxidative value and certain beneficial pharmacological activities like hypolipidaemic effects. This study was designed to investigate the effects of sodium bicarbonate and turmeric powder on performance and haematological parameters of Isa brown hens.

MATERIALS AND METHODS

The experiment was conducted at the poultry house of Department of Animal Production Abubukar Tafawa Balewa University located in Gubi Village, Bauchi. A total of one hundred and eighty four (184) Isa Brown layers at 51 weeks of age were used for the study, which was conducted during the rainy season (July-October). The hens were kept in deep litter system during the experiment. The control birds were administered feed without sodium hydrogen carbonate salt ($NaHCO_3$) and turmeric powder while the other treatments received diet supplemented with $NaHCO_3$ salt at the level of 0.30 g and 0.70 g, turmeric powder at the level of 0.30g and 0.70g, and the combinations S3OT30, S30T70,

S70T30 and S70T70. During lay, the birds were fed once daily with compounded ration containing 16% crude protein with other constituents of the feed ehich includes vitamins, minerals and amino acid. Water was ad libitum.

Haematological Parameters

At the end of the experiment, six hens were randomly selected from each group and bleed using 2ml syringe at the wing. The blood is collected into collection bottle containing EDTA (ethylene diamine tetra acetic acid) as anticoagulant. Samples were taken thereafter to National Veterinary Research Institute, Vom to determine the packed cell volume (PCV), hemoglobin count (Hb), the red blood (RBC) and white blood counts (WBC).

Data Analysis

Data collected were subjected to analysis of variance using statistical package for social science (SPSS) version 26. Significant means were separated using Ryan Einot Gebriel Welsh (REGW) procedure.

RESULTS AND DISCUSSION

Table 1: Effects of Sodium Bicarbonate salt and Turmeric powder on Performance.

Variable (%)	N	Feed/egg (g)	Feed conversion ratio(g)	(%)Hen day production
Overall		107.87±0.35	71.45±1.03	86.23±0.28
Treatment		***	NS	***
Control	67	107.28 ± 2.45^{bc}	71.52±3.26	85.79 ± 1.96^{bc}
S30	99	102.85 ± 2.35^{de}	65.32±3.26	82.18 ± 1.88^{de}
S70	124	113.08 ± 2.12^{a}	72.63±3.26	90.59 ± 1.70^{a}
T30	115	100.92 ± 2.32^{e}	70.55±3.26	80.62 ± 1.86^{e}
T70	119	109.74 ± 2.29^{bcd}	74.13±3,26	87.79 ± 1.83^{bcd}
S30T30	108	110.61 ± 2.31^{bc}	64.88±3.26	88.40 ± 1.85^{bc}
S30T70	107	113.24 ± 2.31^{ab}	70.03±3.26	90.56 ± 1.85^{b}
S70T30	116	108.39 ± 2.32^{bc}	72.82±3.26	86.62 ± 1.85^{bc}
S70T70	121	105.25 ± 2.29^{e}	81.03±3.26	84.14 ± 1.83^{e}
Month		***		***
July	492	115.35 ± 0.46^{a}		92.14 ± 0.37^{a}
August	205	109.44 ± 0.71^{b}		87.49 ± 0.57^{b}
September	194	101.38 ± 0.73^{d}		80.99 ± 0.58^{d}
October	152	105.28 ± 0.82^{c}		84.28 ± 0.65^{c}

*** =P<0.001, NS=Not Significant

Means for groups with the same are statistically similar

S30 =0.30g, S70=0.70g$NaHCO_3$ salt, T30 =30g, T70= 0.70g turmeric powder inclusion in the diet;

N= Overall 1043

Table 2: Effects of sodium bicarbonate salt and turmeric powder on hematological parameters

Variable Reference values.	N	Packed cell volume 27-42%	White blood cell $1.02\text{-}9.5x10^{9}$ g/l	Red blood cell $2.2\text{-}4.0x10^{12}$ g/l	Hemoglobin Hb 9.5-11.7g/dl
Overall		26.93±0.59	6.33±0.21	1.61±0.15	8.97±0.28
Treatment		NS	NS	NS	NS
S30	6	28.50±1.82	7.72±0.65	2.78±0.46	8.77±0.87
S70	6	25.00±1.82	5.15±0.65	1,23±0.46	10.03±.87
T30	6	25.67±1.82	1.27±0.46	1.27±0.46	8.43±0.87
T70	6	25.00±1.82	1.27±0.50	1.74±0.50	9.72±0.95
S30T30	6	27.50±1.82	1.35±0.46	1.50±0.46	9.13±0.87
S30T70	6	25.33±1.82	1.50±0.46	1.50±0.46	6.92±0.87
S70T30	6	25.00±1.82	1.52±0.46	1.52±0.46	8.48±0.87
S70T70	6	28.00±1.82	1.65±0.46	1.65±0.46	9.33±0.87
Control	6	28.40±1.91	6.14±0.68	1.55±0.48	9.45±0.91

***=P<0.001, NS=Not Significant
Means for groups with the same subsets are similar
S30 =0.30g, T70=0.70g $NaHCO_3$ salt, T30 =0.30g, T70=0.70g turmeric powder inclusion in the diet;
N= overall 60

Table 1 shows the results for effects of sodium bicarbonate salt and turmeric powder on performance. The results revealed that the supplementation of sodium bicarbonate salt and turmeric powder could not affect the feed conversion ratio (FCR). However, significant (P< 0.001) differences were in feed per egg and the hen day production (%HDP). It was observed that birds on inclusion level of 0.70g sodium bicarbonate salt (116.74±0.05) increased feed per egg and decreased hen day production while the least values was obtained on birds fed with 0.30g sodium bicarbonate salt inclusion which decreased feed per egg and increased hen day production. This result disagrees with the findings (Yoruk *et al*., 2004) who reported that feed consumption increased with increasing level of dietary sodium bicarbonate salt supplementation. Hen's diet supplemented with 1.5% $NaHCO_3$ consumed greatest amount of feed. Supplementation of turmeric at inclusion level of 0.70g had a significant (P<0.001) effect on feed per egg which was higher (109.74±2.29) than 0.30g turmeric powder inclusion. More so, birds with 0.70g turmeric supplementation tended to have higher (87.79±1.83) percentage of HDP and the lowest value was recorded on birds fed 0.30g turmeric powder. Yoruk *et al.*, (2004) also reported that hens on supplemented sodium bicarbonate diet produced more eggs than hens that are not on sodium bicarbonate supplemented diet. Monthly feed consumption and %HDP significantly (P<0.01) differ in the month of July (115.35± 0.46 and 92.14±0.37) has the highest

values for feed consumption and %HDP respectively. The lowest were recorded in the month of September (101.38±0.73 and 80.99±0.58) for feed consumption and HDP, respectively.

Table 2 shows the results for effects of sodium bicarbonate salt and turmeric powder on haematological parameters. The results slowed that packed cell volume (PCV), white blood cell (WBC), RBC blood cell (RBC) and Haemoglobin (HB) were not significantly (P>0.05) affected by various levels of sodium bicarbonate salt and turmeric powder.

CONCLUSION AND RECOMMENDATION

From the finding of this research it is concluded that sodium bicarbonate salt and turmeric powder significantly improved performance. It was also concluded that sodium bicarbonate salt and turmeric powder did not affect haematological parameters thereby making it safe for the birds and is therefore recommended for Isa brown hens.

REFERENCES

Abbas G., Suttan Mahmood, A. Haq and H. Nawaz (2017) Effect of Dietary Inclusion of Sodium Bicarbonate on Blood, Profile of Caged Layers During Summer. *Pakistan Journal of Agricultural Science* Vol.**54** (2), 443-450 2017 ISSN (Print) 0552-9034, ISSN (Online) 2076-0906: Dol:10.21162/PAKJAS/17.5011.

Ahmad, F. Ahsan-Ul-Hag, M. Ashraf, J. Hussain and M.Z Shidiqui (2010). Production performance of white leghorn hens under different lighting regimes. *Pakistan Veterinary Journal***30** (1) 21 – 24

Defra, (2010) Poultry in the united Kingdom. The Genetic Resources of the National flocks www.defra.gov.uk.

Kaya, I.B, Karademir and O. Ukar (2004) The Effect of Diet Supplementation with Sodium Bicarbonate Upon Blood PH, Blood Gases and Egg Shell Quality in Laying Geese. Veterinary Medical Czech. **49**:201-206.

Naseem, M.T., S. Naseem, M. Younus, Z.I Chauhdary, A. Gtya, Foor, A. Aslam and S. Akhter (2005). Effect of Potassium Chloride and Sodium Bicarbonate supplementation on Thermo-tolerance of Broilers Exposed to Heat Stress. *International Journal Poultry Science* **4**:891-895.

Yoruk, M. A., M. Gul, A. Hayirti and M. Karaoglu (2004) Laying Performance and Egg Qualities of Hens Supplemented with Sodium Bicarbonate During the Late Laying Period. *International Journal of Poultry Science***3**(4)272-278. Asian Network for Scientific Information.

EFFECTS OF SODIUM BICARBONATE SALT AND TURMERIC POWDER ON INTERNAL EGG QUALITY AND BODY PARAMETER MEASUREMENTS OF ISA BROWN HENS

*** Hirdima L.D., Y.P Mancha & D.J.U Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: ihirdima@gmail.com mobile No: 07032892843*

ABSTRACT

This study was conducted to evaluate the effects of sodium bicarbonate salt and turmeric powder on internal egg quality and body parameter measurements of Isa brown hens. The birds were sourced from CHI Nigeria limited farm and raised under similar management techniques. Isa brown is a hybrid brown egg layer being a cross between Rhode Island Whites and Rhode Island Red. The experiment was conducted at the poultry unit of the Department of Animal Production Abubukar Tafawa Balewa University located in Gubi, Bauchi. A total of one hundred and eighty four (184) Isa Brown hens were used for the research which lasted a period of 16 weeks. The results recovered showed that, supplementation of sodium bicarbonate salt and turmeric powder on the internal egg quality of the hens did not affect albumen height (1.03± 0.2) mm, yolk height (1.73±0.2) mm, yolk index (0.51±0.00), and haugh unit (84.47±0.06) mm of the eggs. However, significant (P<0.01) difference was noticed on Yolk diameter where 0.30g sole supplemented sodium bicarbonate salt and interaction between sodium bicarbonate salts and turmeric powder (0.30g $NaHCO_3$ and 0.70g turmeric) recorded the highest values (3.51±0.08 and 3.48±0.08). Body weight and comb length were not significantly (P >0.05) influenced by supplementation level of sodium bicarbonate salt and turmeric powder. However, shank length was affected (P<0.001) by addition of sodium bicarbonate salt and turmeric powder, it was observed that 0.70g sodium bicarbonate salt inclusion had the longest shank length. It was concluded that supplementation of sodium bicarbonate salt and turmeric powder significantly improved Yolk diameter. This singular improvement will influence the overall quality of the egg and also its ability to produce better quality chicks if used for hatching purposes. Shank length was also improved significantly. Sodium bicarbonate salt and turmeric powder is therefore recommended in Isa brown hens.

Keywords: Turmeric, Sodium Bicarbonate, Egg Quality, Body Parameter, Isa Brown

INTRODUCTION

Over the past few decades the production of eggs has grown faster than that of any other major food in developing countries (Shim *et al.,* 2013). This is as a result of increasing demand for animal product due to increase in population, urbanization and westernization of diet. The popularity of poultry has many advantages over other livestock. Poultry birds are good converters of feed into useable protein in eggs. These product has increased much faster than beef and veal or pig meat (Dutta, 2013). Poultry egg is found to be one of the most complete food known to man, and it provides means by which rapid transformation of animal protein intake can be achieved (Shim *et al.,* 2013). The return on investment is high, due to this there is hardly any household in the rural or semi-urban areas that does not keep one form of poultry or the other. Also, genetic improvement could be attained at a faster rate than most farm animals since they have a shorter generation interval. Eggs are also the means by which reproduction takes place in poultry, hence the internal egg quality play a major role in production of good quality chicks. Therefore this study seeks to determine the effects of sodium bicarbonate and turmeric powder on internal egg quality and body parameter measurements of laying hens.

MATERIALS AND METHODS

The eggs used in this study were laid by Isa brown chicken which were sourced from CHI farm and raised under similar management techniques. Isa brown is a hybrid brown egg layer being a cross between Rhode Island Whites and Rhode Island Red. Isa brown are hardy, they adapt themselves to all climates and environment. It has an egg production rate of approximately 300 eggs per hen in the first laying year (Bukunmi and Yusuf, 2015). The experiment was conducted at the poultry house of Department of Animal Production Abubukar Tafawa Balewa University located in Gubi Village, Bauchi. A total of one hundred and eighty four (184) Isa Brown hens were used for the research which was conducted from July to October.

***Albumen Height**:* To obtain the albumen height, each egg was gently broken into two halves not to break the vitelline membrane that enclose the yolk by using a shape knife and its contents poured into a flat tray placed on a flat surface table. The height was obtained by the use of vernier calliper, the calliper stem was pierced into the albumen at its widest part at a position half way between the yolk and the outer margin and adjusted until it touched the albumen from the top and the corresponding reading was recorded as the albumen height.
Albumen Length: The albumen length was measured with the vernier calliper it was taken as a longitudinal section of thick albumen.
Albumen Diameter: The albumen diameter was measured across the wider part of the albumen using the vernier calliper.
Yolk Height: The yolk height was measured using the vernier calliper it was taken at the highest point of egg yolk. It was done the same way albumen height was obtained
Yolk Colour: The Yolk colour has been standardized by the "Roche" colour fan, which is a set of yellow coloured blades varying from a very light yellow (number 1 on the fan) to a dark or almost reddish yellow (no 14).
Yolk Lenght: This was measured as the widest horizontal circumference with a vernier calliper
***Yolk Diameter*:**Yolk diameter determined along the chalazae line was with the calliper.
After collecting egg samples, the birds were weighed individually while the shank length and comb length were measured using a rule.

RESULTS AND DISCUSSION

Table: 1 Effects of Sodium Bicarbonate and Turmeric powder on Internal Egg Quality

Variable (%)	N	Albumen height	Albumen diameter	Albumen length	Albumen index	Yolk height	Yolk diameter	Yolk index	Haugh unit
Overall		1.03±0.01	6.06±0.06	7.22±0.03	0.16±0.00	1.73±0.02	3.40±0.011	0.51±0.00	84.47±0.06
Treatment		NS	NS	NS	NS	NS	***	NS	NS
Control	67	0.58±0.09	5.75±0.43	7.15±0.02	0.15±0.02	1.75±0.06	3.37±0.08^{c}	0.49±0.02	84.03±0.39
S30	99	1.08±0.09	5.89±0.42	7.12±0.20	0.17±0.01	1.71±0.05	3.51±0.08^{a}	0.51±0.02	84.75±0.38
S70	124	1.04±0.09	5.98±0.38	7.19±0.18	0.16±0.01	1.68±0.05	3.47±0.08^{ab}	0.51±0.02	84±51±0.34
T30	115	1.08±0.09	5.89±0.41	7.13±0.19	0.17±0.01	1.75±0.05	3.44±0.08^{abc}	0.53±0.02	84.74±0.37
T70	119	1.01±0.09	6.23±0.40	7.31±0.19	0.15±0.01	1.74±0.05	3.40±0.08^{abc}	0.50±0.02	84.44±0.37
S30T30	108	1.11±0.09	6.18±0.41	7.24±0.19	0.17±0.01	1.75±0.05	3.43±0.08^{abc}	0.51±0.02	84.77±0.37
S30T70	107	0.93±0.09	6.35±0.41	7.44±0.19	0.14±0.01	1.72±0.05	3.45±0.08^{ab}	0.47±0.02	84.01±0.07
S70T30	116	1.05±0.09	5.88±0.41	7.12±0.19	0.16±0.01	1.75±0.05	3.48±0.08^{ab}	0.53±0,02	84.62±0.37
S70T70	121	0.10±0.09	6.66±0.40	7.35±0.19	0.15±0.01	1.72±0.05	3.40±0.08^{abc}	0.50±0.02	84.39±0.37
Months		***	***	***	***	***	****	***	***
July	492	0.86±0.02^{b}	6.07±0.08^{a}	7.55±0.4^{a}	0.13±0.00^{b}	1.68±0.01^{b}	3.48±0.02^{a}	0.47±0.01^{c}	83.45±0.07^{b}
August	205	1.09±0.03^{a}	5.69±0.12^{b}	6.87±0.6^{d}	0.17±0.00^{a}	1.77±0.02^{a}	3.32±0.02^{c}	0.53±0.01^{a}	84.82±0.11^{a}
September	194	1.0.9±0,03^{a}	6.29±0.13^{a}	7.12±0.6^{c}	0.16±0.00^{a}	1.75±0.02^{a}	3.41±0.02^{b}	0.51±0.01^{ab}	84.80±0.12^{a}
October	152	1.11±0.03^{a}	6.20±0.14^{a}	7.34±0.07^{b}	0.16±0.01^{a}	1.75±0.02^{a}	3.40±0.02^{b}	0.51±0.01^{b}	84.83±0.13^{a}

***=P<0.001 NS=Not Significant
Means for groups with the same superscript (s) are statistically similar
S30=0.30g, S70=0.70g $NaHCO_3$ salt and S30=0.30g, T70=0.70g Turmeric powder inclusions in diet.
Means for groups with the same superscript(s) are statistically similar S30 =0.30g, S70=0.70g $NaHCO_3$ salt, T30 =0.30g, T70=0.70g turmeric powder inclusion in the diet; N= overall 1043

Table 1 shows the results for effects of sodium bicarbonate and turmeric powder on internal egg quality. The results recovered showed that, supplementation of sodium bicarbonate salt and turmeric powder on the internal egg quality of layers did not affect albumen height (1.03± 0.2) mm, yolk height (1.73±0.2) mm, yolk index (0.51±0.00), and haugh unit (84.47±0.06) mm of the eggs.

However, significant (P<0.01) difference was noticed on Yolk diameter where 0.30g sole supplemented sodium bicarbonate salt and interaction between sodium bicarbonate salts and turmeric powder (0.30g $NaHCO_3$ and 0.70g turmeric) recorded the highest values (3.51±0.08 and 3.48±0.08), the lowest values were observed on interaction between sodium bicarbonate salt and turmeric powder 0.30g $NaHCO_3$ and 0.70g turmeric. The improvement on the yolk diameter could be as a result of the incorporation of turmeric powder as reported by Balnave and Muhereeza (1997) who incorporated NaCl with $NaHCO_3$ and sowed that the results improved internal egg quality (Yolk diameter) in different breed of pullets. The authors concluded that 1 %. Supplemental $NaHCO_3$ improved egg shell and internal qualities (Yolk diameter) in Rhode Island Red. Internal egg qualities parameters shows that Albumen height, diameter, length, index and Yolk height, diameter, index and haugh unit were significantly (P<0.01) affected the months of production. It was observed that Albumen height, index, Yolk height and haugh unit were better in August, September and October and the least values were observed in July on the various parameters. On the other hand July, September and October were the best months with the highest value in albumen diameter, while the lowest was on August. Similarly July was the best month with the highest values for albumen length and yolk diameter. More so, August had the highest value of Yolk index and the lowest value was noticed in July.

Table 2: Effects of Sodium Bicarbonate and Turmeric Powder on Body parameters measurements.

Variable (%)	N	Body weight	Shank length	Comb length
Overall		1.78±0.03	6.81±0.05	6.45±0.12
Treatment		NS	***	NS
Control	6	1.76±0.09	$6.67±0.15^{cd}$	6.53±0.37
S30	6	1.97±0.09	$7.05±0.15^{abc}$	6.05±0.37
S70	6	1.75±0.09	$7.47±0.15^{a}$	6.87±0.37
T30	6	1.78±0.09	$6.83±0.15^{bcd}$	5.98±0.37
T70	6	1.75±0.09	$6.53±0.15^{cd}$	6.45±0.37
S30T30	6	1.98±0.09	$6.33±0.15^{d}$	7.22±0.37
S30T70	6	1.80±0.09	$6.65±0.15^{cd}$	6.12±0.37
S70T30	6	1.72±0.09	$7.37±0.15^{ab}$	6.53±0.37
S70T70	6	1.55±0.09	$6.57±0.15^{cd}$	6.22±0.37

***=P<0.001, NS=Not Significant Means for groups with the same superscript(s) are statistically similar

S30 =0.30g, S70=0.70g $NaHCO_3$ salt, T30 =0.30g, T70=0.70g turmeric powder inclusion in the diet; N= overall 60

Table 2 shows the results for effects of Sodium Bicarbonate and Turmeric Powder on Body parameters measurements. Body weight and comb length were not significantly (P>0.05) influenced by supplementation level of sodium bicarbonate salt and turmeric powder. However, shank length was affected (P<0.001) by addition of sodium bicarbonate salt and turmeric powder. It was observed that 0.70g sodium bicarbonate salt inclusion had the best longest shank length and the least was observed on 0.30g sodium bicarbonate salt and 0.30g turmeric powder combination. The inconsistency observed in the result could be as a result of turmeric powder and sodium bicarbonate combination, though best shank length noticed on 0.70g sodium bicarbonate salt could be attributed to the fact that $NaHCO_3$ plays vital role in bone formation.

CONCLUSION AND RECOMMENDATIONS

Supplementation of sodium bicarbonate salt and turmeric powder significantly improved Yolk diameter. This singular improvement will influence the overall quality of the egg and also its ability to produce better quality chicks if used for hatching purposes. Shank length was also improved significantly. Sodium bicarbonate salt and turmeric powder is therefore recommended in Isa brown hens. Further research is also recommended.

REFERENCES

Balnave, D and s.KMuhereeza (1997) Improving Eggs Shell Quality at High Temperatures with Dietary Sodium Bicarbonate. *Poultry Science***76**:588-593.

Bukunmi, F. R. and H. A. Yusuf (2015) Analysis of Socio-Economic Factors Influencing Poultry Egg Production among Poultry Farmers in Ondo State, Nigeria. *British Journal of Applied Science and technology* **10**(3): 1-7, 2015, Article No. BJAST.12014 ISSN: 2231-0843.

Dutta R.K., M.S. Islam and M.A. Kabir (2013) production performance of indigenous chicken (Gallus domesticus L.) In some selected Areas of Rajshahi, *Bangladesh. American Journal experimentalAgriculture* **3(**2); 3018 – 323 Science Domain International.

Shim, M. Y., E. Song, L. Billard, S. E Aggrey, G.M. Pesti, P. Sodsee (2013) Effect of balanced Dietary Protein Level on Egg Production and Egg Quality Parameters of individual Commercial Layers. *Poultry Science*, Vol. **92**, Issue 10, 1 ocyober 2013, Pages 2687-2696, https.//dio.org/10.3382/P5.2012-02569.

EFFECTS OF SODIUM BICARBONATE SALT AND TURMERIC POWDER ON EXTERNAL EGG QUALITY OF ISA BROWN HENS

*** Hirdima L.D., Y.P Mancha & D.J.U Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: ihirdima@gmail.com mobile No: 07032892843*

ABSTRACT

A 112-day (16 weeks) study was carried out to investigate the effects of sodium bicarbonate salt and turmeric powder on external egg quality of Isa brown hens. The experiment was conducted at the poultry unit of Department of Animal Production Abubukar Tafawa Balewa University located in Gubi, Bauchi during the rainy season from July to October. A total of one hundred and eighty four (184) Isa Brown hens were used for the research. The result showed that increasing levels of sodium bicarbonate salt and turmeric powder had no significant effect on external egg quality. Egg weight (63.76± 0.19), egg circumference (14.30± 0.12) mm, egg diameter (4.53± 0.06) mm, shell thickness (0.46± 0.4) mm and shell egg proportion (8.46± 0.10) g. July and September recorded the highest value for egg weights which shows that there were significant variations among the months of the rainy season. From the observations of this study it was concluded that increasing levels of sodium bicarbonate salt and turmeric powder had no significant effect on external egg quality of Isa brown hens, however external egg quality was significantly ($P<0.001$) different among the months of the rainy season. It was also concluded that there exist a negative correlation between egg weight and shell thickness.

Keywords: Turmeric, Sodium Bicarbonate, Egg Quality, Isa Brown

INTRODUCTION

Currently poultry are domesticated birds used for both egg and meat production. This includes birds such as chicken, turkey, duck, goose, ostrich, quail, pheasant guinea fowl and peafowl .Chickens are the most popular worldwide irrespective of culture and religion (Al-nasser *et al.,* 2007). In a natural environment, the strength of the eggshell should be able to prevent cracking in order to preserve the embryo until hatching and also for better marketability of the eggs. The size, shape and weight of the eggs also influence the quality of chicks hatched and also consumer decision to buy or not to buy. While on the farm, eggshell is important to prevent breakage from handling and to preserve egg during transport from farm to the market (Mazzuco and Bertechini, 2014). Eggshell quality is a common problem in layer stock. The eggshell consists of 98% calcium carbonate. The necessary calcium for shell formation is derived from the feed and bone. During $CaCo_3$ synthesis in the shell gland, acidosis occurs until the twenty second hour after ovulation. Considering the adverse effect of acidogenic compounds on egg shell calcification, the utilization of alkaline salt as dietary supplements can be used to improve eggshell quality. Nirat and Ratana(2005) reported that the alterations of the dietary sodium/chlorine ratio could produce metabolic acidosis or alkalosis, regardless of the total quantities of these two ions in the diet. The requirement of sodium in laying hens for optimum performance has been a subject of investigation for a number of years. Sodium bicarbonate ($NaHC0_3$) is the sodium- containing mineral compound which is currently being used in poultry feeds. Greater shell thickness or shell strength has been reported if part of the dietary sodium was provided as $NaHCO_3$ salt rather than sodium chloride (Nirat and Ratana, 2005). Mancha *et al* (2004) reported that replacement of sodium chloride (NaCL) salt with sodium bicarbonate ($NaHCO_3$) salt resulted in a definite improvement in egg shell quality. This is because sodium bicarbonate provides sodium which favourably affects blood PH and supplies beneficial bicarbonate. Turmeric on the other hand is believed to posses antioxidant activities which might reduce oxidative stress. Therefore the objective of this research was to determine the effects of sodium bicarbonate and turmeric powder on external egg quality.

MATERIALS AND METHODS

The eggs used in this study were laid by Isa brown strain of chicken which were sourced from CHI farm and raised under similar management techniques. Isa brown is a hybrid brown egg layer being a cross between Rhode Island Whites and Rhode Island Red. Isa browns are hardy and they adapt themselves to all climates and environment. It has an egg production rate of approximately 300 eggs per hen in the first laying year (Bukunmi and Yusuf, 2015). The experiment was conducted at the

poultry house of Department of Animal Production Abubukar Tafawa Balewa University located in Gubi, Bauchi. A total of one hundred and eighty four (184) Isa Brown hens were used for the research which was conducted from July to October.

Determination of external egg quality

Egg Weight: The egg weight was measured with an electronic balance to the nearest 0.01 g. Each egg was placed on the sensitive flat surface of the electronic balance, and then the reading was taken

Egg Circumference: The egg circumference of each egg was obtained by placing a rope round the egg, and then stretching the rope on a rule to take the measurement.

Egg Diameter: The egg diameter was measured with the aid of pair of Vernier calliper (mm). The egg was placed horizontally between the outer dimension jaws of the Vernier calliper, which were moved together until they secured the egg. The screw clamp was tightened to ensure that the reading did not change while the scale was being read and recorded.

Egg shell Thickness: The eggshell thickness was measured after removing the internal content of the egg, using a micrometer screw gauge which has the precision of 0.01 mm. Measurement was taken at middle of the part of shell used.

Shell Weight/Proportion: To measure shell weight/proportion, the shell with membrane was placed on the electronic scale and the reading was obtained.

RESULTS AND DISCUSSION

Table: 1 Effects of Sodium Bicarbonate salt and Turmeric Powder on External Egg Quality

Variable (%)	N	Egg weight (g)	Egg circumference (cm)	Egg diameter (mm)	Shell thickness (mm)	Shell egg proportion (g)
Overall		63.76±0.19	14.30±0.12	4.53±0.06	0.46±0.4	8.46±0.10
Treatments		NS	NS	NS	NS	NS
Control	69	63.39±1.30	14.31±0.11	4.48±0.41	0.68±0.31	8.43±0.71
S30	99	65.24±1.30	14.25±0.11	4.54±0.39	0.36±0.30	8.29±0.68
S70	124	65.41±1.13	14.26±0.10	4.52±0.35	0.38±0,27	8.38±0.62
T30	115	66.01±1.24	14.28±0.11	4.54±0.39	0.36±0.29	8.07±0.67
T70	119	61.91±1.22	14.31±0.11	4.70±0.38	0.40±0.29	8.48±0.67
S30T30	108	62.67±1.23	14.38±0,11	4.40±0.39	0.40±0.29	8.48±0.67
S30T70	107	62.87±1.23	14.36±0.11	4.37±0.39	0.41±0.29	8.68±0.67
S70T30	116	65.00±1.23	14.24±0.11	4.55±0.39	0.43±0.29	9.00±0.67
S70T70	121	61.71±1.22	14.30±0.11	4.75±0.38	0.44±0.29	8.61±0.66
Months		***	***	***	NS	***
July	492	$64.59±0.24^{a}$	$14.38±0.02^{a}$	$4.48±0.08^{b}$	0.50±0.06	$7.96±0.13^{b}$
August	205	$63.12±0.38^{b}$	$14.28±0.03^{b}$	$4.42±0.12^{b}$	0.46±0.09	$8.48±0.21^{ab}$
September	194	$64.28±0.39^{a}$	$14.29±0.03^{b}$	$4.83±0.12^{a}$	0.45±0.09	$9.10±0.21^{a}$
October	152	$63.04±0.43^{b}$	$14.25±0.04^{b}$	$4.41±0.14^{b}$	0.41±0.10	$8.29±0.23^{b}$

***=P<0.001, NS=Not Significant. Means for groups with the same superscript (s) are statistically similar S30=0.30g, S70=0.70g $NaHCO_3$ salt, T30=0.30g, T70=0.70g Turmeric powder inclusions in the diet.

Table 1 shows the results for effects of Sodium Bicarbonate salt and Turmeric Powder on External Egg Quality. The results showed that increasing levels of sodium bicarbonate salt and turmeric powder had no significant effect on external egg quality. Egg weight (63.76± 0.19), egg circumference (14.30± 0.12) mm, egg diameter (4.53± 0.06) mm, shell thickness (0.46± 0.4)mm and shell egg proportion (8.46± 0.10)g. Grizzle *et al* (1992) reported that 1% of sodium bicarbonate salt supplementation did not alter external egg quality of Rhode Island Red. Egg weight, egg circumference, egg diameter and shell egg proportion were significant (P<0.001), among months (July to October). However, August and October (63.12±0.38 and 63.04±0.43), August-October (14.25±0.04-14.29±0.03), August and October (4.42±0.12 and 4.41±0.14) and July and October (8.29±0.23 and 7.96±0.13) for egg weigh, egg circumference, egg diameter and shell egg proportion are the parameters with the lowest value.

Table 2: Correlations among external egg quality parameters and body measurements

	1	2	3	4	5	6	7	8	9	10
HDP(1)										
F/E (2)	1.000**									
EW (3)	0.044	0.044								
EC (4)	0.052	0.052	0.853**							
ED (5)	-0.047	-0.047	0.079*	0.028						
ST (6)	0.012	0.012	-0.067*	-0.052	-0.006					
SEP (7)	0.000	-0.001	0.120**	0.090**	0.008	-0.011				
B W(8)	-0.211	-0.211	-0.123	0.003	-0.007	-0.106	-0.073			
F C R(9)	0.209	0.208	0.079	-0.047	-0.053	0.127	0.042	-0.976**		
S L (10)	0.347**	0.344**	-0.079	-0.030	-0.016	-0.081	-0.304*	-0.013	-0.033	
C L (11)	-0.025	-0.033	0.027	0.094	0.098	0.048	0.018	0.146	-0.168	0.169

HDP=Hen day production; FE=feed/Egg; EW=Egg weight; EC=Egg Circumference; ED = Egg Diameter; ST= Shell Thickness'; SEP=shell egg proportion; BW=body weight; FCR=feed conversion ratios; SL=shank length; CL=comb length

*Correlation significant at P<0.05 the level (2-tailed)

**Correlation significant at P<0.01 the level (2-tailed)

Table 2 shows the correlations among external egg quality parameters. There were positive and negative correlation between external egg qualities, shank and comb length by adding sodium bicarbonate salt and turmeric powder supplementation on the parameter. However, a strong positive correlation (r =1.000; P<0.001) was observed between %HDP and feed per egg. Similarly, very low negative correlation (r= -0.067 P<0.05) was observed between egg weight and shell thickness.

CONCLUSION

From the observations of this study it was concluded that increasing levels of sodium bicarbonate salt and turmeric powder had no significant effect on external egg quality of Isa brown hens, although external egg quality was significantly different among the months of the rainy season. It was also concluded that there exist a negative correlation between egg weight and shell thickness.

REFERENCES

Al-Nasser A., H. Al-khalaifa, Al-saffar, F.Khalil, M.Al-bahouh, G. Ragheb, A. Al-haddad and M. Mashaly (2007) Oview of chicken Taxonomy and domestication. *World poultry science Journal*, Vol. **63.**

Bukunmi, F. R. and H. A. Yusuf (2015) Analysis of Socio-Economic Factors Influencing Poultry Egg Production among Poultry Farmers in Ondo State, Nigeria. *British Journal of Applied Science and technology* **10**(3): 1-7, 2015, Article No. BJAST.12014 ISSN: 2231-0843.

Grizzle, J. M. Iheanacho, A. Saxton and J. Broaden (1992) Nutritional and Environmental Factors involved in Egg Shell of Laying Hens. *British Poultry Science***33**:781-794.

Mancha, Y.P, T. Oguntona and D.M Ogah (2004) Effect off sodium Bicarbonate salt on eggshell quality Ambient temperature. Proceedings of the 38th Annual Conference of the Agricultural society of Nigeria.

Mazzuco, H. and A.G. Bertechmi, (2014) Critical point on egg production: Causes, importance and incidence of eggshell Breaker and defects. Review.

Nirat and Ratana G. (2005) Effects of dietary Sodium Bicarbonate supplementation on eggshell quality and Hatchability in Thai Native Hens. *Kasetsart Journal (Natural Sciences)* **39**: 53 – 63.

HERITABILITY ESTIMATE OF BIRTH WEIGHT IN GUINEA PIG (*Cavia porcellus*)

Maigado, A. I., Ma'aruf, B. S., Shuaibu, A. & Ahmadi, B.
Department of Animal Science, Faculty of Agriculture, Federal University of Kashere, Gombe P.M.B 0182 Gombe State
Corresponding author: alinmaigado@gmail.com

ABSTRACT
The study was conducted to estimate the heritability of birth weight in guinea pigs using using half-sibs and full-sibs methods. A total of 40 piglets generated from 24 matured guinea pigs (4 males and 20 females) nested in the ratio of 1male to 5males were used for the study. After farrowing, birth weight of individual piglet was recorded using a digital weighing scale. Data generated were analyzed using analysis of variance and restricted maximum likelihood, correlation coefficients among parent and offspring birth weights were estimated. Sire had no effect on birth weight and heritability estimates of this trait using different components of variance (sire, dam and sire/dam) were low. Correlation coefficients between the parent weight and birth weight were low, negative and non-significant. This study indicated that birth weight has low transmissibility. Further research involving larger data sets should be conducted to ascertain these findings.

Key words: Guinea pig, heritability, birth weight, phenotypic correlations

INTRODUCTION
Guinea pigs are valuable species that can improve the livelihoods of smallholders (Lammers *et al.*, 2009). Food security in most parts of Africa remains a real challenge especially when quantity and quality is concerned (IFAD, 2011). As such, global poverty and food insecurity continue to remain critical (Lammers *et al*., 2009). Conventional animal species (cattle, sheep and goat) cannot meet the protein deficiency gap because their multiplication rate is not commensurate with rapid increase in human populations (Dikko *et al*., 2009). Cavies (guinea pigs) are promising mini livestock species as they require little capital or labour for keeping and management (NRC, 1991; Ngoupayou *et al*., 1995). Therefore, food from micro-livestock such as guinea pigs, snail and grass cutter could play an important role in alleviation of protein deficiency (USDA, 2007; UA, 2008). The usefulness of guinea pigs as meat producers and source of income in peri-urban (Ngoupayou *et al.*, 1995) and rural areas (Nuwanyakpa, 1993; Lukefahr, 2004) is well documented. Published research information on cavies under different ecological and socio-economic conditions is needed to clearly show that raising of such species of livestock is one way for farmers to raise income, inexpensively produce meat for home consumption and organic manure for backyard crop production (Nuwanyapka, 1997). Therefore, to increase the output obtained from this species of livestock, genetic parameter of growth traits specifically the heritability need to be estimated on which the selection response relies. Therefore, the current studies was designed to estimate the heritability of birth weight using both half and full sib methods.

MATERIALS AND METHODS
Study Area
The study was conducted at teaching and research farm of Federal University of Kashere, Gombe State. The State falls within the northern guinea savannah zone of Nigeria and is 431m above sea level. It is located between longitudes $11^0 10'$ and 11.16^0 7'east and latitudes $10^0 15'$ and 10.25^0 0' North (NPC, 2006). Gombe State has two distinct climates, the dry season (November - March) and the rainy season (April - October) with an average rainfall of 850mm/annum. Relative Humidity of 15 - 60 % in the north zone, 25 - 50 % in the central zone, and up to 80 % in the southern zones was noticed. The ambient temperature could be as low as 16.6^0 C during the dry cold season and as high as 39.4^0 C during the dry hot season (C-GIDD, 2008).

Management of the Experimental Animals and Data Collection
Twenty four guinea pigs consisting of 4 males and 20 females sourced from Jos, Plateau state Nigeria were used for this experiment. On arrival, body weight of each was recorded using electronics scale and this is repeated after two weeks prior to the commencement of the experiment. They were fed mostly forages (grass and legume mixture) and supplemented with broiler finisher diet and Vitamin C. Scanty health management was practiced and animals are kept under good environmental condition.

In each breeding group, 5 females were nested to a male and immediately after farrowing, birth weight of piglets was recorded according to sire and dam ID.

Data Analysis

Sire effect on birth weight and variance components for both sire and dam were generated using one-way analysis of variance (ANOVA) and restricted maximum likelihood (REML), respectively in general linear model (GLM) procedure of SPSS, version 25 (2017). Significantly different means were compared using the least significant difference (LSD). Model utilized to determine the sire effect was as follows:

$\mathbf{Y_i = U + S_i + e_i}$

$\mathbf{Y_i}$ = Observation on dependent variables (birth weight)
$\mathbf{U}$ = Common Mean
$\mathbf{S_i}$ = effect of ith sire
$\mathbf{e_i}$ = random error term

After estimating the components of variance, heritability was calculated according to Becker (1984) using the following formulas:

Sire Variance Component:

$$\boldsymbol{h^2(S) = \frac{4\sigma^2 S}{\sigma^2 S + \sigma^2 D + \sigma^2 W}}$$

Dam Variance Component:

$$\boldsymbol{h^2(D) = \frac{4\sigma^2 D}{\sigma^2 S + \sigma^2 D + \sigma^2 W}}$$

Sire + Dam Variance Component:

$$\boldsymbol{h^2(S+D) = \frac{2(\sigma^2 S + \sigma^2 D)}{\sigma^2 S + \sigma^2 D + \sigma^2 W}}$$

Where

h^2 = heritability
σ^2_S = Sire Variance Component
σ^2_D = Dam Variance Components
σ^2_W = Error Variance Components

The relationships between the parents (sire and dam) live weight and offspring birth weight was determined using the Pearson's product moment correlation.

RESULTS AND DISCUSSION

Average birth weight of piglets according to sire is presented in Table 1 which indicates that sire had no effect on this trait (birth weight). Heritability estimate (h^2) of birth weight from different variance components (sire, dam and combination both sire and dam) are presented in Table 2. The heritability obtained using dam component of variance (0.125) was higher compared to those of sire and sire-dam components (0.068 and 0.012, respectively). The lower heritability estimate obtained for birth weight is consistent with those reported by Canario *et al*. (2010) and Garreau *et al.* (2008) in rabbits (0.14 and 0.06, respectively). Odubote and Somade (1992) reported estimate of 0.33±0.08 for average litter birth weight which is high compared to values of 0.068 obtained in the present study. The variation from other report might have resulted from differences in genotypes, location, environmental factors and different sample sizes. Further report by Ajayi *et al*. (2014) showed that heritability estimate of birth weight is higher and more reliable than that of weaning weight (0.19±0.15 and 0.09±0.12, respectively). Similarly, Wolf *et al.* (2008) estimated a heritability of 0.10 for birth weight in light piglets. However, Randi and Scossiroli (1980) reported higher estimate of 0.455±0.348 and 0.212 from maternal half-sibs and full-sibs methods, respectively among New Zealand white rabbits. The higher value observed when dam component was used in the estimation of heritability agrees with the earlier report of Mostageer *et al*. (1970) who reported value of 0.931 from maternal half-sibs method

and attributed this fact to maternal genetic effect. Blasco *et al*. (1982) reported values of 0.73±0.26 from maternal half-sibs for individual weight at 21 days and related it to maternal genetic effect which is believed to have originated from mitochondrial DNA of ovum (Sato and Sato, 2013). The correlation coefficients between parent weight and off-springs birth weight is shown in Table 3 and were negatively low and not significant, this indicated that off-spring birth weight cannot be predicted from parents' live weight. It also implies that genetic correlation between the two traits is low. This is in agreement with the work of Odubote and Somade (1992) that live weight of parent had no significant relationship with birth of off-spring in rabbits.

Table 1: Effect of sire on birth weight

Sire ID	Birth weight (g)
1	75.00±5.00
2	82.50±6.61
3	79.17±2.39
4	78.00±2.00
LOS	NS

NS = Non-significant

Table 2: Heritability estimates of birth weight from different components

Components	h^2
Sire	0.012
Dam	0.125
Sire + Dam	0.068

h^2 = heritability

Table 3: Correlation coefficients between parents' weight and off-spring birth weight

Parent weight	Birth weight
Sire	-0.322^{NS}
Dam	-0.132^{NS}

NS = Non-significant

CONCLUSION

From the findings of this study, it can be concluded that sire had no effect on birth weight; heritability estimate of this trait was low and parent and offspring birth weights cannot indicate each other

REFERENCE

Ajayi, B. A., Oseni, S. O. and Popoola, M. A. (2014). Heritability estimates and genetic correlations of some reproductive traits in heterogeneous rabbit population in South-west Nigeria. *Tropical Animal Production Investigation*, **17** (1): 52 - 57.

Becker, W. A. (1984). **Manual of Quantitative Genetics**. 4th Edition. Students Book Corporation, Pullman, Washington, D.C.

Blsco, E. A., Baselga, M. and Garcia, F. (1987). Analysis of productive character in meat production rabbits. *Archivos de Zootecnia*, **32** (123): 1 -18.

Canario, L., Lundgren, H., Haandlykken, M. and Rydhmer, L. (2010). Génétique de la croissance et de l'hétérogénéité des poids de porcelets dans les portées de Landrace norvégien. 42e Journées de la Recherche Porcine,181.

C-GIDD (Canback Global Income Distribution Database). Canback Dangel. Retrieved 2008-08-20

Dikko, A. H., Egena, S. S. A., Malik, A. A. and Ibrahim, H. (2009). "Guinea Pig (*Cavia porcellus)* as an Untapped Protein Source for Man. Pp: 43.

Garreau, H., Bolet, G., Larzul, C., Robert-Granié, C., Saleil, G., SanCristobal, M. and Bodin, L. (2008). Results of four generations of a canalising selection for rabbit birth weight. *Livestock Science*,**11**(9): 55 - 62.

International Fund for Agricultural development (IFAD) (2011). "The future of world food security" Accessed from websitewww.ifad.org/pub/index.htm on the 28/03/12

Lammers, P. J., Carlson, S. l., Zdorkowski, G. A. and Honeyman, M. S. (2009). Reducing food insecurity in developing countries through meat production: The potential of the guinea pig (*CaviaPorcellus*). *Renew Agr. Food Syst*. **(24):** 155 – 162.

Lukefehr, S. (2004). Small scale guinea pig production for limited resource rural farmers In Cameroon, West Africa.an internal HPI/Cameroon report. Pp: 10-15.

Mostageer, A., Ghany, M. A. and Darwish, H. I. (1970). Genetic and phenotypic parameters for the improvement of body weight in Gizza rabbits. *Journal of Animal Production*, **10** (11): 65 -72.

National Population Commission, (2006) PHC Priority Tables - Population.gov.ng. Retrieved 2017.

Ngoupayou, J. D. Kouounmenioc, N. J., Tagny, J. M. F., Cicogna, M., Castroville, C., Rigoni, M. and Hardouin, J. (1995). Development opportunities for the guinea pigs in Sub-Sahara Africa, the case of Cameroon. *Animal Review*, 83 **(2)**: 20 - 28.

NRC. (1991). Microlivestock: Little-known small animals with a promising economic future. Board of science and technology for international development, National Research Council (NRC), National Academy Press.Washington DC, USA.

Nuwanyakpa, M. (1993). Analysis of a baseline survey on the incorporation of guinea pigs production with HP/Cameroon (An Internal HPI/Cameroon report). Pp: 7.

Nuwanyakpa, M., Lukefar, S. D. Gudahl, D. and Ngoupayou, J. D. (1997). The current stage and future prospects of guinea pig production under smallholder conditions in West Africa. *Livestock Research forRural Development* **(9)**5: 12.

Odubote, I. K. and Somade, B. (1992). Genetic analysis of rabbit litter traits at birth and at weaning. *Nigerian Journal of Animal Production*, **19**(2): 64-69.

Randi, E. and Scossiroli, R. E. (1980). Genetic analysis of production traits in Italian, New Zealand White and Californian purebred population. 2nd WorldRabbit Congress, April, Barcelona, Spain.

Sato, M. and Sato, K. (2013). Maternal inheritance of mitochondrial DNA by diverse mechanisms toeliminate paternal mitochondrial DNA. *Biochimica et Biophysica Acta*, **18** (33): 1979–1984.

UA, (2008**).** Amino acids. Department of Biochemistry and Molecular Biophysics,University of Arizona.

USDA. (2007). National Nutrient Database for Standard Reference, Release 20. Unite States Department of Agriculture.

Wolf, J., Zakova, E. and Groenveld, E. (2008). Within-litter variation of birth weight in hyper-prolific Czech Large White sows and its relation to litter size traits, stillborn piglets and losses until weaning. *Livestock Production Science,* **11**(5): 195 - 205.

EGG QUALITY CHARACTERISTICS OF NOILER STRAIN COMPARED TO TWO OTHER COMMERCIAL STRAINS OF LAYERS

Mosobalaje, M. A., Tiamiyu, J. O. & Amuda, S. K.
Department of Animal Health and Production, Oyo State College of Agriculture and Technology, Igboora,
**mosobahs@yahoo.com; jamademosobalaje@gmail.com 08034780805; 08057340189*

ABSTRACT
The experiment was conducted using three strains of layers; Isa brown, nera black and noiler (60 each) to compare their egg quality traits of the three strains. The birds were fed with commercial feed and the study lasted 6 weeks. Each strain was randomly allocated into four replicates consisting of 15 birds per replicate in Completely Randomized Design (CRD). Two eggs were collected daily from each replicate per week to determine egg quality. The internal egg quality parameter were accessed after breaking and separating each of the components, the parameter considered for internal egg quality were yolk colour, yolk length and weight. Egg weight, length and width, shell weight and thickness were considered for external egg quality. A non significant influence of strain was detected in all parameters recorded except egg production, egg weight, yolk weight and yolk colour that were significant ($p<0.05$) among the strains. Isa brown had the significantly higher ($p<0.05$) egg production (80.57%) while noiler strain had the lowest value of 57.47%.Noiler recorded the highest values for egg weight (63.80g) and yolk weight (32.17g) while Isa brown had the lowest (58.00g and 28.11g, respectively)Values recorded for egg length, egg breadth, shell weight, yolk length and shell thickness were not significantly affected by the strain of layers and the ranges were 5.17 - 5.35mm, 3.80 - 4.10mm. 7.36 - 7.54g, 1.89 – 2.09mm and 0.34 – 0.36, respectively. Conclusively, egg production of noiler was poor, but other egg qualities were better.
Keywords: Poultry, Isa brown, Nera black, Noiler, Egg Quality.

INTRODUCTION
The internal and external egg quality traits are of major importance to the egg industry worldwide (Ahmadi and Rahimi, 2011). Some researchers have studied the chicken egg quality from different perspectives. It has been reported that the quality of the chicken egg is influenced by genetic and non-genetic factors such as season, environment and feed intake (Ahmadi and Rahimi, 2011). Egg quality traits had been reported to influence embryo development, hatchability, and growth performance of chicks (Khan, 2002). There are reports on the relationship between egg size and egg quality characteristics (Sarica *et al.,* 2012; Abanikanda, 2007). Egg quality characteristics are affected by genotype and age (Zita *et al.,* 2009). According to Pradeepta *et al.* (2015), egg shell thickness of at least 0.33 mm was necessary for the eggs to have at least a 50% chance to stand without breakage under normal handling condition. The shell thickness and porosity help to regulate the exchange of carbon dioxide and oxygen between the developing embryo and the air during incubation (Roque and Soares, 1994). However, yolk colour is a function of feed not breeds Garba *et al*. (2016).Pradeepta *et al.* (2015) reported that white Leghorn had optimum egg weight (57.78g) with albumen height (8.41mm} and H.U. (92.00) and Roberts and Leary (1999) reported that albumen quality was influenced by many factors such as storage time, temperature, environmental conditions , hen age, strain of bird and nutrition. This study evaluated egg quality traits of three different strains of layers.

MATERIALS AND METHODS
The experiment was carried out at Oyo State College of Agriculture and Technology poultry unit of Teaching and Research Farm. A total number of 180, thirty week old birds consisting of 60 each of Noiler, Isa Brown and Nera black strains were obtained from poultry unit of the college farms and used for the study. The layers were allotted to three treatments with four replicates each and fifteen birds per replicate. The birds were fed commercial layer feed for the six weeks. Two eggs were collected daily from each replicate for six weeks to determine egg quality. The parameters considered were egg production, egg weight, egg length, egg breadth, shell weight, and shell thickness. The internal egg quality parameters were assessed after breaking and separating each of the components, the parameters considered were yolk colour, yolk length, and yolk weight.

Results and discussion

Results of the egg quality of the three strains were represented in table 1 and showed the egg weight, egg length, egg breadth, shell weight, yolk weight, yolk length, yolk colour, and shell thickness. Significant ($p<0.05$) effect of strain on egg production, egg weight, yolk weight and yolk colour among the strains was observed. Isa brown had the significantly highest egg production (80.57%) while noiler strain recorded the lowest value of 57.47%. Egg and yolk weight of noiler were the highest (63.80g and 32.17g, respectively) and significant to values recorded for isa brown (58.03g and 28.50g, respectively) and nera black (59.72g and 30.59g, respectively). Yolk weight as a percentage of egg weight was not significant. Yolk colour scores of isa brown (4.86) and nera black (4.35) were similar but higher than value recorded for noiler (2.23). Values recorded for egg length, egg breadth, shell weight, yolk length and shell thickness were not significantly affect by the strain of layers and the ranges were 5.17 - 5.35mm, 3.80 - 4.10mm. 7.36 - 7.54g, 1.89 – 2.09mm and 0.34 – 0.36, respectively.

DISCUSSION

The non significant effect of strain on most egg quality traits contradicted the report of Zita *et al*., (2009) who reported that egg quality characteristics are affected by genotype and age. Pradeepta *et al.* (2015) found eggs collected from 40 weeks aged white Leghorn hens have optimum egg weight (57.78g), and shell characteristics (6 g, 0.32 mm). The quality of eggs depends on physical make up and chemical composition of its constituent parts (Chukwuka, 72011). According to Tadesse *et al*. (2013) the difference in egg shell thickness was due to layer strain difference and Zita *et al*. (2009) reported that difference in egg shell thickness was the effect of layer type difference, environmental conditions and feed quality.

The egg length of isa brown was the highest value and the lowest was recorded in noiler which showed no significant difference. The egg breadth had no significant effect and was similar to that reported value by Roberts and Leary (1999). The shell weight showed no significant difference ($p>0.05$), the shell thickness was also not significantly affected ($p< 0.05$) by the strains

Yolk colour was significantly affected by strain with noiler recorded the lower value than isa brown and nera black strains. This contradicted Garba *et al*. (2016) who stated that yolk colour is a function of feed and not breeds.

Table 1: Egg quality characteristics of the three strains experimental layers

Parameters	Isa brown	Black near	Noiler	SEM
Hen day production (%)	80.57[a]	72.45[b]	57.47[c]	2.51
Egg weight (g)	58.03[b]	59.72[b]	63.80[a]	1.92
Egg length (mm)	5.35	5.36	5.17	0.08
Egg breadth (mm)	4.10	4.20	3.80	0.28
Shell surface area mm^2	14.96	15.56	16.96	0.27
Albumen weight (g)	34.16	36.94	37.59	0.85
Albumen percentage (%)	57.52	54.78	55.25	1.07
Shell weight (g)	7.54	7.40	7.36	0.45

Shell percentage (%)	14.11	14.73	12.59	1.03
Yolk weight (g)	28.50[c]	30.59[b]	32.17[a]	0.44
Yolk percentage (%)	20.69	20.68	20.60	0.79
Yolk length (mm)	2.09	2.08	1.89	0.09
Yolk colour	4.86[a]	4.35[a]	2.23[b]	0.29
Shell thickness (mm)	0.34	0.36	0.35	2.25

[ab] means on the same row with the different superscripts were significantly different ($p<0.05$)

There were no significant differences in all the strains as regards the egg shell thickness and ranged between 0.34 and 0.36, this confirmed the report of Khan *et al*. (2002) who stated that eggshell thickness between 0.33 and 0.35 mm will support hatchability. Egg production was affected by strain, isa brown had the highest value and the lowest was from noiler strain. Genetic variation in egg production between breeds, strains and lines had been reported (Hocking *et al.,* 2003). Egg weight was significantly different, the highest value was recorded in noiler and the lowest value was isa brown. Egg size as an external trait is affected by factors such as maturity, weight, age of flock, breed / genotype, diseases, nutrition and level of feeding. The increase in egg size with age is a result of increase in the yolk size, albumen and shell weight, although these increases are not proportional (Roberts and Leary, 1999). Egg size can also be affected by nutrition, the intake of protein, specific amino acids such as methionine and lysine, energy, total fat and the essential fatty acids, linoleic acid.

REFERENCES

Abanikanda, O. T. F., Olutogun, o. Leigh, A. O and Ajayi, L. A. 2007. Statistical modelling of egg weight an7d egg dimension in commercial layers. *International Journal of Poultry Science* 6:59-63.

Ahmadi, F., and Rahimi, F. 2011. Factor affecting quality and quantity of egg production in layer: a review. *World applied science journal*, 12 (3), 372-384

Chukwuka, O., Okoli, I., Okeudo, N., Udedibie, A., Ogbuewu, I., Aladi, N., Iheshiulor, O. and omede, A. 2011. Egg quality defects in poultry management and food safety. *Asian Journal of Agricultural Research*, 5, 1-16.

Garba, S., Assam, E D., Yusuf, R O., Sa'adu, A and Jibir, M. 2016. Comparative evaluation of eggs from three selected species of indigenous laying hens. *Livestock Research for Rural Development* 28 (5).

Hocking PM, Bain M, Channing CE, Fleming R, Wilson S (2003). Genetic variation for egg production, egg quality and bone strength in selected and traditional breeds of laying fowl. *Br Poult Sci* 44:365-373

Khan, M., Khatun, M. and Kibria, A. 2002. Study the quality of eggs of different genotypes of chicken under semi-scavenging system at Bangladesh. *Pak J Biol Sci*, 7, 2163-2166.

Pradeepta, H. M., Prasanna, K. M., Bandi, K. M.and Nrusingha, C. B. 2015. Evaluation of different egg quality trait and interpretation of mode of inheritance in white leghon. *Veterin. World* 8:440-452

Roberts, J.R. and Leary, A. (1999). The short report No. 5: Factors affecting egg and egg shell quality. RIRDC Publication. 9pp

Roque L. and M.C. Soares. 1994. Effects of eggshell quality and broiler age on hatchability. *Poultry Science.* 73:1838-1845.

Sarica, M., Onder, H. and Yamak, U. S. 2009. Determining the effective variable for egg quality trait of five hen genotype. *Int. J. Agric. Biol.* 14: 235-383.

Tadesse, D., Singh, H., Esatu, A. M. W. and Dessie, T. 2013. Study on productive performances and egg quality traits of exotic chicken under village production system in East Shewa, Ethiopia. *African Journal of Agricultural Research,* 8, 1123-1128.

Zita, L., Tůmová, E. and Štolc, L. 2009. Effects of genotype, age and their interaction on egg quality in brown-egg laying hens. *Acta Veterinaria Brno,* 78, 85-91.

AGES AND BODY WEIGHTS AT PUBERTY OF FOUR STRAINS OF TURKEYS REARED IN NIGERIA

C. C. Nwoga, N. S. Machebe, H. M. N. Foleng & S. O. C. Ugwu
Department of Animal Science, Faculty of Agriculture, University of Nigeria, Nsukka.
Corresponding author: *C.C. Nwoga; E-mail: cornelius.nwoga@unn.edu.ng; Tel: +2348039307202*

ABSTRACT
A study was conducted to investigate the ages and body weights at puberty of four strains of turkeys reared in Nigeria. The four strains comprised 1 exotic strain (White Nicholas, WN) and 3 local strains (White, black and silver plumage colours). A total of eighty (80) turkeys were used comprising 10 toms and 10 hens each of White Nicholas turkeys, White Local turkeys, Silver Local turkeys and Black Local turkeys. All the animals were fed 5% of their live body weights and water was given *ad libitum*. The age at puberty for the toms was determined as when first ejaculate containing viable sperm cells while that for hens was the age at first lay of egg. The trial was done in a completely randomized design (CRD). Data collected were subjected to analysis of variance. The results of the study showed that there were significant ($P<0.05$) strain effect on average daily weight gain, feed intake, feed conversion ratio and ages at puberty in both toms and hens. It was concluded that strain differences with respect to growth performance and age at puberty exist. It was concluded that strain differences affected age and body weights of toms and hens at puberty.
Keywords: Age, body weight, strain, puberty, turkeys

INTRODUCTION
Puberty in animals is sex dependent. Most definitions of puberty capture the female animal more than the male animal. However, it can be defined, in the male, as the time when fertile spermatozoa are in the ejaculate (Bearden and Fuquay, 1997) and in the female as the age at the first oviposition.The age at puberty is influenced *inter alia* by breed, genetic selection, nutrition, season of birth, as well as body size (Jafari and Hashemi, 2014). Thus, determining the age at puberty of male and female turkey genotypes commonly reared in Nigeria will facilitate adequate planning of breeding/multiplication of the various types for meat production.
Turkeys commonly reared in developing countries can be classified by their genotype or plumage colours (Thears, 2007). Several plumage colours of turkey genotype exists which include black, bronze, brown, red and white (Schoger, 1964) with black, bronze and white predominantly existing in the tropical environment (Okoro, *et al.*, 2012). Commercial turkey production in Nigeria is still rudimentary. The reason for this apparent low production seems to be lack of appreciation of its potential role in animal protein generation (Abeke and Ubani, 2008). Nevertheless, the full potentials in turkey cannot be harnessed until we come to terms with their reproductive capacities which include age at puberty.
The assessment of the semen quality characteristics of the poultry species gives an excellent indicator of their reproductive potentials and it is a *sine qua non* to effective artificial insemination programme (Zahraddeen *et al.*, 2005).
The study aimed at evaluating the ages and body weights at puberty of four strains of turkeys reared in Nigeria.

MATERIALS AND METHODS
The study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka.A total of eighty (80) turkeys were used comprising 20 White Nicholas turkeys (10 toms and 10 hens), 20 White Local turkeys (10 toms and 10 hens), 20 Silver Local turkeys (10 toms and 10 hens), and 20 Black Local turkeys (10 toms and 10 hens). Initial body weight values were taken and subsequent weights were taken with a weighing scale and recorded every four weeks till the age at puberty. The age at puberty for the toms was determined as when first ejaculate containing viable sperm cells were collected while that for hens was the age at first lay of egg. The training of toms for semen collection started at twenty weeks of age and their responses were monitored. Semen quality evaluation to determine semen volume and progressive motility were carried out immediately the toms reached puberty. Semen samples were collected from the 10 toms in each of the strains and pooled for analysis. Semen was collected by using the

abdominal massage technique as described by Burrows and Quinn (1937) which was slightly modified in this experiment by tying the two legs with a rope and pegging the rope to the wall to enable one collector in the process as opposed to two persons in the method described by Burrows and Quinn (1937). In Burrows and Quinn's method, two collectors are involved. One is the massager who places the tom on his laps and the other is the collector who grabs the legs of the tom and scoops the semen with the centrifuge tube when it flows. The modification here uses one man for collection as opposed to two-man method by excluding the holder and collector. With this, the massaging, holding and collection can be done by a single person and it saves the cost of paying the second person. Semen quality traits with respect to volume and motility evaluated. This experiment was carried out using a completely randomized design (CRD) with the model below;

$Y_{ij} = \mu + T_i + e_{ij}$

Where;

Y_{ij} = Individual observation;

μ = Population mean;

T_i = Treatment effect, and;

e_{ij} = Experimental error associated with observation.

The data collected on body weights, ages at puberty and semen quality traits were subjected to Analysis of Variance (ANOVA) using the Statistical Package for Social Sciences (SPSS, 2010). Significantly different means were separated using Duncan's New Multiple Range Test (DNMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

The results on ages and body weights of toms and hens and semen volume and sperm motility of toms in four strains of turkeys are presented in Tables 1, 2 and 3.

Table 1: Ages and body weights at puberty of the toms

Parameters/Strains	WN	Black	White	Silver	SEM
Age (days)	189.00±1.41[a]	183.00±1.41[c]	161.00±1.41[d]	175.00±1.41[b]	3.98
Body weight at puberty (k	15.00±0.00[a]	6.81±0.00[c]	6.19±0.00[b]	6.15±0.00[d]	1.42

a, b, c, d means with different superscripts in rows for different traits are significant (P<0.05). WN=White Nicholas.

Age at puberty of toms

The mean age at puberty for the four strains of toms ranged from 161.00±1.41 days – 189.00±1.41 days. White local toms were the first to attain puberty while the WN toms were the last to attain puberty. The results of this study disagree with the findings of Eaton (1992) that toms breed at 10 months of age (280 days). The White local toms with least mean age at puberty is advantageous as it breeds earlier. The reason for this may be because in both animals and humans, the age at puberty appears to be related more to body weight at maturity than to chronological age (Baker, 1985).

Body weight of toms at puberty

The mean body weights of toms at puberty showed significant (P<0.05) differences among all the strains and ranged from 6.15±0.00 kg – 15.04±0.00 kg. The highest mean weight of 15.04±0.00 kg was recorded in WN toms and the least mean value of 6.15±0.00 kg was recorded in Silver local toms. This may imply that body weight at puberty is influenced by the genetic background of the animal with more genetically endowed individuals reaching puberty at higher body weight (Bearden *et al.*, 2004).

Table 2: Ages and body weights at puberty of the hens

Parameters/Strains	WN	Black	White	Silver	SEM
Age (days)	195.00±1.41[a]	192.00±1.41[a]	188.00±1.41[b]	176.00±1.41[c]	2.76
Body weight at puberty (k	9.52±0.00[a]	4.15±0.00[b]	3.41±0.00[d]	3.57±0.00[c]	0.96

a, b, c, d means with different superscripts in rows for different traits are significant (P<0.05). WN=White Nicholas.

Age of hens at puberty

The mean ages of hens at puberty showed significant (P<0.05) differences with the range being 176.00±1.41 – 195.00±1.41 days. The highest mean value of 195.00±1.41 days was recorded in WN hens with the least mean value of 176.00±1.41 days recorded in Silver local hens. The results of this study agrees with the findings of Siopes (2010) who reported the age at lay for hens to be within the range of 24-30 weeks (168-210 days). However, the results disagree with the findings of Eaton (1992) that hens lay eggs at 10 months of age (280 days or 40 weeks). The Silver local hens that commenced laying earlier than others may imply that whether for breeding or for table egg production, they may give more profitable returns to the farmer than other strains. This trait is of considerable economic advantage and should be selected for in a planned genetic improvement of the local turkey.

Body weight of hens at puberty

The mean body weight values for hens ranged from 3.41±0.01kg – 9.52±0.00kg with significant (P<0.05) differences occurring among the strains. The highest mean value of 9.52±0.00 kg was recorded in WN hens and the least mean value of 3.41±0.01kg was recorded in White local hens. This may imply that for meat production, WN hens are more efficient than other strains. It is important to note that the highest body weight attained by the indigenous strains was obtained in Black local hens (4.5 kg). The range of body of body weights at puberty in local strains (3.41 – 4.15 kg) are generally lower and suggest that they are in the light ecotype category of turkeys.

Table 3: Semen volume and progressive motility of the toms at puberty

Parameters/Strains	WN	Black	White	Silver	SEM
Semen Volume (ml)	0.43±0.04[a]	0.28±0.04[b]	0.23±0.04[b]	0.43±0.04[a]	0.04
Progressive Motility (%)	85.00±7.07	85.00±7.07	95.00±7.07	85.00±7.07	0.50

a, b means with different superscripts in rows for different traits are significant (P<0.05). WN=White Nicholas.

Semen volume

The mean semen volumes in the local strains and WN strain studied ranged from 0.23±0.04 – 0.43±0.04 ml. The highest mean volume of 0.43±0.04 ml was recorded in WN toms and Silver local toms and the least mean volume of 0.23±0.04 ml was recorded in White local toms. The results recorded in Black and Silver local toms were in tandem with the results of Zahraddeen *et al.* (2005) and Ogbu *et al.* (2016) who found the ranges of 0.17-0.32 ml in local and exotic strains of turkeys and 0.21-0.38 ml in local toms fed zinc and selenium supplemented diets. However, the 0.43 ml recorded in WN and Silver local toms disagrees with the findings of the above researchers. Ogbu *et al.* (2016) did not consider WN toms in their work and both researchers considered local strains collectively as local breed.

CONCLUSION AND RECOMMENDATIONS

It was concluded that strain differences affected age and body weights of toms and hens at puberty. For meat production in Nigeria, WN turkeys are recommended while for breeding, white local toms and silver local hens are recommended.

REFERENCES

Abeke, F.O. and Ubani, E.O.A. (2008). Turkey production with emphasis on poult management. In: proceedings of the Conference of the *Animal Science Association of Nigeria*, ABU, Zaria. 321-323.

Baker, E.R. (1985). Body weight and the initiation of puberty. Clin. Obstet. Gynecod., 28 (3): 573-9.

Bearden, H.J. and Fuquay, J.W. (1997). Applied Animal Reproduction, 4th edition. Prentice Hall. New Jersey.

Bearden, J. J., Fuguay, J. W. and Willard, S. T. (2004). Applied animal reproduction (6th edn.). Mississipi State University. pp. 183-196.

Burrows, W.H. and Quinn, J.P. (1937). The collection of spermatozoa from the domestic fowl and turkey. Poult. Sci. 26: 19 – 24.

Duncan, D. B. (1955). Multiple Range and Multiple F-tests. Biometrics, 11**:** 1-42.

Eaton, S. (1992). Wild Turkey (*Meleagris gallopavo*). Pp. 1-28 in A Poole, P Stettenheim, F Gill, eds. *The Birds of North America*, Vol. 22. Philadelphia, PA: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Jafari, S. and Hashemi, A. (2014). Estimation of genetic parameters for body measurements and their association with yearling liveweight in the Makuie sheep breed. South African Journal of animal science, 44 (2).

Ogbu, N.N., Ogbu, C.C. and Ugwu, S.O.C. (2016). Effect of selenium and zinc on biochemical constituents and quality of indigenous turkey semen. International Journal of Agriculture Innovations and Research. Vol. 4, Isssue 5, ISSN 2319-1473.

Okoro, V.M.O., Ogundu, U.E., Ezeokeke, C.T., Anyanwu, G.A., Okoro, C.L. and Ukwu, H.O. (2012). Genetic variation in local ecotype turkeys. 2. Effect of genotype, sex and hatch batch on growth-related measurements in live birds. *International Journal of Biosciences*, 2220-6655.

Schorger, J. (1964). The wild turkey. University of Oklahoma Press, Norman, Oklahoma.

Siopes, T. D. (2010). Initiation of egg production by turkey breeder hens: Sexual maturation and age lighting. Poultry Science, 89:1490-1496.

SPSS (2010). Statistical Package for Social Sciences. SPSS Inc. Chicago, USA.

Thears, K. (2007). Starting with turkeys, breeding turkeys. Poultry pages. John Harrison.

Zahraddeen, D., Butswat, I. S., Kalla, D. J. and Bukar, M. T. (2005). Effect of Frequency of Ejaculation on Semen Characteristics in Two Breeds of Turkeys Raised in a Tropical Environment. *International Journal of Poultry Science* **4:** 217-221.

EGG QUALITY OF LOCAL FEMALE TURKEYS ADMINISTERED AQUEOUS *MORINGA OLERIFERA* LEAF AND SEED EXTRACTS.

Ogbu, O.C.
Department of Agricultural Technology Federal Polytechnic, Oko Anambra State Nigeria.
Corresponding author: ogbuonyinyeac@gmail.com

ABSTRACT
A total of two hundred and twelve (212) days trial was conducted to evaluate the effect of Moringa olerifera leaf and seed extracts on egg qualities of female local turkeys. A total of 36 female local turkeys of about 8 - 9 weeks old were used for the study. There were nine turkeys per treatment group, grouped as; T1 (control no extract), T2 (1% seed w/v), T3 (0.5% leaf and 0.5% w/v) and T4 (1% leaf w/v). Each group was replicated three times with three turkeys per replicate. Data collection was done on the external and internal qualities of the egg as well number of eggs laid during the trial period. On the external egg qualities, only the shell weight and the shape index differed significantly (P < 0.05). The weight of the shell was improved by the administration of Moringa extract. All the internal egg qualities (percent shell, yolk weight (g), yolk diameter (mm), yolk depth) did not differ significantly (P>0.05). Egg lying was highest in T3 while T2 (122) had the least number of egg. Therefore, from the results of the experiment, it could be safe to say that the egg quality were not affected by the Moringa per se, but the egg lying ability was improve most by combination of the leaf and seed extracts.
Key words: Turkey, Egg, *Moringa olerifera.*

INTRODUCTION
Moringa oleifera belongs to the order Brassicalis and family,*Moringceae* (Mgbemena and Obodo, 2016). It is a called "Zogale" in Hausa "Ewe ile" among the Fulanis and "Okwe oyibo" in Igbo (Olagbemide and Philips, 2014). It is also called Horseradish (Alemede *et al.,* 2014) and miracle plant. *Moringa oleifera* is a multipurpose plant that is widely cultivated species among *Moringa* plants throughout the tropics (Junick and Robert, 2008). The leaves and seeds of *Moringa* have been used to cure many diseases due to their anti-ulcerative (Pal *et al.,* 1995) anti-hypertensive (Dahot, 1988) anti-oxidant (Nickon *et al*., 2003) and anti-diabetic (Sahoo, *et al.,* 2014) properties. According to Nickon *et al.,* (2003) it also possesses antibacterial cum anti-fungi properties. Even folk medicine practioners use the plant in curing tumors (Gupta *et al.,* 2005). Nutritionally, the fresh *Moringa* leaves contain more than twice the amount of protein (2.8g/100g) found in spinach (Olugbemi *et al*. 2010). The leaves contain magnesium, potassium and all the essential amino acids like cysteine, histidine, arginine, methionine, lysine, phenylalanine, leucine, isoleucine and valine (Alemede *et al.,* 2014). It also has anti-oxidants like $\beta - carotinoids$, lutein and xanthine (Fuglie, 1999). Hence using it to improve the fertility of local female turkeys wouldn't be a bad idea.

MATERIALS AND METHODS
The experiment lasted for 212 days. It was approved and supervised by the Michael Okpara University of Agriculture Umudike College of Animal Science Research and Experiment committee and was carried out at the Poultry unit of Chirex Agro Services Limited in Abakuru, Ohaji-Egbema Local Government Area of Imo State Nigeria.

Collection and Preparation of Experimental material

The freshly harvested leaves and seeds were sorted to remove contaminants sand particles and dead matter. They were shade dried in an open well ventilated room for about one week at room temperature. The seeds and the foliage were ground separately into powder and stored in separate clean dry containers. Treatment one (T_1) was the control group with no *Moringa* powder. One gram of the seed powder was diluted in 1000mls of clean water, sieved with cheese cloth and served as drinking water for treatment two (T_2). Treatment three (T_3) had 0.5g of leaf powder and 0.5g seed powder diluted with 1000mls of clean water sieved with cheese cloth and served as drinking water. One gram of the leaf powder was diluted in 1000mls of clean water, sieved with cheese cloth and served as drinking water for treatment four (T_4).

Experimental Animals and management.

Thirty six (36) local female strains of turkeys of white, black and lavender plumage averagely eight (8) weeks old were used for the study.

The local turkeys were procured from a reputable farm, in Anambra State. Before commencement of the experiment, the local turkeys were quarantined and allowed to acclimatize for 14 days in the Poultry unit. During the acclimatization period, the turkeys were given routine management practices which included deworming with Ivermectin solution (1%w/v) against endo and ecto parasites. Suitable vaccinations for their age were also given prior to the commencement of the experiment.
The treatment groups were administered 0 gram of *Moringa* (T_1), 1 gram of *Moringa* seed alone (T_2) combination of 0.5g of *Moringa* seed and 0.5gram of *Moringa* leaf (T_3) and lastly 1 gram of *Moringa* leaf alone (T_4) . Experimental material was given to the female turkeys at 10 weeks of age. The treatment was administered to the turkeys via drinking water between hours of 7am to 10am after which they were given clean drinking water throughout the rest of the day. The turkeys were given commercial feed during the first 14weeks of the experiment. From 24 weeks of age formulated ration in Table 1 was used. The feed sample was determined to ensure quality assessment in Table 1 by livestock feeds Plc with the aid of the apparatus; DA1650 near infra-red Spectrophotometer.

Table 1: Feed Formula for the Experimental Diet

Ingredients	**(%)**
Groundnut	21.00
Fish meal	2.00
Maize	35.00
Wheat offal	37.00
Bone meal	2.50
Oyster shell	1.50
Methionine	0.25
Lysine	0.25
Salt	0.25
Vitamin Mineral Premix	0.25
Total	100
Determined values	
Crude protein -	19.85
Crude fibre -	7.44
Fat -	5.01
Moisture -	8.28
Ash -	6.99
Energy -	3018.8 kcal/kg

Vitamins and trace mineral declaration: 2.5kg of premix contains.
Vitamin A (Iμ) 12,500.00, Vitamin D_3 (iμ) 2,500,000.00, vitamin E (mcg) 40,000.00, Vitamin K_3 (mg) 2,000.00, vitamin B (mg) 3,000.00, vitamin B_2 (mg) 5,500, vitamin B6 (mg) 5,000, Nicocin (mg) 55,000.00, calcium pantothenate (mg) 11,500.00, Vitamin B_{12} (mg) 25,000, Chlorine Chloride (mg) 500,000.00, Folic acid (mg) 1,000.00, Biotin (mg) 80.00, Manganese (mg) 120,000.00, Iran (g) 100,000.00, Zinc (mg) 80,000.00. Copper (mg) 8,500.00, Iodine (mg) 1,500.00, Cobalt (mg) 300.00, Selenium (mg) 120.00, Antioxidant (mg) 120,000.00.

Experimental Design
The experiment was completely randomized design (CRD). It consisted of four treatments; T_1, T_2, T_3 and T_4 containing 0g, 1g of seed, combination of 0.5g of seed and 0.5g of leaf and 1gram of leaf, respectively. There were nine male turkeys in each treatment with 3 replicates of 3 turkeys per replicate.
Data Collection
As from 196 days of age (126 days into the study) that egg laying started. Egg collection was done three times per day and each of the collected eggs was labeled. The eggs were stored in a clean crate at room temperature and were analyzed within 48 hours of collection.
a. External egg parameters
Egg weight and shell weight were determined with the aid of Ohaus electronic weighing scale. The egg length and width were measured with venier calipers. Shell thickness was measured with micrometer screw gauge. Egg volume was ascertained using the Archimedes principles of water displacement.

b. The Internal egg parameters

The yolk diameter, albumen depth were measured with the Venier calipers.

The yolk weight, albumen weight were weighed with Ohaus electronic scale. The yolk; albumen ratio was obtained by; $\frac{\text{Yolk weight}}{\text{Albumen Weight}}$.

$$\text{Percent Yolk} = \frac{\text{Weight of Yolk}}{\text{Weight of whole Egg}} \times 100$$

$$\text{Percent Albumen} = \frac{\text{Weight of albumen}}{\text{Weight of whole egg}} \times 100$$

Specified gravity of the egg was obtained by dividing the weight of the egg by the weight of equal volume of water displaced by the egg.

$$\text{Specific Gravity (Sg)} = \frac{\text{Weight of Egg}}{\text{Volume of Egg}}$$

$$\text{Egg Shape Index (EI)} = \frac{\text{Weight of Egg}}{\text{Length of Egg}}$$

$$\text{Percent Shell} = \frac{\text{Shell Weight}}{\text{Egg Weigth}} \times 100$$

Results and Discussion

Table 2: Mean Values of external Egg parameters of female Turkeys administered *Moringa* leaf and seed extracts.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Egg Weight (g)	63.18±0.48	62.18±1.32	64.27±1.37	65.93±1.92
Egg Length (g)	59.26±0.39	60.43±0.67	59.55±0.32	60.69±0.79
Egg width (g)	44.34±0.67	42.943±0.32	44.21±0.93	44.20±0.58
Shell weight (g)	7.69 ± 0.40^{ab}	7.033 ± 0.32^{b}	7.63 ± 0.35^{ab}	8.12 ± 0.096^{a}
Shell Thickness (mm)	0.65±0.08	0.6800±0.04	0.68±0.09	0.79±0.11
Shape Index	0.75 ± 0.02^{a}	0.7103 ± 0.00^{b}	0.74 ± 0.01^{ab}	0.73 ± 0.00^{ab}
Egg Volume	60.58±1.15	59.447±1.75	61.62±1.36	62.98±2.22

Means with different superscripts [a, b, c] or [d] on the same row are significantly different (P<0.05).

The result of the mean values of external egg parameters of female local turkeys administered *Moringa* leaf and seed extracts were shown in Table 2. The egg weight, egg length, egg width, shell thickness as well as egg volume were not significantly (P > 0.05) affected by the administration of *Moringa* leaf and seed extracts. Egg shape index was negatively influenced by *Moringa* extracts significantly (P<0.05) when compared with the control. The shell weight, shape index and length increased better in the *Moringa* leaf extracts than on the seed extracts as well as combination of both leaves and seeds effect. The egg weights were within the range of 62.3-79.5 reported by Adeyeye (2009) on turkeys. This was also consistent with the report of Kakengi *et al.* (2007) and the work of Teteh *et al*. (2016) report on ISA Layers with *Moringa* leaves. These improvements may be due to rich amino acid profile found in the leaves of *Moringa*. Gupta *et al*. (2005) and Foidl *et al.* (2001) observed that anti-nutrients like and oxalates have less chelating effect on feed calcium, hence improves calcification of egg shells.

Table 3: Mean Values of Internal Egg parameters of female Turkeys administered Moringa leaf and seed extracts.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Percent Shell	12.17±0.60	11.33±0.65	11.85±0.40	12.41±0.23
Yolk Weight (g)	20.33±0.84	19.67±0.17	19.67±1.16	21.11±0.49
Yolk Diameter (mm)	40.49±0.28	40.92±0.63	40.51±1.03	42.50±0.90
Yolk Depth (mm)	14.89±0.59	14.88±0.63	15.03±0.36	15.41±0.56
Percentage Yolk	32.19±1.37	31.65±0.42	30.61±1.69	32.19±1.10
Albumen Weight (g)	34.56±0.80	34.33±0.83	36.89±1.17	40.82±4.22
Albumen Depth (mm)	9.10±0.93	9.45±0.23	9.58±0.46	10.22±0.73
Percent albumen	54.67±1.24	55.17±0.43	57.33±1.13	56.77±1.73
Albumen : Yolk Ratio	0.59±0.04	0.57±0.01	0.54±0.04	0.57±0.021
Specific Gravity	1.07±0.05	1.05±0.02	1.04±0.02	1.05±0.01

Means with different superscripts [a, b, c] or [d] on the same row are significantly different (P<0.05).

The results of mean internal egg qualities of local female turkeys administered *Moringa* leaf and seed extracts are shown in Table 3. The percent shell, yolk weight, yolk diameter, yolk depth, percentage yolk, albumen weight, albumen depth, percentage albumen, albumen to yolk ratio specific gravity did not differ significantly (P>0.05) among the treatments. This confirms the report of Teteh *et al.*, (2016) on ISA layers who observes that 1% *Moringa* leaves level of inclusion improved the egg qualities of the birds. According to the reports of Gupta *et al*. (2005) and Foidl *et al.* (2001) the level of the leaves extracts should be low so as not to attract the effect of anti- nutrients like phylates and oxalates which usually leads to chelating effect on feed calcium hence reducing shell quality, this incidence was not witnessed in our study.

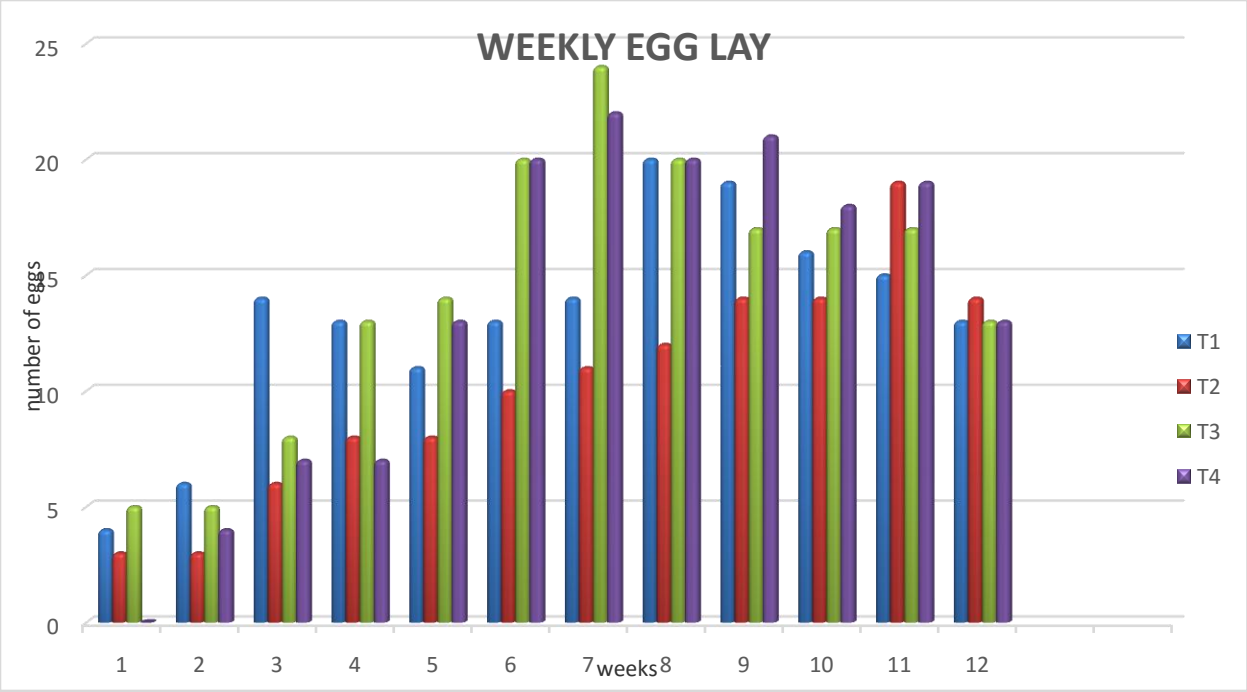


Figure 1: Weekly egg lay of female turkeys administered *Moringa* leaf and seed extracts

Egg production was increased by the combination effect of *Moringa* leaf and seed extracts with 173 eggs laid in 12weeks (figure 1).Turkeys administered leaf extracts alone laid 164 eggs, followed by the control groups which laid 154 eggs and the seed extracts alone laid 122 eggs. These results show that combination of leaf and seed extracts treatment mostly improved the turkey hen egg laying ability. This may be due to the rich steroid content of the leaves and seeds of *Moringa*, which supported egg lying. These results confirms the reports of Yakubu *et al.* (2014) who claimed that the

intake of some amount of estrogenic substances in *Moringa oleifera* inhibits the secretion of LH (Luteinizing hormone) and FSH (follicle stimulating hormone) and reduces, subsequently, endogenous oestrogen and progesterone levels. Hence these lower levels of sexual hormone may have played a serious role in the lower number of follicles and low weight of ovarian grape and oviduct seen in T_4 group. Therefore combination of the two extracts brought better results in terms of egg laying ability of the female turkeys. Although lower egg laying ability of T_2 might be due to anti-nutrients which is nutritional problem that have been observed by Nys and Guyot (2011) to be responsible for reduced rate of egg production synthesis that is very sensitive to these nutritional abnormalities.

CONCLUSION

The study on effect of *Moringa olerifera* seed and leaf extract on the egg quality of local female turkeys show that *Moringa* leaf (T4) improved egg shell weight most. Combination of leaf and seed extracts improved the egg lying ability most. Therefore to improve number of eggs laid among female turkeys there is need to use *Moringa olerifera* seed and leaf extracts at 0.5%leaf and 0.5% seed w/v.

REFERENCES

Adeyeye, E. I. 2009. Comparative study on the characteristics of egg shell of some bird species. *Journal of Bulletin of Shem Society Ethiopia,*23 (2): 159 - 166.

Alemede, I. C., Onyeji, E. A., Tsado, D. N. and Shiaawoya, E. L. 2014. Reproductive response of rabbit does to deits containing horseadish(*Moringa olerifera*) leaf meal. *Int. know. Sharing platform IISTE Journals,* 4: 19.

Dahot, M. U. 1988. Vitamin contents of the flowers and seeds of *Moringa olerifera.* In *Pakistan Journal of Biochemistry.*

Foidl, N., Makkar, H.P.S. and Becker, K. 2001. The potential of *Moringa oleifera* for agricultural and industrial uses. Nikolaus Foild, P.B.H 32 Carr.

Fugile, L.J. 1999. The miracle tree *Moringa oleifera*: Natural Nutrition for the tropic. Church world service, Dakar pp 68, Revised in 2001 and published as the miracle tree: The multiple attributes of *Moringa.*

Gupta, R., Kannan, G.M., Sharma, M. and Flora, S.J.S. 2005. Therapeutic effect of *Moringa oleifera* on arneoc reduced toxicity in rats. *Environmental Toxiology and Pharmacology,* 20(3): 456-464.

Junick, J. and Robert, E.P. 2008. The Encyclopedia of fruit and Nuts. CABI.

Kakengi, A. M. V., Kaijage, J. T., Sarwatt, S. V. and Mutayoba, S. 2007. Effect of *Moringa oleifera* leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. *Livestock Research for Development,* 19: 8.

Mgbemena, N.M. and Obodo, G.A. 2016. Comparative analysis of proximate and mineral composition of *Moringa oleifera* root, leave and seed obtained in Okigwe Imo state, Nigeria. *Journal of Molecular Studies and Medicine Research*, 1(2):57 – 62.

Nickon, F., Saud, Z. A., Rehman, M.H. and Haque, M.E. 2003. In vitro antibacterial activity of the compound isolated from chloroform extract of *Moringa olerifera. Pakistan Journal of Biological Science,*22: 188-190.

Nys, Y. and Guyot, N.2011.Egg formation and chemistry, in: Nys, Y., Bain, M.&Van Immerseel, F. (Eds) *Improving the Safety and Quality of Eggs and Egg Products. Vol. 1: Egg Chemistry, Production and Consumption*, pp. 83–126 (Cambridge, Woodhead Publishing Ltd.)

Olagbemide, P.T. and Philip, C.N.A. 2014. Proximate analysis and chemical composition of raw and defatted *Moringa oleifera* Kernel.*Journal of Advances in Life Science and Technology*,**24**: 92-98.

Olugbemi, T.S., Mutayoba, S.K. and Leukule, F. P. 2010. Effect of Moringa (*Moringa olerifera*) inclusion in cassava based diets fed broiler chickens. *International Journal of Poultry Science*,9 (4): 363-367.

Pal, S. K., Mukherjee, P.K. and Saha, B.P. 1995. Studies on the antiulcer activity of *Moringa olerifera* extract on gastric ulcer models in rats. *Phytotherapy Research*, 9 (6): 463-465.

Sahoo, S., Raghavendra, K.M. and Biswas, S. 2014. Identification of a proteinaceous component in the leaf of *Moringa oleifera* lam with effects on high serum creatinine. *Indian Journal of Pharmacological Science*,76 (1): 78-81.

Teteh, A., Gbeassor, M., Decuypere, E. and Tona, K. 2016. Effects of *Moringa olerifera* leaf on laying rate, egg quality and blood parameters. *International Journal of Poultry Science*,15 (7): 277-282.

Yakubu, A., Abimuku, H.K., Musa Azara, I.S., Idaher, K.O. and Akinsola, O.M. 2014. Assessment of flock structure preference in selection and traits of economic importance of domestic turkey genetic resources in Nasarawa State.*Nigeria Livestock Research and RuralDevelopment*,25 (1): 21 – 30.

GENETIC DIVERSITY OF SELECTED CHICKEN BREEDS IN NIGERIA, SEGREGATING AT THE CHICKEN GROWTH HORMONE GENE LOCUS

Ojimah, C.O., Adigun, U. O., Egena, S.S.A., Usman, A. & Otu, B.O.

Department of Animal Production, Federal University of Technology, P.M.B. 65, Minna, Niger State, Nigeria.

Corresponding author: oikochristian@gmail.com

ABSTRACT

The study was carried out to evaluate genetic diversity of selected chicken breeds in Nigeria focussing on the chicken growth hormone gene locus. The chickens studied were: Fulani ecotype, FUNAAB Alpha, frizzled feathered, Noiler and Cobb 500 broilers chicken. Genomic DNA was extracted from blood samples collected from 50 chickens (10/chicken breed). The extracted DNA was amplified using PCR and the gene sequenced. The sequenced data was used to evaluate genetic diversity and to carry out phylogenetic analysis. Results showed that the mean number of alleles (Na), mean number of effective alleles (Ne), mean Shannon information index (I), mean observed heterozygosity (Ho), mean expected heterozygosity (He), mean unbiased expected heterozygosity (uHe), mean fixation index (F) and % polymorphic locus were 2.000±0.000, 1.956±0.014, 0.682±0.004, 0.449±0.067, 0.489±0.004, 0.516±0.004, 0.083±0.138 and 100%, respectively. The gene flow (Nm) for all the population was 13.141. Results of Analysis of Molecular Variance (AMOVA) showed that the percentage of molecular variance among and within individuals was 13 and 87%, respectively. Phylogenetic analysis divided the five chickens into two broad claves; Noiler and the frizzled feathered occupied one while, the Fulani ecotype, FUNAAB Alpha and Cobb 500 occupied the other. It was concluded that great genetic diversity exists in the chicken breeds which could be exploited for further improvement especially in the more native breeds.

Key words: Genetic diversity, chickens, growth, hormone, gene locus.

INTRODUCTION

Growth performance and associated traits such as carcass traits are very important economic characters in broiler chickens production, and they are controlled by sets of multifarious genes. Growth is a very complicated procedure which is synchronized by an extensive network of neuroendocrine pathways. It is therefore very difficult to make rapid progress using more conventional methods of genetic selection within breeds (Zhang *et al.,* 2008). Recent advances in molecular technology have however provided new lee ways to evaluating genetic variability existing at the DNA level of animals (Kaya and Yildiz, 2008). The candidate gene approach has become a very powerful technique for genetic improvement in chicken breeding programmes. Applying this approach (the candidate gene approach), will likely result in higher efficiency in the detection of desired traits necessary to improve productive performances. The chicken growth hormone (*cGH*) gene located on chromosome 27, is one of the most promising candidate genes for improving growth performance and carcass quality traits in chickens (Anh *et al.,* 2015). Growth hormone and the transforming growth factor-β subfamily are the most important groups of hormones that play key roles in many physiological functions such as growth and reproduction. The *cGH* is a 22-kDa protein, consisting of 191 amino acid residues (Hrabia *et al.,* 2008). The *cGH* gene contains four exons and five introns with an overall length of 4.1kb (Kansaku *et al.,* 2008). A cursory look at the growth performance of the various chickens reared in Nigeria will show that they do not grow at the same rate. Could it be that differences exist in the *cGH* of the chickens manifesting in differential performances of the birds especially between the exotic and the more indigenous ones? It is with this in hindsight that the current study was conceived to evaluate genetic diversity at the *cGH* gene locus focussing on selected chicken breeds.

MATERIALS AND METHODS

Blood samples were collected from 50 chickens, 10 each of Fulani ecotype, FUNAAB Alpha, frizzled feathered, Noiler and Cobb 500 broilers chicken. The blood samples kept on ice packs were transported to the laboratory (African Biosciences, Ibadan, Oyo State, Nigeria) where genomic DNA was extracted using the protocols of gSYNC™ DNA extraction kit (Geneaid). The extracted DNA was checked for quality and then PCRed. The PCR products were sequenced and then aligned against the chicken genome using the BLAST programme to verify their identity. Prior to sequencing, the DNA were cleaned to ensure that the gene is not contaminated with impurities. This was done using DNA clean and concentrator kit according to the manufacturers protocol (ZYMO Research). The measurement of genetic diversity including Na, Ne, Ho, He, uHe, I, % polymorphic locus, F and AMOVA were estimated using GenAlEx 6.2 software (Peakall and Smouse, 2012). Dendrogram based on Nei's unbiased genetic distances, using the unweighted pair group method with arithmetic mean (UPGMA), was generated to show the genetic distances of the populations or subpopulations was generated using MEGA X.

RESULTS AND DISCUSSION

The genetic differentiation at the *cGH* gene locus of the chicken breeds is presented in Table 1. The FUNAAB Alpha and Cobb 500 had lower Ne (1.923), I (0.673), He (0.480) and uHe (0.505). The lowest Ho (0.200) was observed in the Cobb 500 while the highest F (0.583) was observed in the Cobb 500 broilers chicken. The entire gene locus was found to be polymorphic (100%) and the Nm over all populations for each locus was 13.141. The mean Na over the loci for each population (2.000) is much lower than the 5.10-6.28 and 3.52-6.62 reported by Lyimo *et al.* (2013) and Mtileni *et al.* (2010) in Tanzanian and South African chickens, respectively. The lower Na in the current study as compared to these other populations is indicative of the presence of a relatively limited sample of gene pool. The mean expected heterozygosity (0.464) concurs with the 0.351-0.434 reported by Marle-Koster and Nel (2000). Mtileni *et al.* (2010) reported expected heterozygosity of 0.67-0.69 among South African free range chickens while Lyimo *et al.*(2013) reported expected heterozygosity values of 0.58-0.67 in Tanzanian chicken populations. The difference observed in heterozygosity values may be due to variation in geography, chicken types, sample sizes, laboratory and sources of microsatellites used. Expected heterozygosity value of <0.5 may be due to inbreeding and admixture associated with population constraints and bottlenecks (Fariba, 2008).

Table 1. Genetic differentiation at the *cGH* gene locus of five chicken breeds

Population	N	Na	Ne	I	Ho	He	uHe	F	%P	Nm
Noiler	10	2.000	1.980	0.688	0.500	0.495	0.521	-0.010	100	
Fulani ecotype	9	2.000	1.976	0.687	0.444	0.494	0.523	0.100	100	
FUNAAB Alpha	10	2.000	1.923	0.673	0.600	0.480	0.505	-0.250	100	
Frizzled feather	10	2.000	1.980	0.688	0.500	0.495	0.521	-0.010	100	
Cobb 500	10	2.000	1.923	0.673	0.200	0.480	0.505	0.583	100	
Mean	**9.800**	**2.000**	**1.956**	**0.656**	**0.516**	**0.464**	**0.477**	**-0.075**	**100**	13.141
SE	0.200	0.000	0.014	0.031	0.126	0.030	0.031	0.225	0.000	

SE=standard error, Na=number of alleles, Ne=number of effective alleles, I=Shannon's information index, Ho=observed heterozygosity, He=expected heterozygosity, uHe=unbiased expected heterozygosity, F=fixation index, %P=percentage of polymorphic locus, Nm=gene flow.

The negative fixation index (F, an index of inbreeding) suggests out-breeding is still occurring in the Noiler, FUNAAB Alpha and frizzled feathered chickens. The reverse is the case in the Fulani ecotype and Cobb 500. The high values could be due to high level of selection involved in the creation of Cobb 500; the close population, in which Fulani ecotype chickens are reared probably, explains the positive nature of the fixation index. Negative fixation index in a population indicates that homozygous deficiencies may have arisen from population sub divisions owing to null alleles, genetic drift and selection against inbreeding (Pemberton *et al.,* 1995). The % polymorphic loci observed (100%) showed that markers used in this study were highly informative in showing genetic diversity. Halima *et al.* (2007) used polymorphic information content to assess how informative markers were and got an average value of 0.71. The main effect of gene flow (Nm) is the homogenization of allele frequencies between populations. The more flow of a particular gene between populations, the more their similarity (El Hentati *et al.*, 2012). The estimated Nm in the studied chicken's populations (13.141) is high; this is evidence of the popular use of commercial chicken lines to improve indigenous ones. The impact of such introgressions is rather limited, possibly due to poor adaptation of exotic birds to village conditions/consumers' preference for local chickens. Diffusive gene flow prevents substantial genetic differentiation due to genetic drift, if gene flow is greater than unity (Slatkin, 1985 cited by Udeh, 2015).

Variation within and between populations of chicken breeds estimated using AMOVA (Table 2) revealed that a large proportion (87%) of the observed variance occurred within the breeds and 13% of the variance was contributed due to differences among individuals within populations. Variation among populations was 0%.

Table 2:.AMOVA table showing variation within and between chicken populations

Source of variation	df	SS	MS	Estimate of variance component	% variation
Among population	4	0.464	0.116	0.000	0
Among individual	44	12.944	0.294	0.035	13
Within animal	49	11.000	0.224	0.224	87
Total	97	24.408		0.259	100

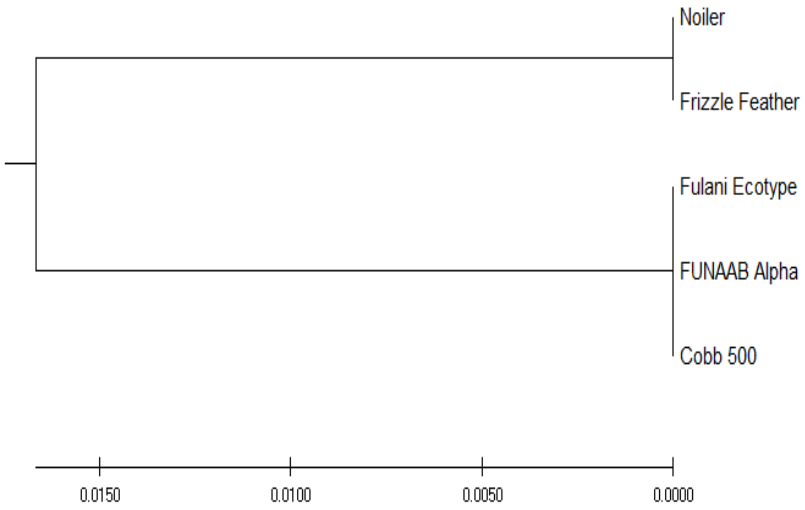


Figure 1: Phylogeny showing genetic relationships between chicken breeds at the *cGH* gene locus

A cluster analysis generated based on Nei's standard distance matrix (Figure 1) showed that Noiler and frizzled feathered chickens were in the first cluster, while Fulani ecotype, FUNAAB Alpha and Cobb 500 were in the second cluster. The closeness of the Fulani ecotype chicken to FUNAAB Alpha and Cobb 500 might not be too surprising because it has some exotic bloodline. The Fulani ecotype chicken could have been developed from crosses between exotic cockerels and indigenous hens. Halima *et al.* (2007) clustered Ethiopian indigenous chickens into two (similar to this result), showing the presence of two major breeds. A cluster shows the level of inbreeding and populations in it could be having coancestry (Halima *et al.,* 2007).

CONCLUSION

Results of the study showed the existence of great genetic diversity in the chicken breeds which could be exploited for the genetic improvement especially of the more native breeds.

REFERENCES

Anh, N.T.L., Kunhareang, S. and Duangjinda, M. (2015). Association of chicken growth hormones and insulin-like growth factor gene polymorphisms with growth performance and carcass traits in Thai broilers. *Asian-Austral. J. Anim.Sci.,* 28(12): 1686-1695.

El Hentati, H., Mohamed, B. H. and Ali C. (2012). Genetic differentiation and gene flow between the Tunisian ovine breeds Barbarine and Western thin tail using random amplified polymorphic DNA-polymerase chain reaction (RAPD-PCR) analysis. *Afri.J.Biotechn.,* 11(96):16291-16296.

Fariba, I.S. (2008). A molecular genetic survey of immune response genes and biodiversity of industrial and non-industrial chickens. Electronic Theses and Dissertations (ETDs) 2008. University of British Columbia, Canada.

Halima, H., Neser, F.W.C.., De-Kock, A. and Van, M.K.E. (2007). Study on the genetic diversity of native chickens in northwest Ethiopia using microsatellite markers. *Afr. J.Biotechn.,* 8:1347-1353.

Hrabia, A., Paczoska-Eliasiewicz, H.E., Berghman, L.R., Harvey, S. and Rząsa. J. (2008). Expression and localization of growth hormone and its receptors in the chicken ovary during sexual maturation. *Cell Tiss. Res.,* 332:317-328.

Kansaku, N., Hiyama, G., Sasanami, T. and Zadworny, D. (2008). Prolactin and growth hormone in birds: protein structure, gene structure and genetic variation. *J.Poult. Sci.,* 45:1-6.

Kaya, M. and Yıldız, M. A. (2008). Genetic diversity among Turkish native chickens, Denizli and Gerze, estimated by microsatellite markers. *Biochem. Genet.,* 46:480-491.

Lyimo, C.M., Weigend, A., Janben-Tapken, U., Msoffe, P.L., Samianer, H. and Weigend, S. (2013). Assessing the genetic diversity of five Tanzanian chicken ecotypes using molecular tools. *South Afri. J. Anim. Sci.,* 4:43.

Marle-Koster, E.V.M. and Nel, E.L.H. (2000). Genetic characterization of native southern African chicken population: evaluation and selection of polymorphic microsatellite markers. *South Afri. J. Anim. Sci.,* 30:1-6.

Mtileni, B.J., Muchadeyi, F.C., Maiwashe, A., Groeneveld, E. Groeneveld, L.F., Dzama, K. and Weigend, S. (2010). Genetic diversity and conservation of South African indigenous chicken populations. *J. Anim. Breed. and Genet.,* 128:209-218.

Peakall, R., and Smouse, P.E. (2012). GenAIEx 6.5: genetic analysis in Excel. Population genetic software for teaching and research-an update. *Bioinformatics* 28(19): 2537-2539.

Pemberton, J. M., Slate, J., Bancroft, D. R. and Barrett, J. A. (1995). Non amplifying alleles at microsatellite locus: a caution for parentage and population studies. *Mol. Ecol.,*4, 249-252.

Udeh, F.U. (2015). Genetic diversity of five populations of the Nigerian local breeds of goat using Random Amplified Polymorphic DNA (RAPD) markers. MSc thesis. University of Nigeria, Nsukka, Nigeria.

Zhang, C., Zhang, W., Luo, H., Yue, W., Gao, M. and Jia, Z. (2008). A new single nucleotide polymorphism in the IGF-I gene and its association with growth traits in the Nanjiang Huang goat. *Asian Austra. J. Anim. Sci.,* 21:1073-1079.

BENEFITS OF BIOTECHNOLOGY FOR IMPROVED LIVESTOCK PRODUCTION IN NIGERIA

Ojo, O.A & Buba, W.
National Agricultural Extension and Research Liaison Services, Ahmadu Bello University Zaria, Nigeria.
Corresponding Author: kemiojo20@gmail.com.

ABSTRACT
This review paper discusses the use of biotechnology in livestock production. It takes into consideration the application of biotechnology in solving problems of livestock production, current uses and ethical issues. Application of biotechnology in livestock production include: production of good and high yielding animals, nutrition and feed utilization, reproduction, animal breeding and genetics as well as animal health. Application of biotechnology in animal husbandry has the potential to rapidly increase livestock production, help address some challenges of un-favourable environmental and climatic conditions and food insecurity in Nigeria.

INTRODUCTION
Biotechnology refers to any technique that utilizes living organisms or substances from such organisms to produce or modify a product, to improve animals or to develop micro-organisms for specific purposes (Armstrong and Gilbert, 1991). This sphere of science is becoming a frontier in ensuring a sustainable means of improving livestock production by influencing nutrition, reproduction, breeding and genetics as well as animal health. In recent years, biotechnological achievements have emerged as powerful tools to improve various livestock products including milk and meat products. Other applications of biotechnological tools include: production of high yielding animals, improved animal products, production of hormones, efficient by-product utilization and quality control (Fereja, 2016). Application of biotechnology will lead to a shift in the economic returns from livestock. Livestock production currently accounts for about 6% of the overall gross domestic product and 10% of the agricultural GDP in Nigeria (Rege, 1994). Globally, livestock production is growing faster than any other sector and by 2020 livestock is predicted to become the most important agricultural sector in terms of added value (Fereja, 2016). The demand for livestock products has significantly increased, hence the need to improve livestock and its derivatives through genetic manipulation and related technologies (Onteru *et al.*, 2010). Therefore, the purpose of this paper is to review available biotechnologies which have potential application in livestock production.

Production of good and high yielding animals
Livestock production in Nigeria is expected to grow rapidly with the projected demand for animal products as well as increase in human population (Rege, 1994). This has necessitated that methods of livestock production have to be changed to allow for efficiency and improvement in productivity. Biotechnological research will serve as tools to respond to the pressure of producing feed for animals which in turn will cater for the animal protein requirement of the ever-teeming human population in Nigeria. Transgenic animals such as Cattle, sheep, pigs and rabbits have been developed with the aid of biotechnology (Gupta and Savalia 2012). Transgenesis is a technique that involves the manipulation of genes of one organism and subsequent introduction into the genome of another organism of the same or other species such that the genes are not only expressed but also get transmitted into its progeny (Srinivasa and Goswami 2007). Transgenesis enhances growth rate and improved quality of meat and milk of livestock. For example, transgenic cows were developed to produce milk containing high amount of beta and kappa casein in milk fat and increased level of human lactoferrin (Brophy *et al*., 2003). Similarly, transgenic pigs with IGF 1 had 30 % more loin mass, 10% more carcass lean tissue and 20% less total carcass fat (Pursel *et al*., 1999).

Nutrition and Feed Utilization
The application of Gene-based technologies to improve animal nutrition by modifying feeds to make them more digestible is on the increase (Bedford, 2000). Such applications will go a long way in combating the shortage of feed in most developing countries such as Nigeria as well as reducing the cost of feed ingredients implying reduced production costs. Application of biotechnology in animal nutrition such as the use of enzymes, probiotics, single-cell proteins and prebiotics in feed (Fereja,

2016). In Nigeria some of these technologies are currently being used to improve nutrient availability of feeds and productivity of livestock and poultry.

Reproduction

Artificial insemination (AI) and Embryo Transfer (ET) are popular methods adopted in most developed and developing countries (Cunnigham, E.P. (1990). Artificial insemination is the most widely used biotech in animal reproduction in Nigeria and has resulted in rapid genetic progress that is four times better than natural mating (Van Vleck, 1981). Also, the use of reproductive hormones such as progesterone and pregnant mare's serum gonadotropin (PMSG) treatments as well as immunization against androstenedione have been reported to increase ovulation in both large and small ruminant animals (Kahi and Rewe 2008). However, modern biotechnological techniques which have the potential for increased reproductive efficiency are marred with complexity in process and implementation such as production of transgenic animals and cloning and will probably have low rates of adoption in both large scale and small-scale farms in future. This low adoption rates may be as a result of ethical considerations and not necessarily cost implications (Bonneau and Laarveld 1999).

Animal Breeding and Genetics

Biotech tools have been useful in influencing the rate of genetic gains in different livestock species. Such tools include: marker assisted selection (MAS), Genome mapping through the use of restriction fragment length polymorphism (RFLP) which makes use of amplifiers, short DNA Primers in polymerase chain reaction (PCR) have been essential in developing DNA fingerprinting technique and genetic characterization of a wide range of organisms (Williams *etal.,* 1990, Kahi and Rewe 2008). The application of transgenic techniques in gene manipulation of different livestock is beneficial, such that genes are not only expressed but transmitted to offspring (Gupta and Savalia 2012). These techniques are already in use in Nigeria and have great potential for adoption in livestock breeding schemes.

Animal Health

Biotech in animal health have been developed in a number of areas which includes: disease prevention, diagnosis, treatment and control (Bonneau and Laarveld, 1999). Disease prevention is key to livestock survival as well as production of healthy animals. Vaccine development and vaccination is a biotechnique that is now well rooted in most African countries including Nigeria. Vaccines are widely used either as attenuated or inactivated and have proved very efficient in establishing resistance (Bourne and Bostock,1992). The application of biotech in disease discovery has helped to identify diseases at early stages to facilitate treatment. It has also enabled the application of enzyme-linked immunosorbent assay (ELISA) which now uses recombinant antigens developed via gene cloning and sequencing for detection of antibodies and provide information to antibody recognition sites (Kahi and Rewe 2008).

Biotechnologies and their potential impact on livestock production

Area of Application	Biotechnologies	Scale of Impact	Potential of Adoption	
			Developed Countries	Developing Countries
Animal health	SAD	Large	High	High
	ELISA	Large	High	Moderate
	DNA detection	Large	High	Low
	Vaccination	Large	High	High
	PCR	Large	High	Moderate
Animal nutrition				
	Enzyme degradation of fibrous feeds	Large	High	Low
	Rumen (GIT) manipulation	Large	High	Moderate
Animal reproduction	AI	Large	High	High
	MOET	Large	High	Moderate
	Embryo sexing	Large	High	Low
	Cloning	Large	Low	Low
Animal breeding	Nucleus breeding	Large	High	Moderate
	Developing of composite breeds	Large	High	Moderate
	MAS	Large	Moderate	Low

SAD=specific antibody detection; ELISA=enzyme linked immuno-sorbent assay; DNA=di-neuclic acid; PCR=Polymerase chain reaction; GIT=gastro-intestinal tract; AI = artificial insemination; MOET= multiple ovulation embryo transfer; MAS= marker assisted selection. Modified from Cunnigham (1990) and Doyle and Spradbow (1990)

Constraints in applying Biotechnology

A number of factors act as deterrents against the use of biotechnology for livestock production in developing countries. Developing countries such as Nigeria are plagued withpoor hygiene, poverty, malnutrition and disease incidences. In recent years, the green revolution has brought comparative prosperity to farmers who are land owners, whereas those who keep livestock were neglected. Some of the major constraints in the use of biotechnology are: lack of trained personnel (scientists, technicians and extension agents) to develop and apply the technologies, absence of accurate database on livestock and their herders, high cost of technological inputs (materials, biological and equipment), failure to address issues of biosafety and conduct of risk analysis, as well as the negligible investment in animal biotechnology (Fereja, 2016).

CONCLUSION AND RECOMMENDATION

The application of biotechnology to animal husbandry is of great significance in ensuring increased productivity in the livestock sector of Nigeria. It is therefore necessary to create awareness to encourage its usage amongst livestock producers in Nigeria.

REFERENCES

Armstrong D.G. and Gilbert H.J. (1991). The application of biotechnology for future livestock production. In: *Proceedings of the 7th International Symposium on Ruminant Physiology, Sendai, Japan*. Academic Press, San Diego, USA. 737-761.

Bedford, M.R. (2000) Exogenous enzymes in monogastric nutrition: their current value and future benefits. *Animal Feed Science Technology*, 86, 1-13.

Bonneau, M., Laarveld, B. (1999). Biotechnology in animal nutrition, physiology and health. *Livestock Production Science*, 59: 223-241.

Bourne J. and Bostock C. (1992). Disease control. In: Thelwall A.D. (ed), Innovation in *Agro-Biotechnology*. *Case Study on Animal Production*. Commission of the European Communities. pp. 71-83.

Brophy, B., Smolenski, G., Wheeler, T., Wells, D., L'Huilier, P. and Liable, G. (2003). Cloned transgenic cattle produce milk with higher levels of b-caesin and K-casein. *Nature Biotechology*, 21:157-162.

Cunnigham, E.P. (1990). Animal production. In: Persley G.J (ed), Agricultural Biotechnology: Opportunities for International Development. CAB (Commonwealth Agricultural Bureaux) International, Wallingford, UK. Pp 169-175.

Doyle, J.J., Spradbrow P.B. (1990). Animal health, Animal production. In: Persley G.J (ed), Agricultural Biotechnology: Opportunities for International Development. (Commonwealth Agricultural Bureaux) International, Wallingford, UK. Pp 169- 175.

Fereja, G.B. (2016). Use of biotechnology in livestock production and productivities: A Review. *International Journal of Research* 4 (6) 100-109.

Gupta, S. and Savalia C.V (2012). Application of biotechnology to improve livestock products, *Veterinary World,* Vol. 5(10):634-638.

Kahi, A.K and Rewe T.O. (2008). Biotechnology in livestock production: Overview of possibilities for Africa. *African Journal of Biotechnology*7 (25) 4984-4991.

Onteru, S., Ampaire, A. and Rothschild, M. (2010). Biotechnology developments in the livestock sector in developing countries. *Biotechnology Genetical Engineering Revolution*, (7) 217-228.

Pursel, V.G., Wll, R.J, Mitchell, A.D., Elsasser, T.H., Solomon, M.B., Coleman, M.E., Mayo, F.and Schwartz, R.J.1999). Expression of insulin-like growth -I in skeletal muscle of transgenic pigs. In transgenic animals in agriculture (J.D. Murray, G.B. Anderson, A.M. Oberbauer and M. M. Mc Gloughlin, eds). CABI Publishing, New York, 131-144.

Rege, J.E. O. (1994). Biotechnology options for improving livestock production in developing countries with special reference to Sub-Saharan Africa. Proceedings of the third biennial conference of the African Small Ruminant Research network, UICC Kampala, Uganda, 5-9

Srinivasa V. and Goswami S.L. (2007). Transgenic farm animals -A mobile Pharmaceutical Industry. *Indian Dairyman* 59:26-32.

Williams J.G., Kublelik, A. R, Livak, K.J.C, Rafalski, J. A, Tingey, M.S. V (1990). DNA Polymorphisms amplified by arbitrary primers are useful as genetic markers. *Nucleic acids Research* 18(22): 6531-6535.

Van Vleck L.D. (1981). Potential genetic impact of artificial insemination, sex selection, embryo transfer, cloning and selfing in dairy cattle. In: Brackett B.G., Seiedel, S.M (eds), *New Technologies in Animal Breeding*. Academic Press, New York, USA. Pp 221-242.

PREVALENT BACTERIA ISOLATED FROM BOAR SEMEN EXTENDED WITH THE INCLUSION OF MORINGA LEAF EXTRACT (MLE) IN BELTSVILLE THAWING SOLUTION.

***Omodewu, I. A., Olorungbohunmi, T., & Boladuro B. A.**
**Institute of Agricultural Research and Training, Moor Plantation, Ibadan*
***Corresponding Author**: Omodewu Ifeoluwa. A. **E mail**: ifeayo24@yahoo.com**Tel:** 08167330502*

ABSTRACT:
Antimicrobial agents are added to semen extenders to control the growth of microbes contaminating semen. However, non-therapeutic use of antibiotics comes with its challenges as it may contribute to antibiotic resistance. This study compared the efficacy of Natural antibiotic source: MLE as an alternative to Penicillin and streptomycin. Forty ejaculate each of four exotic boar breeds (Large White, Landrace, Duroc and Gene Converter 750 boars) were collected using gloved hand technique and extended with MLE incorporated at 0, 0.25, 0.50, 0.75 and 1.00g/250ml of BTS although 0g inclusion had penicillin and streptomycin as control. Semen samples were analysed for microbiological contamination and isolate identity was deduced from the Bergey's manual of Systematic Bacteriology, results revealed absence of bacteria in 0g MLE for all breeds except Gene Converter 750 where *Alcaligenes spp* was found. Gram –ve bacteria were isolated in all the ejaculates with MLE (0.25-1.00g). *Pseudomonas spp, Aeromonas spp, Enterococcus spp, Alcaligenes spp, Serratia marcescens, Escheria coli* were isolated in all breeds. *Acinetobacter baumanii, Buchholdera mallei, citrobacter spp and Pseudomonas fluorescens* were also isolated. We inferred that the inhibitory activity of the MLE as an antimicrobial agent for swine extender may be limited or inadequate because of the high presence of gram –ve bacteria in MLE inclusions. The presence of bacteria would in turn lead to reduction in the quality of stored semen, the utilization of a higher dosage of MLE is recommended and procedures with high standards of hygiene and microbiological control.
Key words: Ejaculate, antimicrobial, antibiotic, extenders and bacterial contamination.

INTRODUCTION
Bacteriospermia remains a challenge in processing boar semen; it leads to decreased shelf life, motility, sperm agglutination as well as reproductive problems in inseminated females (Althouse *et al*., 2000). The boar itself is a source of bacterial contamination in the ejaculate, likely due to the preputial diverticulum (Althouse and Evans, 1994). Appropriate hygiene during semen collection can decrease contamination (Althouse *et al*., 2005). Sources of contamination could also include human handlers, water used for semen extension, collection and laboratory equipment (Althouse *et al*., 2005). To determine the source of contamination, raw and corresponding extended ejaculates should be cultured, as well as the water source and laboratory equipment. Even if there is no known bacterial problem on site, semen should be cultured regularly to monitor for contamination (Reicks, 2003). Most boar semen extender contains at least one antibiotic with the aim of inhibiting the growth of bacteria; however, there are disadvantages to this practise both for sperm quality and for the environment. The antimicrobials may have detrimental effect on sperm survival, thus limiting the choice of agents that can be added to semen extenders. In a bid to reduce the toxicity caused by bacteria various highly potent broad spectrum antibacterial agents are used. However, use of antibiotics can contribute to the development of antibiotic resistance and this can in turn be transferred to other bacteria in other host species (Johansson *et al*., 2004) one of such extender with the inclusion of broad spectrum antimicrobials is the Beltsville Thawing Solution (BTS). The BTS was initially developed for frozen semen and later adapted to condition fresh swine semen at 15-18°C. Due to challenges of antibiotics resistance, unavailability, expensive price and the ban on some antibiotics the use of natural plant sources to boost and preserve semen is on the increase. *Moringa oleifera* as a plant has an impressive range of medicinal uses with high nutritional value throughout the world. *Moringa* contains pterygospermin which has powerful antibacterial effects (Rao *et al*., 1946). The leaves of *Moringa oleifera* have been reported to be a valuable source of macro and micronutrients, rich source of β-carotene, protein, vitamin C, calcium, potassium and act as a good source of natural antioxidants (Siddhuraju and Becker, 2003). A number of medicinal properties attributed to different parts of Moringa have been recognized by both Ayurvedic and Unani systems of medicines (Mughal

et al., 1999). Components of *Moringa* preparations have been reported to have antibacterial activity which includes 4–(4'-O–acetyl-α-L rhamnopyranosyloxy) benzyl isiothiocyanate, niazimicin, pterygospermin, and 4– (α-L-rhamnopyranosyloxy) benzyl glucosinolate (Fahey *et al.*, 2005). The benefit for the treatment or prevention of disease or infection that may accrue from either dietary or topical administration of *Moringa* preparations (e.g. extracts, deconcoctions, poultices, creams, oils, emollient, powders) are not quite well known (Palada, 1996) hence, culturing semen extended in BTS with MLE replacing antibiotics and identifying prevalent bacteria isolated in semen of four exotic breeds of boar is encouraging**.**

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Artificial Insemination Centre of the Trypano-tolerant Livestock Improvement Program of the Institute of Agricultural Research and Training, Ibadan (I.A.R & T) in Ikenne, Ogun state, West Africa (Latitude $6^0$55' N, longitude $30^0$35' E).

Experimental animals and management

A total of 16 exotic boars of different breeds and of similar age (2year) and weight (150-200kg) namely 4 Large White, 4 Landrace, 4 Duroc and 4 Gene Converter 750 (GC 750) were used for the experiment. The boars were housed intensively and fed balanced ration according to NRC (2005) maintenance requirement for breeding boars.

Methanolic extraction of *Moringa oleifera* leaf

Fresh *Moringa Oleifera* leaves were obtained from Bora Farm of the Institute of Agricultural Research and Training (I. A. R & T.) Ibadan. The leaves were air dried for two weeks and 2000 g of the powdered leaves was extracted with 500 ml of 70% methanol for 72 hours. The mixture was filtered and extracted on a water bath for evaporation and solidification of the extract (Afolabi *et al*., 2013).

Preparation of the BTS extender

The Beltsville thawing solution (BTS) was constituted from: Glucose 39.1g, Sodium bicarbonate 1.32g, Tri-sodium citrate 1.32g, EDTA 1.32g, Potassium chloride 0.79g, Streptomycin 1.1g, Penicillin (IU/ml) 1.1g and 1000 ml Distilled water. The Moringa leaf extract were included at T1 (BTS+ antibiotics), T2 (BTS+0.25gMLE), T3 (BTS+0.50gMLE), T4 (BTS+0.75gMLE) and T5 (BTS+1.00gMLE)

Semen Collection

Semen was collected from boars weekly using gloved-hand technique as described (King and Macpherson, 1973). Forty (40) ejaculates were collected from each breed between 8.00 and 10.00am over a 10 week period. The semen was extended with the constituted Beltsville thawing solution at a ratio 1:10. The extended semen were transferred into labelled tubes with the inclusion levels and then transferred in a climate box to the laboratory.

Bacteriological Evaluation of Extended Semen

All semen samples were analysed for the presence of microbiological contamination by plating on the following media: Nutrient Agar, MacConkey agar (Oxoid), Blood agar, Sabouraud agar (Oxoid, UK), Manittol Salt Agar and nitrate reduction medium. The media were prepared according to the manufacturer's instructions and the plates were incubated in aerobic conditions at 37^oC. The phenotypic properties of isolated bacteria were investigated using different methods, depending on type; the identification process was based on the use of the Gram staining and Analytical Profile Index systems (API 10S, API Staph and API 20NE; bioMe´rieux, France). Motility test, Catalase test, Oxidase test, Indole test, Starch hydrolysis, Methyl red test, Voges-Proskauer test, Citrate utilization test, Nitrate reduction test and Sugar Fermentation were all carried out as described (Bergeys manual of Systematic Bacteriology, 2000).

Biochemical characterization of isolates

Pure cultures of bacteria isolates were subjected to various biochemical tests to determine the probable identity of the bacteria isolates. The result of each test was recorded and the probable identity of the isolates was deduced with reference to the Bergeys manual of Systematic Bacteriology (2000). Bacteriological characteristics were determined as described (Bezuidenhout *et al*., 2002).

RESULTS AND DISCUSSION

The results of bacteria isolation obtained in this study showed that T1(0g MLE + antibiotics) inhibited the growth of bacteria in all boar semen except the Gene Converter 750, which had *Alcaligenes spp*. Inhibition of bacteria growth observed in T1 attest to the potency of synthetic antibiotics as reported by Vyt *et al*. (2007). The presence of gram –ve bacteria *Alcaligenes spp* in Gene Converter (GC) 750 could be breed dependent as reported by Kommisrud *et al.* (2002). Duroc semen with varying inclusions of MLE had *Alcaligenes spp and Acinetobacter iwoffi* at 0.25g, *Serratia marcescen* and *Alcaligenes spp* at 0.50g, *Citrobacter spp and E coli* at 0.75g inclusion while 1.00g MLE had *Pseudomonas auregenosa and Enterococcus spp*.

The semen samples of Large White had *Aeromonas spp* at T2, T3 and T4 while *Serrattia marcescens and E coli* were isolated at T5. The Landrace boar semen had no growth at T1, while T2 had *Buckholdera mallei;* T3 had *Shewanella putrifaciens and Pseudomonas flourescens,* T4 *had Shewanella spp and Shawanella putrifaciens* while T5 had *Pseudomonas Flourescens and Escherichia coli*. GC 750at T1 had *Alcaligenes spp,* T2 and T3 had *Acinetobacter baumanii* while *Alcaligenes spp* was isolated from T4. In T5, *Alcaligenes spp* and *Enterococcus spp* were the most prevalent. Enterococcus *spp, Pseudomonas flourescens, Serrattia marcescens, Citrobacter spp* were similar to bacteria reported by Althouse *et al*. (2000). Althouse *et al*. (2000) reported that potential sources of contamination include Laboratory equipment, disposable and non-disposable supplies, powdered/reconstituted extenders, boars and the boar stud environment. *Alcaligenes spp, Acinetobacter iwoffi, Aeromonas spp*, *Buckholdera mallei*,*Shawanella putrifaciens*, *Acinetobacter baumanii* and *Alcaligenes spp* were different from bacteria reported byAlthouse *et al.* (2000) and this could be as a result of ecological differences. The results from this study are in line with the works of Althouse and Lu 2005, Okazaki *et al*. 2010, U´ beda *et al*. 2013 and Kuster and Althouse (2016) that largely confirms the general view that Gram-negative bacteria, especially from the *Enterobacteriaceae* family are most prevalent in boar semen. These results are consistent with those of other authors, compiled by Maroto Martı´n *et al*. (2010), who concluded that, of at least 25 different bacteria genera identified in boar semen, the species *Pseudomonas*, *Staphylococcus*, *Proteus*, and *E. coli*, occur most frequently. The isolates in these results suggest the low efficacy of the MLE inclusions. Results are nevertheless consistent with the reports of Althouse *et al*. (2000) and Baracaldo and Ward (2008).

CONCLUSION

The synthetic antibiotic (penicillin and streptomycin) remains more effective against bacteria in semen when compared to natural antibiotic source (MLE). This study discourages the utilization of all inclusion of MLE (0.25-1.00g) in semen extender BTS as this could result in reproductive challenges in inseminated gilt/sows. A higher dose of MLE is recommended for further research to examine if a higher dose could reduce or further inhibit bacteria population.

Table 1: The prevalent bacteria isolated from semen samples extended with varying inclusions of MLE in BTS.

Breeds	MLE	Prevalent Isolates from sample with MLE
Duroc	T1 (0g)	No growth
	T2 (0.25g)	*Alcaligenes spp, Acinetobacter iwoffi*
	T3 (0.50g)	*Serratia marcescens, Alcaligenes spp*
	T4 (0.75g)	*Citrobacter spp, E coli*
	T5 (1.00g)	*Pseudomonas auregenosa, Enterococcus spp*
LargeWhite	T1 (0g)	No growth
	T2 (0.25g)	*Aeromonas spp*
	T3 (0.50g)	*Aeromonas spp*
	T4 (0.75g)	*Aeromonas spp*
	T5 (1.00g)	*Serrattia marcescens, E coli*
Landrace	T1 (0g)	No growth
	T2 (0.25g)	*Buckholdera mallei*
	T3 (0.50g)	*Shewanella putrifaciens, Pseudomonas flourescens*
	T4 (0.75g)	*Shewnell spp, Shawanella putrifaciens*
	T5 (1.00g)	*Pseudomonas Flourescens, Escherichia coli*
GC 750	T1 (0g)	*Alcaligenes spp*
	T2 (0.25g)	*Acinetobacter baumanii*
	T3 (0.50g)	*Acinetobacter baumanii*
	T4 (0.75g)	*Alcaligenes spp*
	T5 (1.00g)	*Alcaligenes spp, Enterococcus spp*

*All the bacteria isolated are gram –ve

REFERENCES

Afolabi, A. O., Hameed, A. A. and Alagbonsi I. A. 2013. Effects of Methanolic Extract of *Moringa oleifera* Leaves on Semen and Biochemical Parameters in Cryptorchid Rats. *African Journal of Traditional Complement Alternative Medicine*.10(5):230-235

Althouse, G. and Hopkins, S., 1995. Assessment of boar sperm viability using a combination of two fluorophores. *Theriogenology*, 43: 595-603.

Althouse, G. C and Kuster, C. E., 2000. Field investigations of bacterial contaminants and their effects on extended porcine semen. *Theriogenology* 53(5): 1167-1176.

Althouse, G. C. and Lu, K. G. 2005. Bacteriospermia in extended porcine semen. *Theriogenology* 63(2): 573-584.

Althouse, G. C. and Evans, L. E., 1994. Closed resection of the preputial diverticulum in the boar. *Agricultural Practice* 15(9): 18-21.

Althouse, G., Kuster, C., Clark, S. and Weisiger, R., 2000. Field investigations of bacterial contaminants and their effects on extended porcine semen. *Theriogenology*, 53, pp. 1167-1176.

Althouse, G., Wilson, M., Kuster, C. and Parsley, M., 1998. Characterisation of lower temperature storage limitations of fresh-extended porcine semen. *Theriogenology*, 50: 535-543.

Fahey, J. W., 2005. *Moringa oleifera*: a Review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1, *Trees for Life Journal*, 1: 5-7.

Kommisrud, E., Paulenz, H., Sehested, E., and Grevle, I., 2002. Influence of boar and semen parameters on motility and acrosome integrity in liquid boar semen stored for five days. *Acta Veterinaria Scandinavica*, 43: 49–55.

Mughal, M. H. S., Ali, G., Srivastava, P. S. and Iqbal, M., 1999. Improvement of drumstick (Moringa pterygosperma Gaertn.) A unique source of food and medicine through tissue culture, *Hamdard Medicus*, 42: 37–42.

Okazaki, T., Mihara, T., Fujita, Y., Yoshida, S., Teshima, H., and Shimada, M. 2010. Polymixin B neutralizes bacteria-released endotoxin and improves the quality of boar sperm during liquid storage and cryopreservation. *Theriogenology* 74: 1691-1700.

Palada, M. C., 1996. *Moringa oleifera*: A versatile true crop with horticultural potential in the subtropical United States. Hortscience 794-797.

Reicks, D. L., 2003. Bacterial contamination and semen quality. Proceedings of the Allen D. Leman Swine Conference: 169-170.

Rao, R. R., George, M. and Pandalai, K. M., (1946). Pterygospermin: the Antibacterial Principle of *Moringa pterygosperma*, Gaertn. *Nature* 158:745-746.

Saadabi, A. M., and Abu, Z. A. I., 2011. An *in vit*ro antimicrobial activity of *Moringa oleifera* L. seed extracts against different groups of microorganisms. *Asian Journal of Basic and Applied Science*. 5:129-134.

Siddhuraju, P., and Becker, K., 2003. "Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (Moringa oleifera Lam.) leaves," *Journal of Agricultural and Food Chemistry*, vol. 51, no. 8: 2144–2155.

Vyt, P., Maes, D., Sys, S.U., Rijsselaere, T., Van Soom, A. 2007. Air contact influences the pH of extended porcine semen. *Reproduction of Domestic Animals* 42: 218-220.

ESTIMATION OF HETEROSIS AND HERITABILITY OF BODY WEIGHT IN PROGENIES OF CROSSES BETWEEN TWO BREEDS OF RABBITS

Onodugo, M.O., Ndofo-foleng, H.M., Udeh, F.U. & Nwoga, C.C.
Department of Animal Science, University of Nigeria, Nsukka.
Correspondence author's email:matthew.onodugo@unn.edu.ng; Tel: +2348035491878

ABSTRACT
This study was conducted with New Zealand White (NZW) and Dutch Black (DTB) breeds of rabbits' crosses to estimate heterosis and heritability. Forty-eight (48) rabbits, comprising twelve (12) bucks (6 per breed) and thirty-six (36) does (18 per breed) were used in the mating ratio of 1:3. Parameters taken on both the parents and their progenies according to the different breeding groups include Body Weight (BW) and Body Length (BL). The measurements were taken at 4, 8, 12 and 16 weeks of age. The results revealed negative heterosis of -1.90% and -4.34% at 4th and 12th week for NZW x NZW, -2.58% at 8 weeks for DTB x DTB, while NZW x DTB and DTB x NZW yielded positive heterosis of 2.22%, 20.96%, 15.96% and 5.30% at week 4, 8, 12 and 16 respectively. Heritability estimates from the body weight were generally low to moderate at 4th to 8th weeks for all the crosses. Conversely, at 12th week heritability estimates were high, 0.68±0.15, 0.44±0.15, 0.50±0.39 and 0.56±0.53 for NZW x NZW, DTB x DTB, NZW x DTB and DTB x NZW respectively. It could be concluded from this study that using the DTB to sire DTB x NZW crossbred progeny in rabbit breeding programme can yield considerable hybrid vigour.
Key words: Rabbits, crossbreds, heterosis, heritability and hybrid vigour.

INTRODUCTION
Rabbit is in the class of micro livestock that provides alternative to meat production instead of the traditional use of cattle, sheep and goat. It has gained much prominence in recent times due to its prolificacy, comparatively low production cost, and no religious restriction (Ansah *et al.,* 2014). Rabbit has been used as an experimental animal in genetics and reproductive physiology since the beginning of the century. It was not until 1950 that first findings on quantitative genetics were published, about the maternal influence on birth weight in rabbits, and research on the genetic improvement of the rabbit for meat production (FAO, 1997). Rabbits are characterized by high reproductive ability with a short generation interval and so can produce a high quantity of meat in a short period (Zerrouk *et al*., 2005). Rajendra (2000) opined that rabbits are highly prolific and are 2.5 and 4 times more efficient in extracting protein from forages than sheep and beef cattle, respectively. This study seeks to exploit all the hybrid vigour thereby improving genetically the production traits of rabbit for mankind.

Crossbreeding is one of the tools with which the breeder improves his animals. That is why Apori *et al.,* 2014) observed that crossbreeding has offered a much better alternative for improving on the growth rate and litter size of some chosen rabbits. One major challenge in crossbreeding exercise is the choice of the breed to serve as sire or dam line, hence we rely on reciprocal crossing (Hagon and Opoku-Mensah, 2019). Reciprocal effect is the deviation between crosses of two parental lines in which their roles were reversed.

In Nigeria today, there is need to diversify our animal production from the natural cattle, sheep, goat, swine and poultry to micro livestock animals like rabbit so as to fulfill the ever-growing demand for animal proteins. A person with one pair of rabbits can produce 60 to 80 rabbits each year to eat or sell (Elmer, 1990). It is no longer secret that most Nigerians struggle for meat in any gathering which exposes their scarcity of meat. Besides, the minimum animal protein requirement according to World Health Organization is 35g per head per day, but an average Nigeria animal protein intake is as low as 6.5g per head per day (FAO, 2005). In addition, genetic improvement of rabbit is important in order to increase their contribution to the much-needed animal protein. One of the pre-requisites for genetic improvement is knowledge of genetic parameters for important economic traits (Akanno and Ibe, 2005). It is very unfortunate that the information on these parameters is scanty in available literature for rabbits raised in the tropics. Buchanan and Northcutt (2011) observed that heterosis or hybrid vigour is a difference between the hybrid and the mean of the two parents and it is often called midparent heterosis. It is therefore a measure of the superior performance of the crosssbred relative to

average of the pure breed parents involved in the cross. The probable cause of most heterosis is due to combining genes from different breeds, concealing the effects of the inferior genes. This is very important to a farmer in exploiting parents to achieve a better offspring.

MATERIALS AND METHODS

The study area

The study was carried out at the Rabbitry unit of the Teaching and Research farm, Department of Animal Science, University of Nigeria, Nsukka

Experimental animals and management

A total of forty eight (48) rabbits, comprising twelve (12) bucks (6 per breed i.e. 6 New Zealand White Bucks and 6 Dutch Black Bucks) and thirty six (36) does (18 per breed i.e. 18 New Zealand White does and 18 Dutch Black does) were used and assigned into the experimental hutch cages at mating ratio of 1:3.

Routine hygiene was maintained especially during kindling. The nest box was checked regularly to remove any dead animals during parturition. The newly born rabbits were weighed and weaning age was 28 days or a month. Commercial feed (vital growers feed, CP= 15% min, fat 7% max, CF=10% min, available phosphorus = 0.35% min and metabolizable energy = 2550Kcal/kg minimum) was used throughout the experiment as the concentrates. Forages-grasses and legumes like *Panicum maximum*, *Centrosema pubescens*, *Ageratum conizoides*, *Aspilia africana* and *Andropogon gayanus* were used throughout the experiment as supplementary ration.

Percentage heterosis = (crossbreed average- pure breed average/ Pure breed average) x 100.

Heritability (h^2) (narrow sense) is the measure of additive genetical variation in proportion to the phenotic variation for a trait expressed in a rabbit population (Mahmoud, 2008).

Experimental design and statistical analysis

The statistical package used was Statistical Product and Service Solutions (SPSS) in which variance components from the procedures of analysis of variance (ANOVA) were used to estimate heritability.

The statistical design was the nested (hierarchical) design in which each sire was mated to 3 dams and each mating resulting in number of progenies. The model **was as shown below:**

$Z_{ij} - \alpha_i = \mu + \beta (X_{ij} - \bar{x}) + E_{ij}$ (Beker, 1992).

Where:

Z_{ij} = is the mean of the records of the offspring from a mating ofi-th sire to the j-th dam;

μ = common mean;

α_i = the effect of the i-th sire;

β = the regression co-efficient of Z on X;

X_{ij} = the record on the j-th dam mated to the i-th sire;

$\bar{x}$ = the phenotypic mean of the dams; Eij = the deviation of the means of the progeny.

The regressions from the sire families are pooled to obtain the common regression co-efficient, β.

Sire effect was removed by obtaining the regression of offspring on dam within the sire.

RESULTS AND DISCUSSION

Table 1: Estimation of heterosis for the different breeding groups at different weeks.

Weeks	Pure crosses		Main crosses	Reciprocal
	NZW x NZW	DTB x DTB	NZW x DTB	DTB x NZW
4	-1.90%	2.58%	12.12%	2.22%
8	5%	-2.58%	4.28%	20.96%
12	-4.34%	2.58%	5.55%	15.46%
16	5.56%	9.09%	1.92%	5.30%

Key: NZW = Newzeland white, DTB = Dutch black

Table 1 above shows the estimate of heterosis from the mid-parent method. There were negative heterosis for body weight of -1.90% at 4th week and -4.34% at 12th week for the pure crosses (NZW). There was also a negative heterosis of -2.58% at 8th week for the pure crosses of (DTB). The main crosses and reciprocal crosses of NZW and DTB yielded positive heterosis for body weight especially the reciprocal crosses of DTB x NZW which yielded 2.22%, 20.96%, 15.96% and 5.30% at week 4, 8, 12 and 16 respectively. This result was similar to Ibe *et al*. (2005) who reported 5% and 5.81% heterosis for body weight for a crossbreed of New Zealand White rabbit and Dutch black, Chinchilla and Dutch rabbit crosses respectively. This supports the fact that non-additive effects of genes could be exploited by crossbreeding for body weight. This shows that, apart from selection for economic improvement for traits highly heritable, crossbreeding method is an asset to achieve the same goal. This result also is similar with that of Fayeye (2013) who reported that the percentage heterosis for litter size in local white x local brown crossbred rabbits were positive at the 7th, 14th and 21st day postpartum (+24.20%, +31.63% and + 22.94% respectively). Similarly, Yousset *et al*. (2008) showed a direct heterosis of 24 and 28 percent for litter size at birth and at weaning age in crossing v-line and Baladi Red rabbits.

Table 2: Heritability estimates of body weight (BW(g)) of the breeding groups. Breeding groups and their h^2± S.E (h^2).

Weeks	NZW x NZW	DTB x DTB	NZW x DTB	DTB x NZW
4	0.17±0.48	0.17±0.46	0.10±0.25	0.27 ±0.32
8	0.01± 0.37	0.01±0.37	0.32±0.44	0.23±0.36
12	0.68±0.15	0.44±0.15	0.50±0.39	0.56±0.53
16	NE	NE	NE	NE
Mean ($\bar{x}$)	0.29±0.33	0.21±0.33	0.31±0.36	0.35±0.40

Key**:** BW (g) = Body weight in (g), h^2 = Heritability, NE =negative variance, S.E (h^2) = Standard error of heritability

Table 2 shows the heritability estimates of the body weight of the breeding groups at various weeks. At 4th week (the weaning age), all the groups recorded low heritability for body weight except the reciprocal crosses (DTB x NZW) which recorded a moderate heritability of 0.27. The implication of low heritability is that variation due to additive gene action is probably small or that the non-additive gene action (dominance, over dominance and epistasis) may be more important than additive and environmental factors. Low heritability here could be that at this age (4th week), all the genes have not fully expressed themselves. However, Rojan (2009) obtained a moderate heritability 0.38±24 at 4th week. However, at 12th week, all the breeding groups yielded high heritability of 0.68, 0.44, 0.50, and 0.56 respectively. The implication of high heritability is that additive gene effect was stronger than the non- additive gene effect, epistasis or even environmental factors and that at this age crossbreeding aim was very much achieved.

At 16th week however, heritability could not be estimated. This was as a result of negative offspring variance components in the analysis of covariance. That is, pooled offspring weight was less than that of parent (dam). Negative variance components are regarded as an indication of the negligible contribution of additive genes to variation of the traits concerned. This could be that there was a negligible contribution of additive gene effect or that environmental factors seem to take the lead in the interplay between the genes and the environment

CONCLUSION

In this study, there was a positive heterosis for body weight especially among the crossbred.
Therefore, the potentials of crossbreeding to tap the non-additive genes for improvement of economic traits were seen in this study. The high heritability estimates at week 12 for all the breeding groups had been implicated on the age of the animals.

REFERENCES

Ansah, T., Francis, K, Joejoe, N.S and Rockson. T.K (2014). Growth Carcass and Blood Profile of Rabbits Fed Agro-Industrial by-products in Northern Ghana. Ghana Journal of Science, Technology and Development 1(1):38-45.

Apori, S.O, Hagan, J.K and Osei, D (2014). The Growth and Reproductive Performance of Different Breeds of Rabbits Kept Under Warm and Humid Environment in Ghana. Journal of Animal Feed Research 4(3):51-59.

Becker, W. A. (1992). *Manual of quantitative genetics*. 5th edition student book cooperation, Pullman, USA: 103-112. *Production*, 26: 23-24.

Elmer, L. C. (1990). Agriscience Fundamentals and Applications. USA: Delmer publishers inc. pp 390

FAO. (2005). Nutrition profile Nigeria Food and Agricultural Organization Rome, Italy.

Fayeye, T. R. (2013). Heterosis for preweaning litter characteristics in Nigeria crosses. International Journal of Agricultureal and Food Research, 2(**2**), 1-6.

Hagan, J.K and Opoku-Mensa (2019). Evaluation of Heterosis and Combining Ability for Growth and Reproductive Traits in Rabbit Crosses Kept Under Hot and Humid Environment in Ghana. Livestock Research for Rural Development 31 (95):1-11.

Ibe S. N, Obasi, V. N, Ojewale, G. S and Nwachukwu, E. N (2005). Heterosis and reciprocal effects for growth rate in crosses of New Zealand white, Dutch and Chinchilla breeds of rabbits. *Nigerian Journal of Animal Production*, 32 (**2**): 191 – 197.

Ibe, S. N, Oke, U.K and Nwachukwu, E.N. (2005). Genetic Society of Nigeria/30th Animal Nigeral Conference pp144-147.

Mahmoud, G.G. M. (2008). A study of some productive and reproductive traits in two strands of rabbits and their crosses. Department of Animal production, faculty of Agriculture. Al-Azhar University.

Rajendra, K. R. (2000). Peri urban Small Livestock Production for Food and Community Development: Department of Food Production. Faculty of Agriculture and Natural Sciences UWI, st, Augustine Trinidad.

Rojan, P. M., Bindu, K. A., Raghunandanan, K. V and Raghavan, K. C. (2009). Genetic analysis of body weigths in rabbits. *Journal of Veterinary Animal Science*, 40, 26-28.

Yousset, Y.M.K. (2008). Evaluation of litter traits in crossing project of V-line and Baladi Red rabbits in Egypt. *Livestock Research for Rural Development.* 20, 9.

Zerroouk N., Bolet G., Bercluhe, M., and Lebas, F. (2005). *World Rabbit Science***,** 13:29-37.

SOME PHENOTYPIC CHARACTERISTICS AND BREEDING METHODS OF EXOTIC BREEDS OF PIGEON IN BAUCHI METROPOLIS, BAUCHI STATE, NIGERIA

Onwuneme, P. C[1]., Abdu, I[1]., Ibrahim, T[1] & Shuaibu, A[2].
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
[2]Department of Animal Science, Federal University Kashere
***Corresponding author**: iabdu@atbu.edu.ng*

ABSTRACT
The study was conducted to determine the characteristic and economic value of exotic breeds of pigeon in Bauchi Metropolis. Purposive sampling was employed to select farmers of exotic breeds of pigeon in Bauchi metropolis and a total of 60 respondents were used. The study revealed that 100% of the respondents were males and 50% aged between 26-35 years, followed by 16-25 years (25%) while the least (10%) aged between 5-15 years. Majority (51.67%) of the respondents had secondary school certificate while 48.33% attained tertiary education level. Majority (58.33%) of the farmers practiced inbreeding only. However, 41.67% of the respondents practiced both inbreeding and out-breeding. Furthermore this study revealed that 28 different exotic breeds of pigeon with unique features were available in Bauchi metropolis. Majority (66.7%) of the exotic breeds of pigeon with good flying ability were small size while the least (11.1%) was recorded among large ones. However, the large breed recorded highest poor flying ability (60%) followed by (40%) among average size, none of small size breed had poor flying ability. Most (75%) of them had average resistance to prevalence diseases when compared with the local breed. Female farmers should be encouraged to rear exotic breeds of pigeon. Cross breeding of exotic and local breeds of pigeon should be employed to complement each other.
Keywords: Exotic, Breed, Pigeon

INTRODUCTION
The domestic pigeon (*Columba livia domestica*) belongs to class: Aves, order: Columbiformes and family: Columbidae. Pigeons have made contributions of considerable importance to humanity especially in times of war (Levi, 1997). In war the homing ability of pigeons has been put to use by making them messengers. The homing pigeon is a variety of domestic pigeon derived from the rock pigeon, selectively bred to find its way home over extremely long distance (Levi, 1997). Members of this breed of pigeon are still being used in the sport of pigeon racing and the white release-dove ceremony at weddings, anniversaries and funerals. The wild rock pigeons have an innate homing ability (Blechman, 2007) meaning that they will generally return to their nest and mate.

Pigeon can also be reared as a meat. Young pigeons bred for meat are known as squabs. Rearing pigeons for meat is an accepted industry in overseas countries, particularly Europe and the United States (Bolla, 2007). In Kano state, the domestic pigeon (*Columba livia domestica*) is reared for meat production by some household, thereby contributing significantly to the protein need of the local populace (Rabiu and Arzai, 2012). However this aspect is yet to be optimally exploited in Nigeria as a whole. Breeding for fancy pigeon is an overwhelming aspect in pigeon production with a lot of economic and tourist potentials. There has been an insignificant development in the Nigerian fancy pigeon industry since its introduction from overseas some years ago. Most of exotic breeds of fancy pigeon have been proven to be adaptive to our local environment. Those who love bird life can find unlimited pleasure in the breeding of pigeons and besides, as they become more proficient in the art of breeding can earn a nice little income from their birds (Hazard, 1922). Pigeon can be bred for purposes which include: breeding for utility, breeding for fancy, breeding for homing and breeding for racing and show. All these provide wider areas of specialization for breeders and researchers in pigeon production. However, there is limited information today on the characteristic and availability of exotic breeds of pigeon in Nigeria. Their potentials and production are yet to be efficiently exploited in Nigeria. Therefore, this study aimed to determine the phenotypic characteristic and breeding method exotic breed of pigeon in Bauchi metropolis.

MATERIALS AND METHOD

Description of Study Location

The study was carried out from January to August 2019 in Bauchi metropolis. Bauchi state is located in the northern guinea savannah agro-ecological zone of Nigeria. The state is located geographically at approximately 10°17'N, 9°49'E and 690.3m above sea level (Kowal and Knabe, 1972).

Sampling Procedure

The Research-sampling design that was used to select the sample was non-probability purposive sampling. A total of 60 exotic breeds of pigeon farmers were used.

Methods of Data Collection

Data for this study were collected using both primary and secondary sources. The primary data (Type, size, flying ability, and relative disease resistance,) were collected through farm visitation and physical examination of the pigeons. Secondary data (breeding methods) were collected by using a questionnaire.

Statistical Analysis

The data collected were subjected to simple descriptive statistic and χ^2 test for association using SPSS version 17

RESULTS

The socio-Economic characteristic of the exotic breeds of pigeon farmers in Bauchi metropolis were presented in Table 1. The results revealed that 100% of the respondents were male and (50%) were within the age bracket of 26-35 years, followed by 16-25 years (25%) and 36-45 years (25%) while the least (10%) were within 5-15 years old, non-of the farmers was above 45 years.Majority (51.67%) of the respondents had secondary school certificate, 48.33 % were able to attained tertiary education while none of the respondent had non-formal or primary education as highest level of education. The results also showed that (50%) of the respondents were new in the pigeon farming with 0-5 years of experience followed, by 31.7% with 6-10 years of experience while the least (18.3%) had above 10 years of experience.

Table 2 presented the distribution of some phenotypic characteristics of exotic breeds of pigeon in Bauchi metropolis. The results showed that most (78.6%) of the exotic breeds of pigeon in Bauchi metropolis were fancy type while the least 21.4% were utility.With respect to size 39.3% of the breeds were medium, followed by large (35.7%) while 25% were small in size. Majority (53.6%) of the breeds had poor flying ability, 32.1% were good, while 10.7% had average flying ability. Most (75%) of the breeds had average resistance to diseases while 25% were susceptible to prevalence diseases.

Table 1: Socio-Economic Characteristics of the Exotic Pigeon Farmers in Bauchi Metropolis.

Variables	N (%)
Sex	
Male	60 (100)
Female	Nil
Total	60(100)
Age Group (years)	
5-15	6(10)
16-25	15(25)
26-35	30(50)
36-45	9(15)
>45	Nil
Total	60(100)
Level of Education	
Non-formal	Nil

Primary	Nil
Secondary	31(51.67)
Tertiary	29(48.33)
Total	60(100)
Years of Experience	
0-5	30(50)
6-10	19(31.7)
>10	11(18.3)
Total	60(100)

N= Number; % = Percentage

Table 2: Distribution of the Characteristics of Exotic Breeds of Pigeon in Bauchi Metropolis

Characteristic	**N (%)**
Type	
Fancy	22 (78.6)
Utility	6 (21.4)
Relative Body Size	10 (35.7)
Large	10 (35.7)
Medium	11 (39.3)
Small	7 (25)
Relative Flying Ability	
Good	9 (32.1)
Average	4 (10.7)
Poor	15 (53.6)
Relative Diseases Resistance	
Average	21 (75)
Good	7 (25)

N= Number; % = Percentage

Table 3 presented the association between the body size and flying ability of exotic breeds of pigeon in Bauchi metropolis. Significant (P > 0.01) association between body size and flying ability of exotic breeds of pigeon in Bauchi metropolis was detected. Majority (66.7%) of the exotic breeds of pigeon with good flying ability were small size while the least (11.1%) was recorded among large ones. However, the large breed recorded highest poor flying ability (60%) followed by (40%) among average size, none of small size breed had poor flying ability.

Table 4 presented breeding methods employed by exotic breed of pigeon farmers in Bauchi metropolis. The results revealed that (55%) of the respondents practice only inbreeding, followed by 45% practice both inbreeding and out-breeding, while none practice only out-breeding. Out of 45% of the respondents that practice out-breeding, only few (3.33%) performed a planned cross-breeding while majority (41.67%) performed unplanned cross-breeding without targeting any trait.

Table 3. Association between Body Size and Flying Ability of Exotic Breeds of Pigeon

Body Size	**Flying Ability**			χ^2	**LOS**
	Good	Average	Poor	17.4	**
Small	6 (66.7%)	1 (25%)	0 (0.0%)		
Medium	2 (22.2%)	3 (75%)	6 (40%)		
Large	1 (11.1)	0 (0.0%)	9 (60%)		
Total	9 (100%)	4 (100%)	15 (100%)		

N= Number; % = Percentage; LOS= Level of Significance; $\chi^{2=}$ Chi-square; **P<0.01

Table 4: Breeding Method of Exotic Breeds of Pigeon in Bauchi Metropolis

Breeding Methods	**N (%)**
Inbreeding only	33(55)
Out-breeding only	Nil
Both	27(45)
Total	60(100)
Cross-breeding Planning	
Planned cross-breeding	2(3.33)
Unplanned cross-breeding	25(41.67)
Total	27(45)

N= Number; % = Percentage

DISCUSSION

The result obtained from this study that only males embarked on exotic breeds of pigeon farming in Bauchi metropolis is in line with the findings of Bakoji *et al.* (2012) and Suleiman *et al.* (2017) they reported more males participation than females in poultry farming in Bauchi and Kaduna states respectively. The (50%) of exotic breeds of pigeon farmers in Bauchi metropolis were within the age bracket of 26-35 years is similar to findings of Bakoji *et al.* (2012), who reported (48.89%) of quail birds' farmers in Bauchi Local Government were within the age bracket of 31-40 years. . The age distribution might have been influenced by the nature of the business which required highly energetic and independent youths for effective farming and marketing. The high literacy level of the respondents in this study is in line with the findings of Nurudeen (2012) that the majority of the poultry farmers had tertiary education. Bukunmi and Yusuf (2015) reported that level of education had a positive coefficient which could be because education helps the farmers to understand better the innovation introduced to them. Experience in poultry production usually determines the effectiveness of farmers' decision with respect to inputs combinations or resource allocation (Umar, 2012). The (50%) of respondents were still new in the business with 0-5 years of experience. This implied that the business was still at young stage and therefore, more studies were still needed to be done in the exotic pigeon farming for better improvement.

The majority (78.6%) of the exotic breeds of pigeon in Bauchi metropolis were fancy type. Fancy pigeon breeds are kept for their gorgeous colour, form and texture. The higher availability of fancy breeds could be an indication that exotic breed of pigeon production in Nigeria was mostly targeted for pet. Most of these exotic breeds of pigeon had average resistance to diseases when compared with the local breeds is in accordance with the findings Bunza *et al.* (2008) reported zero infestation of tick on local breed of pigeon at Sokoto central market.

The significant association observed between body size and the flying ability of exotic breeds of pigeon. Sudik (2007) reported high and positive correlations between live weight and body size in chickens. Pigeons with larger body size will likely have higher body weight which will make them have poor flying ability. Pigeon with small body size has the tendency of lower body weight and good flying ability. This might serve as vital guide line to future breeders. While selecting for racing pigeon breeding, the size of the pigeon should be considered.

Majority (58.33%) of the respondent practice only inbreeding was to maintain the breed purity and to prevent any limitation on the required features.

CONCLUSION AND RECOMMENDATION

It can be concluded that most of the farmers practice inbreeding. Therefore, Cross breeding of exotic and local breeds of pigeon should be employed to complement each other.

REFERENCES

Bakoji, I., Aliyu, M.K., Haruna, U., Jibril, S.A., Sani, R.M. and Danwanka, H. (2012) "Economic Analysis of Quails Bird (*Cortunix cortunix*) Production in Bauchi local Government Area, Bauchistate, Nigeria".*Research Journal of Agriculture and Environmental Management.* Vol. 2(12), pp. 420-425

Blechman, A.D. (2007). *Pigeons: The fascinating saga of the world's most reverd and reviled bird.* St. Lucia, Queensland: University of Queensland Press.

Bolla, G.(2007). *Squab raising.* New South Wales: Department of Primary Industries. Retrieved from http://www.dpi.nsw.au/primefacts.

Bukunmi, F. R., & Yusuf, H. A. (2015). "Analysis of Socio-Economic Factors Influencing Poultry Egg Production among Poultry Farmers in Ondo State, Nigeria". *British Journal of Applied Scienec and Technology, 10* (3), 1-7.

Bunza, M.D.A, Yahaya, M.M.M, Muhammad, A.S and Saidu, A.R.(2008). "A Survey on Tick Species Infesting Domestic Birds Sold at Sokoto Central Market, Nigeria". *Sokoto Journal of Veterinary Sciences.* 7(2): 52-54

Hazard, F. A. (1922). "Profitable Pigeon Breeding".*American Pigeon Journal Company.* Warrenton, MO, USA.

Levi, W. (1977). *The pigeon.* Sumter, S.C.: Levi Publishing Co, Inc.

Nurudeen, J. A. (2012). "Economics and Social Characteristics of Registered Poultry Producers in Ilorin, Kwara State". *Russian Journal of Agricultural and Socio- Economic Sciences, 11* (11).

Rabiu, B. M. & Arzai, A.H. (2012). "Incidence of Pseudolynchia canariensis (macquart) of Domestic Pigeons (*Columba livia domestica)* in Kano State, Nigeria." *Biological and Environmental Sciences Journal for the Tropics* 9(1).

Sudik, S.D. (2007). Characterization of local chickens in Plateau State, Southern Zone. An Msc Theses. Animal Production Programme, School of Agriculture, ATBU, Bauchi.

Suleiman, R., Mahmud, A. M., Oladimeji, Y.U., Olanrewaju, T.O. & Ojeleye. O. A (2017) "Effects of Socio-Economic Characteristics on the Profitability of Poultry ProductionamongPoultry Farmers in Kaduna State".*Proceedings of the Annual Conference of Agricultural Extension Society of Nigeria.* 22nd Annual Conference.

Umar, M. (2012). *Economic Analysis of Poultry Egg Production in Bauchi Local Government Area, Nigeria. A thesis submitted to the school of postgraduate studies, Ahmadu Bello University Zaria, Kaduna State, Nigeria*

ANTIOXIDATIVE EFFECT OF WATERMELON (*Citrullus lanatttus)* JUICE ON MORPHOLOGY OF EXTENDED BOAR SEMEN

Oyeniran J.O[*], Mohammed A[*], Nuhu S.H[*],Yaro S.S[*], Sani A[*], Sokunbi O.A[x] Arire E.O[+]
[*]*Department of Animal Health and Production Technology, Federal Polytechnic, Bauchi, Nigeria.*
[X]*Department of Animal Science, University of Ibadan*
[+]*Department of Agricultural Technology, Federal Polytechnic, Ado Ekiti*

ABSTRACT
Boar semen preservation is associated with the production of reactive oxygen species which leads to reduction of sperm quality and decrease in fertilizing ability. The aim of this study was to replace conventional semen extender with watermelon juice (WMJ) and to determine the most effective dilution rate that will maintain the viability of the spermatozoa over a 48-hours extension period. Semen was collected from a boar at the piggery unit of the teaching and research farm University of Ibadan, Ibadan using the glove hand method. The experiment was divided into five treatments with Beltsville Thawing Solution being replaced by WMJ at the following rate; 0, 12.5, 25, 37.5 and 50% and designated as T1, T2, T3, T4 and T5 respectively. Diluted semen samples were stored at 17^0C and were evaluated at 0, 24 and 48 hours for morphology. The experimental design was a completely randomised Design; data obtained were analysed using descriptive statistics and ANOVA.
The results showed that 50 % of BTS can be replaced by watermelon juice. However the effect of watermelon juice was only ascertained not more than 48 hours of storage. This evaluation shows that extender developed with WMJ could be an extender of choice for a reliable short term preservation in swine artificial insemination programme.
Keywords: Boar, Watermelon Juice extension, Semen quality, Spermatozoa.

INTRODUCTION
Successful swine fertility programs can be achieved using extended cooled semen when compared to those using natural service. Although the former is a routine procedure, its use is limited because sperm cells remain viable for about 3 to 5 days (Gadea *et al.*, 2005). Many studies have been carried out on carotenoids, considered an important group of natural antioxidants (Bast *et al*., 1998, Møller *et al*., 2000, Schabath *et al*., 2004 and Rao and Rao, 2007). For over a decade, lycopene, a carotenoid present in tomatoes (*Lycopersicon esculentum*) and several ripe fruits and vegetables, such as watermelon, pink grapefruit and carrots (Nguyen and Schwartz, 1999, Perkins-Veazie *et al*., 2003 and Tadmor *et al*., 2005), has been considered in some studies related with human and animal health (Bhuvaneswari and Nagini, 2005, Rao *et al*., 2006, Avci and Durak, 2007 and Bhom, 2007) and reproductive physiology (Martino *et al*., 2006, Goyal *et al*., 2007, Mangiagalli *et al*., 2007, Turk *et al*., 2007 and Mendiola *et al*., 2010). In roosters, in particular, Mangiagalli *et al*. (2010) found positive effects of lycopene addition on fertility and qualitative characteristics of semen.
With AI expanding rapidly, the demands for semen increased. The simplest way to meet this demand was to "stretch" each ejaculate further by using fewer spermatozoa per insemination, provided that this could be accomplished without sacrificing fertility.
The main objective of semen preservation is to extend the usefulness of genetically superior males for purposes of expanding the genetic base of breed, repopulating/recreating breeds or lines and discovering new gene (Waberski *et al.*, 1994; Purdy *et al.*, 2008). It is important to evaluate the effectiveness of natural antioxidants that are readily available, such as watermelon juice in reducing the oxidative stress in post ejaculated boar semen, to evaluate the effectiveness of antioxidant in watermelon juice on the boar semen quality and determine the proportions of *watermelon juice* that is suitable for preserving boar semen quality.

RESULTS

TABLE 1: Characteristics of semen collected from Boar.

Parameters	Value
Volume (ml)	50
Progressive Motility (%)	95
Mass activity	++++
Morphology (%)	95

Characteristics of semen collected

Table 1 shows the results from the initial evaluation of boar semen before extension was done. The result reveals that the sample was suitable for extension as the values fall within acceptable ranges for high quality semen.

Table 2: Effect of water melon juice fortification on extended boar semen quality at 0 hour (Mean ±SD)

Parameters (%)	T1	T2	T3	T4	T5
Morphology	94.33±0.57^{a}	90.00±0.00^{a}	85.00±5.00^{b}	91.67±5.77^{a}	86.67±2.88^{a}

abc = mean values in the same row with different superscripts are significantly different (P<0.05); SD = Standard deviation

Effect of water melon juice fortification of boar semen quality at 0 hours

Table 2 shows the mean of morphology and of extended boar semen supplemented with graded levels of watermelon juice refrigerated at 17 ^{0}c.

There was a significant reduction (P<0.05) in morphology in treatment 3 (25 % WMJ) which gave the least mean value.

Table 3: Effect of water melon juice fortification on extended boar semen quality at 24 hours (Mean ± SD)

Parameter	T1	T2	T3	T4	T5
Morphology	87.66±2.51^{a}	87.66±0.57^{ab}	85.30±0.57^{ab}	85.30±0.00^{ab}	81.66±0.88^{b}

abc = mean values in the same row with different superscripts are significantly different (P<0.05); SD = Standard deviation.

Semen quality of extended (17 ^{0}c) boar semen fortified with water melon juice, (24 hours)

Table 3 shows the mean values of morphology of extended boar semen supplemented with graded level of watermelon juice refrigerated at 17^{0}C. There was a significant difference (P<0.05) in mean value at 24 hours. Significant reduction (P<0.05) in morphology was observed with the increase in concentration of watermelon juice extract.

Table 4: Effect of water melon juice fortification on extended boar semen quality at 48 hour (Mean ± SD)

Parameters	T1	T2	T3	T4	T5
Morphology	83.66±1.15^{a}	82.00±0.00^{ab}	80.00±0.57^{b}	80.33±0.57^{b}	79.33±1.15^{b}

abc = mean values in the same row with different superscripts are significantly different (P<0.05); SD = Standard deviation

Effect of water melon juice fortification on extended boar semen quality at 48 hours
Table 4 shows the mean values of morphology of extended boar semen supplemented with graded level of watermelon juice refrigerated at 17^0C. Significant differences in mean values was observed. It was significantly lower ($P<0.05$) in T5 (50 % WMJ).

DISCUSSION

Morphology

For sperm morphology, it was observed that significant amount of spermatozoa were normal according to Shipley *et al.* (1999) that the percentage spermatozoa should be at least 70 %. Also, Cerolini *et al*. (2000) reported that inclusion of antioxidant into storage diluents prevented deterioration of boar spermatozoa quality and provided protection to the cells up to 5 days of storage through its prevention of oxidative reduction in the levels of major polyunsaturated fatty acid.
The highest mean value recorded for spermatozoa morphology in treatment 2 can be accrued to inclusion of antioxidant as a supplement in the extender. This is in agreement with the report of Cerolini *et al*. (2000) that the inclusion of antioxidant into storage diluents prevented deterioration of boar semen quality and provided protection to cells up to 5 days of storage through its prevention of oxidative reduction in levels of major polyunsaturated fatty acid.

CONCLUSION

This study was carried out to investigate the effect of watermelon juice fortification of extended boar semen. Semen was collected from a mature landrace boar and extended with BTS (Beltsville thawing solution). The control treatment contained only BTS with a semen- extender ratio of 1 to 4, while the other treatments contain BTS with different concentrations of watermelon juice. The semen was stored using liquid storage (17^0C). After collection and assessment for odour, colour, volume, morphology and satisfactory results were obtained, the semen was added to the extender and placed in a regulated refrigerator. Semen evaluation was carried out at every 24 hours for three days. Semen characteristics evaluated include morphology. Mean value for morphology was reduced but falls within the normal range that can support fertilisation. The results obtained in the study suggest that 50 % of BTS can be replaced by watermelon juice; however the effect of WMJ anti-oxidative properties is inconclusive up to 48 hours of storage. Watermelon juice extract has proven to have potentials to supply exogenous antioxidant thus inhibiting oxidative stress condition in boar semen. Even at a high level of inclusion in extended semen, it was able to give a percentage motility that was capable of fertilising the oocyte. From this study, extended semen (17^0C) at 12.5% inclusion level of watermelon juice extract gave the best percentage in morphology throughout the experimental period because all mean values are within acceptable range of normal values indicative of good semen quality.

REFERENCES

Avci A., Durak I. 2007. Tomato and cancer. In: Durak I. (Eds.). Nutraceuticals and natural products in cardiovascular diseases, cancer and hemorrhoids. 41-46.

Bast, A. Haenan, G. R, Van Den Berg, R, and Van Den Berg H. 1998. Antioxidant effect of carotenoids. *International journal for vitamin nutrition research, 68: 3999-403.*

Bohm ,F., Tinkler, J.H., and Truscott, T.G, 2007. Carotenoids protect against cell membrane damage by nitrogen dioxide radical. *Natural Medicine.* 1: 98-99.

Bhuvaneswari V., Nagini S. 2005. Lycopene: a review of its potential as an anticancer agent. *Current Medical Chemistry. Anti-Cancer Agents*, 5: 627-635.

Cerolini, S, Maldjian, A, Surai, P and Noble, R. 2000. Viability, susceptibility to peroxidation and fatty acid composition of boar semen during liquid storage. *Animal Reproduction Science*, 58: 99-111.

Gadea J, García-Vazquez F, Matás C, Gardón JC, Cánovas S, 2005 Cooling and freezing of boar spermatozoa: supplementation of the freezing media with reduced glutathione preserves sperm function. *Journal of Andrology* 26: 396-404.

Gagnon C, Iwasaki A, De Lamirande E, Kovalski N,1991 Reactive oxygen species and human spermatozoa. *New YorkAcademy of Science*.; 637: 436-444.

Gil , J, Rodriguez-Irazoqui, M, Lundeheim,N, Soderquist, L, and Rodriguez- Martinez, H,2003. Fertility of ram semen frozen in bioexcell and used for cervical artificial insemination. *Theriogenology.*59:1157-1170.

Goyal A., Chopra M., Lwaleed B.A., Birch B., Cooper A.J, 2007. The effects of dietary lycopene supplementation on human seminal plasma. BJU International., 99: 1456-1460.

Mangiagalli M.G., Martino P.A., Smajlovic T., Guidobono Cavalchini L., Marelli S.P. 2010. Effect of lycopene on semen quality, fertility and native immunity of broiler breeder. *British Poultry Science.*, 51: 152-157.

Martino P.A., Mangiagalli M.G., Marelli S.P., Smajlovic T., Guidobono Cavalchini L. 2006. Effect of lycopene on semen bacteriological status and native immunity in roosters. *World Poultry Science Journal*., XII European Poultry Conference, Verona, Italy. 62 *Supplement*.: 415.

Mendiola J., Torres-Cantero A.M., Vioque J., Moreno-Grau J.M., Ten J., Roca M., Moreno-Grau S., Bernabeu R. 2010. A low intake of antioxidant nutrients is associated with poor semen quality in patients attending fertility clinics. *Fertility Sterility*, 93: 1128-1133.

Møller, A.P., Biard C., Blount J.D., Houston D.C., Ninni P., Saino N., Surai P.F. 2000. Carotenoid-dependent signals: indicators of foraging efficiency, immunocompetence or detoxification ability? *Avian Poultry Biology Rev*., 11: 137-159.

Nguyen M.L., Schwartz S.J. 1999. Lycopene: chemical and biological properties. *Food Technology*, 53: 38-45

Perkins-Veazie P., Collins J. K., Edwards A., Wiley E., Clevidence B. 2003. Watermelon: rich in the antioxidant lycopene. *Acta Horticulture*., 628: 663-668.

Purdy , P.H.R.,Knox, W., Singleton, K, Spencer,S.F, Spiller, T, Stewart, I, Tharp, N, Welsh, C.S, and Blackburn, H.D,2008. Preservatives on cryopreservation , quality control and artificial insemination of frozen-thawed boar sperm in a natural repository. *Symposium proceedings, Mid west Boar and Manager Conference,* August 7-8, St Louis, MO, USA.

Rao A.V., Rao L.G. 2007. Carotenoids and human health. *Pharmacology Research*., 55: 207-216.

Rao A.V., Ray M.R., Rao L.G. 2006. Lycopene. *Advanced Food Research*., 51: 99-164.

Rigau, T, Piedrafita, J, Reverter, J, Canal, M, Rodriguez-Gil, J.E,1996. The rate of l-lactate production, A feasible parameter for the fresh diluted boar semen quality analysis. *Animal Reproductive Science* 43:161-172.

Schabath M.B., Grossman H.B., Delclos G.L., Hernandez L.M., Sue Day R., Davis B.R., Lerner S.P.,Spitz M.R.,Wu X. 2004. Dietary carotenoids and genetic instability modify bladder cancer risk. *Journal of Nutrition*, 134: 3362-3369.

Shipley C.F., Clifford F., Hurtgen J.P, 1999. Breeding soundness examination of the Boar, *Swine Health Production*, 3: 117-120

Tadmor Y., King S., Levi A., Davis A., Meir A., Wasserman B., Hirschberg J., Lewinsohn E. 2005. Comparative fruit colouration in watermelon and tomato. *Food Research International.*, 38:837-841

Turk G., Atessahin A., Sonmez M., Yuce A., Ceribasi, A.O. 2007. Lycopene protects against cyclosporin A-induced testicular toxicity in rats. *Theriogenology*, 67: 778-785.

Waberski, D, Weitze, K.F, Lietmann, C, 1994. The initial fertilizing capacity of long term stored liquid boar semen following pre and post ovulatory insemination. *Theriogenology 41, 1367-1377.*

SEMEN CHARACTERISTICS AND FERTILITY OF THREE STRAINS OF NOILER COCKS

***S Amur.,D.J.U Kalla & Y.P Mancha**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: amursamaila@gmail.com mobile No: 07063937365*

ABSTRACT

A study was carried out to determine the semen characteristics and fertility of three strains of noiler cocks. A total 180 normal feathered Noiler birds were procured at nine weeks of age from Bauchi state Agricultural Development Program (BSADP) farm comprising of 45 Noiler cocks (15 brown, 15 black and 15 spotted) and 135 Noiler hens (45 brown, 45 black and 45 spotted). The experiment lasted a period of eight months and they were fed commercial diet throughout the period of the experiment. Two types of incubator were used, namely automatic incubator (A) and locally built water bed (B). The study was conducted at the poultry unit of the BSADP. The result showed that in parameters such as semen colour, pH, total motility, dead sperm, abnormal sperm cells and sperm concentration ($x10^9$) there were no significant difference ($p<0.05$) between the strains however volume, mass activity and sperm concentration were significantly different ($P<0.05$). Statistical difference ($P<0.05$) were observed from incubator A, where brown strain showed high fertility, followed by spotted and least in black with 83.7%, 80.8% and 75.3% respectively. From incubator B, it shows significant difference ($P<0.05$) with black strain showing highest fertility percentage (86.3%) followed by spotted (78.1%) and least were observed in brown with 72.6%. Chick quality with regards to weight is statistically not different ($P<0.05$) among strains. The data obtained from this study indicate that there were variations among the stains in parameters such as semen volume, mass activity and semen concentration. However these variations did not influence the quality of day old chicks as no statistical difference was observed. This study there for recommends that any of the three strains of Noiler cocks can be used for breeding purposes.

Keywords: Noiler, Semen, Strain, Cocks, Characteristics

INTRODUCTION

The demand for animal protein has globally increased, in the last five years meat consumption has gone up satisfactorily. The recent ban on the importation of poultry and their products has constituted a major challenge to the indigenous poultry industry to meet up the immediate and future protein needs of the country. This challenge calls for improvement and/or change in the traditional production system and optimization of poultry reproductive traits such as fertility, hatchability and chick quality. With Noiler chicken breed, the production of animal protein is cheaper and sustainable. The Noiler chicken is a dual purpose breed of chicken developed in Nigeria, Noiler s are suitable for rural communities and small holder farmers (justagric.com, 2019). Reproductive performance is usually expressed in terms of egg production in the hen and seamen yield and quality in cocks. Assisted reproduction technologies (ART's), such as artificial insemination (AI) contribute to increased poultry production, as it allows a wider use of genetically superior cockerels. In a breeder flock, fertility rates are often related to the male performance Surai and Fisin (2012) stated that chick viability is important in the profitability of the poultry industry. In contrast to mammals, chicken embryonic development takes place in a semi-closed environment, the egg, with only exchange of gas and water with the outside. However, information about Noiler chicken's fertility, hatchability and chick quality is not fully understood. This research was designed to determine the semen characteristics and fertility of three strains of Noiler cocks.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the Bauchi State Agricultural Development Project (BSADP) Bauchi State, Nigeria. It lies between latitude 9.30° and 12.3° north of the equator, and Latitude 8.48° and 11° East of the Greenwich meridian. A total 180 normal feathered Noiler birds were procured at nine weeks of age from Bauchi state Agricultural Development Program (BSADP) farm comprising of 45 Noiler cocks (15 brown, 15 black and 15 spotted) and 135 Noiler hens (45 brown, 45 black and 45 spotted). The experiment lasted a period of eight months and they were fed commercial diet throughout the period of the experiment. Two type of incubator were used, namely automatic incubator (A) and locally built water bed (B).

Semen collection

Semen samples were collected weekly by abdominal massage technique (Donoghue and Wishart, 2000). After restraint, the back of the cock was gently stroked from behind the wings but firm and rapidly toward the tail. The cock responded with tumescence erection of the phallus, and the handler then gently squeezed the cloaca expressing semen through the external papillae of the ducti deferentis and collected semen into clean 1 ml Eppendorf tubes. The tubes were then held at a suitable temperature for analysis.

Semen analysis

Semen volume-this was obtained as the difference between weight of tube and sample. Semen colour-this was visually assessed immediately after collection and scored as; 1=creamy, 2=creamy-white and 3=opaque (Peters et al., 2008).

Semen $_{P}$H- a drop of semen was evenly placed onto a $_{P}$H paper, after the colour of the impregnated zone became uniform (<30 seconds) it was compared with the calibrated strip to read the $_{P}$H. Mass activity (gross motility) - was determined by placing a drop of raw undiluted semen on a pre-warmed slide and covered with a slip to spread it into a uniform thickness and to prevent drying up, it was viewed under a microscope at 100x and motility estimated by subjectively assessing the wave patterns and ranked as follows, 4 – rapid swirling, 3- slower swirling, 2 – generalized oscillation and 1 – sporadic oscillation.

Individual sperm motility-examined at 400x magnification several fields were examined and estimated to the nearest 10% subjective assessment was carried out and expressed as percentage of motile sperm with moderate to rapid progressive movement.

Percentage live dead and normal/abnormal spermatozoa were evaluated using the eosin nigrosine staining procedure. One drop of the stain was taken using a pipette and placed at the end of a warm slide and mixed with one drop of semen. After making the smear the slide was allowed to dry, and then examined using a light microscope at a magnification power of 400x, the live spermatozoa were identified as bright and not stained. Their outlines were clearly defined and their heads were bright and retractile against the backgrounds. The dead spermatozoa stained pink and outlines were not clearly defined. The percentage of live and dead spermatozoa was calculated from 200 spermatozoa which were counted in each slide from different microscope fields. The morphologically abnormal spermatozoa were also estimated on the same smears by counting 200 spermatozoa in different microscope fields.

Semen concentration was determined using the improved neubauer hemocytometer and applying the direct cell count method. Counting was carried out at 400x magnification. The spermatozoa's head that falls within the sub-divided smaller squares at the four edges and Centre of the hemocytometer were counted. The concentration was expressed (Peters et al., 2008) as: C = 50,000 xNxD, Where

C=concentration of semen per volume (ml),

N=number of sperm cells counted,

D=dilution rate.

Chick quality

Chick quality was assessed based on chick weight. Weight was taken using an electronic balance to the nearest 0.01g.

RESULTS AND DISCUSSION

The semen analysis for three strains of Noiler cocks are presented in table 1. It shows that, in parameters such as colour, pH, total motility, dead sperm, abnormal sperm cells and sperm concentration ($x10^9$) there were no significant difference ($p<0.05$) between the strains however, volume, mass activity and sperm concentration were significantly different ($P<0.05$). The pH observed in the three strains in this study are similar to those reported by Peters et al. (2008) for Nigeria indigenous cocks. Siudzinska and Lukas Zewicz (2008) indicated that chicken sperm can tolerate a pH range of 6.0 to 8.0. Low pH reduces motility, lactic acid production and oxygen whereas high ph increases metabolic rates in vitro (Donoghue and Wishart, 2000). The sperm concentration observed in this study are similar to those reported by Bah et al. (2001). It is however lower than the reported by peters et al (2008) for Nigerian cocks. The influence of strain on fertility percentage for incubator A and B are presented in table 2. Statistical difference ($P<0.05$) were observed from incubator A, where brown strain showed high fertility, followed by spotted and least in black with

83.7%, 80.8% and 75.3% respectively. From incubator B, it shows significant difference (P<0.05) with black strain showing highest fertility percentage (86.3%) followed by spotted (78.1%) and least were observed in brown with 72.6%. Table 3 shows the influence of strain on chick quality, from both incubators, it shows that chick quality with regards to weight is statistically not different (P<0.05) between strains.

Table 1. Semen characteristics for Three Strains of Noiler Cocks

Parameters	Black	Spotted	Brown	SEM	LS
Volume (ml)	0.61a	0.61a	0.68b	0.005	*
Colour	1.00	1.00	1.00	0.00	NS
PH	7.19	7.30	7.17	0.03	NS
MA	3.72b	3.80a	3.85a	0.01	*
TM (%)	81.37	80.96	81.76	0.29	NS
DS (%)	8.46	8.79	8.95	0.22	NS
AS (%)	2.82	2.74	2.66	0.08	NS
SC (ml)	2.57a	2.42a	2.14b	0.06	*
SC/E (ml)	1.38	1.41	1.45	0.05	NS

Ph = degree of acidity, MA = mass activity, TM = total motility, DS = dead sperm, AS = abnormal sperm, SC = sperm concentration, SCE = sperm concentration/ejaculation, SEM = standard error of mean, LS = level of significance, NS = not significant (p<0.05), * = significant (p<0.05)

Table 2. Fertility Percentage

Strain	Number of Eggs Set	Number of Fertile Eggs	Fertility Percentage
A			
Black	73	55	75.3
Spotted	73	59	80.8
Brown	73	61	83.7
B			
Black	73	63	86.3
Spotted	73	57	78.1
Brown	73	53	72.6

a, b and c = means within the same row bearing different superscript varies significant
A = automatic incubator
B = water bed incubator

Table 3. Chick Quality at Day Old

Strains	Weight	SEM	LS
A			
Black	39.71	0.64	NS
Spotted	39.67	0.57	NS
Brown	39.38	0.61	NS
B			
Black	39.94	0.38	NS
Spotted	39.00	0.43	NS
Brown	38.91	0.35	NS

SEM = standard error of mean, LS = level of significance, NS = not significant
A = automatic incubator
B = water bed incubator

CONCLUSION AND RECOMMENDATION

The data obtained from this study indicate that there were variations among the stains in parameters such as semen volume, mass activity and semen concentration. However these variations did not influence the quality of day old chicks as no statistical difference was observed. This study there for recommends that any of the three strains of Noiler cocks can be used for breeding purposes.

REFERENCES

Bah, G. S., Chaughari, S. U. R. and Al-Amin, J. D. (2001). Semen characteristics of local breeder cocks in the Sahel region of Nigeria. *Revue d'elevage et medecine veterinaire des pays tropicaux*, 54: 153-158.

Donoghue, A. M. and Wishart, G. J. (2000). Storage of poultry semen. *Animal Reproduction Science*, 62: 213 - 232.

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Peters S.O., O.D. Shoyebo, B.M. Ilori, M.O. Ozoje, C.O.N. Ikeobi and O.A. Adebambo, 2008. Semen Quality traits of seven strains of chicken Raised in the Humid Tropics. Int. J. Poul. Sci., 7(10): 949-953.

Siudzinska, A. and Lukas zewicz, E. (2008). Effect of semen extenders and storage time on sperm morphology of four chicken breeds. *Applied Poultry Research*, 17: 101 - 108.

Surai, P. and Fisinin, V. 1. (2012). Feeding breeders to avoid oxidative stress in embryos. In: Proceedings of the XXIV World's Poultry Congress, Salvador, Bahia, Brazil.

EFFECTS OF STRAIN ON GROSS TESTES MORPHOLOGY OF THREE STRAINS OF NOILER COCKS

***S Amur., D.J.U Kalla & Y.P Mancha**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: amursamaila@gmail.com mobile No: 07063937365*

ABSTRACT

A study was conducted to determine the effects of strain on gross testes morphology of three strains of noiler cocks (brown, black and spotted). The study was conducted at the poultry unit of the Bauchi State Agricultural Development Project (BSADP). The study lasted a period of eight months. A total of 45 normal feathered Noiler cocks were used for this experiment which were procured at nine weeks of age from the BSADP farm and fed commercial diet throughout the duration of the experiment. They comprised of three strains (15 brown, 15 black and 15 spotted). Testes were collected from all cocks. Testes were trimmed of all adhering fat and tissue, and weighed to the nearest 0.01mm using an electronic scale. Testis length and width were measured using a Vanier calliper to the nearest 0.01mm. Using a measuring cylinder containing known quantity of water, the testis was dropped in the cylinder and the volume of water displaced was recorded as value. The result showed that live weight, paired testes weight, paired testes volume, left testes volume and right testes volume were statistically different ($P<0.05$) among the strains. There were no significant differences observed from the other parameters across the strains which comprises of the right and left testes weight, length, width. The results showed that brown strain was superior to black and spotted. Testis weight of all the three strains fell within the range of 9-30g. From the finding of this study it is concluded that strain had significant effect on the gross testes morphology of Noiler Cocks.

Keywords: Strain, Testes, Noiler, Cocks, Morphology

INTRODUCTION

The most commonly reared poultry in Nigeria are chickens, turkeys, ducks, guinea fowls, pigeons and more recently ostriches. Those that are of commercial importance are chickens, guinea fowl's quails and turkeys. Local chickens are reared through extensive or semi-intensive system, thus reducing cost of production. They are more tolerant to endemic diseases and environmental conditions, as compared to the exotic breeds (Okpe etal, 2010). The recent ban on the importation of poultry and their products has constituted a major challenge to the indigenous poultry industry to meet up the immediate and future protein needs of the country. This challenge calls for improvement and/or change in the traditional production system and optimization of poultry reproductive traits such as fertility, hatchability and chick quality. Despite the advantages of the local chickens, most poultry improvement programmes in Nigeria have been directed towards introduction of specialized or exotic breeds, (Ikanni and Annatte, 2000). Efforts have been geared towards the development of indigenous chicken breed with improved meat and egg production and these efforts has led to the development of the Noiler breed by Amo farm sieberer hatchery limited. Therefore this research was designed to investigate the gross testes morphology of three strains of Noiler cocks.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the Bauchi State Agricultural Development Project (BSADP) Bauchi State, Nigeria. It lies between latitude 9.30° and 12.3° north of the equator, and Latitude 8.48° and 11° East of the Greenwich meridian. The study lasted a period of eight months. A total of 45 normal feathered Noiler cocks were used for this experiment, they were procured at nine weeks of age from the Bauchi state Agricultural Development Program (BSADP) farm and fed commercial diet throughout the duration of the experiment, they comprised of three strains (15 brown, 15 black and 15 spotted).

Gross Morphology of Testes

Testes were collected from all cocks. Testes were trimmed of all adhering fat and tissue, and weighed to the nearest 0.01mm using an electronic scale (SF – 400). Testis length and width were measured using a Vanier calliper to the nearest 0.01mm (Bath and chaudhari, 2002). Volume was obtained using Archimedes principle. Using a measuring cylinder containing known quantity of water, the testis was dropped in the cylinder and the volume of water displaced was recorded as the volume.

Statistical Analysis

The data collected was subjected to analysis of variance procedure as contained in statistical package for social sciences (SPSS) 2011 version. Significant means were separated using Duncan Multiple Range Test (DMRT) procedure.

RESULTS AND DISCUSSION

Table 1 Gross Testes Morphology of Three Strains of Noiler Cocks.

Parameter	BLACK	SPOTTED	BROWN	SEM	LS
Live weight (kg)	3.53b	3.43b	3.83a	0.942	*
Paired Testes weight (g)	33.00b	32.66b	37.00a	0.846	*
Left Testis weight(g)	15.00	15.66	18.00	0.503	NS
Right Testis weigh (g)	17.00	17.00	18.33	0.412	NS
Left Testis length (mm)	39.84	40.07	44.46	1.049	NS
Right Testis length(mm)	40.50	39.81	42.70	0.866	NS
Left Testis width(mm)	20.56	21.39	22.94	0.554	NS
Right Testis width(mm)	21.47	31.53	21.63	0.497	NS
Paired Testis volume(ml)	34.02b	29.95b	41.07a	1.88	*
Left Testis volume(ml)	16.85b	15.17b	19.97a	0.715	*
Right Testis volume(ml)	17.17b	15.14b	21.10a	1.02	*

NS = Not Significant ($p>0.05$), LS = level of significant, * = significant ($p<0.05$), a b = means within the same row bearing different superscript varies significant.

Table 1 shows the influence of strain on gross testes morphology. Live weight, paired testes weight, paired testes volume, left testes volume and right testes volume were statistically different ($P<0.05$) between the strains. There were no significant difference ($P<0.05$) observed from the other parameters across the strains which comprises of the right and left testes weight, length, width. The results showed that the brown strain was superior to black and spotted. Testis weight of all the three strains fell within the range of 9-30g which has been widely reported for chickens at sexual maturity. Testicular length and width were slightly lower than values reported by Chidozie et al. (2010). The width diameter for the different strains recorded in this study are lower than the average reported by Chidozie et al. (2010) for the Nigerian local chicken.

CONCLUSION

From the finding of this study it is concluded that strain had significant effect on the gross testes morphology of Noiler Cocks.

REFERENCES

Bath, GS and Chaurdhari, SUR (2002).Sperm Reserve and its Relationship to Parameters of the Testis, Epididymis and Vas Deferns of Local Cocks in the Sahel Region of Nigeria. International Journal of Agricultural and Biology.1560-8530/2002/04-4-562-564.

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics 11:1-42.

Ikani, E. I. and Annatte, A. I. (2000). Improving the performance of local chickens. Extension Bulletin No. 92, Poultry series No.6, National Agriculture Extension and Research Liaison Services, Ahmadu Bello University Zaria, Zaria, Nigeria.

O.G Chidozie, N Ugochukwu and A Kenneth (2010). Morphometric study of the testes of the Nigerian localbreed of chicken. *Animal Research International* 7(2): 1163 – 1168.

Okpe, G. C., Nwatu, U. and Anya, K. (2010). Morphometric study of the testes of the Nigerian local breed of chicken. *Animal Research International,* 7(2): 1163 - 1168.

SPSS (2011) SPPSS Statistics for windows, version 20.0 Armonk, NY.IBM Corp.

EFFECT OF SEASON ON REPRODUCTIVE AND GROWTH PERFORMANCE OF WEANING NON DISCRIPT RABBIT

Sabuwa, M. A., Gambo, D., Baba, M. K., +Mundi, I. & Shuaibu, S.
Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Nigeria
+Department of Animal Breeding and Physiology, College of Animal Science, University of Agriculture Makurdi, Benue State.
Author for correspondence: Email: gambodauda21@gmail.com

ABSTRACT
The study was conducted to determine the effects of season on reproductive and growth performance of non-descript rabbits. A total of 24 non descript late grower rabbit comprising a males and 20 females were purchased from Dagwom farm of the National Veterinary Research Institute (NVRI) Jos and used as parent stock. 59 kits (34 in dry season and 25 in raining season) were used for the experiment. The kits were housed according to season. Data on litter size, birth weight, weekly body weight, weekly body weight gain and growth rate were obtained and subjected to one way analysis of variance. The results obtained from this study indicated that season had significant ($P \leq 0.05$) effect on birth weight, weekly body weight, weekly body weight gain and growth rate. Rabbits raised in raining season had significantly ($P<0.05$) higher body weight except at week 7 and 8 which were not significant. Also, season had significant ($P<0.05$) effects on body linear measurements. Rabbits raised in raining season had significantly ($P<0.05$) better body length and hind leg length while rabbits raised in dry season had significantly ($P<0.05$) longer tail length and ear length than those of raining season. From the findings of this research, it was recommended that rabbits should be bred and raised in the raining season than the dry season to maximise better growth performance.
Key word: body linear measurements, body weight, Growth rate, litter size.

INTRODUCTION
In tropical countries, the high temperature or heat stress affects the success of rabbit farming (Carneiro*et al.,* 2009), as it leads to a significant reduction in the daily weight gain, daily feed intake and feed efficiency. Above 25-28°C of ambient temperature, rabbits decreased their feed consumption and required more digestible energy (Lebas *et al.*, 1983). At 30°C, the average feed consumption was reported to be decreased by 30% and affected growth as well (Carneiro *et al.*, 2009). The effect of experimental hot environment conditions in rabbits have been extensively discussed in the last two decades mainly on growth performances and feed intake (Lebas *et al.*, 1983). But, the information based on experimental conditions, which are often quite different from each other, provide incomplete picture (Carneiro *et al.*, 2009) and cannot be implemented universally at least under farmer's conditions in developing countries. The objective of this study was therefore to determine the effect of season on reproductive performance of non descript weaner rabbit.

MATERIALS AND METHODS
The experiment was carried out at the Livestock Teaching and Research Farm of the Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University, Nasarawa State. The total of twenty four non-descript late growers rabbit were purchased from Dagwom farm of the National Veterinary Research Institute (NVRI) Jos and used as parent stock for generating offspring to be used as the foundation stock.

This was comprised of 4 males and 20 females. They were bred at ratio of 1 male to five females. Extra 2 males were bought and kept as reserve in case of mortality. 59 kits (34 in dry season and 25 in raining season) were used for the experiment. The kits were housed according to season. Hutches were cleaned, scrubbed and disinfected using vinkokil disinfectant and allowed to fallow for two weeks before arrival of the rabbits. The males were kept separately from the females for a period of four weeks for quarantining and determination of pregnant rabbit doe. During quarantining, the rabbits were given anti stress, antibiotics and all other necessary medications as appropriate. After quarantining, female rabbit on heat was taken to the male rabbit hutch for mating. This was to ensure successful mating. Each rabbit doe were mated twice to ensure conception. However, palpation was carried out ten days after successful mating to determine pregnancy. Any rabbit doe detected not to be pregnant after palpation was re-mated. The rabbit were fed formulated diet at the rate of 3kg of their body weight and forages *adlibitum*. The offspring were housed according to the season in which they

were kindled. Two major seasons such as dry (October to April) and rainy (May to September) season were considered. The rabbits were assessed to determine the effect of seasons on their reproductive and growth performance up till weaning. During this period, the rabbits were fed both concentrate and forages.

Parameters that were measured: Data collected include litter size, birth weight, weekly body weight, weekly body weight gain, growth rate and body linear measurements at weaning

Experimental Design and Analytical Procedure

The design of the experiment was Completely Randomized Design (CRD). Data collected on phenotypic traits of body weight and body linear measurements were analyzed using Analysis of Variance (ANOVA) of the Statistical Package for Social Science (SPSS) 2011 version. Duncan Multiple Range Test were used to separate the means were significant difference was observed.

RESULT

The effect of season on litter size, birth weight and weekly body weight of non discript rabbits is presented in table 1. Season had significant (P<0.05) effect on birth weight, body weight at weeks 1, 2, 3, 4, 5 and 6. Rabbits raised during raining season had significantly (P<0.05) higher birth weight and weekly body weight. However, no significant influence of season on litter size and body weight at weeks 7 and 8 was detected.

Table 1: Effect of season on litter size, birth weight and weekly body weight of non-discript rabbits

Body weight	Dry season	Raining season	LOS
Litter size	4.00±0.58	4.75±0.69	NS
Birth	35.74±0.95^{b}	39.16±1.18^{a}	*
Week 1	69.08±2.17^{b}	94.53±4.99^{a}	*
Week 2	100.65±3.82^{b}	150.58±9.50^{a}	*
Week 3	130.57±5.24^{b}	191.81±13.00^{a}	*
Week 4	188.62±7.66^{b}	251.90±15.24^{a}	*
Week 5	243.53±10.33^{b}	317.55±18.10^{a}	*
Week 6	318.97±11.99^{b}	387.74±23.97^{a}	*
Week 7	406.08±13.90	456.23±29.45	NS
Week 8	508.74±16.23	540.57±34.44	NS

NS = not significant, * = significant at 5 percent probability, ^{ab} = values with different superscript in the same row are significant (P<0.05)

Table 2 present the effect of season on weekly body weight gain of non discript rabbits. Season had significant (P<0.05) effect on weekly body weight gain at weeks 0-1, 1-2, 5-6 and 7-8. Rabbits raised during raining season had significantly (P<0.05) higher body weight gain at weeks 0-1 and 1-2 while rabbits raised during dry season had significantly (P<0.05) higher body weight gain at weeks 5-6 and 6-7. Season effect was not significant on body weight gain at weeks 2-3, 3-4, 4-5 and 7-8.

Table 2: Effect of season on weekly body weight gain of non discript rabbits

Body weight	Dry season	Raining season	LOS
Week 0-1	33.34±1.79[b]	54.39±3.97[a]	*
Week 1-2	33.03±3.01[b]	57.00±5.25[a]	*
Week 2-3	29.92±2.65	41.23±4.82	NS
Week 3-4	58.05±3.20	60.10±5.57	NS
Week 4-5	61.57±6.72	65.65±4.14	NS
Week 5-6	98.19±9.54[a]	70.19±7.14[b]	*
Week 6-7	100.63±11.90[a]	71.97±6.60[b]	*
Week 7-8	102.65±4.36	87.71±8.31	NS

NS = not significant, * = significant at 5 percent probability, [ab] = values with different superscript in the same row are significant (P<0.05)

Season effect on weekly growth rate (Table 3) was significant (P<0.05) at weeks 0-1, 3-4, 5-6, 6-7 and 7-8. Rabbits raised in raining season had significantly (P<0.05) higher growth rate at week 0-1. However, at weeks 3-4, 5-6, 6-7 and 7-8, rabbits raised in the dry season had significantly (P<0.05) higher growth rate compared to those of raining season.

Table 3: Effect of season on weekly growth rate of non-discript rabbits

Body weight	Dry season (1)	Raining season (2)	LOS
Week 0-1	47.37±1.32[b]	56.79±1.33[a]	*
Week 1-2	31.68±1.57	36.43±1.69	NS
Week 2-3	22.25±1.48	20.56±1.40	NS
Week 3-4	30.43±0.97[a]	24.36±1.86[b]	*
Week 4-5	23.74±1.65	20.93±0.87	NS
Week 5-6	28.94±2.30[a]	17.43±1.07[b]	*
Week 6-7	23.48±2.35[a]	15.29±0.81[b]	*
Week 7-8	20.23±0.69[a]	16.15±1.30[b]	*

NS = not significant, * = significant at 5 percent probability, [ab] = values with different superscript in the same row are significant (P<0.05)

Body linear measurements (Table 4) were significantly (P<0.05) affected by season except fore-leg length, and chest circumference which were not significant. Rabbits raised in raining season had significantly (P<0.05) better body length and hind leg length while rabbits raised in dry season had significantly (P<0.05) longer tail length and ear length.

Table 4: effect of season on weaning weight and body linear measurements at weaning of non-discript rabbits

Parameters	Dry season (1)	Raining season (2)	LOS
Number of observation	34	25	
Body length	28.91±0.27[b]	31.40±0.39[a]	*
Tail length	7.13±0.11[a]	6.39±0.25[b]	*
Hind leg length	14.06±0.12[b]	14.94±0.19[a]	*
Fore leg length	7.91±0.11	7.59±0.26	NS
Ear length	8.45±0.16[a]	7.32±0.32[b]	*
Chest circumference	5.93±0.09	6.23±0.18	NS

NS = not significant, * = significant at 5 percent probability, [ab] = values with different superscript in the same row are significant (P<0.05)

DISCUSSION

The significant effect of season on birth weight and weekly body weights of non discript rabbits with respect to mean birth weight of 35.74±0.93 and 39.16±1.18 g for dry and raining season observed in this study is lower than 51.0 g reported by Zerrouki (2004). Differences in litter size at birth may be due to differences in ovulation rate, pre-implantation viability, high uterine capacity, maternal effects, body size and age of the rabbit doe (Rashwan *et al.*, 1995; Argente *et al.*, 2003). The body weight increased progressively till week 8 as similarly reported by Zerrouki (2004). The results of weekly body weights at birth and from week 1 to 8 obtained in this study were similar to those of Khader *et al.* (2001) at birth and by De Paula *et al.* (1996) and El-Maghawry *et al.* (1999) at weaning and those of Darwish *et al*. (1995) and Saleh *et al.* (2005). The mean body weight obtained in this study across season at week 3 (130.75±5.24 and 191.81±13.00 g, respectively for dry and raining season) were lesser than the value of 205g and 222g for Egyptian and Bouscat rabbits reported by Brun and Ouhayoun (1989).

The effects of season on the body weight gain and growth rate of non discript rabbits indicates that season had significant effects on body weight gain and growth rate. With advancing age, body weight gain increased while growth rate decreases. The present result agrees with the report of El-Bayomi *et al.* (2012) who observed a decline in growth rate with advancing age in their work on the New Zealand White, Californian and Gray Giant Flander breeds. The significant better birth weight and weekly body weight for rabbits raised in raining season in current study is in agreement with those obtained by Seleem (2005) who reported that superiority of litters weight may be due to hybrid vigour which appeared in different ages of kits up till weaning.

CONCLUSION AND RECOMMENDATION

The result of this study indicates season had significant effects on birth weight, weekly body weight and body linear measurements. Rabbits raised in raining season had better birth weight and weekly body weight. Body weight and body weight gain increases progressively with age until 8 weaning. However, growth rate decreases with advancing age. Generally, rabbits raised in raining season performed better than their counterpart raised in the raining season. From the findings of this research work it was recommended that: Rabbits should be bred in the raining season than the dry season to maximized better litter size and higher birth weight which will translate to higher body weight at various ages.

REFERENCES

Argente, M. J., Santacreu, M. A., Climent, A. and Blasco, A. (2003). Relationships between uterine and fetal traits in rabbits selected on uterine capacity. *Journal Animal Science.* **81**:1265 – 1273.

Brun J.M., and Ouhayoun, J. (1989), "Qualités bouchères de lapereaux issus d'un croisement diallèle de 3 souches: interaction du type génétique et de la taille de portée d'origine", *Ann. Zootec*. **43:**173-183

Carneiro, M., Ferrand, N. and Nachman, M. W. (2009). Recombination and speciation: loci near centromeres are more differentiated than loci near telomeres between subspecies of the European rabbit (Oryctolagus cuniculus). *Genetics*; **181:**593-606.

Darwish, A. A.; Khalifa, M. A., Abd El-Azim, A. M. and El-Kamash, E. M. A. (1995). Some physiological reactions of New Zealand White under subtropical conditions. In: Proceeding 7th Annual Congress (Under Patronage of the Egyptian Society Animal Reproduction Fertility), 21-23 Jan., 1995, Cairo, Egypt. 123 – 141.

De Paula, M. G., Pontes, J. R., Ferraz, J. B. S. and Eler, J. P. (1996). Breed and some non genetic effects on growth of Californian and New Zealand White rabbits raised in south-eastern Brazil. In: Proceeding 6th World Rabbit Congress, 9 - 12 July, Toulouse, France, **2:** 269 - 272.

El-Bayomi, Kh. M., El-Tarabany, M. S. and Abdel-Hamid, T. M. (2012), "Estimation of Heterosis and Combining Ability for Some Weaning and Post-Weaning Traits in three different breeds of rabbits" *Journal of American Science*,**8(9):** pp. 282-288.

El-Maghawry, A. M., Ahmed, S. S., Yamani, K. A. and Radwan, H. (1999). Some reproductive and productive traits of New Zealand White, Rex Rabbits and their crosses. *Egyptian Journal Rabbit Science*, **9:** 159 - 177.

Khader, A. F., Abou-Steit, T. and Tharwat, E. E. (2001). Characterization Sinai Gabali rabbit does using New Zealand White rabbit as a reference breed. *Minufiya Journal Agriculture Research*. **26:** 1211 - 1219.

Lebas, F., Coudert, P., Rouvier, R. and Rochambeau, H. (1983). The Rabbit Husbandry, Health and Production. FAO, United Nations Publications divisions, Termedi, Caracilla, 00100, Rome, Italy.

*Rashwan, A. A., Ahmed, S. S. and Tawfeek, M. I. (1995). Doe reproduction and preweaning and postweaning litter performance of straightbred and crossbred rabbits. Journal Agriculture Science. **20:** 2839 - 2851.*

Saleh, K., Nofal, R., Younis, H. and Abou Khadiga, G. (2005). Evaluation of line V, Baladi Black rabbits and their crosses under Egyptian conditions. 2. Litter weight and mean kit weight. In: Proceeding 4th International Conference Rabbit Production Hot Climates, 24-27 Feb., Sharm El-Sheikh, Egypt. 31 - 37.

Seleem, T. S. T. (2005). Some reproductive; productive and physiological aspects of purebred and crossbred Flander and New Zealand White rabbits under Egyptian environmental conditions. In: Proceeding 4th International Conference Rabbit Production Hot Climates, 24 - 27 Febr., Sharm El-Sheikh, Egypt. 161 - 168.

Zerrouki, N.; Bolet, G.; Berchiche, M. and Lebas, F. (2005). Evaluation of breeding performance of a local Algeria rabbit population raised in the TiziOuzou area (Kabylia). *World Rabbit Science*.**13:** 29 – 37.

LIVE WEIGHT, SERUM BIOCHEMICAL INDICES AND HORMONAL PROFILES OF YEARLING MUSCOVY DRAKES (*CAIRINA MOSCHATA*) IN MAIDUGURI, BORNO STATE, NIGERIA

***Saleh, B., Iliyasu, S.H. & Zoaka, E. M.**

Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Maiduguri, Borno State

**Corresponding Author: Saleh, B. Mobile – 08185927245, email - bbsaleh@unimaid.edu.ng*

ABSTRACT

A study was carried out to determine live weight, serum biochemical indices and hormonal profiles of Muscovy drakes in Maiduguri, Borno state. Fifteen (15) one year old drakes were dewormed and quarantined for a period of two weeks during which they were fed a commercial layer diet (16%CP) and water *ad libitum*. The live weight of each drake was taken before blood collection. Blood samples for serum biochemical analysis and hormonal assay was collected from the wing-vein by means of a sterile disposable (21-guage) syringe and needle and placed in anticoagulant free samples bottles to obtain serum. Total protein, albumin, globulin, sodium, potassium, chlorine, testosterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH) levels were recorded. Live weight of the drakes ranged from 1800-3900g with an average of 2766.67±139.71g. The mean levels of total protein, albumin and globulin were 48.67g/l, 17.00g/l and 31.53g/l respectively. Testosterone level of 3.79±0.45ng/mol, Follicle stimulating hormone (FSH) range of 0.10-1.40mmol/ml with a mean of 0.51mmol/l and mean Luteinizing hormone (LH) of 2.93±0.44 mmol/ml were recorded. A positive relationship was noted between body weight and luteinizing hormone levels while serum protein was negatively related to body weight. It was concluded that the sex hormones levels (testosterone, FSH and LH), testicular morphology and serum biochemical profiles of Muscovy ducks in the semi-arid zones of Nigeria are similar to those reported in literature.

Key Words: Ducks, Serum biochemistry, Testosterone, Follicle stimulating hormone

INTRODUCTION

Ducks have the potential to play an important role with respect to food production and security in Nigeria. With an estimated population of about 9,553,911, ducks are the third most populous poultry in Nigeria (National Bureau of Statistics, 2012). Ducks lay many and large eggs and have rapid growth rate and high dressed weight (Duru *et al.*, 2006). Yakubu (2013) opined that increased duck rearing would be a great addition to total poultry output since they do not interfere with chicken production due to different rearing and scavenging venues. Yakubu (2013) further noted that the morphological, meat and egg attributes of the Muscovy duck readily make it the waterfowl of choice for Nigerian poultry farmers. He concluded that Nigeria needs to take advantage of the economic and nutritional benefits from duck rearing to improve the shortage in the animal protein supply in the family diet. Pym *et al.* (2002) also noted that keeping ducks is one of the possible means of breaking out of the poverty trap for resource poor small holder families in low income countries. Small scale duck farming has not only been proved to be beneficial occupation for small, marginal and landless farmers, but also a potential source of self-employment (Jabber, 2004).

The domestic duck in Borno and elsewhere in Nigeria is the Muscovy duck, of South American origin. It was probably introduced on the sea-coast by the Portuguese and spread inland. Ducks are kept sporadically throughout northeast Nigeria, especially in riverine areas (Blench, 1995). Duck farming is still carried out under extensive management in the form of small family flocks. Low fertility is a major problem in such flocks and the role of drakes in this problem has not been sufficiently studied. Information on blood parameters and reproductive hormone levels of the Muscovy drakes can be used to serve as baseline data to be used in clinical evaluation and improvement in fertility of local stock. This study was therefore designed to determine the relationship among reproductive hormonal profile and serum biochemical parameters of Muscovy drakes in Maiduguri, Borno state.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno state – Nigeria. Maiduguri is located between latitude 11º 15 and 12 º north, longitude 30º 05 and 14º east and at an altitude of 345m above sea level (Raji *et al.,* 2014).

A total of fifteen (15) one year old drakes were purchased from households in Maiduguri and used for the experiment. The drakes were dewormed and quarantined for a period of two weeks during which they were fed a commercial diet (16%CP) and water *ad libitum.*

The live weight of each drake was taken before blood collection using a manual weighing balance to the nearest 50g. To obtain blood samples for sera analyses, the drakes were fasted overnight and 5ml of blood was collected from the wing-vein by means of a sterile disposable (21-guage) syringe and needle and placed in anticoagulant free samples bottles to obtain serum for serum biochemical analysis and hormonal assay measurements. Total protein, albumin, globulin, sodium, potassium and chlorine levels were estimated through calorimetric method using Digital Vas Ultraviolet Spectrophotometer while testosterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH) were estimated using ELISA kits by a solid phase enzyme immuno-assay. The blood biochemical analysis and hormonal assay were done at the haematology laboratory of the University of Maiduguri Teaching Hospital.

RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics for live weight, serum biochemical indices and hormonal profiles of Muscovy drakes in Maiduguri, a semi-arid environment. The live weight of the drakes ranged from 1800-3900g with an average of 2766.67±139.71g which is similar to the 2.73 kg and 2.2 kg reported for Muscovy drakes in Nigeria by Yakubu (2013) and Ikani (2003) respectively.

The mean levels of total protein, albumin and globulin were 48.67g/l, 17.00g/l and 31.53g/l respectively which were similar to those reported by Olayemi *et al*. (2006) in adult Nigerian ducks. The means for serum sodium and potassium observed in this study was similar to the means (140.00±1.00 mmol/l and 3.77±0.15) observed by Okeudo *et al.* (2008) for Muscovy drakes in southeastern Nigeria.

The testosterone level of 3.79±0.45ng/mol was similar to values reported by Snapir *et al.* (1998) for healthy Muscovy drakes. FSH range of 0.10-1.40mmol/ml with a mean of 0.51mmol/l and LH level of 2.93±0.44 mmol/ml were obtained in this study.

Table 2 shows the correlation between live weight, reproductive hormone levels and serum biochemical profiles of Muscovy drakes. Live weight of the drakes was highly correlated (r = 0.59) with LH levels but negatively correlated with total protein (r = -0.56) and globulin (r = -0.57). A moderate but negative relationship existed between albumin and the total protein. There was a high and positive relationship between globulin and total protein, whereas it was strong but negative between globulin and albumin. This is an expected trend since albumin and globulin are components of total protein. A moderate but negative correlation between sodium and total protein, sodium and albumin were observed. There was a low but positive relationship between potassium and sodium and a moderate but negative relationship between potassium and chlorine.

Table 1: Live weight, Serum Biochemical Indices and Hormonal Profiles of Yearling Muscovy Drakes in Maiduguri

Parameter	Minimum	Maximum	Mean	±SEM
Live weight (g)	1800.00	3900.00	2766.67	139.61
Total protein (g/l**)**	39.00	69.00	48.67	1.98
Albumin (g/l)	10.00	22.00	17.00	0.84
Globulin (g/l)	17.00	56.00	31.53	2.54
Sodium (mmol/l)	129.00	152.00	141.47	1.88
Chlorine (mmol/l)	89.00	106.00	97.33	1.58
Potassium (mmol/l)	3.20	6.20	4.42	0.25
Testosterone (ng/mol)	1.00	6.60	3.79	0.45
FSH (mmol/ml)	0.10	1.40	0.51	0.09
LH (mmol/ml)	0.10	6.90	2.93	0.44

FSH – Follicle stimulating hormone; LH – Luteinizing hormone

Table 2: Correlation of Some Serum Biochemical Indices and Hormonal Profile of yearling Muscovy Drakes in Maiduguri

Parameter	1	2	3	4	5	6	7	8	9	10
1. **Total protein**	1									
2. A**lbumin**	-0.49	1								
3. G**lobulin**	0.95**	-0.73*	1							
4. S**odium**	-0.35	0.62*	-0.49	1						
5. C**hlorine**	0.42	0.00	0.31	-0.08	1					
6. P**otassium**	-0.18	-0.03	-0.12	0.22	-0.30	1				
7. T**estosterone**	0.13	-0.43	0.26	0.03	-0.37	0.45	1			
8. **FSH**	0.47	-0.07	0.41	-0.13	0.51	-0.23	0.04	1		
9. **LH**	-0.41	0.28	-0.45	0.31	-0.17	0.07	0.03	-0.34	1	
10. **Live weight (g)**	-0.56*	0.31	-0.57*	0.27	-0.02	0.04	0.23	0.04	0.59*	1

*- Correlation is significant at 0.05 level (2 tailed); **- Correlation is significant at 0.01 level (2 tailed)

CONCLUSION AND RECOMMENDATION

It was concluded that the sex hormones levels (testosterone, FSH and LH), testicular morphology and serum biochemical profiles of Muscovy ducks in the semi-arid zones of Nigeria are similar to those reported in literature. A positive relationship was noted between body weight and luteinizing hormone levels while serum protein was negatively related to body weight.

REFERENCES

Blench, R. M. (1995). A history of domestic animals in North eastern Nigeria. *Cah. Sci. Hum. 37 (1): 787-237.*

Duru, S., Akpa, G. N., Sai'du, L., Olugbemi, T. S. and Jokthan, G. E. (2006). A preliminary study on duck management under peri-urban system. *Livestock Research for Rural Development 18:* http://www.lrrd.org/lrrd18/3/duru18036.htm. Accessed 14th September, 2019.

Ikani, E. I. (2003). Duck production in Nigeria. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria Nigeria. Extension Bulletin No. 133, Poultry Series 7. Pp: 31.

Jabber, M. A. (2004). Smallholder livestock for poverty alleviation: issues and prospects. Keynote paper presented at BARC, Dhaka.

National Bureau of Statistics [NBS] (2012). National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development Collaborative Survey on National Agriculture Sample Survey (NASS), 2010/2011-Draft Report. May, 2012.

Ogah, D. M. and Musa, I. S. (2011). Evaluation of growth and egg production traits between first and second laying cycle in two ecotypes of Muscovy duck. Proceedings of the 18th International Conference, KRMIVA, June 8-10 2011, Croatia.

Olayemi, F. O., Ojo, E. O. and Fagbohun, O. A. (2006). Comparative study of the hematological and plasma biochemical parameters in the Nigerian duck (*Anas platyrhynchos*) and the Nigerian laughing dove (*Streptopelia senegalensis*). *Veterinary Archives,* 76:145-151.

Pym, R. A. E., Lanada, E. B. and Morbos, E. Y. (2002). Case studies of family poultry development. 2nd INFPD-FAO, Electronic conference. May 13-July 5, 2002.

Raji, A.O., Adamu, S.B. and Babangida, S. (2014). Growth performance of the Japanese quail in a semi-arid area of Nigeria. *Africa Journal of Animal and Biomedical Sciences,* 8(1): 1 – 10.

Snapir, N., Rulf, J., Meltzer, A., Gvaryahu, G., Rozenboim, I. and Robinzon, B. (1998) Testosterone concentrations, testes weight and morphology of mule drakes (Muscovy drake X Khaki Campbell), *British Poultry Science*, 39:4, 572-574, DOI: 10.1080/00071669888791

Yakubu, A. (2013). Characterisation of the local Muscovy duck in Nigeria and its potential for egg and meat production. *World's Poultry Science Journal*, 69: 931 – 938.

EFFECT OF CRYSTALLINE PROGESTERONE LEVELS ON OVARIAN CHANGES OF LOHMANN BROWN HENS

Salisu N[1], Nasir M[2], Hassan A.M[2], Khaleel A.G[2], Ashiru. RM[2], Zango M.H[1], Sabo A.A[3], Haladu S[4], MadakiS[2], Abdullahi A.Y[2], Mu'az J[5], Aliyu A.M[6]

[1]Department of Animal Production, Binyanu Usman Polytechnic Hadeja, [2]Department of Animal Science, Kano University of Science and Technology, P.M.B 3045, Wudil, [3]Department of Biology, SRCOE, Kumbotso, Kano. [4] Federal polytechnic Ede, Osun State. [5]Department of Geography CAS, Kano. [6]Department of Animal Science, Federal University, Dutsin-ma

ABSRACT

The experiment was conducted at the Teaching and Research Farm of the Department of Animal Science, Bayero University, Kano to determine the effect of crystalline progesterone on ovarian changes of eighteen Lohmann Brown hens between March to July, 2017. A single factor completely randomized design was used with each treatment replicated three times. Six different doses (0, 5, 10, 15, 20 and 25 mg/bird) of crystalline progesterone were administered intramuscularly via the keel muscle twice a week for a total period of six weeks. Data obtained were analyzed using GraphPad InStat® statistical package. Results revealed that median ovulation rate (33.3%) in the 5 mg crystalline progesterone group decreased significantly by a magnitude of 66.7% when compared to its corresponding value (100%) in control birds.No significant changes were observed in median weights of ovarian stroma and oviduct across crystalline progesterone treatment groups.Significant decrease was recorded in median count of large yellow follicles across crystalline progesterone treatment groups.There were no significant differences in median counts of small yellow, large white and medium white follicles. In conclusion, crystalline progesterone has effect on the birds ovulation rate, large yellow follicle count, laying pause days, egg sequence length, egg shell weight and egg yolk and albumen volumes in Lohmann Brown hens. It is therefore commended that crysteline progesterone could administerd on laying birds up to 20 mg.

Key word: Crystalline Progesterone, Ovarian, Lohmann Brown Hens

INTRODUCTION

The term poultry is used on birds domestically raised primarily for the economic purpose of producing eggs and meat. Poultry production involves egg and meat production from egg type and broiler chickens (Kumaravel, Hema & Kamaleshwari, 2012). Poultry meat and eggs offer considerable potential for meeting human needs for dietary supply of animal protein (Folorunsho & Onibi, 2005). Egg production in laying hens is a process that takes around 24 to 27 hours (Akbas, Unver, Oguza & Altan, 2002). The Lohmann Brown strain of chicken is an early maturing hybrid bird which is among the best egg producers with good quality eggs and excellent feed conversion rate (Lohmann Tierzucht, 2015). The Lohmann Brown strains are easy to manage and are adaptable to all types of production systems with laying commencing at about 18 weeks of age, producing about 300 to 320 eggs in a year (Lohmann Tierzucht, 2015). Eggs are the major business output in commercial egg production and the higher the egg production the better will be the profit (Farooq, Mian, Ali, Durrani Asghar, & Mugarrab, 2001). Hormones are very essential for poultry reproductive functioning (Johnson & Tilly, 1990). Progesterone is a hormone secreted by granulosa cells of large mature hierarchical follicles (F1) in birds (Bahr, Wang, Huang & Calvo, 1983). It acts at the level of the ovary to stimulate the luteinizing hormone surge for ovulation. Its production by F1 follicle peaks 6 to 8 hours prior to ovulation (Johnson & van Tienhoven, 1984). Progesterone triggers release of gonadotropin-releasing hormone (GnRH) by the hypothalamus. This in turn is followed by an increase in luteinizing hormone and follicle stimulating hormone release from the anterior pituitary (Bahr *et al*., 1983). The luteinizing hormone stimulates an even greater output of progesterone by the granulosa cells of the F1 follicle, completing the positive feedback loop and producing the LH peak 4 to 6 hours prior to ovulation (Tanabe, Nakamura, Tanase & Dior, 1981). The present study aimed at determining the effect administration of exogenous progesterone on ovarian changes of loman Brown hen.

Experimental Location and Duration of Study

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Faculty of Agriculture, Bayero University Kano (GPS coordinates: N11.97643°, E008.42995°) for a duration of six weeks.

Experimental Design and Treatment

The experiment was laid in a Single Factor Completely Randomized Design, comprising six treatments replicated three times. The six treatments were 0, 5, 10, 15, 20 and 25 mg crystalline progesterone/bird. These doses were administered via the breast muscle between 10 and 11 am on Mondays and Thursdays throughout the experimental period.

Oviposition Pattern

Oviposition pattern comprising number of egg sequences, egg sequence length, pause days and intersequence pause length were determined according to the procedure described by Blake, Balander, Flegal and Ringer (1987).

Statistical Analysis

To determine the effect of crystalline progesterone on ovarian changes, oviposition pattern, laying performance and egg quality parameters, Kruskal-Wallis Test was used. Where significant effects exist, mean rank differences were compared using Dunn's Multiple Comparisons Test. Graphpad Instat package (Graphpad InStat®, version 3.05, 32 bit for Win 95/NT, Graphpad Software Inc., 2000) was used for the statistical analysis.

RESULTS AND DISCUSSION

Ovarian Changes

The effect of crystalline progesterone levels on oviduct weight in Lohmann Brown hens is presented in Table 2. There was no statistically significant ($P>0.05$, Kruskal-Wallis Statistic = 9.075) difference in median oviduct weights (74.5, 46.0, 26.0, 38.5, 30.0 and 47.0) across progesterone treatments. The minimum oviduct weights recorded were 74.5, 32.0, 20.0, 30.0, 20.0 and 46.0 g across 0, 5, 10, 15, 20 and 25 mg crystalline progesterone treatment groups, respectively. Crystalline progesterone treatments levels (0, 5, 10, 15, 20 and 25 mg) recorded respective maximum oviduct weights of 76.8, 60.0, 31.0, 47.0, 52.0 and 51.0 g.

Chronic injection of progesterone has been shown to increase baseline concentrations of progesterone and result in arrested laying and disrupted distribution of hierarchical follicles in turkeys (Liu *et al*., 2001; Bacon & Liu, 2004). High baseline concentrations of progesterone in arrested hens might negatively feedback on the ability of the hypothalamus to secrete surges of GnRH and subsequently surges of LH, or on the ability of the pituitary to respond to surges of GnRH secretion if they occur (Liu *et al*., 2001; Bacon & Liu, 2004; Liu & Bacon, 2005). This could explain the dose-dependent decrease in ovulation rate, count of large yellow follicles, number of eggs laid and egg sequence length in the current work due to low GnRH and LH which subsequently translates into low endogenously produced progesterone. Also, no egg was produced at crystalline progesterone dose beyond 5 mg probably due to strong negative effect on egg production rate and hierarchical follicular maintenance and development (Zaghari, Taherkhani & Honarbakhsh, 2009). It is also evident that, though the decrease in egg production started as early as when 5 mg crystalline progesterone was administered, reduction in egg production to the level of zero production manifested as the dose of crystalline progesterone was increased to 10, 15, 20, and 25 mg. The arrested laying and disruption in hierarchical follicles observed in the present study agrees with results of Liu *et al*., (2001) and Bacon and Liu (2004).

In conclusion, intramuscular administration of crystalline progesterone to actively laying Lohmann Brown hens affected ovulation rate, large yellow follicle counts, laying pause days, number of egg sequence, egg sequence length, egg yolk and albumen volumes, and egg shell weight.

Table 1 Summary Statistics, KW Statistic and Selected Pairs Dunn's Multiple Comparisons Test for Ovulation Rate across Crystalline Progesterone Treatments in Lohmann Brown Hens

Crystalline Progesterone (mg)	N	Median	Minimum	Maximum	Sum of Ranks	Mean of Ranks	Kruskal-Wallis (KW) Statistic, corrected for ties
0	38	100.00	33.33	100.00	7613.0	200.340	
5	38	33.33	0.00	100.00	5474.0	144.050	
10	38	0.00	0.00	100.00	3298.5	86.803	134.29***
15	38	0.00	0.00	100.00	4116.5	108.330	
20	38	0.00	0.00	66.67	3153.0	82.974	
25	38	0.00	0.00	0.00	2451.0	64.500	

Comparison	Mean Rank Difference	Level of Significance
0 mg *vs*. 5 mg	56.289	***
0 mg *vs*. 10 mg	113.540	***
0 mg *vs*. 15 mg	92.013	***
0 mg *vs*. 20 mg	117.370	***
0 mg *vs*. 25 mg	135.840	***
5 mg *vs*. 10 mg	57.250	***
5 mg *vs*. 15 mg	35.724	*
5 mg *vs*. 20 mg	61.079	***
5 mg *vs*. 25 mg	79.553	***
15 mg *vs*. 20 mg	25.355	ns
15 mg *vs*. 25 mg	43.829	**

ns=not significant; ***P<0.001, **P<0.01, *P<0.05

Table 2 Summary Statistics (including KW Statistic) for Oviduct Weight across Crystalline Progesterone Treatments in Lohmann Brown Hens

Crystalline progesterone (mg)	n	Median	Minimum	Maximum	Sum of Ranks	Mean of Ranks	Kruskal-Wallis (KW) Statistic, corrected for ties
0	3	74.50	58.5	76.8	47.0	15.667	
5	3	46.00	32.0	60.0	30.5	10.167	
10	3	26.00	20.0	31.0	10.5	3.500	
							10.220^{ns}
15	2	38.50	30.0	47.0	15.0	7.500	
20	3	30.00	20.0	52.0	19.0	6.333	
25	3	47.00	46.0	51.0	31.0	10.333	

n = not significant, P>0.05

REFERENCES

Akbaş, Y., Ünver, Y., Oğuza, İ. and Altan, Ö. (2002).Comparison of Different Variance ComponentEstimation Methods for Genetic Parameters ofClutch Pattern in Laying Hens. *European Poultry Science*,6: 232-236.

Bahr, J.M., Wang, S.C., Huang, M.Y. and Calvo, F.O. (1983). Steroid Concentrations in Isolated Theca and Granulosa Layers of Preovulatory Follicle during the Ovulatory Cycle of the Blake, A.G., Balander, R., Flegal, C.J. and Ringer, R.K. (1987). Ahemeral Light-Dark Cycles and Egg Production Parameters of Ring-Necked Pheasants (*Phasianus colchicus*). *Poultry Science*, 66 (2): 258-263.

Kumaravel, S., Hema, R. and Kamaleshwari, A. (2012). Effect of Oven Drying on Nutritional Properties of Whole Egg and its Components. *International Journal of Food and Nutrition Science*, 1: 1-4.

Farooq, M., Mian, M.A., Ali, M., Durrani, F.R., Asghar, A. and Mugarrab, A.K. (2001). Egg Traints of Fayumi Birds under Tropical Conditions. Food and Agriculture Organization of the United Nations. *Sarhad Journal of Agriculture Pakistan*, 17: 142-145.

Folorunsho, O.R. and Onibi, G.E. (2005, April). Assessment of the Nutritional Quality of Eviscerated Waste from Selected Chicken Type. In: Proceedings of the First Annual Conference on Developments in Agriculture and Biological Sciences Held at School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Nigeria.

Lohmann Tierzucht, (2015). Management Guides. Retrieved from: www.ltz.de/en/downloads/management-guides.pdf

Liu, H.K., and Bacon, W.L. (2005).Changes in Egg Production Rate Induced by Progesterone Injection in Broiler Breeder Hens. *Poultry Science,* 84: 321-327.

Tanabe, Y., Oguwa, T., Nakamura, T. and Tanabe, Y. (1982). Endocrine Mechanism of Ovarian Follicular Atresia Caused by Fasting of the Hen. In Aspects of Avian Endocrinology: Practical and Theoretical Implication 3rd (Edn.). Lubbock Texas. Texas Tech Press. U.S.A. Volume 26th pp. 1-41.

BODY WEIGHT AND REPRODUCTIVE PERFORMANCE OF FOUR GENOTYPES OF RABBITS RAISED IN HUMID TROPICS

***Sam, I. M., Essien, C. A, & Edet, B. M.**
Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Akwa Ibom State.
**Corresponding author. Email: sidorenyin@yahoo.com*

ABSTRACT
A study was conducted to evaluate the influence of genotype on reproductive performance of two breeds of rabbit and their reciprocal crosses as well as body weight performance of their first filial generation. A total of 126 kittens were generated from cross of Newzealand white (NZWXNZW), Chinchilla (CHXCH) and their reciprocal crosses Newzealand male and Chinchilla female (NZWXCH) and Chinchilla male and Newzealand female (CHXNZW). The parameter measured were Gestation length (GL), Litter size at birth (LSB), Litter size at weaning (LSW), Birth weight (ABWT), Body weight at weaning (AWWT) and weekly body weight. The data obtained were subjected to analysis of variance and significance means were separated using Duncan multiple range test. The results indicated that genotype significantly ($p<0.05$) influenced weekly body weight during the preweaning stages. The NZWXCH had significantly higher body weight than the other three genotypes. It was also observed that NZWXCH had significantly ($p<0.05$) better LSW (4.95±0.03), ABWT (37.00±0.03), GL (28.33±0.67), AWWT (594.55 ±12.18), and percentage mortality (5.71±8.69) than other genotypes. It was concluded that NZW X CH be used for breeding purposes to increase rabbit production, as this genotype indicated better suitability in the tropics, thus increasing and improving protein intake in the study area.
Key words: Rabbit, Body weight, Reproductive, Performance, Genotype

INTRODUCTION
The population growth in developing countries like Nigeria is rapidly increasing, thus the need for alternative source of protein to meet up the protein requirement of the population. Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria (Ajala and Balogun, 2004), because rabbit has immense potentials and good attributes which include high growth rate, high efficiency in converting forage to meat, short gestation period, and high prolificacy, relatively low cost of production, high nutritional quality of rabbit meat which includes low fat, sodium and cholesterol levels. It also has a high protein level of about 20.8% and its consumption is bereft of cultural and religious biases (Biobaku and Oguntona, 1997).

The production of rabbit meat is based on pure breed selected for meat traits and on their crosses (Maj *et al.*, 2009). As production of livestock directly depends on reproduction, reproductive performance of rabbits becomes an important aspect in determining profitability and economic success of commercial rabbits breeding. Litter size (the number of kits born) is the most important economic character in rabbit production (Nofal *et al*., 2005).. Litter size is mainly controlled by heredity and can be improved by crossbreeding between breeds (Nofal *et al*., 2005). Pre-weaning survival percentage of kit rabbits is of vital importance in commercial rabbit farming, where it plays a major role in determining the net financial income of the farms (Rashwan and Marai 2000)..

Factors such as breed, season, age and weight of females influence the reproductive performance of animals (Lazzaroni *et al.*, 2012). Cross breeding is one of the fast tools offered to a breeder to improve many traits in farm animals including rabbits (Nofal *et al.*, 2005). The major essence of deliberate selection for breeding is to improve the quantitative traits.

Genetic improvements of animal require a good understanding of basic concepts of animal breeding (Ibe, 1998). Previous works by Fayeye (2013) revealed significant heterosis for growth rate and body weight though at variable values of parental means. Chineke,(2006) reported superiority of the crossbreds over pure breeds for mean body weight and linear body parameters. Rochambeau (1988) in a study conducted to compare pure breed rabbits and the terminal crosses involving these breeds, observed heteroic effect on litter growth rate. In similar experiment, (Oseni *et al.*, 1999) reported that crossbred rabbits showed superior performance over pure breeds in all pre-wearing litter traits studies. These findings suggested that cross breeding under tropical condition hold some promises in improving performance traits in

rabbits. Therefore, this study was conducted to evaluate reproductive and pre-weaning characteristics of two strains of rabbits and their reciprocal crosses in Obio Akpa, in Nigeria.

Experimental Site

This experiment was carried out at the Rabbitary Unit, Teaching and Research Farm, Akwa Ibom State University Obio Akpa Campus. Obio Akpa is located between latitudes $5^0 17^1$N and $5^0 27^1$N and between longitudes $7^0 27^1$N and $7^0 58^1$E with an annual rainfall ranging from 3500mm – 5000mm and average monthly temperature of 25^0C, and relative humidity between 60-90%. (Wikipedia, 2016).

Experimental Animals and Management

A total of forty (40) adult rabbits (New Zealand White and Chinchilla) comprising 18 New Zealand White does and 18 Chinchilla does, 2 New Zealand White bucks and 2 Chinchilla bucks were used. One New Zealand White buck was selected to mate with 9 New Zealand White does and the second new Zealand buck was selected to mate with 9 Chinchilla does. While one Chinchilla buck was selected to mate with 9 Chinchilla does and the second chinchilla buck selected to mate with 9 New Zealand White does. At the end of breeding period one hundred and twenty six (126) kittens produced from crosses comprising of NZW x NZW, CHA x CHA, NZW x CHA and CHA x NZW (Table 1) were used for this study. The rabbits were kept in 4 hutches each measuring 170cm by 32cm and consisting of 10 cells, each of which was measuring 34cm x 30cm x 28cm such that one rabbit was accommodated in one cell. Identification marks such as tags were placed on the cell in which each rabbit was accommodated.

All the rabbits in their respective cells were fed with forages such as *Ipomea batata*, *Centrosema spp*, *Peuraria phaseoloides* and commercial concentrates feed was also given with drinking water ad-libitum. The diet fed to the animals consisted of 18% CP, 2600 Kcal/kgME, and 8% CF as analyzed. Routine management operations were carried out on a daily basis. Pregnancy was detected by careful abdominal palpation on 14th and 21st days after mating, if confirmed pregnant, nest boxes were provided on 28th day of pregnancy.

Table 1: Mating scheme and number of progeny produced

Genotype	Number of sire	Number of Dam	Number of Progeny
CH X CH	1	9	35
NZW X NZW	1	9	27
CH X NZW	1	9	31
NZW X CH	1	9	33

Note: CH = Chinchilla; NZW = New Zealand White

DATA COLLECTION

Measurement/Data Collection

The following parameters were measured

Gestation Length: This was measured by finding the interval between the date of last mating and date of kindling.

Litter Size at Birth: This was measured by direct counting of the kittens immediately after kindling with still birth inclusive.

Litter Size at Weaning: This was the number of weaner's (young rabbits) in each litter at weaning time (6 weeks).

Birth Weight: This was measured by transferring all the kittens in a litter with gloved hands well rubbed on the body of the doe in question to the weighing scale and the weight of the litter read off and divided by the total number of kittens in the litter.

Body Weight at Weaning: This was measured by taking the weight of each kitten in a litter at weaning time (6 weeks).

Weekly Body Weight: This was measured by weighing each kitten in a litter on weekly basis.

Statistical Analysis / Experimental Design

The effect of sire breed and dam breed on performance traits (gestation length, litter size at birth, birth weight, litter size at weaning, body weight at weaning and weekly body weight) were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SPSS. Significant means were separated using New Duncan Multiple Range Test. The Model incorporated Genetic Groups as fixed factors while performance traits (gestation length, litter size at birth, birth weight, litter size at weaning, body weight at weaning and weekly body weight) were dependent variables.

The linear model was as follows;

$Y_{ij} = \mu + Bi + E_{ij}$

Where:

Y_{ij} = measurement on traits

μ = Population mean

B_i = Effect of ith genetic groups (CH x CH, NZW x NZW, NZW x CH, and CH x NZW)

E_{ij} = Random error effect

RESULTS AND DISCUSSION

The means of weekly body weight of kittens from the four genetic groups are presented in Table 2, the result showed that NZW X CH genotype had significantly ($P<0.05$) highest weight (145.23g) followed by NZW X CH (133.30g) and CH X NZW (111.75g) which were statistically similar; while CH X CH had the least weight (84.62g) at end of week one. At week two NZW X CH still showed significant ($P<0.05$) higher body weight (201.08 ± 3.85) than other genetic groups which were statistically similar, 127.83 ± 7.09, 182.61 ± 4.18 and 146.160 ± 2.96 for CH X CH, NZW X N2W and CH X NZW respectively. This trend was observed throughout the pre weaning period of 6 weeks. The result obtained from this studies are similar to those reported by Ajayi *et al*., (2018), Oke *et al*., (2010) who all observed significant differences on body weight of different breeds of rabbits. But this study is contrary to the reports of Ozimba and Lukefahr (1991) who observed no significant differences for growth traits of different breeds of rabbit in a comparative study. The animals increased in body size and other body dimensions as they grow in age indicating that, the animals were in normal good physiological and health conditions, Ajayi *et al.*, 2018 had earlier indicated that the genotype and environmental factors such as nutrition, disease, hormone and general management could lead to variation in growth rate or weight gain of rabbit within the same breed or among different breed. However variation in body weight in this study could be as a result of genetic variations in the various genotypes used. Body weight is said (Ajayi *et al*., 2018) to be highly heritable and hence the selection of heavier individuals in a population should result in genetic improvement of the trait.

Table 2: Mean (± s.e) Body weight (g) performance of 2 breeds of rabbit and their crosses

Age (weeks)	CH × CH (g)	NZW × NZW (g)	CH × NZW (g)	NZW × CH (g)
1	84.62 ± 5.33[c]	133.30 ± 3.39 [b]	111.75 ± 1.285[b]	145.23 ± 4.39[a]
2	127.83 ±7.09[b]	182.61 ± 4.18[b]	146.160 ± 2.96[c]	201.08 ± 3.85[a]
3	190.12 ±10.77 [c]	267.77 ± 11.16[b]	188.20 ± 2.94[c]	315.48 ±15.11[a]
4	326.59 ±14.91[b]	397.53 ± 9.09[b]	266.60 ± 6.08[c]	468.09±13.87[a]
5	364.57 ± 16.77 [c]	474.88 ± 8.57[b]	335.76 ± 6.06[c]	522.26 ±12.82[a]
6	418.78 ± 16.57 [c]	532.88 ± 7.554[b]	394.04 ± 8.07[c]	594.55±12.18[a]

a,b,c = Mean with different superscripts in the same row are significantly different (P<0.05).

The means of the reproductive traits of the four genotypes are presented in Table 3. The result indicated that there were no significant differences among the genetic groups in litter size at birth (LSB). The result of this study is contrary to reports of Fadara and Fatoba (2018) who observed significant differences between genetic groups in litter size. But agrees with the work of MaryKitty and Nandakumar (2000) who reported non-significant effect of breed on litter size and litter weight at births.

However, significant (P<0.05) differences were observed among genetic groups in litter size at weaning (LSW) ,NZW X CH crosses had significantly (p<0.05) higher litter size at weaning (4.95 ± 0.54) than other genotypes which were similar statistically. The average birth weight (ABWT) also followed the same trend as litter size at weaning. The NZW X CH crosses had significantly (P<0.05) heavier body weight at birth, while other genotypes were similar. Litter size at weaning is considered to be the best trait to us as selection criteria for improving reproductive performance (Moustafa *et al*., 2014; Fadara and Fatoba (2018). This is because the productivity of rabbit depends primarily on the number of young kits surviving the pre-weaning stage. The ability of the doe to produce thrifty young at birth and to raise this young to weaning determines her productivity (Sorensen *et al*., 2001). Thus, to maintain efficiency in rabbit production, high litter size at weaning is necessary. The report from this study is in line with the reports of Fadara and Fatoba (2018) who observed that litter size and litter weight at weaning were affected by breed.

The best gestation length (shortest) of 28.33 ± 0.67 days was recorded for NZW X CH crosses which was significantly (P<0.05) different from other genotypes which were statistically similar 31.67 ± 1.14, 31.37 ± 0.67 and 30.50 ± 0.56 for CH X CH, NZW X NZW and CH X NZW respectively. Variations in gestation length of rabbit due to differences in breed had earlier been reported by Apori *et al*., 2015.

The result (Table 3) indicated that there were significant (p<0.05) differences between the genetic groups in percentage mortality. It was observed that NZW X NZW genetic group had the highest percentage of mortality (50.28 ± 5.78) followed by CH XCH genetic group (25.10 ± 3.87) the crosses CH X NZW and NZW X CH genetic groups had similar percentage mortality, 8.87 ± 4.05 and 5.71 ± 8.69 respectively. The high percentage mortality observed in NZW X NZW genetic group could be attributed to poor mothering ability, which may have resulted from inability of the does to produce sufficient fur in the nesting boxes for the naked kits at birth. It may also be attributed to tropical environmental condition which may not favour the genotype. Earlier report by Topezewka (2013) and Fadara and Fatoba (2019) indicated variation between rabbit breeds in percentage mortality.

Table 3: Mean (± s.e) of reproductive traits of 2 breeds of rabbit and their crosses

Age	CH × CH	NZW × NZW	CH × NZW	NZW × CH
LSB	5.83 ± 0.98	5.50 ± 0.34	4.50 ± 0.67	5.17 ± 0.67
LSW	4.30 ± 0. 89[b]	2.67 ± 0.21 [b]	4.00 ± 0.52[b]	4.95 ± 0.54[a]
ABWT	32 .55 ± 0.02[b]	35 50 ± 0.01[b]	33. 05 ± 0.01[b]	37.00 ± 0.03[a]
GL	31.67 ± 1.14[a]	31.37 ± 0.67[a]	30.50 ± 0.56[b]	28.33 ± 0.67[a]
AWWT	418.78 ± 16.56[b]	532.88 ± 7.56[b]	394.04 ± 8.07[b]	594.55 ±12.18[a]
% MORT	25.10 ± 3.87[b]	50.28 ± 5.78[a]	8.87 ± 4.05[c]	5.71 ± 8.69[c]

Mean with different superscripts in the same row are significantly different (P<0.05), LSB = Litter size at birth,

CONCLUSION

NZW X CH had a significant higher performance in body weight during the pre-weaning stage and other reproductive parameter measures (LSB, LSW, ABW, GL, AWWT and %mortality). Therefore, the NZW X CH genotype is suitable in the humid tropics in serving as protein source for the populace in Obio Akpa.

REFERENCES

Ajayi, F.O, Ologbose, F.I. and Esenowo, E. S (2018). Influence of Genotypes and Litter Size on Body Weight and Linear Body Measurements Of Rabbits,*Applied Science Reports,* 21 (3): 88-93.

Ajala, M. K. and Balogun, J. K. (2004) Economics of Rabbit production in Zaria, Kaduna State. *Tropical Journal of Animal Science* 7(1):1-10.

Apori, S. O.,Hagun, J. K and Osei, Y. D.(2015). Growth and reproductive performance of two rabbit breeds reared under intensive system in Ghana. Tropical Animal Health and Production 47(1):221-224

Biobaku, W. O. and Oguntona E. B. (1997). The effects of feeding Multi Nutrient Mini Blocks and Pelleta diet on the Growth of Rabbits. *Nigeria Journal of Animal Production* 24(2):147-149.

Chineke C. A. (2006). The relationship among body weight and lives dimensions in rabbit breeds and crosses. *Journal of Animal and Veterinery Advances* 4 (9): 775 – 784.

Fayeye, T. R. (2013).Heterosis for Preweaning litter Characteristics in Nigerian Rabbit Crosses, *International Journal of Agricultural and Food Research*, 2(2):1-6.

Fadare, A. O. and Fatoba, T. J. (2018). Reproductive performance of four breeds of rabbit in the humid tropics,Livestock Research for Rural Development, 30(7):1-7.

Ibe, S. N. (1998). An Introduction to Genetics and Animal Breeding, Longman, Nigeria PLC Logos, Nigeria.

Lazzaroni C., Biagini d., Redaceli V., Luzi F., (2012) Year, season and Parity effect on Wearing Performance of the Carmagnole Grey Rabbit Breed, World Rabbit Science, 20:57-60 Doi: 10.4995/Wis. 2012.103.

Maj, d., Bieniek, J., Hapa P. and Steinstein, I. (2009). The Effect of Crossing New Zealand White with Californian Rabbits on Growth and Slaighter Traits. Arch Tierzucht 52 (2009) 2, 205-211, ISSN 003-9438.

Marykutty, T. and Nandakumar, P. (2000). Factors influencing litter traits and body weight up to 12 weeks among temperate rabbit breeds in humid tropics. World Rabbit Science 8 (2) 67- 70.

Moustafa H A , El-Raffa A , Shebl M K, El-Delebshany, A. and El-Sayed N. A. (2014). Genetic evaluation of some economic traits in a maternal line of rabbits. *Egyptian Poultry Science* 34 (1):85-98.

Nofal, R., Saleh, K, Younis, H. and Abou Khadiga, G. (2005). Evaluation of Spanish synthetic line V, Baladi Black rabbits and their crosses under Egyptian conditions. In: Proceeding 4th International Conference Rabbit Production Hot Climates, 24-27 Feb., Sharm El-Sheikh, Egypt, 23 - 29.

Oseni, S. O. I. K. Odubote and O. Akinokun (1999). Evaluation of Purebred and Cross Bred Rabbits for Fertility and Pre-weaning litter Performance in the Humid tropics Proceeding of 26th Annual conference of Nigerian Society for Animal Production, pp 319 – 322.

Ozimba, C. E. and Lukefahr, S. D. (1991). Comparison of rabbit breed types for post weaning 5 litter growth, feed efficiency and survival performance traits. *Journal of Animal Science* 69(9):349-355.

Rochambeau, H. (1988). Genetic of the Rabbit for Wool and Meat Production (1984 – 1988). In World Rabbit Congress, pp 1-68. Buda Pest Hungary.

Sorensen, P., Kjaer, J. B., Brenoe, U. T. and Su, G. (2001). Estimates of genetic parameters in Danish White rabbits using an animal model: II. Litter traits. World Rabbit Science 9(1):33-38.

Topczewska, J., Rogowska., A. and Gacek, L. A.(2013). The effect of breed on reproductive performance in commodity rabbit production. *Journal of Central European Agriculture*, 14 (2): 828-835.

Wikipedia (2016). The free Encyclopedia *http*.s:// *en.wikipedia*.org/ wiki/ Akwa – Ibom.

EFFECT OF FLOCK AGE ON FERTILITY AND HATCHABILITY TRAITS OF SHIKABROWN® CHICKENS

Suleiman S., W.A. Hassan & A.A. Kwaido
Department of Animal Science, Kebbi State University of Science and Technology Aliero, Nigeria
Corresponding author: Suleiman S.; Email: sstune98@yahoo.com Mobile:+2348060792941

ABSTRACT
The research was conducted to determine the effect of flock age on fertility and hatchability traits of ShikaBrown® chickens in Aliero. A total of 1177 hatchable eggs were collected from birds of African Chicken Genetic Gains (ACGG) project in Kebbi State and incubated at different flock age (48, 49, 50 and 51 weeks). The experimental design used was the Nested type (Henderson, 1963). The Parameters considered include mean egg weight, fertility, hatchability, hatch weight and embryonic mortality. The data was analyzed using GLM of SPSS (2013). Significant interaction (P≤0.05) was observed between flock age and egg weight, fertility, hatchability, embryonic mortality and hatched weight. Highest egg weight (58.40±0.32g) and hatchability (68.57±1.91%) were recorded at age 51, fertility was highest (94.65±1.75%) at age 50 weeks and lowest (89.52±2.21) at 48 weeks. Egg weight, hatchability and hatched chicks' weight were amplified (P≤0.05) with increase in age (48-51 weeks). Embryonic mortality improves with advancing age (P≤0.05) and was highest at the early stage and lowest at mid-stage of incubation.
Key words: Flock age; fertility; hatchability traits; chick weight; ShikaBrown®

INTRODUCTION
Fertility and hatchability are interrelated heritable traits that vary among breeds, and individuals in a breed (King'or, 2011). According to Brillard (2003), fertility of individual egg is a function of the genotype of the embryo to which both parent (sire and dam) contribute. Thus if the fertility in a flock is low many infertile eggs will be incubated. Hatchability on the other hand is the rate at which incubated or fertile eggs are turned into viable chick after 21 days of incubation. Hatchability is determined based on the number of eggs set or fertile eggs set after candling on the seven and eighteen days of incubation (Orunmuyi *et al.*, 2011). Failure of an egg to hatch is caused by infertility or by death of embryo after fertilization.

Several genetic and non-genetic factors have been reported to influence fertility and hatchability of chicken eggs. These factors include: breed, egg age, storage condition, nutrition, system of husbandry and rearing technology, mating system, mating ratio, incubation relative humidity, temperature and eggs turning angle (Wilson, 1997; King óri, 2011; Bobbo *et al.*, 2013).

The ShikaBrown® chicken breed is the preferred layer breed in Nigeria having remarkable characteristics that include excellent shell quality, high production rate, persistency, egg weight, livability, and feed conversion and is well adapted to the harsh tropical environment with resistance to many diseases of economic importance (Ayorinde *et al.*, 2016). However, there is paucity of information on fertility and hatchability traits of the breed. The present work was carried out to determine effect of flock age on the fertility and hatchability traits of ShikaBrown® chickens.

MATERIALS AND METHOD
Location of experiment

The research was conducted at the Animal Science Laboratory, University campus at Aliero (Lat. 12° 18'18" N, Long. 4° 29'52"E and Alt. 266.2m above sea level) in the dry sub-humid zone of Nigeria.

Management of breeding stock

During the onset of lay, the birds were fed diet containing 2,600 ME Kcal/kg and 16-18% crude protein. Egg production of the parent stock was observed before selection and setting up of mating pens. A total of 96 ShikaBrown® chickens of age 48 weeks were used as parents for the study. The birds which consisted of 84 pullets and 12 cocks were selected and allowed to mate in separate pens labelled according to the cocks (sire).

Mating and incubation of fertilized eggs

The pullets with brown plumage were mated to white- brown cocks at a ratio of 1:7. Fertile eggs were collected three times daily (7:00am, 2:00pm, and 5:00pm). The eggs were sorted to remove cracked eggs, soiled eggs, small sized or oversized eggs.

Selected eggs were labeled, fumigated and stored in cool room at a temperature of 19°C for a period of 24 hours before setting them in an automated incubator. The incubation process was conducted according to flock age, taken into account the number of fertile eggs and number of eggs hatched in each breeding pen. Candling was done at the 7th and 14th day to remove infertile eggs and eggs with dead embryos. At the 20th -23rd day of each batch of incubation hatched chicks were removed and eggs that failed to hatch were removed, examined and counted as late stage of embryonic mortality.

Experimental design

The experimental design used was the Nested type (Henderson, 1963), in which a sire is mated to several dams with each mating producing several offspring. The model is given below:

$Y_{ijk} = \mu + A_i + B_j + W_k + \varepsilon_{ijk}$

Where Y_{ijk}= any observation; μ = overall mean; A_i = effect of sire; B_j = effect of flock age;

W_k = effect of interaction between sire and flock age and ε_{ijk} = random error

RESULTS AND DISCUSSION

Effect of age on egg weight of ShikaBrown® pullets

Expectedly, age has significant effect on egg weight (P≤0.05). Eggs of age 51 weeks were heaviest (58.40±0.32g) and were statistically similar in weight with those of 48 and 50 weeks (57.82±0.29 and 57.90±0.28). However, eggs of 49th week (57.41±0.24) were the lightest (P≤0.05). The mean egg weight in this study concurred with the findings of Abudabos *et al.* (2010) who reported that egg weightwas affected by collection week or hen's age (p≤0.05), heavier eggs were produced in weeks 3 and 4 (45.42 and 45.48 g, respectively) compared with weeks 1, 2, 6, 7, 8, and 11 (44.72, 44.54, 44.59, 44.65 and 44.28 g respectively).

Effect of age on fertility of ShikaBrown® chickens

The fertility of 94.65±1.75 and 93.69±1.87 percent observed at the age 50 and 49 weeks, were similar and higher (P≤0.05) than 92.07±1.96 and 89.52±2.21 of age 51 and 48 weeks respectively. Percent fertility at week 51 and 48 were similar (P≤0.05). The flock fertility observed increases with age reached maximum and tends to decline at 51 weeks of age. The results agreed with the findings of Abudabos *et al.* (2017) who reported that fertility (F) was influenced by collection week or hens' age (p≤0.05), with eggs collected in week 3 presenting the lowest fertility percentage (60.45%), which, however, was similar to those collected in weeks 2, 6, 8, and 9 (73.68, 71.53, 71.79, and 71.14%, respectively). Similarly, Elibol and Brake (2006) reported 97.1% and 81.1 % fertility for young (34 and 37 weeks) and old (59 and 61 weeks) broiler breeder flocks respectively and suggested that fertility of total eggs differed with flock age (P ≤ 0.01) and was more for young than for old flocks.

Effect of age on hatchability of ShikaBrown® eggs

Hatchability of eggs was influenced significantly by the flock age (P≤0.05). The highest hatchability recorded at 51st week (68.57±1.91%) and the lowest was at 48th week (47.00±1.66%). Hatchability at 49th week (61.66±1.78) was similar (P≤0.05) with that of 50th week (59.51±3.02). Expectedly, the results showed a trend of relatively increasing hatchability rates with the flock age since the flocks studied were within their first year in lay and under normal conditions, hatchability is expected to drop during second year in lay (Oluyemi and Roberts, 2000).

Effect of age on hatch weight of ShikaBrown® chicks

Hatch weight was significantly influenced by flock age (P ≤ 0.05). The hatch weight at age 50 (43.12±0.25g) and age 51 weeks (43.08±0.22g) were not different statistically, but were higher (P ≤ 0.05) than the hatch weight of 42.42±0.20g and 42.69±0.19g for age 48 and 49 weeks respectively. Expectedly, the results show a linear relationship between age and hatch weight which proves that as the pullets ages hatch weight increases. The hatch weights obtained in this report agreed with the findings of Abudabos *et al.* (2017) who studied hatch weights of free-range Hassawi indigenous chickens and

reported that lightest hatchlings were obtained from eggs collected in week 1 (28.96 g), while eggs collected in week 2 produced intermediate weight hatchlings (29.77 g) ($P \leq 0.01$) and the heaviest chicks hatched were from eggs collected in weeks 3, 4, 6,7, and 8 (30.65, 30.99, 30.70 and 30.56, respectively).

Effect of age on embryonic mortality

Age had significant effect on early, mid and late stage embryonic mortality ($P \leq 0.05$). Early embryonic mortality was higher at age 48 weeks (27.24%±2.23) than 17.96%±1.84, 20.34%±1.78 and 16.17%±1.58 (at age 49, 50 and 51 weeks respectively). Similarly, midterm embryonic mortality was highest (9.56%±1.58) at 50 weeks of age and the lowest (4.56%±1.04) was at 49 weeks. Late embryonic mortality was higher ($P \leq 0.05$) at age 48 (18.54±1.61%) and 49 weeks (15.81±2.12%) than at 50 (10.59±1.20%) and 51 weeks (8.98±1.68%). Late embryonic mortality decreases with flock age (48-51 weeks). Generally, highest embryonic mortality was observed at the early stage of incubation followed by the late stage while the least was observed at mid-stage of incubation. The results partially disagree with the findings of Iqbal *et al*. (2016) who reported that age of hen had no influence ($P \geq 0.05$) on embryonic mortality during incubation but observed highest embryonic mortality at early stage of incubation and the least at mid-stage of incubation. The results however, partially agreed with the findings of Elibol and Brake (2006) who observed highest embryonic mortality in the early phase followed by the late phase and mid phase had the least embryonic mortality in both young and old broiler breeder flocks. They however reported higher early and late embryonic mortality in old than in young flocks ($P \leq 0.01$).

Similarly, total embryonic mortality varied significantly ($P \leq 0.05$) with flock age. The highest (52.9±1.66%) was at 48 weeks of age and the lowest (31.4±1.83%) was at 51 weeks.

Table 1: Age effects on hatchability traits of ShikaBrown® eggs

Parameter	Age of birds (week)			
	48	49	50	51
Egg weight (g)	57.82±0.29^{ab}	57.41±0.24^{b}	57.90±0.28^{ab}	58.40±0.32^{a}
Egg fertility (%)	89.52±2.21^{b}	93.69±1.87^{a}	94.65±1.75^{a}	92.07±1.96^{ab}
Hatchability (%)	47.00±1.66^{c}	61.66±1.78^{b}	59.51±3.02^{b}	68.57±1.91^{a}
Chick weight (g)	42.42±0.20^{b}	42.69±0.19^{ab}	43.12±0.25^{a}	43.08±0.22^{a}
Early E.M (%)	27.24±2.23^{a}	17.96±1.84^{b}	20.34±1.78^{b}	16.17±1.58^{b}
Mid E.M (%)	7.22±1.19^{ab}	4.56±1.04^{b}	9.56±1.58^{a}	6.27±1.11^{ab}
Late E.M (%)	18.54±1.61^{a}	15.81±2.12^{a}	10.59±1.20^{b}	8.98±1.68^{b}
Total E.M (%)	53.00±1.66^{a}	38.34±1.78^{b}	40.49±3.01^{b}	31.43±1.91^{c}

Means along the same row bearing different superscripts are significantly different ($P \leq 0.05$).
E.M = Embryonic mortality

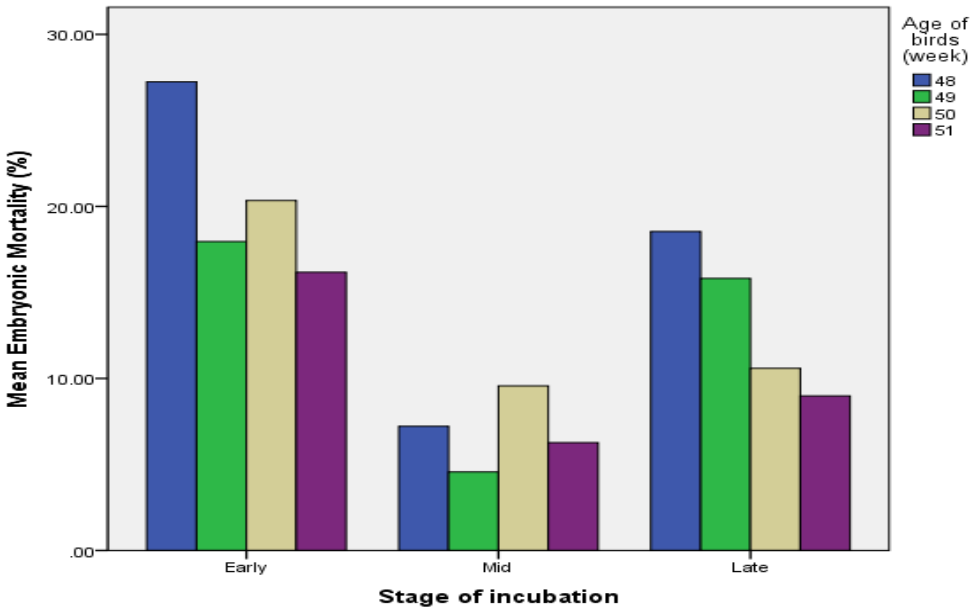


Figure 1: Stages of embryonic mortality based on flock age

CONCLUSION AND RECOMMENDATION

From the results of this work, it can be deduced that age has great influence on egg weight, fertility, hatchability, embryonic mortality and hatched chicks' weight of ShikaBrown® chickens. At the age (48-51 weeks) investigated, the birds proved to have high fertility, increasing hatchability rates and hatched chicks' weight. Further research should be conducted beyond the period covered in this study to determine the period of maximum reproductive efficiency of the breed.

REFERENCES

Abudabos A. (2010). The effect of broiler breeder strain and parent flock age on hatchability and fertile hatchability. International Journal of Poultry Science. 9:231–235.

Abudabos A.M., R.S. Aljumaah, A.S. Algawaan, H. Al-Sornokh and R.M. Al-Atiyat (2017). Effects of Hen Age and Egg Weight Class on the Hatchability of Free Range Indigenous Chicken Eggs. *Brazilian Journal of Poultry Science/ v.19 / n.1 / 033-040.*

Ayorinde, K. L., Joseph, J. K. and Ayandibu, O. E. (2016). African Chicken Genetic Gains: Shika Brown Breed. Retrieved from http://www.naerls.gov.ng/extmat/bulletins/Local C

Bobbo, A. G., M. S. Yahaya and S. S. Baba (2013). Comparative assessment of fertility and hatchability traits of three phenotypes of local chickens in Adamawa State. *IOSR Journal of Agriculture and Veterinary Science, 4(2):22-28.*

Brillard, J.P., (2003). Practical aspects of fertility in poultry. *World's Poultry Science Journal,* 59: 441-446.

Elibol O. and J. Brake (2006).Effect of Flock Age, Cessation of Egg Turning, and Turning Frequency Through the Second Week of Incubation on Hatchability of Broiler Hatching Eggs. *Poultry Science.85:1498–1501.*

Henderson, C.R. (1963). Selection index and expected genetic advance. Statistical genetics and plant breeding. National Academy of Sciences, National Resources Council. Pub. P. 982. Washington. D.C.

King'ori, A. M. (2011). Review of the factors that influence egg fertility and hatchability in poultry. *International Journal of Poultry Science*, 10 (6): 438-492.

Oluyemi, J. A. and F. A. Roberts (2000). *Poultry Production in warm wet Climates*. Spectrum Books Limited, Ibadan, Nigeria, p. 217.

Orunmuyi, M., I.A. Adeyinka and O.O. Oni (2011). Genetic parameter estimates (full sib and half sib analysis) of fertility and hatchability in two strains of Rhode Island Chickens. Nigerian Journal of Animal Production 38(1):14-22.

Wilson, H.R., (1997). Effects of maternal nutrition on hatchability. *Poultry Science*, 76: 134-143.

GENETIC DIVERSITY AT TLR7 GENE IN NIGERIAN INDIGENOUS CHICKENS AND ISA BROWN COMMERCIAL LAYER CHICKEN

[1]Ukwu, H. O., [*]Ibe, S. N., [*]Nwachukwu, E. N. & [+]Imumorin, I. G., [1]Audu, M. O.

[1] Department of Animal Breeding and Physiology, Federal University of Agriculture Makurdi, Benue State, Nigeria.

[*] Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

[+]School of Biological Science, Georgia Institute of Technology, Atlanta, USA.

Corresponding author's e-mail: ukwuhenry@gmail.com

ABSTRACT

The objective of this study was to estimate genetic diversity at TLR7 locus in the Nigerian indigenous chicken populations and ISA Brown commercial layer chicken. Eight (8) chicken populations (naked neck, normal and frizzled-feathered Nigerian indigenous chickens in rain forest and Guinea Savannah regions respectively, Fulani ecotype chicken and ISA Brown commercial layer chicken) were used for this study. Blood samples were collected from each of the eight chicken populations. Genomic DNA was isolated from each blood sample using the Zymo Quick-gDNA^{TM} Miniprep kit. Sequencing of chTLR7 gene was done using the Sanger Sequencing Chemistry. Genetic distance estimates ranged from 0.007 to 0.054 and were close to zero, which suggests that the chickens have a close ancestor. The estimates of nearest-neighbour statistic ranged from 0.227 to 0.714, which showed that the chicken populations were part of the same panmictic population, hence were not genetically differentiated (P>0.05) at the TLR7 locus.

Keywords: Chicken, diversity, genetic distance, nucleotide, Toll-like receptor.

INTRODUCTION

Toll-like receptor 7 (TLR7) gene is one among the genes implicated in the immune system of vertebrates, especially in recognition of viral Pathogens. TLR genes are proven associated with resistance to infectious diseases. Chicken toll-like receptor (chTLR) genes have been reported to be polymorphic among different avian breeds, suggesting a varied resistance across numerous chicken breeds (Ruan *et al*., 2012a; 2012b). Although TLR domains are highly conserved among species and among different members of the multi-gene family because of their crucial participation in signaling transduction (Barreiro *et al*., 2009), recent reports have revealed that mutation on their sequences can bring about single nucleotide polymorphisms (SNPs), hence creating genetic variants among populations of the same species. For example, four new single nucleotide polymorphisms (SNPs) of TLR7 gene were discovered in Chinese ducks (Zhu *et al*., 2011). Recent reports suggest that the ability of certain individuals to respond properly to TLR ligands may be impaired by single nucleotide polymorphisms (SNPs) within TLR genes, resulting in an altered susceptibility to, and development of infectious or inflammatory disease (Schroder and Schumann, 2005).

However, TLR7 gene has not been investigated in the Nigerian indigenous chicken populations. The Nigerian indigenous chickens found in different ecological locations in Nigeria may have evolved adaptive characteristics in response to changes in natural environmental conditions, which could potentially affect individual's ability to sense invading viral pathogen-associated molecular patterns.

We hypothesize that indigenous chicken ecotypes in different regions of Nigeria may have developed varied ability to respond to viral pathogens.

This study, therefore, was designed to access the genetic diversity at the TLR7 locus in the Nigerian indigenous chickens and ISA Brown commercial layer chicken.

MATERIALS AND METHODS

Blood sample collection

About 1 ml of blood sample was aseptically collected from the brachial vein of each bird, separately into vacutainer tubes (SARSTEDT Monovette®) containing Ethylene-diamine-tetra-acetic acid (EDTA), using sterile needles. Blood samples were collected from naked neck, normal-feathered, frizzle-feathered

indigenous chickens from rainforest zone, Guinea Savannah zone, Fulani ecotype chicken, and ISA Brown commercial layers chickens.

DNA extraction, Polymerase Chain Reaction and Sequencing

Genomic DNA was isolated from each blood sample using the Zymo Quick-gDNA™ Miniprep kit (D3024, Zymo Research Corporation, Irvine, CA, USA) following the manufacturer's instructions. The concentration and purity of each DNA sample was ascertained using Nanodrop Spectrophotometer.

Three (3) DNA samples from each genetic group were taken for polymerase chain reaction (PCR) amplification of TLR7 gene. The primers used were designed using the Primer3 and BLAST option at the NCBI database (www.ncbi.nlm.nih.gov). The following primers were used: Forward-AGGCTTGCTGTTGTGGCATGGA and Reverse- ACTGGAAGCCCTTCCTCCACTGT. PCR were performed in a 50 µl reaction volume containing 10 µl of 5X FIREPol® Master Mix (Solis BioDyne, Tartu, Estonia), 2.5 µl each of forward and reverse primers, 31 µl of nuclease-free water and 4 µl sample DNA template. PCR conditions consist of 1 cycle of 95°C for 4 minutes initial denaturation, 35 cycles each of 95°C for 30 seconds denaturation, 62°C for 30 seconds annealing, 72°C for 1 minute elongation, followed by 72°C for 10 minutes final elongation. DNA sequencing of chTLR7 gene was done using the Sanger Sequencing Chemistry. Laboratory analysis was performed at African Bioscience Laboratory in Ibadan, Nigeria.

RESULTS AND DISCUSSION

Estimates of Nearest-neighbour statistic (Snn) between the Nigerian indigenous chickens in rain forest region, Guinea savannah region, Fulani ecotype and ISA Brown layer chickens ranged from 0.292 to 0.714, with a value of 0.227 for the sequences pulled together (Table 1). Permutation test on estimates of Snn with 1000 replications and excluding sites with alignment gaps gave *P*-values ranging from 0.186 to 0.687 and were not significant ($P>0.05$). This implies that the Nigerian indigenous chickens from rain forest and Guinea savannah, Fulani ecotype and ISA Brown layer chickens were not genetically differentiated at the TLR7 locus.

The nearest-neighbour statistic (Snn) is a measure of how often the nearest neighbours (in sequence space) of sequences are from the same locality in geographic space (Hudson, 2000). The Snn estimates are expected to be near one when the populations at the two localities are highly differentiated and near one-half when the populations at the two localities are part of the same panmictic population (Hudson, 2000). The nearest–neighbour statistic is very useful when genomic data are collected on individuals from two or more geographic locations. In this study, analysis of TLR7 gene sequences from the Nigerian indigenous chicken populations and ISA Brown commercial layer chicken revealed that the nearest-neighbour statistic (Snn) were close to one-half, which implies that the Nigerian indigenous chickens from rain forest, Guinea savannah, Fulani ecotype chicken and ISA Brown commercial layer chicken were part of the same panmictic population.

Table 1: Nearest-neighbour statistic, Snn between populations of Nigerian indigenous chickens and ISA Brown commercial layer chicken

Populations	S_{nn}	P-value of S_{nn}
Fulani ecotype VS. Guinea savannah	0.525	0.517^{NS}
Fulani ecotype VS. ISA Brown	0.467	0.382^{NS}
Fulani ecotype VS. Rain forest	0.714	0.186^{NS}
Guinea savannah VS. ISA Brown	0.292	0.854^{NS}
Guinea savannah VS. Rain forest	0.388	0.687^{NS}
ISA Brown VS. Rain forest	0.438	0.635^{NS}
Entire population	0.227	0.459^{NS}

NS= not significant (P>0.05)

The estimates of mean genetic distance among Nigerian indigenous chicken populations from different locations and ISA Brown commercial layer chicken are presented in Table 2, while Table 3 shows the estimates of mean genetic distance among the Nigerian indigenous chicken genotypes and ISA Brown

commercial layer chicken. The estimates of mean genetic distance (Table 2) ranged from 0.007 to 0.014, and were also close to zero. The least between group mean genetic distance (0.007) was observed between the Fulani ecotype chicken and the rain forest chicken, while the highest mean distance (0.014) was between ISA Brown layer chicken and Guinea savannah chicken. Analysis of TLR7 gene sequences from the different chicken genotypes (naked neck, frizzle-feathered and normal feathered chickens) from different regions, Fulani ecotype chicken of Nigeria and ISA Brown commercial layer chicken revealed that genetic distance estimates ranged from 0.006 to 0.054 and were also close to zero (Table 3). The observed close-to-zero estimates of genetic distance is an indication that the Nigerian indigenous chickens genotypes found in different regions of the country and ISA Brown commercial layer chicken were closely related at the TLR7 locus. This report seems to be the first investigation of TLR7 locus in the Nigerian indigenous chickens and ISA Brown commercial layer chicken. The level of genetic relatedness observed in this study showed that although the indigenous chickens are found in different region in Nigeria, the locus was not under ecological or geographical divergence; consequently, the TLR7 locus is highly conserved among the Nigerian indigenous chicken populations. This finding corroborates the report of Bulumulla *et al*. (2011) that the TLR7 locus is a conserved region among Sri Lankan indigenous chicken population and Ceylon jungle fowl (*Gallus lafayetti*).

Table 2: Estimates of mean genetic distance among Nigerian indigenous chicken populations and ISA Brown commercial chicken

*Populations	FEC	GSC	ISA	RFC
FEC	-	0.002	0.003	0.002
GSC	0.011	-	0.003	0.003
ISA	0.010	0.014	-	0.003
RFC	0.007	0.013	0.010	-

Estimates of genetic distance are shown below the diagonal; Standard error of estimates are shown above the diagonal; FEC= Fulani ecotype chickens; GSC= Guinea Savannah chickens; ISA= ISA Brown layer chickens; RFC= Rain forest chickens

Table 3: Estimates of mean genetic distance among the Nigerian indigenous chicken genetic groups and ISA Brown commercial layer chicken

Groups	FE	GF	Gn	GN	ISA	RF	Rn	RN
FE	-	0.004	0.006	0.003	0.004	0.004	0.0040	0.003
GF	0.014	-	0.007	0.004	0.005	0.003	0.004	0.004
Gn	0.042	0.054	-	0.007	0.006	0.007	0.006	0.007
GN	0.007	0.012	0.048	-	0.004	0.003	0.004	0.005
ISA	0.026	0.034	0.045	0.028	-	0.005	0.004	0.005
RF	0.010	0.009	0.051	0.006	0.030	-	0.004	0.005
Rn	0.020	0.022	0.045	0.019	0.030	0.016	-	0.005
RN	0.007	0.014	0.047	0.012	0.031	0.013	0.024	-

Estimates of genetic distance are shown below the diagonal; Standard error of estimates are shown above the diagonal; FE= Fulani ecotype chicken, GN= Guinea savanna naked neck chicken, Gn= Guinea savannah normal chicken, GF= Guinea savannah frizzle-feathered chicken, RF= Rain forest frizzle-feathered chicken, RN= Rain forest naked neck chicken, Rn= Rain forest normal chicken, ISA= ISA Brown commercial layer chicken

The percent identity of TLR7 gene sequence from the Red jungle fowl (*Gallus gallus*) retrieved from the National Centre for Biotechnology information (NCBI) database (Accession No.NC_006088.5), with the consensus sequence of TLR7 gene of Nigerian indigenous chickens and ISA brown was 99%. The estimates of genetic distance between the Red jungle fowl and the Nigerian indigenous chickens and ISA

brown commercial layer chicken at the TLR7 locus were very low and ranged from 0.007±0.002 to 0.012±0.003 (Table 4). This implies a very close relationship and low level of divergence at the TLR7 locus in the Nigerian indigenous chicken populations, ISA Brown commercial layer chicken and the Red jungle fowl. This also suggests that the Nigerian indigenous chickens and ISA Brown commercial layer chicken are not genetically distanced from the Red jungle fowl at the TLR7 locus. This is in line with the report of Bulumulla *et al*. (2011) that TLR7 locus is a conserved region among the indigenous chicken population.

Table 4: Genetic distance between the Nigerian indigenous chickens, ISA Brown commercial layer chicken and the Red jungle fowl (reference sequence)

Chickens	Red jungle fowl
Fulani ecotype	0.008±0.004
Guinea savannah	0.012±0.003
Rain forest	0.007±0.002
ISA Brown layers	0.008±0.003

CONCLUSION

The results of this study revealed that genetic distance estimates among the Nigerian indigenous chickens, ISA Brown commercial layer chickens and the Red jungle fowl were close to zero, which suggests that the chickens were not under ecological divergence. The estimates of nearest-neighbour statistic obtained in this study showed that the Nigerian indigenous chickens from the rainforest, Guinea savannah, Fulani ecotype and ISA Brown commercial layer chickens were not genetically differentiated at the TLR7 locus, thus were part of the same panmictic population.

REFERENCES

Barreiro, L. B., Ben-Ali, M., Quach, H. (2009). Evolutionary dynamics of human Toll-like receptors and their different contributions to host defense. *PLoS Genet*., 5(7): e1000562. https://doi.org/10.1371/journal.pgen.1000562

Bulumulla, P. B. A. I. K., Silva P. and Jianlin, H. (2011). Genetic Diversity at Toll Like Receptor 7 (TLR7) Gene of Sri Lankan Indigenous Chicken and Ceylon Jungle Fowl (*Gallus lafayetti*). *Tropical Agricultural Research* 22 (4): 367 – 373

Hudson, R.R. (2000). A new statistic for detecting genetic differentiation. *Genetics*, 155: 2011 – 2014.

Ruan, W. K., Wu, Y. H., An, J. Cui, D. F., Li, H. R. and Zheng, S. J. (2012a). Toll-like receptor 2 type-1 and type-2 polymorphisms in different chicken breeds. *Poult. Sci*., 91: 101 – 106

Ruan, W. K., Wu, Y. H., An, J. and Zheng, S. J. (2012b). Polymorphisms of chicken Toll-like receptors 4, 15 and 21 in different breeds. *Poult. Sci*., 91: 2512 – 2516.

Schroder, N. W. and Schumann, R. R. (2005). Single nucleotide polymorphisms of Toll-like receptors and susceptibility to infectious diseases. *Lancet Infect. Dis*., 5: 156 – 164.

Zhu, W., Li, H., Song, W., Hu, Y., Zhu, C., Song, C., Shu, J. and Chen, K. (2011). Four new single nucleotide polymorphisms (SNPs) of Toll-like receptor 7 gene discovered in Chinese ducks. *African J. Biotechnol*., 10(83): 19294 – 19298

HYBRIDIZATION BETWEEN *CLARIAS GARIEPINUS* (BURCHELL 1822) AND *HETEROBRANCHUS BIDORSALIS* (GEOFFROY SAINT HILAIRE, 1809)

Wasiu Adekunle OLANIYI [a*] & Ofelia Galman OMITOGUN [b]

[a]Department of Animal Science, Adekunle Ajasin University, PMB 001, Akungba-Akoko, 342111, Ondo State; [b]Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, 220005, Osun State, Nigeria*

**Corresponding author: wasiu.olaniyi@aaua.edu.ng; waolaniyi@gmail.com*

ABSTRACT

This study was carried to produce hybrids between crosses of *Clariid* catfish species of *Clariasgariepinus* and *Heterobranchusbidorsalis* for stock improvement. Fertility data revealed significant difference ($p<0.05$) between the hybrid cross ♀*C. gariepinus*× ♂*H. bidorsalis* (88.00±1.00%) compared to its reciprocal ♀*H. bidorsalis*× ♂*C. gariepinus* (71.67±10.41%). The reciprocal ♀*H. bidorsalis*× ♂*C. gariepinus* recorded the highest deformity (11.67±3.06%) that was significantly different ($p<0.05$) from the rest of the crosses. Equal sex ratio in the hybrids compared with the two parent species was recorded. Specific growth rate (SGR) of the fish species revealed highest significant difference ($p<0.05$) in the hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* (2.64±0.09%), followed by the cross of ♀*C. gariepinus*× ♂ *C. gariepinus* (1.91±0.02%) while there were no significant differences ($p>0.05$) between the reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* (2.20±0.57%)and♀*H. bidorsalis*× ♂*H. bidorsalis* (2.19±0.19%). The SGR analysis proved that the crosses ♀*C. gariepinus*× ♂*C. gariepinus* had slow growth performance compared to its hybrid ♀*C. gariepinus*× ♂*H. bidorsalis*. Critical evaluation based on survival and specific growth performance showed superiority of the hybrid ♀*C. gariepinus*× ♂*H. bidorsalis*. The least survival in reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* (27.33%) can be explained from significant deformity (11.67%) recorded due to maternal effects. Hence, the hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* performed better in the SGR and survival.

Keywords: catfish, hybrid, specific growth rate, survival, deformity

INTRODUCTION

Hybridization has been of importance in both research and commercial aquaculture due to its benefits such as increased growth rate, sex ratio manipulation, production of sterile species and enhancement of many other desirable economic traits (Colombo *et al.,* 1996; Beaumont and Hoare, 2003; Dunham, 2004). Hybrid species possibly present higher growth and survival than either one or both of their parents species, and/or one or more characteristic(s) sought-after in the either parent species e.g. robustness, salinity/ thermal tolerance, morphology, flesh quality among others (Lenormand, 1988). Hybridization may also result to other traits that cannot be predicted from the knowledge about their parents' species and may be absent altogether, particularly in certain teleost families (Colombo *et al.,* 1996). Therefore, hybridization can be a source of evolution and speciation (Dunham, 2004). This study was aimed at producing hybrid progenies between the of *C. gariepinus* and *H. bidorsalis* for enhanced stock improvement.

MATERIALS AND METHODS

Location: The research was carried out at Biotechnology Laboratory, Department of Animal science, Obafemi Awolowo University, Ile-Ife.

Research Design: Milt and eggs of both *C. gariepinus* and *H. bidorsalis* were collected for same parent species and inter-specific crosses. The data on fertility, hatchability, deformity and survival were obtained following Olaniyi and Omitogun (2013). The hatchlings were left for 2 weeks in the hatchery before they were transferred to bigger breeding plastic tank (2M × 1M ×

0.5M). Thirty-five fingerlings of each of the crosses were allotted into breeding plastic tank, whereby more parameters such as survival, weight, and specific growth rate were recorded up to 12th week. The data were subjected to statistical analysis using the General Linear Models (GLM) procedure of software SAS, 2002 (SAS Institute, 2002).

RESULTS AND DISCUSSION

Effects of hybridization on fertility, hatchability and survival on the hybrids of C*larias gariepinus* and *Heterobranchus bidorsalis*: Table 1 showed the effects of hybridization on fertility, hatchability and survival with respect to crosses between *C. gariepinus* and *H. bidorsalis*. The fertility data revealed significant difference between the hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* (88.00±1.00%) compared to its reciprocal cross ♀*H. bidorsalis*× ♂*C. gariepinus* (71.67±10.41%). While all the other crosses hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* (88.00±1.00%), reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* (71.67±10.41%), were not significantly different from other crosses - same parent crosses (♀*C. gariepinus*× ♂*C. gariepinus*, 83.00±7.21%; ♀*H. bidorsalis*× ♂*H. bidorsalis*, 80.67±6.03%), ($p>0.05$). Hatchability revealed no significant differences between the all same parent species crosses (♀*C. gariepinus*× ♂*C. gariepinus*, 74.67±7.23%; ♀*H. bidorsalis*× ♂*H. bidorsalis*, 68.33±3.06%) ($p>0.05$), and hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* (79.33±4.04%), except with reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* (48.67±5.13%) that these were significantly different from all other crosses ($p<0.05$). The reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* recorded the highest deformity (11.67±3.06%) that was significantly different ($p<0.05$) from the rest of the crosses.The percent deformity of other crosses were not significantly different from one another ($p>0.05$). A week survival (%) revealed no significant difference ($p>0.05$) between the ♀*C. gariepinus*× ♂*C. gariepinus* (70.33±4.16%) and hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* (71.00±5.29%), but both showed significant difference ($p<0.05$) compared to the crosses of the reciprocal hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* (27.33±6.81%) that had the least at a week survival. Survival at both 4th through 12th weeks for hybrid ♀*H. bidorsalis*× ♂*C. gariepinus* was lowest and revealed significant difference among the rest of the crosses ($p<0.05$).

Table 1: Effects hybridization on fertility, hatchability and survival in C*larias gariepinus* and *Heterobranchus bidorsalis* hybrids

Parameters (%)	♀**C**×♂**C**	♀**C**×♂**H**	♀**H**×♂**C**	♀**H**×♂**H**
Fertility	83.00±7.21^{ab}	88.00±1.00^{a}	71.67±10.41^{b}	80.67±6.03^{ab}
Hatchability	74.67±7.23^{a}	79.33±4.04^{a}	48.67±5.13^{b}	68.33±3.06^{a}
Deformity	2.67±0.58^{b}	2.00±1.00^{b}	11.67±3.06^{a}	2.00±1.00^{b}
A wk survival	70.33±4.16^{a}	71.00±5.29^{a}	27.33±6.81^{c}	61.00±1.73^{b}
4wks survival	69.67±4.62^{a}	69.00±7.21^{a}	23.00±6.08^{c}	58.33±4.73^{b}
8wks survival	66.00±6.56^{a}	66.67±10.41^{a}	21.67±7.64^{b}	55.00±5.29^{a}
12wks survival	65.30±5.42^{a}	64.67±11.93^{a}	20.96±6.78^{b}	52.33±3.06^{a}

^{abc}Means within a row with different superscripts are significantly different (P<0.05). General Linear Model procedure (SAS®, 2002). C= *Clarias gariepinus*, H=*Heterobranchus bidorsalis*

Table 2: Growth evaluation and sex ratio of the C*larias gariepinus* and *Heterobranchus bidorsalis* hybrids

Parameters	♀**C**×♂**C**	♀**C**×♂**H**	♀**H**×♂**C**	♀**H**×♂**H**
Weight (g) @ 4wks	4.58±0.28^{a}	2.06±0.63^{a}	5.69±5.51^{a}	2.82±0.61^{a}
Weight (g) @ 12wk	53.39±1.67^{a}	61.23±11.97^{a}	74.66±32.73^{a}	47.27±1.46^{a}
Avg. daily weight gain (g)	0.87±0.03^{a}	0.32±0.00^{b}	1.23±0.49^{a}	0.79±0.04^{ab}
Specific growth rate (%/d)	1.91±0.024^{b}	2.64±0.09^{a}	2.20±0.57^{ab}	2.19±0.19^{ab}
Sex ratio* (Male:Female)	1:1^{ns}	1:1^{ns}	1:1^{ns}	1:1^{ns}

^{abc}Means within a row with different superscripts are significantly different (P<0.05). General Linear Model procedure (SAS®, 2002). C= *Clarias gariepinus*, H=*Heterobranchus bidorsalis*

Body weights at 4th and 12th weeks of the different crosses revealed no significance (P<0.05). The specific growth rate analysis proved that the progenies of ♀*C. gariepinus*× ♂*C. gariepinus* recorded slow growth performance compared to its hybrid ♀*C. gariepinus*× ♂*H. bidorsalis*. However, critical evaluation on the survival and specific growth performance showed the superiority of hybrid ♀*C. gariepinus*× ♂*H. bidorsalis*. In a related study, but with *C. gariepinus* with *H. longifilis*, Legendre *et al.* (1992) reported the hybrids to have similar growth rates performance with *H. longifilis* and at the same time in one of their experiments hybrid ♀*H. longifilis*× ♂*C. gariepinus* displayed faster growth than the *H. longifilis.* In another related study, the performance of hybrid ♀*C. gariepinus*× ♂*H. bidorsalis* was significant than its reciprocal

♀*H. bidorsalis*× ♂*C. gariepinus* (Ndimele *et al.*, 2011). Colombo *et al.* (1996) explained that five possible beneficial outcomes may result from hybridization, viz: intermediacy, combinability, luxuriance, monosexuality and novelty. In the light of this study, the outcome of hybridization with respect to parameters like SGR, average daily weight gain, sex ratio etc of the different crosses confirmed the varying or mixed outcome of hybridization. Colombo *et al.* (1996) further explained that hybridization can give traits that cannot be predicted from the knowledge about the hybrids' parent species and also, it may be absent altogether particularly in some teleost families. The sex ratio (male: female) showed no significant deviation from 1:1 chi-square testing ($p>0.05$) across all the progenies (Table 2). This study showed an outcome of equal sex ratio in the hybrids compared to their parents. This result corroborated the study of Legendre *et al.* (1992) that also found out equilibrated sex ratio in the hybridization study between *H. longifilis* and *C. gariepinus*. The outcome of equal sex ratio between the hybrids and the parents confirmed the hypothesis of same sex determining mechanism as also reported in hybridization study between *H. longifilis* and *C. gariepinus* (Legendre *et al.*, 1992).

CONCLUSION AND RECOMMENDATION

♀*C. gariepinus*× ♂*H. bidorsalis* revealed better survival and growth based on the data, and is therefore recommended to commercial fish farmers.

REFERENCES

Beaumont, A.R. and Hoare, K. 2003. Biotechnology and Genetics in Fisheries and Aquaculture. Blackwell Science Ltd, 0-632-05515-4 Blackwell Publishing Company, USA. 158pp.

Colombo, L., Barbaro, A., Francescon, A., Libertini, A., Benedetti, P., Balla Valle, L., Pazzaglia, M., Pugi, L., Argenton, F., Bortolussi, M., and Belvedere, P. 1996. Potential gains through genetic improvements: Chromosome set manipulation and hybridization. ln:*Proceedings of the International Workshop on Seabass and Seabream Culture: Problems and Prospects,* Chatain, B., Saroglia, M., Sweetman, J. and Lavens, P. (eds). International Workshop, Verona, Italy, 16/18-10-1996, *Published by European Aquaculture Society,* Oostende, Belgium, 343-362pp.

Dunham, R.A. 2004. Aquaculture and Fisheries Biotechnology, Genetic Approaches. CABI Publishing, CAB International, Oxfordshire OX10 8DE, UK. 372p.

Legendre, M., Teugels, G.G., Canty, C., and Jalabert B. 1992. A comparative study on morphology, growth rate and reproduction of *Clarias gariepinus* (Burchell 1822), *Heterobranchus longifilis* (Valenciennes, 1840), and their reciprocal hybrids (Pisces: *Clariidae*). *J. Fish Biol*. 40: 59-79.

Lenormand, S., Slembrouck J., Pouyaud L., Subadgja J., and Legendre, M. 1988. Evaluation of hybridisation in five *Clarias* species (Siluriformes, *Clariidae*) of African (*C. gariepinus*) and Asian origin (*C. batrachus, C. meladerma; C. nieuhofii and C. teijsmanni*). In: Mare Legendre, Antoine Pariselle (eds.). Proceedings of the mid-term workshop of the "Catfish Asia Project": The biological diversity and aquaculture of *Clariid* and *Pangasiid* catfishes in South-East Asia. Cantho, Vietnam, 11-15 May. 195-209 pp.

Ndimele, P.E., Owodeinde, F.G., Kumolu-Johnson, C.A., Jimoh, A.A., Whenu, O.O. and Onyenania, O.B. 2011. Growth Performance of the reciprocal hybrids of *Clarias gariepinus* (Burchell, 1822) and *Heterobranchus bidorsalis* (Valenciennes, 1840). *Current Res J Biol Sci* 3(1): 137-140.

Olaniyi, W.A., and Omitogun, O.G. (2013). Stages in the early and larval development of the African catfish *Clarias gariepinus* (Teleostei, *Clariidae*). *Zygote,* 22: 314 – 330.

GENETIC VARIABILITY OF GRASSCUTTER (*Thyronymus swinderianus L) IN IMO STATE* USING RANDOM AMPLIFIED POLYMORPHIC DNA (RAPD) MARKERS

Ahamba S. I., U. E. Ogundu & C. U. Ekugba
Department of Animal Science and Technology, Federal University of Technology, P.M.B. 1526 Owerri, Nigeria.
Corresponding author:** S. I. Ahamba, **Email; ahambaifeanyi@futo.edu.ng

ABSTRACT
Genetic variability of grasscutter (*Thyronymus swinderianus L*) was investigated using random amplified polymorphic DNA markers in Imo state. A total of four primers of arbitrary sequence were used and all of them generated reproducible, scorable and polymorphic bands. The highest percentage polymorphic band was recognized for primer OPA19 (100%) while the lowest percentage of polymorphic band was recognized for the primers OPA14 (50%). The observed number of alleles (Ne) had values ranging between 1.50±0.52 – 2.00±0.00 for OPA14 and OPA19 respectively. Similar trend was observed for Ne, H, and I with values ranging between 1.39±0.42 for OPA14 to 1.81±0.14 for OPA19; 0.22±0.23 for OPA14 to 0.44±0.05 for OPA19 and 0.31±0.33 for OPA14 to 0.64±0.05for OPA19 respectively considering the genetic diversity indices for combined loci. Similarly, considering the genetic diversity indices between the grasscutter population/strain, the light strain had the higher value for all the diversity indices; Na (1.71), Ne (1.56), H (0.25) and I (0.44) than the dark strain; Na (1.61), Ne (1.39), H (0.25) and I (0.34). The study therefore suggested that RAPD can be successfully utilized for detecting genetic variability among the studied grasscutter population and there could be selection within and between the studied populations for genetic improvement.
Keywords: Grasscutter, RAPD markers, genetic variability, strain, heterosis.

INTRODUCTION
Asibey and Adel (2000) reported that grasscutter is the most preferred and most expensive bush meat in West Africa (Nigeria, Togo, Benin, Ghana and Cote d'ivoire) and contributes to both local and export earning of most of these countries. The meat is a delicacy (Adu and Yeboah, 2000; Addo, 2002) eaten by all classes of people with no religious prohibition (Opara, 2010b), and is also exported to continental Europe and the United states, where it is sold mainly to West Africans living in these regions (Adu, 1999).

According to Akinloye (2005), Grasscutters show slight phenotypic variations especially in the colour of their fur so it is important to analyze their genetic variability in order to identify populations and individuals of particular merit.

Nowadays, due to advancement in molecular genetics and affordability of DNA analysis, genetic diversity can be measured directly on the DNA itself and it accurately presents the genetic variations between breeds, within breeds, and within half and full-sib groups. Hence the study intends to identify the genetic variability of grasscutter in Owerri, Imo State, using RAPD markers; determine allelic diversity of the populations and the genetic distance between the two studied strains of grasscutter (*thryonymus swinderianus),* to help understand the evolutionary process that affect it.

MATERIALS AND METHODS
The research was conducted in Owerri and Okigwe, Imo State Nigeria. Owerri is one of the largest and the populous cities in Southern Nigeria. It is the capital city of Imo State with coordinates; 5°28'34.7160" N and 7°1'33.0708" E. and Okigwe has the coordinates; 5°49'0" N and 7°21'0" E. Annual rainfall in Imo State usually varies from 1990mm to 2200mm. The mean annual temperature is above 20° c with an average annual relative humidity of 75%. Five to ten hair samples were taken from a total of 30 grasscutters (15 grasscutter from each colour variants) selected from two different locations; the wild (by hunters from bush meat market, Okigwe) and from Imo State Zoo, Owerri, both in Imo State between November - December, 2018 during the survey stage of the study. The hair samples were preserved and transported to African Bioscienecs Laboratory, Ibadan, Oyo State, for molecular analysis. Out of the 30

hair samples collected, only 24 samples lysed while 6 samples were unable to lyse. Therefore, DNA extraction was carried out with 24 samples that were able to lyse. The quantity and quality of DNA was measured using NanoDrop spectrophotometer (Thermo Scientific, USA). The DNA was then stored at -30°C until ready for use. The extracted DNA was amplified by Polymerase Chain Reaction (PCR), and the amplified products were size-fractionated in a 1.2% agarose gel containing ethidium bromide in Tris-borate EDTA buffer and visualized under UV transillumination. The PCR amplified bands were scored visually on the basis of their presence (1) or absence (0). The scores obtained were then pooled for constructing a single data matrix, which was used for estimating the genetic diversity indices using GenAlex software.

RESULTS AND DISCUSSIONS

The result on table1 reveals the genetic diversity indices for all loci combined. The displayed diversity indices were; observed number of allele (Na), effective number of alleles (Ne), Nei's heterozygosity (H) and Shannon's index (I). The observed number of alleles (Na) had values ranging between 1.50±0.52 – 2.00±0.00 for OPA14 and OPA19 respectively. Similar trend was observed for Ne, H and I with values ranging between 1.39±0.42 for OPA14 to 1.81±0.14 for OPA19; 0.22±0.23 for OPA14 to 0.44±0.05 for OPA19 and 0.31±0.33 for OPA14 to 0.64±0.05 for OPA19 respectively. There is no previous information about using RAPD marker to investigate genetic diversity of grasscutter. However, the range values obtained for the diversity indices are compared with other rodents such as rabbits and laboratory rats, guinea pig and mice. Shannon index value obtained in the study was lower than that reported by Kumar *et al*., (2014). The Shannon Index of Nigerian grasscutter breed in the study revealed low species richness and evenness since all the indices were below 3.5, the mark set for high species evenness and richness (Krebs, 1989). The low average Shannon's Index (I) obtained in the study could be attributed to close descent. The value of effective number (Ne) of alleles obtained in the study was lower than the findings of El- Sayed *et al*., (2018) and Mohammed and Abdelfattal (2018). The lower value of (Ne)could be attributed to effective sample size. This agrees with the findings of de Vicente, (2004) who opined that effective number of allele (Ne) can be used with codominant marker data and its calculation may be affected by sample size. Heterozygosis deficiency (low genetic variability) recorded in the study may have also resulted from one or more of these following factors; presence of null alleles, small sample size, Wahlund effect and/or the decrease in heterozygosity due to increased consanquinity (inbreeding) (Kumar *et al.,* 2006).

Table 1: **Genetic diversity indices for all the loci combined**

Markers	Na	Ne	H	I
OPA08	1.92 (0.29)	1.72 (0.33)	0.32 (0.16)	0.56 (0.21)
OPA11	1.92 (0.29)	1.58 (0.31)	0.34 (0.14)	0.51 (0.19)
OPA14	1.50 (0.52)	1.39 (0.42)	0.22 (0.23)	0.31 (0.33)
OPA19	2.00 (0.00)	1.81 (0.14)	0.44 (0.05)	0.64 (0.05)

Na – Observed number of allele, Ne – Effective number of allele, H – Nei's heterozygosity or gene diversity, I – Shannon's Information Index, OPA08 – primer 1, OPA11 – primer 2, OPA14 – primer 3, OPA19 – primer 4.

The result of the genetic diversity indices within the grasscutter population is shown in table 2. Diversity indices values for the light strain population were; Na (1.71), Ne (1.56), H (0.31) and I (0.44). While indices for the dark strain were; Na (1.61), Ne (1.39), H (0.25) and I (0.34). the values for the light strain were generally higher than those for the dark strain/population.

Table 2: Genetic Diversity Indices between the Grasscutter Population/Strain

Population/strain	Na	Ne	H	I
Light	1.71	1.56	0.31	0.44
Dark	1.61	1.39	0.25	0.34

Na – Observed number of allele, Ne – Effective number of allele, H – Nei's heterozygosity or gene diversity, I – Shannon's Information Index.

Nei's original measure of genetic similarity and Genetic distance were used to assess the genetic similarity (above diagonal) and genetic distance (below diagonal) across the two colour variants population of grasscutter in Imo state as shown in Table 3. The genetic similarity obtained in the result was 0.7904 (79.04%), while the genetic distance was 0.2353 (23.53%). Genetic distance is a measure of the genetic divergence between species or between populations within a species, whether the distance measures time from common ancestors or degree of differentiation (Nei, 1987). However, the genetic similarity of the grasscutter populations studied in Imo state was very high while genetic distance in the grasscutter populations was very low. This is an indication that the population/strains are closely related and have common ancestors. Hence, this will give an insight on the level at which the species is endangered as suggested by Ruane (1999).

Table 3: Measures of Genetic Similarity and Genetic Distance (Nei's 1972)

Population ID	Dark	Light
Dark	…….	0.7904
Light	0.2353	……

Above diagonal, genetic similarity; below diagonal, genetic difference

CONCLUSION

As far as genetics of grasscutter is concerned, this is the first time RAPD markers have been used to study the population in Nigeria and of course the first of its kind in the species range. These results will form a baseline from which inferences can be made for comparison in future variability, and diversity studies on the grasscutter. Since variations exist within and between the studied populations, selection of superior individuals within and between the populations/strains could be done for outcrossing. The diversity indices revealed how informative the primers are in assessing heterogeneity in the population and serves as an index that reflects genetic variation of RAPD loci. Hence, the various values of the diversity indices showed that assertions should not be made only with an index. There is need to combine the various information from the indices before assertions could be made.

RECOMMENDATIONS

The study therefore recommends that the light population should be given more attention for selection and improvement, since it harbors more diversity in the gene, as this will help the population to adapt to changing environmental conditions. However, superior individuals within the different populations/strains could be selected, cross bred within the populations (inbreeding) and crossed between the populations/strain (outcrossing) for improvement and heterosis respectively. Further molecular genetic

studies should be conducted on grasscutter in Nigeria, especially one involving the use of other marker tools and sequencing of the DNA to infer accurately and precisely, if the colour variations that exist within this breed could have a genetic potential needed for breeding, other than mere phenotypic variation.

REFERENCES

Addo, P. (2002). Detection of Mating Pregnancy and Imminent Parturition in the Grasscutter (*Thryonomys swinderianus*) Livest. Res. *Rural Dev., 14: 8-13.*

Adu, E.K. & Yeboah, S. (2000). The Efficacy of the Vaginal Plug Formation after Mating for Pregnancy Diagnosis and Embryonic Resorption In-Utero in the greater Cane Rat (*Thryonomys swinderianus Temminck). J. Trop. Animal Health Prod*., 32: 1-10.

Adu, E.K. (1999). Grasscutter Farming: *A Manual for Beginners*. INSTI. and CSIR., Accra, Ghana.

Akinloye, A.P. (2005). Update on Grasscutter Rearing-*Thryonomys swinderianus Akwa Ibom State, pp: 537-550.*

Asibey, E.O.A. & Adel, P.G. (2000). The Grasscutter, a Promising Animal for Meat Production. In: African Perspective Practices and Policies Supporting Sustainable Development, *Turnham, D. (Ed.). Weaver Press*, Zimbabwe.

de Vicente, M.C., López, C. and Fulton, T. (eds.). 2004. Genetic Diversity Analysis with Molecular Marker Data: Learning Module. International Plant Genetic Resources Institute (IPGRI), Rome, Italy.

El-Sayed, M.A., Sahar, S.E.A., Amira, E., Neama, I. A., Sherif, R. & Ahmed, F. (2018). Genetic and Phenotypic Characterization of the Native Rabbit in Middle Egypt. *Vet World*. 11(8): pp 1120-1126.

Krebs, C.J. (1989). Ecological Methodology. *Haper and Row*, New York.

Kumar, M. & Kumar, S. (2014). Genetic Structure and Inter-generic Relationship of Closed Colony of Laboratory Rodents Based on RAPD markers. *Molecular Biology*, 41(11): 7273-80. http://doi.org/10.1007/s11033-014-3612-9

Kumar, S., Gupta, T., Kumar, N., Dikshit, K., Navani, N., Jain, P. & Nagarajan, M. (2006). Genetic Variation and Relationships among Eight Indian Riverine Buffalo Breeds. *Mol. Ecol*., 15: 593-600

De Vincent, M. C. (IPGRI), Lopez, C. (Universided Nacional Agrasia 'La Molina;Pern) and Fulton, T. (Institute for Genomic Diversity, Cornell University), (2003). Genetic diversity analysis with molecular marker data. *learning module*,

Mohamed, E. A., Abdelfattah, M. G., (2018). Genetic diversity assessment among six rabbit breeds using RAPD and SRAP markers. *Egyptian Journal of genetics and cytology.* 15(1): 0046-161

Nei, M. (1987). Molecular Evolutionary Genetics. *Columbia University Press*. New York.

Opara, M. N. (2010). The Grasscutter I: A livestock of tomorrow. *Research Journal of Forestry* 4: 119–135.

Ruane, J. (1999). A Critical Review of the Genetic Distance Studies in Conservation of Resources. *J. Anim. Breed. Genet*.116, 317-323.

EFFECT OF HEAT STRESS ON MILK YIELD AND MILK COMPOSITION TRAITS OF HOLSTEIN-FRIESIAN COWS IN KANO STATE

[1]Garba, M.S., [1]Adedibu, I.I., [1]Kabir, M. & [1]Agboola, L.O.,
[1]Department of Animal Science, Ahmadu Bello University, Zaria
Corresponding author: mujaheedmajesty@gmail.com; 08034413424

ABSTRACT
This study was conducted to evaluate the effect of temperature-humidity index on milk traits of pure Holstein-Friesian cows in Kano State. Twenty mid-lactating Holstein-Friesian cows (three years of age with a mean weight of 1200kg) were used for this experiment. The cows were raised intensively in a covered free stall barn ($3m^2$ per cow) with straw bedding. Metrological data, both inside and outside, of the barn including temperature (maximum and minimum) from both digital and analogue (dry and wet bulb) thermometers and relative humidity were collected. Three composite samples of milk from the cows were taken per month (on the 15th day of each month) and were analysed for protein, fat and somatic cells. Meteorological data were analysed to identify the most appropriate temperature-humidity index (THI) to measure heat stress in this study. Data were analysed using Analysis of Variance (ANOVA) and correlation procedures in the Statistical package SAS (2013). Comparison of the Means was done using Duncan Multiple range tests of the same statistical package. The minimum temperature for the period of the experiment had the lowest value (23.08 ± 0.62^0C) in the month of December in Early dry season while the highest value (33.64 ± 0.83^0C) was recorded in the April of the Late dry season. The differences in the THI for the two periods resulted in significant different ($P < 0.05$) in milk yield and milk composition traits. It was concluded that, heat stress affect milk production, milk composition of Holstein-Friesians cows reared in Kano State environment.
Keywords: Heat stress, Milk yield, Milk composition traits, Holstein-Friesian, and Kano State

INTRODUCTION
Nigeria population is increasing rapidly (Ibeawuchi *et al*., 2000) and domestic output of 407,000 metric tonnes of milk (Olaloku, 1999) obtaining from 14 million cattle in the country (RIM, 1992) can barely satisfy the milk demands of the growing population. For this reason, milk production in the country is being supplemented by milk from imported breed of dairy cows. Holstein Friesian is one of the commonly exotic breeds of cows being used for milk production in Nigeria. This breed however tends to perform below their potential when compared with their level of production abroad.

Thermal environment is a major factor that can negatively influence milk production of dairy cattle especially those of high genetic merit (Kadzere *et al*. 2002). Yano *et al.* (2014) indicated that individual cow genetic composition and some environmental conditions such as temperature are contributing factors that affect milk yield in dairy cow. The temperature-humidity index (THI) could be used to determine the influence of heat stress on productivity of dairy cows (Ghavi *et al*., 2013; Adedibu *et al*., 2015). Extensive efforts have been made to quantify the effect of heat on milk production, investigating such factors as humidity, wind speed, daylight length, and temperature and humidity indices (THIs) (Bouraoui *et al*., 2002; Ghavi *et al*., 2013; Yano *et al*., 2014) for different breeds of cattle in different environments in the world. Results from such works would provide useful information on heat tolerant traits and could be used as a guide in making selection decision from existing breeds and also a guide in management of dairy breeds. This kind of information however is limited for Holstein breed of cattle in Nigeria. The objective of this research is to evaluate the effect of temperature-humidity index on daily milk production of Holstein cows under climate conditions in Kano State.

MATERIALS AND METHODS
Study Area
The study was conducted at Sa'ada Farm Dawakin Kudu Local Government Area of Kano State, Nigeria.TheState covers an area extending between Latitudes 10º 3'N and 12º 4'N of Equator and

Longitude 7º 4'E and 9º 3'E of the Prime meridian. The State experiences two seasons, the rainy season, which starts in April and ends in late October, and the dry season, which starts in November and ends in April (Asimalowo, 2011). This can be subdivided into early dry (November, December and January), late dry (February, March and April), early rain (May, June and July) and late rain (August, September and October) (Josiah *et al*., 2015).

Experimental Animals and their Management

Twenty mid-lactating Holstein Friesian cows (three years of age with a mean weight of 1200kg) were used for this experiment, the cows were raised intensively in a covered free stall barn ($3m^2$ per cow) with straw bedding. They were fed according to the production level. The metal roofs used in covering the stall barn is covered with straws.

Data Collection

Daily Milk Yield and Milk Composition

The cows were milked two times daily (6:00 - 7:00, and 17:00 – 18:00 h) with Asin® electric milking machine manufactured by Popsort® of China. Three composite samples were taken per month (on the 15th day of each month) and were analyzed for protein, fat and somatic cells. Milk samples were prepared following the method proposed by Bobe *et al*. (1998) and were preserved using Bronopol, 2-Bromo-2-Nitropropane-1,3-diol that was added immediately to raw milk samples at 0.6:100 to prevent microbial growth. The samples were later stored at 4^0C (Nagy *et al.*, 2013) before it they were transported for laboratory analysis.

The milk samples were taken to the Biochemistry laboratory, Department of Biochemistry, Bayero University, Kano to analyse for, milk fat (%) and milk protein (%). Fat yield and protein yield were deduced from milk fat (%) and milk protein (%) respectively, following the methods of Bouraoui *et al.* (2002). The fat yield was estimated as milk fat (%) times milk yield ($kg.d^{-1}$) and protein yieldwas estimated as milk protein (%) times milk yield ($kg.d^{-1}$).

Somatic Cell Count

Part of the milk was also analysed for Somatic cell counts at the Clinical Microbiology Laboratory in the Department of Microbiology Bayero University, Kano. The electronic microscope was used to determine the somatic cell counts using the microscopic factor to determine the number of cells per ml of milk.

Meteorological data

Temperature and humidity both inside and outside of the barn were measured using two of Youkong® digital thermometer and hygrometer manufactured by HTC of China. Daily maximum and minimum temperatures were recorded at 7:00 hour, 13:00 hour and 17:00 hour using maximum-minimum thermometers.. This digital thermometer and hydrometer were mounted in the open, under the tree, and the other thermometer and hydrometer mounted in the shed

Data Analysis

Meteorological data was analyzed to identify the most appropriate temperature-humidity index (THI) to measure heat stress in this study. Temperature-Humidity index for the period of experiment was calculated using Angular (2008):

$$THI = (1.8 \times T + 32) - (0.55 - 0.0055 \times RH) \times (1.8 \times Ta - 26);$$ (Angular, 2008);

T = Temperature in degree Celsius (^{0}C); RH = Relative humidity in percentage (%)

Statistical analysis

To determine the effect of temperature humidity index on milk yield and milk compositions a fixed model where repeated measurements per cow was considered random. Data was analysed using Analysis of Variance (ANOVA) procedures in the Statistical package SAS (2013). Comparison of the Means was done using Duncan Multiple range tests of the same statistical package.

Statistical Models

$$Y_{ij} = \mu + P_i + \mathcal{E}_{ij}$$

Where: Y_{ij} = the ith observations (milk yield, milk fat, milk protein) at the different i^{th} period;

μ = mean effect;
Pi = effect of ith period (early dry and late dry);
$\mathcal{E}_{ijk}$ = residual effect.

RESULTS AND DISCUSSUION

The results of the average values of climatic factors for the period of experiment and the conventional comfort zone for Holstein-Friesian cows is presented in Table 1. There was variation in the average temperature (T), relative humidity (RH), the temperature-humidity index (THI) during the period of the experiment. T, RH and THI for the late dry season was higher than the early dry and also was higher than the values of the comfort zone for dairy cattle.This indicates that during these seasons Holstein cows reared in Kano state were subjected to heat stress. Gantner *et al*. (2011) gave the bovine thermal comfort zone to be between -13°C to +25°C, within this temperature range, the animal comfort is optimal, with a body temperature between 38.4°C and 39.1°C. However, in situation where temperature is above 25°C, and even as low as 20°C (Gantner *et al.*, 2011) the cow suffers from heat stress: its health status and production performance are affected. On the other hand, a mean daily THI in value of 72 is considered to be the critical point at which milk yield is reduced (Johnson, 1985; Gantner *et al*., 2011).

The results of the effect of heat stress on milk yield and milk composition is as shown in Table 2. Temperature humidity index (THI) values went from 69 in the early dry period to 74.38 in the late dry season period. The differences in the THI for the two periods resulted in significant different ($P<0.05$) in milk yield and milk composition traits. The milk production was higher in the Early dry season compared to the late dry season. Similar pattern was also observed for milk fat, milk protein, fat yield, protein yield and somatic cell counts. This results corroborate with the findings of Bouraoui *et al*. (2002) who indicated that a rise in THI from 68 in spring to 78 in the summer had effect on milk production in confined Holstein cows in the Mediterranean climate. This is because heat stress is known to result in reductions in voluntary feed intake and thus subsequent declines in milk production in lactating dairy cows (Johnson, 1985; Bouraoui *et al*., 2002). The resultant declination in milk yield lead to consequential reduction in the milk composition as researchers have found a high correlation between milk yield and other milk composition (Ghavi, *et al*., 2013). This explain the lower values recorded for milk composition traits in this study when the THI was above the comfort zone for Holstein-Friesian cows.

Table 1: Average value of climatic factors for the experimental period and the comfort zone for Holstein-Friesian cows

Factor	Early dry season	Late dry season	Comfort zone for Holstein cattle
Temperature (^{0}C)	25.88±0.36	31.22±0.31	-13 to +25 (Lefebvre and Plamondon, 2003)
RH (%)	13.10±0.31	13.19±0.49	0 to 45 (Gantner *et al*., 2011)
THI	68.99±0.44	74.38±0.47	Bellow 72 (Johnson, 1987)

THI- Temperature-Humidity index RH- Relative Humidity

Table 2: Heat stress (THI) effect on milk yield and milk composition

Traits	Periods		
	Early dry season (THI = 69.00)	Late dry season (THI = 74.38)	P-value
Milk yield ($kg \cdot d^{-1}$)	20.12±1.04[a]	12.99±1.04[b]	0.0002
Milk fat (%)	3.56±0.16[a]	2.84±0.16[b]	0.0048
Milk protein (%)	3.26±0.12[a]	2.48±0.12[b]	0.0004
Fat yield ($g \cdot d^{-1}$)	0.72±0.039[a]	0.36±0.039[b]	0.0001
Protein yield ($g \cdot d^{-1}$)	0.66±0.04[a]	0.33±0.04[b]	0.0001
Somatic cell counts × 10^5	2.86±0.45[a]	4.03±0.45[a]	0.0482

THI- Temperature-Humidity index for the period

[ab]means along the same row are significantly different

CONCLUSION AND RECOMMENDATION

Heat stress influence milk production traits, milk composition traits, body weight, body condition score and udder traits of Holstein-Friesians cows reared in Kano State environment. Breeder and dairy farmer should consider milk yield and milk composition traits in the selection and in the management of dairy cows.

REFERENCES

Adedibu I.I., Barje, P.P., Mohammed, A., Kabir M. and Akinsola, O.M. (2015). Comparison of Friesian x Bunaji Crosses for Milk Production Traits in the Era of Climate Change. *Journal of Agriculture and Agricultural Technology*, 6(1): 47-52.

Angular, I. (2008). Genetics of heat tolerance for production traits in dairy cattle. A thesis Submitted to the Graduate Faculty of the University of Georgia in Partial Fulfilment of the Degree Master of Science. Athens, Georgia.

Asimalowo A. A. (2011). Kano, Nigeria: Adoption and impact of dry-season dual-purpose cowpea in the Nigerian semiarid region. Horizon International Solutions Site (https://www.solutions-site.org/node/41). Assess on 29 September 2018.

Bobe, G., Beitz, D.C., Freeman, A.E. and Lindberg, G.L. (1998). Separation and quantification of bovine milk proteins by reversed-phase high performance liquid chromatography. *Journal of Agricultural and Food Chemistry*, 46 :458-463.

Bouraoui, R. Lahmar, M., Majdoub, A., Djemali, M. and Belyea, R. (2002). The relationship of temperature-humidity index with milk production of dairy cows in a Mediterranean climate. *Animal Research, EDP Sciences*, 51 (6):479-491.

Gantner, V., Mijic, P. Kuterovac, K. Solic D. and Gantner, R. (2011). Temperature-humidity index values and their significance on the daily production of dairy cattle. *Mljekarstvo*, 61: 56-63.

Ghavi, H. N., Mohit, A. and Azad, N. (2013). Effect of temperature-humidity index on productive and reproductive performances of Iranian Holstein cows. Iranian Journal of Veterinary Research,14 (2) :106-112.

Ibeawuchi, J.A., Chindo, L. and Ahamefule, F.O. (2000). Milk production characteristics of imported Holstein-Friesian cattle maintained in a tropical high altitude environment. *Journal of Sustainable Agricultural Environment*. 2: 14-19.

Johnson, H. D. (1985). Physiological responses and productivity of cattle, in: Yousef M.K. (Ed.), Stress physiology in livestock. Basic principles, Vol. 1, 4-19, CRC Press, Boca Raton, Florida. pp. 4–19.

Josiah, G. J., Omalu, C. J., Makun, H. J., Chiezey, N. P. And Abah, O. I. (2015). Haemonchosis and Haemoparasites of Small Ruminants Reared in North Western, Nigeria. *Animal Research International*, 12(3): 2284 – 2291.

Kadzere, (2002). Heat stress in lactating dairy cows: a review. *Livestock Production Science*, 77:59-91.

Nagy, P., Faye B., Marko, O., Thomas, S., Wernery, U. and Juhasz, J. (2013). Microbiological quality and somatic cell count in bulk milk of dromandry camels (*Camelus dromedaries)*: Discriptive statistics, correlations, and factors of variation. *Journal of Dairy Science*, 96 :5625–5640.

Olaloku, E.A. (1999). Problems and possibilities for milk production. In: Animal production in the tropics. Ibadan press, pp: 43-64.

R.I.M. (1992). Resources Inventory and Management. Federal Department of Livestock and pest control services, Abuja, Nigeria.

SAS Institute. (2013). SAS®/STAT Software, Release 9.2. SAS Institute, Inc., Cary, NC. USA

Yano, M., Shimadzu, H. and Endo, T. (2014). Modelling temperature effects on milk production: a study on Holstein cows at a Japanese farm. *SpringerPlus*, 3(129) :1-11. doi:10.1186/2193-1801-3-129

EFFECT OF ALOE VERA GEL ON SEMEN PRODUCTION AND QUALITY CHARACTERISTICS OF NOILER COCKS

[1]Nuhu, S. H., [1]Oyeniran J. O., [2]Kalla, D. J. U., [3]Saleh, B. [1]Mohammed, A., [1]Yaro, S. S. & [1]Sani, A.
[1]Department of Animal Health and Production Federal Polytechnic, Bauchi. [2]Department of Animal Production Abubakar Tafawa Balewa University, Bauchi. [3]Department of Animal Science, University of Maiduguri
Corresponding author hussainisn80@gmail.com 08038677482

ABSTRACT
A total of twelve (12) healthy Noiler cocks, with an average weight 4.3kg were randomly allotted to three experiment groups in complete randomized design. Treatment one (T1) was provided with aloe vera free water while treatments two (T2) and three (T3) were provided with 10% and 20% aloe vera gel per litre of drinking water respectively. The cocks were housed individually and were fed with commercial grower diet. Feed and water were offered *adlibitum* throughout the two months experiment period. Data collected from the study included semen colour, ejaculate volume, motility, semen concentration and live sperm cells percentage. The data obtained were subjected to statistical analysis. The result showed that semen color were similar for all groups. There was significant ($P<0.05$) impact of the aloe vera gel on ejaculate volume, motility, sperm concentration and live sperm cells percentage. Ejaculate volume was higher ($P<0.05$) for cock on 20% aloe vera gel compared to the control and 10% inclusion. It was concluded from the study that 20% aloe gel had better semen quality than 10% and control, hence based on this aloe gel can enhance semen characteristics in adults Noiler cocks at 20% inclusion level.
Key words: Aloe vera gel, Noiler, Semen production, Semen quality.

INTRODUCTION
Local chickens are important in overall food production systems in developing economies mostly because of their adaptation to the tropical environment. They may appear to produce less than highly specialized commercial breeds; however, they possess attributes that make their sustainability on available local resources more ecological and economical in the long term. Incorporation of the Nigerian local chicken as a parent breed stock in the nation's breeding programme is important to meet the increase in poultry product demand by the citizenry (Adeoye *et al*., 2017). Noiler is an improved breed of chicken that have some adaptive features of local chicken. It however, grows faster and bigger. They are dual purpose hardy breed. They require low technology inputs and are becoming popular among back yard farmers (Olurundare, 2015).
Resistance of pathogenic microorganism to drugs frequently as feed additive on poultry production has made scientist to focus on medicinal plants (aloe vera, neem, mulberry leaves etc.) to improve nutritional and health status of poultry (Babak *et al*., 2011). The consumption and demand for medicinal plants in poultry production have been adopted in many countries because of its low cost, availability, affordability for a common farmer, good antimicrobial nature, reduced diseases associated risks, lowering blood cholesterol level and diversified functions in improving performance in birds. *Aloe vera* is a wild plant, however its application in the domestic society cannot be over emphasized (Darabighane and Nahashon, 2014). The most important part of *Aloe vera* is its leaf which is composed of two main sections: latex and gel. The gel composed of about 98.5% to 99.5% water, Polysaccharides (glucomannan and acemannan) Others are carboxypeptidase, magnesium, zinc, calcium, glucose, cholesterol, salicylic acid, prostaglandin precursors (gammalinolenic acid [GLA]), vitamins A, C, E, lignins, saponins, plant sterols and amino acids (Sharrif and Sandeep, 2011).
Modaresi and Khodadadi (2014) reported that aloe vera extract in Mice affected spermatogenesis directly via stimulating activity of germinal cells and cell division and also indirectly via stimulating leydig cells and increasing testosterone. The assessment of semen quality characteristics of poultry birds gives an excellent indicator of their reproductive potential (Hani *et al*., 2016).

The aim of this study was to determine the effect of aloe vera gel on the semen characteristics of Noiler cocks.

MATERIALS AND METHOD

Location

The study was conducted at the teaching and research farm of Federal Polytechnic Bauchi, Nigeria. Bauchi is on latitude 10^{0C} 27'North, 9^{0c}49' East at an altitude of 690.2 meters above sea level (Zaharaddeen *et al*., 2005).

Experimental Birds and Management

A total of twelve apparently healthy Noilers cocks, with an average weight of 4.3kg were used for the present study. The cocks were obtained from back yard poultry farmers in Bauchi metropolis. They were individually housed single in a well-ventilated cage. They were fed a commercial grower diet. Fresh water was given, medical care such as deworming and broad spectrum anti-biotic were provided during the adjustment period. The twelve cocks were weighed and randomly divided into three treatments (i.e. four cocks per treatment).The control group (T1) were provided with plain water while treatment T2 and T3 were provided with 10 and 20ml aloe-Vera gel per litre of water respectively.

Preparation of Aloe Vera Gel Infusion

Aloe Vera gel infusion was prepared according to method of Durrani *et al*., (2008). Fresh aloe Vera was collected from garden for extraction of the gel. The extraction from the leaf was done manually by making a cut, using a small knife. Latex of the leaf was remove and gel was collected in a beaker. The 10% and 20% concentration infusion were prepared by mixing 100g and 200g of fresh gel in a glass bottle and one litre of boiled water at room temperature was shaked for 5-7 minutes to ensure through mixing and was then kept for 6-8 hours at room temperature prior to usage.

Semen Collection and Evaluation

Prior to the collection of the semen, the birds were subjected to preliminary training for two weeks to enable them produce enough semen during actual semen collection exercise. Semen was collected twice a week using abdominal massage methods (Quinn and Burrow, 1936). Semen colour was obtained by visual appraisal of the sample. Volume was determined using a calibrated pipette. Motility of cells were obtained by placing a drop of the sample on a glass slide and observed with a microscope using low power at X10 and X40 magnification respectively. The results were graded from 1 to 5 (Tarif *et al*., 2013). To determine concentration, the sample was diluted with normal saline at 1:400. Hemocytometer was filled with the diluted semen by capillary action. The hemocytometer was then mounted and the sperm cells were counted and expressed as billion per ml. Eosin was used to determine the live sperm percentage. The stain was prepared by dissolving 1.67g of eosin, and 2.9g sodium citrate with two molecules of water in 100ml distilled water. The stain was filtered before use. Briefly, a 10µl drop of fresh semen was mixed with 200µl of eosin stain on a glass slide followed by making a thin smear of it. The spermatozoa were examined at 400x magnification under a phase contrast microscope. At least 100 spermatozoa were counted to determine the percentage of live sperm spermatozoa. The spermatozoa which appeared pink (stained with eosin) were regarded as dead while those not stained (no penetration of eosin stain) were regarded as live (Tarif *et al*., 2013).

Statistical analysis

The data were were subjected to analysis of variance in a completely randomized design using SPSS software (ver.20.0 for windows, IBM SPSS) Means were compared for significance of differences by Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Table below showed that the ejaculate volume varies ($P<0.05$) at 20% percent level of aloe gel from control and 10% inclusion. The semen volume obtained in this study was within the range (0.2 to 0.8ml) for red and white Shika brown as recorded by Rwaan *et al.* (2009). The motility of the semen was significant at 10% ($P<0.05$), followed by 20% level of aloe vera gel and the least ($P<0.05$) in control

group. The values for motility in this study were within the range of 61.22 to 83.00 recorded by Adeoye *et al*. (2017). The motility of the sperm cells suggests the number of sperms assumed to be capable of advancing from the point where semen is deposited in the course of insemination to the sperm storage tubules in the hen (Adeoye *et al*., 2017). Semen concentration was highest at 20% aloe vera gel and least at 0% (control group). The semen concentrations in the present study were similar to range 1.58 to 2.78 billion cells reported Saleh *et al*. (2018) for FUNAAB-alpha cocks but lower than values 8.6 to 9.5/ml obtained in different lines of cocks as recorded by Tariff *et al*. (2013) in Bangladesh.

The proportion of live sperm varies from 68.4 to 74.4% in the present study. Live sperm were highest ($P<0.05$) at 20% aloe gel compared to 10% and control. This is within the range of 45 to 80 as recorded by Rwaan *et al*. (2009) for White Shika brown challenged with New castle disease and those administered vaccine.

Table 1: Semen quality characteristics of Noiler Cocks fed Aloe vera Gel

Treatments	**Ejaculate Volume(ml)**	**Semen Color**	**Motility (%)**	**Semen Concentration X 10^9**	**Live Sperm (%)**
Control (0%)	0.40^{b} ±0.00	Milky	60.00 ± 0.00^{c}	2.07 ± 0.21^{c}	68.40 ± 0.51^{b}
10% Aloe Gel	0.41^{b} ±0.02	Milky	70.52 ± 0.18^{a}	2.56 ± 0.20^{b}	69.40 ± 0.93^{b}
20% Aloe Gel	0.50^{a} ±0.00	Milky	66.20 ± 0.81^{b}	4.31 ± 0.19^{a}	74.40 ± 1.03^{a}

^{a,b,c,}……means within each column with different superscript differ significantly at $P < 0.05$

CONCLUSION

It was concluded that 200g of *aloe vera* gel per litre (20%) of improves semen quality of noiler cocks drinking water can have influence on semen parameters at 20% inclusion level of adult Noiler cocks. However, further studies should examine its effect on morphology of spermatozoa as well as testicular morphology and histology.

REFERENCES

Adeoye, G.O., Oleforuh-Okoleh, V.U. and Chukwuemeka, U.M. (2017) Influence of Breed Type and Age on Spermatological Traits of Nigerian Local Chickens.*Journal of Tropical Agriculture, Food, Environment and Extension***16 (**1): 11 – 16.

Babak D., Abolfaz, Z., Ahmad Z. S. and Ali, M. (2011) Effects of different levels of *Aloe vera* gel as an alternative to antibiotic on performance and ileum morphology in broilers, *Italian Journal of Animal Science*, **1**:189-194

Darabighane, B. and Nahashon, S.N. (2014). A Review on Effects of Aloe Vera as a Feed Additive in Broiler Chicken Diets *Annals Animal Science.***14** (3): 491–500.

Duncan, D. B. 1955 Multiple Range and Multiple F-Test. *Biometrics***11**:1-42.

Durrani F. R., Sanaullah, N., Chand, Z. and Akhtar, S. (2008). Using of aqueous extract of aloe gel as anticoccidial and immune stimulant agent in broiler production. *Sarhad Journal of Agriculture*.**24**: 666-670.

Frydrychova, S., L Opletal, K Maca´ kova, A Lustykova´ , M Rozkot and J Lipensky´(2010) Effects of Herbal Preparation on Libido and Semen Quality in Boars *Reproduction in Domestic Animals* **1**:1-5

Hani N. H., Ahmed S. S., Basheer M.A., Hasafa, T. R. Al-Khatib Sardar Y. S. and Jamil S. T. (2016) Evaluation Semen Characterization of Roosters Resulted from Different Local Lines and Their Crosses with ISA Brown. *International Journal of Agricultural Science.* **1:**7-14

Modaresi, M., and Khodadadi A. (2014) The Effects of Aloe vera Extract on Reproductive Parameters in Mice. International Conference on Biological, Environment and Food Engineering (BEFE-2014) August 4-5, 2014 Bali (Indonesia).

Olurundare, O. S. (2015) Bauchi Workshop on Amo-Noiler Breed. R and D product of the year. Amo Farm Sierberer Hatchery Limited. 2nd September 2015.

Quinn, J. P. and W. H. Burrows, (1936). Artificial Insemination in fowl. *Journal of Heredity*, **27**: 31-37.

Rwaan, J. S., Rewot, P. A., abdu, L.O., Eduvie and J. A. Obidi (2009) Semen Characteristics of Vaccinated Shika Brown Cocks Challenged with a Velogenie Newcastle Disease Virus. *International Journal of Poultry Science***8** (9): 896-901.

Saleh, B., Duwa, H., Mohammed, A. A., and Raymond, J. B. (2018) Semen Quality of FUNAAR- alpha Cocks in a Sudano-Sahelian Region of Nigeria. In: Proceeding of 7th ASAN-NIAS Joint Annual Meeting, Ilorin 9th – 13th September, 2018 Pp. 150-153.

Sharrif, M. M. and Sandeep K. V. (2011) Aloe vera their chemicals composition and applications: A review. *International Journal of Biological & Medical Research***2** (1): 466-471

Tarif, A. M. M., Bhuiyan, M. M. U., Ferdousy, R. N., Juyena, N. S. and Mollah M. B. R. (2013) Evaluation of semen quality among four chicken lines. *IOSR Journal of Agriculture and Veterinary Science* **6** (5):07-13

Zahraddeen, D., Butswat, I.S.R., Kalla, D. J. U. Sir, S.M. and Bukar, M.T. (2005) Effect of Frequency of Ejaculation on Semen Characteristics in Two Breeds of Turkeys (*Meleagris gallopavo*) raised in a Tropical Environment. *International Journal of Poultry Science* **4** (4): 217-221

EFFECT OF AQUEOUS ADMINISTRATION OF *MORINGA OLERIFERA* LEAF AND SEED EXTRACTS ON THE GROWTH PHYSIOLOGY OF LOCAL MALE TURKEYS.

Ogbu, O.C.
Department of Agricultural Technology, Federal Polytechnic, Oko Anambra State Nigeria.
Corresponding author: ogbuonyinyeac@gmail.com

ABSTRACT
The aim of the study was to evaluate the effect of Moringa olerifera leaf and seed extracts on the growth physiology of male turkeys. A total of 36 turkeys of about 8 – 9 weeks were used. There were nine turkeys per treatment groups, grouped as; T_1 (control) T_2 (1% leaf w/v) T2 (0.5% leaf and 0.5% seed w/v) and T_4 (1% w/v) Each group was replicated three times with three turkeys per replicate. The study latest for 154 days with all routine management practices duly observed. Data were collected from body weight gain, feed intake, feed conversion efficiency, carcass cut part weight, viseromatic index on the internal organ weights. The result of the experiment showed that, average final body weights were improved significantly ($P<0.05$) by the administration of Moringa extracts with T_4 (6.20 ± 0.02^a) having the highest weight. Feed efficiency was also better ($P<0.05$) among the Moringa administration group than the control with the T_4 (3.90 ± 0.00^c) been most efficient. The viscera-somatic index differed significantly ($P<0.05$) in the mean percentage size of the pancreas, gizzard and gall bladder only, but did not take adequate pattern that can be attributed to the Moringa. The cut parts were greater ($P<0.05$) quarter thigh weight(kg) and asymmetry half carcass cut(kg) which are prime cut parts. These differences were higher among the Moringa extract group.In conclusion, Moringa seed and leaf extracts improved the growth on male local turkeys with the leaf extract alone (T4 1% w/v) giving the best results.
Key words: Turkey, Growth, Extracts.

INTRODUCTION
The local turkeys in Nigeria are gradually becoming endemic. The poultry population in the country is estimated at 104.3 million comprising 72.4 million chickens, 11.8 million ducks, 4.7 million fowl, 15.2 million pigeon and only 0.2 million turkeys (FDLPCS 1992). Despite the quick return rate to investment, turkey production has not being as successful as successful as chicken production. Its production in Nigeria is largely on a backyard small scale level. Therefore to improve this, there is need for additives preferably natural ones that can improve maturation rate so as to generate, quicker returns to investment. *Moringaolerifera* plants are loaded with lots of chemicals like phenols substances, antioxidants, vitamins, minerals and earth rare metals found to improve general well-being. *Moringa* leaf extract has been used to check growth performance apparent digestibility of broiler chicken (Alshukri *et al*., 2018). Khan *et al.*, (2017) have studied the effect of *Moringaolerifera* leaf powder supplements on growth rate as well as intestinal morphology of broiler chickens and had a positive observation.Hence, using both the leaf and seed of *Moringaolerifera* on local male turkeys will bring to lime light a serious improvement in the turkey production industry.

MATERIALS AND METHODS
The experiment lasted for 154 days. It was approved and supervised by the Michael Okpara University of Agriculture Umudike (CASAP) Research and Experiment committee and was carried out at the Poultry unit ofChirex Agro Services Limited in Abakuru, Ohaji-Egbema Local Government Area of Imo State Nigeria.

Collection and Preparation of experimental material

The freshly harvested leaves and seeds were sorted to remove contaminants sand particles and dead matter. They were shade dried in an open well ventilated room for about one week at room temperature. The seeds and the foliage were ground separately into power and stored in separate clean dry containers. Treatment one (T_1) was the control group with no *Moringa* powder. One gram of the seed powder was diluted in 1000mls of clean water, sieved with cheese cloth and served as drinking water for treatment two (T_2). Treatment three (T_3) had 0.5g of leaf powder and 0.5g seed powder diluted with 1000mls of clean water sieved with cheese cloth and served as drinking water. One gram of the leaf powder was

diluted in 1000mls of clean water, sieved with cheese cloth and served as drinking water for treatment four (T_4).

Experimental animals and their management

Thirty six (36) local male strains of turkeys of white, black and lavender plumage averagely eight (8) weeks old were used for the study.

The local turkeys were procured from a reputable farm, in Ikenga,Aguata Local Government Area in Anambra State. Before commencement of the experiment, the local turkeys were quarantined and allowed toacclimatize for 14 days in the Poultry unit. During the acclimatization period, the turkeys were given routine management practices which included deworming with Ivermectin solution (1%w/v) against endo and ecto parasites. Suitable vaccinations for their age was also given prior to the commencement of the experiment. The 36 male turkeys were randomly allotted into treatments. There were four (4) treatments in all with nine (9) turkeys per treatment. Each treatment group was replicated three times to contain three (3) turkeys per replicate. The treatment groups were administered 0 gram of *Moringa*(T_1), 1 gram of *Moringa*seed alone (T_2) combination of 0.5g of *Moringa*seed and 0.5gram of *Moringa*leaf (T_3) and lastly 1 gram of *Moringa*leaf alone (T_4) . Experimental material was given to the male turkeys at 10 weeks of age. The treatment was administered to the turkeys via drinking water between hours of 7am to 10am after which they were given clean drinking water throughout the rest of the day. The turkeys were given commercial feed during the first 14weeks of the experiment. From 24 weeks of age formulated ration in Table 3.1 was used. The feed sample was determined to ensure quality assessment in Table 3.1 by livestock feeds Plc with the aid of the apparatus; DA1650 near infra-red Spectrophotometer.

Table 1: Feed Formula for the Experimental Diet

Ingredients		**(%)**
Groundnut		21.00
Fish meal		2.00
Maize		35.00
Wheat offal		37.00
Bone meal		2.50
Oyster shell		1.50
Methionine		0.25
Lysine		0.25
Salt		0.25
Vitamin Mineral	Premix	0.25
Total		100
Determined values		
Crude protein	-	19.85
Crude fibre	-	7.44
Fat	-	5.01
Moisture	-	8.28
Ash	-	6.99
Energy	-	3018.8 kcal/kg

Vitamins and trace mineral declaration: 2.5kg of premix contains.

Vitamin A (Iμ) 12,500.00, Vitamin D_3 (iμ) 2,500,000.00, vitamin E (mcg) 40,000.00, Vitamin K_3 (mg) 2,000.00, vitamin B (mg) 3,000.00, vitamin B_2 (mg) 5,500, vitamin B6 (mg) 5,000, Nicocin (mg) 55,000.00, calcium pantothenate (mg) 11,500.00, Vitamin B_{12} (mg) 25,000, Chlorine Chloride (mg) 500,000.00, Folic acid (mg) 1,000.00, Biotin (mg) 80.00, Manganese (mg) 120,000.00, Iran (g) 100,000.00, Zinc (mg) 80,000.00. Copper (mg) 8,500.00, Iodine (mg) 1,500.00, Cobalt (mg) 300.00, Selenium (mg) 120.00, Antioxidant (mg) 120,000.00.

Experimental Design

The experiment was completely randomized design (CRD). It consisted of four treatments; T_1, T_2, T_3 and T_4 containing 0g, 1g of seed, combination of 0.5g of seed and 0.5g of leaf and 1gram of leaf, respectively. There were nine male turkeys in each treatment with 3 replicates of 3 turkeys per replicate.

Data collection

Growth performance

Daily feed intake was measured by weighing the quantity of feed given to the turkeys and their left over with the Dana weighing scale**.** The initial body weight was take before the commencement of the experiment and final body weights taken at the end of the study. These data were used to calculate;

$$\text{Daily weight gain} = \frac{\text{final body weight} - \text{initial body weight}}{\text{number of turkey per treatment} \times \text{number of days}}$$

$$\text{Feed efficiency } \frac{\text{Quanity of feed consumed}}{\text{weight gained}}$$

Weight gain = final body weight – initial body weight

Carcass evaluation

Three turkeys from each treatment was scarified at the end of the experiment. The carcass was carefully sectioned into parts thigh, shank, and head, quartered and symmetrical half body measurements were weighed with the aid of Dana weighing scale. While there lengths were measured with tape rule. The internal organs (liver, heart, kidney, lungs, gizzard, bile, large, intestine and small intestine were weighed using Ohams electronic scale.

Data analysis

Data collected were subjected to analysis of variance using SAS (2008).

RESULTS AND DISCUSSION

Growth performance

The growth performance of male local turkeys administered aqueous *Moringa* extracts is shown in Table 2.

Table 2: Mean values of growth parameters of male turkeys administered aqueousextractsof*Moringa* leaves and seeds

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Average Initial Body weight (kg)	0.70 ± 0.04	0.70 ± 0.01	0.70 ± 0.03	0.70 ± 0.00
Average Final body weight (kg)	5.80 ± 0.03^{c}	6.07 ± 0.36^{b}	6.02±0.04^{b}	6.20± 0.02^{a}
Weight gain (g)	5103 ± 0.03^{d}	5407± 0.00^{b}	5307± 0.00^{c}	5503± 0.03^{a}
Daily weight gain (g)	28.60 ± 0.03^{c}	29.70 ± 0.03^{b}	29.70 ± 0.00^{b}	30.20 ± 0.03^{a}
Daily feed intake(g)	120.41± 0.02	118.50 ± 0.001	118.21± 0.002	117.78±0.00
Dressing percentage (%)	87.93 ± 0.58^{b}	91.80 ± 0.58^{a}	91.67 ± 0.58^{a}	93.55 – 0.58^{a}
Feed efficiency	4.21 ± 0.00^{a}	3.99 ± 0.00^{b}	3.98 ± 0.00^{b}	3.90 ± 0.00^{c}

Means with different superscripts $^{a, b, c}$ or ^{d} on the same row are significantly different (P<0.05).

The mean values of growth parameters of male turkeys administered aqueous extracts of *Moringaoleifera* leaves and seeds are shown in Table 2.2. There were significant differences (P<0.05) between the

treatments for the final body weight, weight gain, feed conversion ratio and daily weight gain. The mean final body weight was highest in T_4 (leaf extracts) 6.19 ± 0.02kg followed by T_2 (seed extracts) 6.07± 0.04kg, and T_3 (seed and leaf extracts 6.02 ± 0.04kg, compared with T_1 (control) 5.84± 0.03kg. The mean weight gain was highest among the *Moringa* treated turkeys (T_4 5.50 ± 0.03; $T_2$5.41± 0.00 and T_3 5.31± 0.00kg) than the control treatment (T_1 5.10± 0.03) kg.

The mean daily weight gain was also significantly higher (P< 0.05) in T4 30.20±0.00g, T_3 29.70± 0.03g and T_2 29.70± 0.33g than T_1 28.60g± 0.03g. The feed conversion ratio was significantly (P<0.05) lower among the treatment groups administered aqueous *Moringa* leaf and seed extract ($T_4$3.91± 0.00; T_3 3.98±0.00 and T_2 3.99±0.03) when compared with the control (T_1 4.21±0.00).

The results suggest that *Moringaoleifera* improved the growth rate of male turkeys in this study. This could be due to high protein content of *Moringaoleifera* which is advantageous in poultry (Dong *et al*., 2007; Krauze and Grela, 2016). This finding collaborates with the resultsof Nkukwana*et al*. (2014); Khan *et al*. (2017) and Sun *et al*.(2017) on the benefits of *Moringaoleifera*.

This improvement in weight gain could also be attributed to the nutrients and contents of the administered extracts which according to Sowande*et al.* (2008) is the basis for improved productivity. The increase in daily weight gain was significantly higher (P<0.05) in the leaf extract treatment group than in the combined seed and leaf as well as seed extracts alone. This advantage may be due to the anti- nutrients like saponines found in*Moringa* which Francis *et al.* (2002) reported to have inhibitory properties. The leaves of *Moringa* according to Fereira*et al.* (2008) are good sources of highly digestible protein. This could be the reason for their higher weight gain and better dressing percentage on T_4.

The mean values of feed efficiency (FE) were significantly lower in the *Moringa* extract administered treatments. Ogbonna*et al*. (2002) noted that low feed efficiency (FE) value is a measure of superiority of the treatment. There was higher weight gain and lower FE values among the local male turkeys administered aqueous *Moringa* leaf extracts. These facts therefore make T_4 the preferred treatment of choice among the groups.

Viscero-somatic index of male turkeys administered aqueous*Moringa* leaf and seed extracts

Viscero-somatic index of male turkeys administered aqueous*Moringa* leaf and seed extracts is shown in Table 3.

Table 3:The mean values of viscero-somatic index of male turkeys administered aqueous*Moringa* leaf and seed extracts

Parameter (%)	**T_1**	**T_2**	**T_3**	**T_4**
Live Weight	5.10 ±0.35	5.50±0.23	5.40±0.06	5.60±0.23
Spleen	0.06±0.04	0.06±0.01	0.05±0.01	0.06±0.01
Pancreas	0.14±0.01^{a}	0.12±0.00^{ab}	0.15±0.00^{a}	0.10±0.00^{b}
Heart	0.48±0.05	0.41±0.01	0.46±1.00	0.34±0.04
Kidney	0.32±0.02	0.39±0.04	0.38±0.03	0.31±0.04
Liver	1.41±0.02	1.51±0.16	1.57±0.18	1.22±0.08
Lungs	0.52±0.05	0.55±0.05	0.61±0.08	0.52±0.04
Gizzard	2.96±0.02^{a}	2.55±0.01^{ab}	2.56±0.12^{b}	2.36±0.01^{c}
Small Intestine	2.26±0.16	2.24±0.03	2.22±0.14	1.93±0.09
Large Intestine	0.87±0.03	0.82±0.10	0.78±0.12	1.00±0.19
Gall bladder	0.10±0.04^{a}	0.03±0.01^{b}	0.04±0.00^{ab}	0.06±0.00^{ab}

Means with different superscripts $^{a, b, c}$ or ^{d} on the same row are significantly different (P<0.05).

The mean values of viscero-somatic index of male turkeys administered aqueous*Moringa* leaf and seed extracts are shown in Table 3.

There were significant differences (P<0.05) in the mean percentage sizes of the pancreas, gizzard and gall bladder while the heart, kidney, liver, lungs, small intestine and large intestine did not differ significantly among the treatments.

The pancreas which performs dual function; digestion as well as to regulate blood sugar (Widmaier*et al.*, 2004), differed significantly (P<0.05) with T_1 (control 0.14 ± 0.01%) and T_3 (0.15 ± 0.00%) been higher than T_2 (0.12 ± 0.00%) then T_4 (0.10±0.00) as the least. The abnormal increase in size of the pancreas in the treatment T_1 may be attributed to the high level of glucose seen in this study on T_1.Small sized of pancreas may mean that the pancreas was not over stressed trying to metabolise and digest micronutrient of digestion as was seen in T_4. The size of gizzard differed significantly (P<0.05) among the Turkeys administered *Moringa* leaf and seed extracts. The *Moringa* extract groups had the significantly small sized gizzard which may have resulted due to the degrading effect of the aqueous extract on the feed particles thereby facilitating fast digestion rate of feeds. This affirms the reports of Amerah*et al.* (2009) that coarse feed particles normally stimulate constriction of the gizzard, which affects its development and increases the size. This increase in size as a result of over work to augment the shortage or ameliorate the effect of excess supply of fiber was not witnessed among the *Moringa* groups.

There were significant differences (P<0.05) on the gall bladder size among the Turkeys administered *Moringa* leaf and seed extracts. The bile aids in emulsification of fat. Decreasing size of the bile organ could be attributed to the fact that extracts from *Moringa* aids degradation as well as emulsification of fats thereby reducing the work load of the gall bladder in secreting bile salt thus enhancing its functionality especially in the leaf extract treatment group as against the control group that had the biggest increase in gall bladder size.

Carcass parameters of male turkeys

Table 4: The mean values of cut parts of male turkeys administered *Moringa* leaf and seed extracts

Parameter	**T_1**	**T_2**	**T_3**	**T_4**
Dressed weight (kg)	5.10±0.35	5.50±0.23	5.75±0.14	5.60±0.23
Thigh Length (cm)	21.85±0.32^{a}	17.85±0.43^{b}	15.55±0.43^{c}	18.00±0.12^{b}
Thigh Width (cm)	17.60±0.92	17.40±0.52	17.80±0.75	17.25±1.13
Shank Length (cm)	11.65±0.66	12.03±0.03	11.60±0.23	11.90±0.06
Breast length (cm)	18.33±0.17	18.45±0.26	18.00±0.12	18.15±0.87
Back length (cm) (Head to rum)	18.33±0.17	18.45±0.26	18.00±0.12	18.15±0.87
Head Weight (g)	119.00±0.58^{b}	126.50±5.48^{b}	143.50±0.87^{a}	124.05±2.92^{b}
Paired shank weight (g)	106.50±15.88^{b}	136.00±5.20^{a}	126.50±0.87^{ab}	147.00±3.46^{a}
Neck weight (g)	525.00±14.43	540.50±23.38	445.00±10.39	537.50±108.83
Quarter wing weight (kg)	0.90±0.00	0.93±0.04	0.93±0.04	1.000±0.06
Quarter thigh weight (kg)	1.03±0.01^{b}	1.15±0.06^{a}	1.08±0.02^{ab}	1.10±0.29^{ab}
Half carcass symmetry (kg)	2.02±0.02^{ab}	2.02±0.09^{ab}	1.98±0.01^{b}	2.15±0.03^{a}

Means with different superscripts $^{a, b, c}$ or ^{d} on the same row are significantly different (P<0.05).

The mean values of cut parts of male turkeys administered *Moringa* leaf and seed extracts are shown in Table 4.4. The thigh length, thigh weight, head weight, paired shank weight quartered thigh weight and half carcass symmetrically differed significantly ($P<0.05$). However dressed weight, thigh width, shank length, breast length, back length, neck weight as well as quartered wing weight did not differ significantly ($P<0.05$). From these results, the quartered thigh (kg) which is a prime meat cut differed significantly among the treatment groups with things of turkeys exposed to *Moringa* extracts having bigger weights ($P<0.05$) compared with the control. This therefore implies that *Moringa* promoted muscle weight gain which may be due to the fact that it is rich in easily digestible protein found in the leaves (Ferreira *et al*., 2008),thus making the leaf extracts a better option when muscle building in male turkeys is desired.

In conclusion, *Moringa* seed and leaf extracts improved the growth on male local turkeys with the leaf extract alone (T4 1% w/v) giving the best results.

REFERENCES

Amerah, A. M., Ravindran, V. and Lentle, R. C. 2009. Influence of insoluble fibre and whole wheat inclusion on the performance digestive tract development and ideal micobita profile of broiler chickens. *British Poultry Science*, 50: 366 - 375.

Alshukri, A.Y., Ali, A., Rabia, J., Alkassar, A.M. and Jameel, Y. J. 2018. N. Effect of Dietary supplementation with different levels of *Moringaolerifera*meal on the productivity and carcass characterics of broiler chickens. International Journal of Poultry Science, 17: 536-542.

Dong, X.F.,Gao, W.W., Tong, T.M., Jia, Q.H., Sa, R.N. and Zhang, Q. 2007. Effect of Polysavone (alfalfa extract) on abdominal fat deposition and immunity in broiler chickens. *Poultry Science*, 86: 1955-1959.

FDLPCS 1992. Federal Department of livestock Pest control services. Nigerian National Livestock survey Aburu, Nigeria.

Ferreira, P. M. P., Farias, D. F., Oliveira, J. A. and Carvalho, F. U. 2008.*Moringaoleifera*: bioactive compound and nutritional potential (Review), 21(4): 33 - 48.

Francis, G., Kerem, Z., Makkar, H. P.S. and Becker, K. 2002. The biological actions of saponins in animal systems: a review. *British Journal of Nutrition***,**88: 587 - 605.

Khan, I., Zaneb, H., Masood, S., Yusuf, M.S. Rehan, H.F. and Rehma, H. 2017. Effect of *Moringaolerifera* leaf powder supplementation on growth performance and intestinal morphology in broiler chickens. *Journal of Animal Physiology and AnimalNutrition*, 101(51): 126-134.

Nkukwana, T.,Muchenja, V.,Pieterse, E. and Dzoma, K. 2014. Effect of *Moringaolerifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *JournalofLivestockScience*,161:139-146.

Ogbonna, I. U., Oredein A. O. and Adesehinwa, A. O. K. 2002. Effect of replacing groundnut cake with raw soybeans residue on diet in performance and nutrient digestibility of cockerel chicks; A preliminary study. *Nigeria Poultry Science Journal*, 1: 2.

SAS, 2008. Statistical Analysis System, SAS users guilde: statistics. SAS institute inc. Cary N.C. USA

Sowande, O. S., Aina, A. B. J., Oguntona, E. B., Fanimo, A. O., Unaka, V. U., Hassan, T. A. and Oseni, M. O. 2008. Performance Blood chemical constituents and minerial balance of West Africa dwarf sheep fed preserved elephant grass, layer's droppings and cassava peel during dry season. *Nigeria Journal of Animal Production*,35(1): 90 - 102.

Sun, B., Zhang, Y., Ding, M., Xi, Q., Liu, G, Li, Y. Liu, D. and Chen, Y. 2017. Effect of *Moringaolerifera*leaves as a substitute for alfalfa meal on nutrient digestibility, growth performance, carcass trait, meat quality, antioxidant capacity and biochemical parameters of rabbits. *J of Animal Physiology and Animal Nutrition*, 102:1.

Widmaier, E.P., Ruff, H. and Strang, K. T. 2004.Vand, Sherman and Luciano's Human physiology the mechanisms of body functions Mcgraw Hill Publishers. pp 563-600.

COMPARATIVE ANALYSIS OF EGG QUALITY PARAMETERS OF GUINEA FOWL AND LOCAL CHICKENS IN BENUE AND TARABA STATES

[1*]Olusiyi, J. A., [2]Igila, T. T, [3]Yusuf, H. B., [2]Jatutu, S. S., & [2]Ebule, K

[1]Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria

[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi

[3]Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa State, Nigeria

ABSTRACT

The study was conducted to evaluate some parameters of external and internal egg quality of local chickens and guinea fowl in Benue and Taraba states. A total of 160 eggs (40 eggs from each breed per state) were collected to study for egg (weight, shape index), albumen (weight, percentage), yolk (weight, percentage) and shell (weight, percentage, thickness, strength) quality. The results showed that the egg weight and egg length of local chickens in Benue were significantly higher ($P < 0.05$) than that of guinea fowl in the same state, whereas difference in egg shape index between these breeds were not significant ($P > 0.05$). Differences in albumen weight, albumen percentage, yolk weight and yolk percentage of the chicken breeds were statistically non-significant ($P > 0.05$). Albumen height was significantly higher ($P < 0.05$) in local chickens in Benue compared with local chickens in Taraba state. The significantly ($P < 0.05$) higher values of yolk height and yolk index were detected in guinea fowl in Bemue state than others. The shell weight and proportion were affected by the breed of hens ($P < 0.05$) but there were no significant differences ($P > 0.05$) in egg shell thickness and strength. It was concluded that the breed of chicken and location affected some parameters of exterior and interior quality of eggs. Further were recommended on other breeds of chicken to also determine the quality of their eggs.

Key words: Egg quality, guinea fowl, local chickens.

INTRODUCTION

The livestock industry is an important subsector of the agricultural sector of Nigeria's economy. The role of this sector cannot be over- emphasized considering the importance of animal protein in the diet of people and contribution from this sector to the gross domestic product (Adekaye and Akinrade, 2006). They enumerated livestock types found in Nigeria to include cattle, sheep, goats, pigs, poultry, horses, donkeys and camel. The term poultry refers to all domesticated birds kept for meat or egg production which consist of chicken (domestic fowl), turkey, ducks and geese (Obioha, 1992). Poultry eggs yield desirable products in all parts of the country with no cultural restrictions. Poultry eggs are rank second to cow milk in terms of nutritive value and are the most economically produced animal protein (Ikeme, 1990). Eggs are considered a wholesome diet, since an egg contains adequate amounts of protein, energy, amino acid, vitamins and minerals to satisfy the body needs. Lombin (2001) emphasized that, the FAO/WHO recommended daily intake of 65g of protein out of which 35g (38.8%) should be from animal sources. She further stressed that Nigeria's consumption of protein is now 5g per head per day (14.3% requirement). The need therefore to bridge the gap of protein shortage through good quality eggs cannot be over-emphasized. Eggs have constituted an important part of human diets for centuries because of its high quality protein (Forson *et al*., 2011). They are known to supply the best proteins besides milk (Vaclavik *et al*., 2008). It is also rich in amino-acids, carbohydrates, easily digestible fats and minerals, as well as valuable vitamins (Huopalahti *et al*., 2007). The yolk and white components are all of high biological value and are readily digested (Joel *et al*., 2010). Eggs play important culinary roles and are therefore prepared into different dishes. There are many types of poultry species' eggs consumable as a protein and amino acid supplement (Trziska, 2000). Nigeria has the highest number of poultry farm in Africa. Nigeria presently produces about 300,000 tons of poultry meat per annum officially and 650,000 tons of eggs (USDA, 2014). A parallel record from Poultry Association of Nigeria (PAN), indicates that Nigeria produces presently above 1.25million tons of egg per year. South Africa is the second producer of eggs in Africa. The question arises whether there are interspecies differences in poultry eggs quality which may affect the nutritive value and quality as human food. In Nigeria, domestic fowl dominated the

poultry industry. Out of 150 million poultry population, 120 million (80%) were indigenous. Domestic fowl constituted 91% of this while guinea fowl, duck, turkey and others were 4%, 3% and 2% respectively (Adenowo *et al*., 1999). Chicken eggs are the most commonly consumed eggs; they are also an inexpensive single-food source of protein.

MATERIALS AND METHODS

The study was conducted in Benue and Taraba state. Freshly-laid egg samples from birds of two (2) different genotypes (domestic chicken and guinea fowl) were obtained between September and October 2018 from poultry keepers in Benue and Taraba States, Nigeria. The eggs were analyzed for different parameters of egg quality. At laying time the domestic fowl were approximately 28 weeks and guinea fowl were approximately 32 weeks old. The birds' genotype was Pearl (guinea fowl) and normal feathered (domestic chicken). Both the domestic chicken and guinea fowl had outdoor access all the year round Fed with cereal, hay, clover, vegetables, green crops and cereal-based mixed fodder with several additives daily. The egg samples were thoroughly washed with distilled water in the laboratory. The yolk and albumin were separated by breaking a small part of the egg shell at one end and separating the egg albumin from the yolk. Forty (40) eggs each from both local chickens and guinea fowl were used for the study.Freshly laid eggs were collected at 26, 34, 42, and 50 wk. For each examination, 40 eggs were randomly selected from each group to measure the internal and external characteristics. Time interval between the eggs being laid and measured was less than 24 hours. The eggs were stored at room temperature before measurement.

RESULTS AND DISCUSSION

The result of thecomparative analysis of egg quality of guinea fowl and local chickens in Benue and Taraba states is presented in table 1, 2, 3 and 4.

Table 1: Effect of Breed on Egg Parameters

	Benue State		Taraba State	
Parameters/ Breed	**Local chicken**	**Guinea fowl**	**Local chicken**	**Guinea fowl**
Egg weight (g)	58.69±3.64^{a}	56.74±3.58^{c}	57.96±3.59^{b}	57.78±3.67^{b}
Egg length (cm)	5.83±1.14^{a}	5.71±1.13^{bc}	5.79±1.14^{b}	5.78±1.13^{b}
Egg width (cm)	4.34±1.08	4.27±1.07	4.31±1.10	4.32±1.09
Egg shape index (%)	74.44±0.44	74.78±0.35	74.43±0.31	74.74±0.36

Table 2: Effect of Breed on Egg Albumen Parameters

	Benue State		Taraba State	
Parameters/ Breed	**Local chicken**	**Guinea fowl**	**Local chicken**	**Guinea fowl**
Albumen weight (g)	34.87±3.85	33.07±3.68	34.23±3.88	34.12±3.79
Albumen percentage (%)	59.41±3.96	58.29±3.88	59.05±3.95	58.75±3.94
Albumen height (mm)	55.86±2.42^{a}	55.07±2.46^{b}	54.72±2.39^{b}	55.11±2.44^{ab}
Albumen width (mm)	78.25±0.78	78.63±0.65	78.06±0.68	78.48±0.72
Albumen index (%)	71.39±2.14^{a}	70.04±2.08^{b}	70.09±2.13^{b}	70.22±2.09^{ab}

Table 3: Effect of Breed on Egg Yolk Parameters

	Benue State		Taraba State	
Parameters/ Breed	**Local chicken**	**Guinea fowl**	**Local chicken**	**Guinea fowl**
Yolk weight (g)	17.83±1.08	17.93±1.66	18.07±1.64	18.23±1.68
Yolk percentage (%)	30.38±0.85	31.60±0,87	31.17±0.89	31.39±0.82
Yolk height (mm)	17.25±1.17	17.97±1.09[a]	17.12±1.14	16.73±1.07
Yolk width (mm)	41.26±0.68	40.98±0.59	41.22±0.64	41.14±0.67
Yolk index (%)	41.81±0.69	43.85±0.79[a]	41.53±0.75	40.67±0.61
Yolk colour (^{0}LR)	9.65±0.95		9.49±0.99	9.57±0.88

Table 4: Effect of Breed on Egg Shell Parameters

	Bauchi State		Gombe State	
Parameters/ Breed	**Local chicken**	**Guinea fowl**	**Local chicken**	**Guinea fowl**
Shell weight (g)	5.99±0.33[a]	5.74±0.33[b]	5.67±0.32[b]	5.43±0.33[b]
Shell percentage (%)	10.21±0.65[a]	10.11±0.61[a]	9.98±0.62[ab]	9.40±0.60[b]
Shell thickness(μm)	371.45±24.29	368.82±24.42	364.39±24.27	361.58±24.22
Shell strength (N cm^{-2})	30.44±5.62	29.81±5.39	29.27±5.48	30.18±5.53

The result of the egg parameters is presented in Table 1. The result showed that there were significances difference in egg weight and egg length while there were no significance differences in some of the parameters such as egg width and egg shape index. The study showed significantly (P<0.05) lower egg weight of guinea fowl in Benuein comparison with local chicken, followed by guinea fowl in Taraba. Eggs from local chickens in both states gave higher values compare to guinea fowl.

The values obtained in this study were similar to those recorded by Zanon *et al*. (2006), who published egg weight for local light Italian breeds Modenese and Romagnolo (53.7g and 54.0g). For guinea fowl, hen egg weightwas balanced from 57.0 to 58.0g (Anderle *et al*., 2014).For example, Turkish breeds Benizli and Gerze lay eggs with weight 53.94 and 54.30g (Sarica *et al*., 2006).

The study also recorded a similar average egg shape index from 74.43% for local chickens in Taraba state to 74.78 % forguinea fowl in Benue state. The values in this study were lower than those reported bySingh (2000) who recorded higheregg shape index (75.46%). Egg shape is influenced by genetic factors and individual traits, and is determined in the oviduct. The egg shape index ranges between 57 % and 92 %, but it is believed that values under and below 74 % are a cause for higher incidence of cracked and broken eggs (Narushin, 2005; Popova-Ralcheva *et al*., 2009).

Albumen Parameters

The result of the albumen parameters is presented in Table 2. There were significant differences in albumen height and albumen index while there were no significant differences in albumen weight, albumen percentage and albumen width. The values obtained in this study were lower than those reported by Anderle *et al*. (2014) reported albumen proportion for local chicken from 58.4 to 60.1 %. In the present study it has been observed that local chickens in Benue state have significantly (P<0.05) higher albumen height than local chickens in Taraba. Albumen percentage was significantly higher (P<0.05) in local chickens in Benue compared with guinea fowl in Benue, local chicken in Taraba and guinea fowl in Taraba. The difference in albumen height observed is in agreement with the results of Monira *et al*. (2003) who reported different albumen heights for different breeds, but Haunshi *et al*. (2011) observed non-significant differences in albumen height among Vanaraja and White Leghorn breeds of chickens.

Yolk Parameters

The results of the yolk parameters are presented in Table 3. The results showed that there was no significant difference in yolk weight and yolk percentage among chicken breeds. Guinea fowl in Benue showed significantly (P<0.05) higher yolk heightand yolk index than local chicken in Benue, local chickens in Taraba and guinea fowl in Taraba. The yolk weightof chickens breed was from 17.83 g (local chickens in Benue) to 18.23 g (guinea fowl in Taraba). Stahishevskaya and Toritisna (2007) published similar weight of yolk in local breeds, 18.2g, in Rhode Island 18.3g and in Leghorns 17.4g.In this study, the yolk percentage range from 30.38% for local chickens in Benue to 31.60% for guinea fowl in Benue state. Anderle *et al*. (2014) reported yolk proportion for Czech Golden Spotted hens from 31.2 to 32.9 % and Zanon *et al*. (2006)found yolk proportion 34.69% in Modenese and 32.35% in Romagnolo. Haunshi *et al*. (2011) observed significant differences in the yolk index of different breeds of chickens.The colour of yolkwas almost uniform in all the breeds of chickens, this could be due to the fact that the birds received thesame compound poultry feed.

Egg Shell Parameters

The weight, percentage, thickness and strength of egg shell are presented in Table 4. In shell weight and percentage, there was significantly (P<0.05) lower value for guinea fowl in Taraba compared with local chickens in Benue and guinea fowl in Benue. There were no significant differences (P>0.05) in egg shell thickness and strength among local chickens in Benue, guinea fowl in Benue, local chickens in Taraba and guinea fowl in Taraba state.Zanon *et al*. (2006) reported higher eggshell proportion for both Italian breeds Modenese and Romagnolo (12.88 and 13.29%)compared with the result in this experiment. The proportion of eggshell from the egg weight in Czech Golden Spotted hens ranged from 9.0 to 9.5 % (Anderle *et al*., 2014). Shell percentage can be used to estimate the eggshell quality (Mertens *et al*. 2006).

CONCLUSION

Based on the results obtained in this study, it can be concluded thatthe breed of chicken and location affected some parameters of exterior and interior quality of eggs considered. This effect is most pronounced in egg weight, egg length, quality of albumen, yolk (height, index), egg shell weightand percentage.

RECOMMENDATIONS

From the study conducted, it can be concluded that, layers should be fed with high quality diets to improve the quality of their external and internal egg parameters. Proper management practices should be carried out in a layers house to ensure the laying of eggs with high quality parameters. Further research should be carried out on other breeds of chicken to also determine the quality of their eggs.

REFERENCES

Adekaye, M.B. and Akinrade, A. (2006) "Animal Production in Nigeria." *Proceedings of the 1lth Annual Conference of Nigerian Society of Animal Production.* ABU Zaria, March 23-27

Adenowo JA, Awe FA, Adebambo OA, Ikeobi CON (1999). Species variations in chemical composition of local poultry eggs In: *Book of Proceedings of 26th Annual National Society of Animal Production Conference* 21-25 March 1999 Ilorin Nigeria. Pp. 278-280.

Anderle, V. Sonnaiya, E.M and Chawla, R. (2014). Egg quality of gene reserve, the Czech golden spotted hens. *Poultry science.* 17: 84-86

Forson A, Ayivor JE. Banini GK, Nuviadenu C, Debrah SK. (2011). Evaluation of some elemental variation in raw egg yolk and egg white of domestic chicken, guinea fowl and duck eggs. *Annals of Biological Research.* 2011;2(6):676-680.

Haushi, S. Shanmugam, M. Padhi, M. K. Reddy, M. R. Sunitha, R. Rajkumar, U. and Panda, A. K. (2011). Characterisation of two Indian native chicken breeds for production , egg and semen quality, and welfare traits. *Poultry science.* 90:314-320.

Huopalahti R, Lopez-FR, Anton M, and Schade R. (2007). Bioactive egg compounds springer-verlag heidelberg. Pp.298.

Ikeme, A.I. (1990). Challenges of Agriculture in Nigeria Development. Faculty of Agriculture, University of Nigeria, Nsukka.

Joel N, Udobi1 CE, and Nuria A (2010). Effect of oven drying on the functional and nutritional properties of whole egg and its components. *African Journal of Food Science.* 4(5):254-257.

Lornbin, H.L. (2001). Stimulating livestock industry on the Plateau. Agriculture Training Manual, 26th April. Pp. 44.

Mertens, K., F. Bamelis, B. Kemps, B. Kamers, E. Verhoelst, B. De Ketelaere, M. Bain, E. Decuypere, and J. De Baerdemaeker. (2006). Monitoring of eggshell breakage and eggshell strength in different production chains of consumption eggs. *Poultry Science*. 85:1670–1677.

Monira, K.N., M. Salahuddin and G. Miah, (2003). Effect of breed and holding period on egg quality characteristics of chicken. *International Journal of Poultry Science* 2: 261-263.

Narushin ,V .G. (2005). Egg geometry calculation using the measurements of length and breadth. *Poultry science* 84: 482-484.

Obioha F C (1992)**A guide to poultry production in the tropics**. 1st edition. Acena Publishing.Enugu, Nigeria. Pp. 56-65.

Popova-Ralcheva, S. Olayide, S.O . and Okaigeto, P.O. (2009). The effect of age and genotype on morphological egg quality of parent stock hens. *World poultry science.* 12:24-30

Sarica, M., Sekeroglu, A. and Karacay, N. (2006). Comparative Yolk Cholesterol and Fatty Acid Contents of Turkish Indigenous Hens of Breeds and Layers Hybrids. In *XIIEuropean Poultry Conference : Book of Abstracts, Verona, Italy, 10-14 September 2006. Beekbergen: World Poutry Science Association*.

Singh, R. (2000). Production performance and egg quality of four strains of laying hens kept in conventional cages and floor pens. *Poultry Science*. *88*: 256-264

Stanishevskaya, O. Y. and Toritsina, E. S. (2007). Alteration of hen egg quality as a result of intense selection for egg performance improvement. In *Proceedings of the XVIII.*

Trziska T. (2000). Processing of eggs in egg science Ed University of agriculture in Wroclaw (Poland). 291-401.

USDA (2014). The National Agricultural Statistics Service's Chicken and Eggs' Report typically Pp. 1 and 9 produced by USDA; 2014.

Vaclavik AV, Christain WE and Udobil C. E (2008) Essentials of food science springer science business media LLC New York. 2008;205-230.

Zanon, A. Toritsina, E. S and Tumova , E .(2006) Physico-chemical characteristics of eggs from two Italian autochthonous chicken breeds: Modenese and Romagnolo. In *XII European PoultryConference : Book of Abstracts, Verona, Italy, 10-14 September 2006.* Beekbergen: World Poutry Science Association, Pp. 203.

FERTILIZING ABILITY OF BOAR SEMEN EXTENDED WITH GARLIC (*Allium sativum* L.) EXTRACTS

Sokunbi, O.A, *Alaba, O., Ogunwumiju, B. & Eboh, S.
Animal Physiology and Bioclimatology Laboratory, Department of Animal Science, University of Ibadan, Ibadan, Nigeria.
Corresponding author: Sokunbi, O. A.; E-mail: femialaba@gmail.com; Mobile: 07054634435

ABSTRACT
Preservation of boar semen is associated with the production of reactive oxygen species which leads to a reduction of spermatozoa quality and decrease in fertilizing ability. The outcome of Artificial Insemination (AI) largely depends on the ability of the acrosome to penetrate the zona pellucida, for the deposition of DNA materials into the oocyte, for a successful fertilization and embryonic development. The objective of this study was to investigate the potential of Ethanolic Allium sativum Extracts (EASE) on acrosome integrity and pH of extended boar semen. Semen was collected using the gloved hand technique. Aliquot portions of semen were divided into sixty sample bottles comprising of five treatments with three replicates. T1 served as the control (Beltsville Thawing Solution (BTS) + semen) in ratio 1:3 semen-extender, while other treatments T2 to T5 contained semen-extender at the same ratio, but supplemented with EASE at varying concentrations of 50, 75, 100 and 125 µg/L respectively in a completely randomized design. Extended semen samples were stored at 17 °C . Data obtained were subjected to assess relationship between acrosome integrity and pH and one way ANOVA to evaluate extract effects.
Results suggest a strong and negative relationship between pH and acrosome integrity. Also, supplementation of BTS with EASE at 125 µg/L maintained the acrosome integrity of the spermatozoa compared to control.
Keywords: Acrosome Integrity, Boar semen, Ethanolic *Allium sativum* Extracts (EASE), semen quality, spermatozoa fertilizing potential.

INTRODUCTION
The outcome of Artificial Insemination (AI) largely depends on the semen quality and the insemination procedure. The fertilizing potential of a semen dose is inherently linked to the quality of the spermatozoa itself (Tsakmakidis *et al.*, 2010). But during preservation after collection, due to fluctuation and changes in temperature and other metabolic activities, the fertilizing potential, acrosome integrity inclusively of the spermatozoa is altered or impaired. The quality of boar semen stored in a liquid state is influenced by the type of extender and storage time (Johnson *et al.*, 2000). Currently, many different diluents are used for the storage of semen, which help maintain the viability of the spermatozoa for several days (Gadea, 2003). Research has shown that short and medium-term extenders (up to 5 days), as early as on the second day of storage, spermatozoa motility and the percentage of normal spermatozoa morphology decrease and DNA disintegration increases, which makes them unsuitable for insemination (Klimont *et al.*, 2015). It is well-known that for *in vitro* semen preservation, a good extender should also provide an environment that inhibits the formation of harmful reactive oxygen species (ROS) or lipid peroxide (Orok *et al*., 2010) and cold shock. Boar spermatozoa are very sensitive to cold-shocked temperature resulting in reduced survivability during preservation (Gączarzewicz *et al.*, 2015). The fertility enhancing capacity of plant extract has been reported in numerous studies. Plant derived antioxidants have been getting major focus due to their lower cytotoxicity and are considered to be better than synthetic antioxidants (Gupta and Sharma, 2006 and Sen *et al*., 2010).
Garlic (*Allium sativum*) has been shown to have varied biological properties, including anti-carcinogenic, anti-thrombotic, anti-microbial, anti-inflammatory, anti-atherosclerotic, anti-oxidative, and various other biological actions. Potential antioxidant properties of garlic are as a result of presence of phenolic and flavonoids fractions (Miller *et al*., 2000).
Hence, the study to investigate the effect of garlic (*Allium sativum*) on the acrosome integrity of extended boar semen.

MATERIALS AND METHODS

Experimental Location

Semen collection was carried out at the Piggery Unit of the Teaching and Research Farm, University of Ibadan (7º20'N, 3º50'E; 200 - 300 above sea level), while the analyses of semen were carried out at the Animal Physiology and Bioclimatology Laboratories of the Department of Animal Science of the same institution.

Management of the Boar and Semen collection

Semen was collected from a mature boar with a proven semen quality and fertility for this study. The boar was kept in an intensively managed, clean and well ventilated pen. Feed and clean water were supplied *ad libitum.* Semen was collected into a boar semen collection cup; lined with a disposable plastic bag and covered with a disposable milk filter. The gel-fraction was separated from the sperm-rich fraction by the milk filter covering the semen collection cup. The gloved-hand technique/method was used to collect semen from the boar. Before the ejaculate collection, the boar was thoroughly washed to eliminate urine and other materials that could lead to semen contamination during collection. As the boar initiates extension of the penis on a standing heat sow, the end of the penis, which is cork screw shaped was held strongly by gloved hand. Collection procedure started with strong force to the coiled part of the penis by hand. Collection continued until the boar dismounted.

Preparation of Extracts from Garlic *(Allium sativum L.)*Bulb

Fresh garlic bulbs were purchased from a location, about 2 km from the study site. The fresh garlic bulbs were peeled and 150g was weighed out and fully chopped to increase its surface area, then oven dried at 45 ºC, for seven days and later ground into a powdery form using a ceramic mortar. Ethanol (absolute) was used for the extraction using a Sohxlet extractor. Rotary evaporator was further used to obtain a concentrated garlic extracts. Afterwards, the garlic extracts was dried up in an incubator at 45 ºC for 24 hours. The garlic extracts was recovered and reconstituted using dimethyl sulfoxide (DMSO) and stored (4 ºC) for subsequent use.

Semen Processing

Semen samples collected were immediately evaluated for mass activity, progressive motility, liveability, percentage normal spermatozoa, pH and the temperature was checked 15 minutes after collection. The volume of collected ejaculate was estimated by weighing on a top loader balance. Semen aliquots were diluted in each of experimental extenders (treatments). Diluted semen was preserved in a thermo regulated fridge at 17 ºC and evaluated for acrosome integrity.

Acrosome integrity assessment:

Ejaculate smears of all samples were prepared for confirmation of acrosome integrity condition utilizing eosin-nigrosin stain. All the slides were assessed under oil immersion at X1000 magnification using a bright field microscope. A total of one hundred spermatozoa per slide were assessed, and normal acrosomes (spermatozoa without apical shifts) were expressed as percentages.

Experimental Treatment and Design

Aliquot portions of diluted semen were allotted to five treatments with three replicates per treatment in a completely randomized design (CRD) and spermatozoa of acrosome integrity was evaluated .

Treatment description:

Treatment 1: Semen+ Beltsville Thawing Solution (BTS®)
Treatment 2: Semen+ BTS + 50 µg/L Ethanolic *Allium sativum* Extract (EASE)
Treatment 3: Semen+ BTS + 75 µg/L EASE
Treatment 4: Semen+ BTS + 100 µg/L EASE
Treatment 5: Semen+ BTS + 125 µg/L EASE

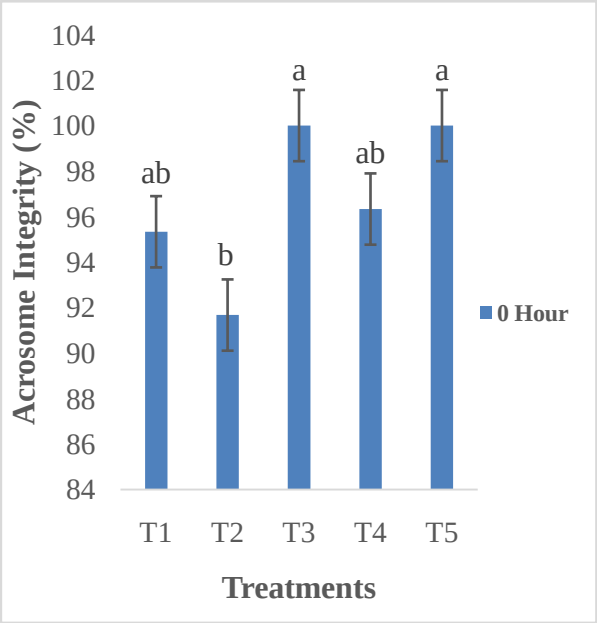
Statistical Analyses

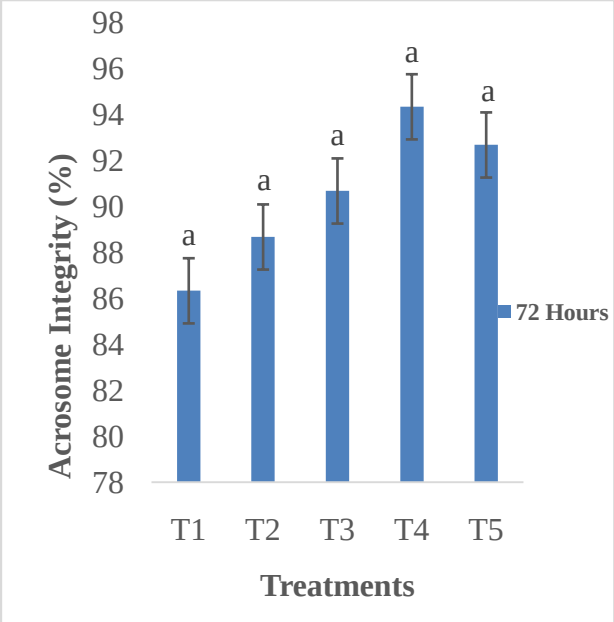
Data obtained were analyzed using one-way analysis of variance (ANOVA) procedure of SAS (2010) and means were compared using Duncan's multiple range test of the same software.

RESULTS

Table 1: Correlations between pH and Acrosome integrity

Parameter	Acrosome integrity
pH	-0.585





T1: Control; T2: 50µg EASE; T3: 75µg EASE; T4: 100µg EASE; T5: 125µg EASE; EASE: Ethanolic *Allium sativum* Extract

a,b: bars with different superscripts are significantly different (P<0.05)

Figure 1&2: Effect of EASE on acrosome integrity of extended boar semen at 0 and 72 hours respectively

DISCUSSION

Effect of EASE on Acrosome Integrity of Extended Boar Semen

Acrosome integrity of spermatozoa in extended boar semen, supplemented with EASE at 17 °C is presented in Figures 1 and 2. Significant difference (P<0.05) occurred at 0 hour. Acrosome integrity is an important parameter useful in predicting the fertilizing capacity of

spermatozoa *in vitro*. From this study, it was observed that acrosome integrity was intact across the treatments from 0 to 72 hours of observation, except for a little fluctuation in T4 at 48 hours observation. This is an indication that EASE has the capacity to maintain the integrity of the acrosome. However, acrosome integrity decline with storage time at 17 °C. This finding supports Gadea *et al.* (2005) report that reduced gluthathione could reduce acrosome integrity, improving the function and fertilizing capacity of frozen boar spermatozoa. This aligns with Orok *et al*. (2010) storage of semen for longer period causes ultra-structural, biochemical and function damage to the spermatozoa, resulting in a decline in motility, viability, fertility and impaired acrosome integrity and transport. Also, reduction in acrosome integrity will result in induced acrosome reaction of greater portion of spermatozoa before reaching the site of fertilization. This scenario is suggested in the negative relationship in pH and acrosome integrity. Reduced pH indicates more metabolic activity in the system and possibility of acrosome reaction before spermatozoa arrival at fertilization site. This finding indicates that EASE inclusion at 125µg competes favourably in preservation of the acrosome integrity better than a conventional extender (T1).

CONCLUSION

From this study, it was observed that BTS supplemented with 125 µg/L EASE, has the potential of maintaining the acrosome integrity of extended boar semen for 72 hours of preservation.

REFERENCES

Gączarzewicz, D., Udała, J., Piasecka, M., Błaszczyk, B. and Stankiewicz, T. (2015). Storage temperature of boar semen and its relationship to changes in sperm plasma membrane integrity, mitochondrial membrane potential, and oxidoreductive capability. *Tur J Biol*, 39: 582-594.

Gadea, J., (2003). Review: semen extenders used in the artificial insemination of swine. *Spanish Journal of Agricultural Research.* 1 (2):17-27.

Gupta, V. K. and Sharma, S. K. (2006). Plants as natural antioxidant. *Nat. Prod. Radiance*, 5: 326-334.

Johnson, L. A., Weitze, K. F., Fisher, P., Maxwell and W. M. (2000). Storage of boar semen. *Anim. Reprod. Sci*. 62 (1-3): 143-172.

Klimont, M., Wrona, Z., Brodzki, P. and Krakowski, L. (2015). Influence of season and storage of boar semen on the degree of DNA fragmentation of sperm. *Med Weter*, 71: 171-175.

Miller, H. E., Rigelhof, F., Marquart, L., Prakash, A. and Kanfer M. (2000). Antioxidant content of whole grain breakfast cereals, fruits and vegetables. Journal of America Coll. *Nutrition*; 19:1 8.

Orok, E. E., Essien, A., Akpet, S. O., Ibom, L. A. and Etop, S. C. (2010). Mean sperm concentration and percent motility of extended porcine semen as affected by antibiotics from selected sources and storage time. *Int. J. Curr. Res*. 10, 001-006.

Sen, S., Chakraborty, R., Sridhar, C., Reddy, Y. S. R. and De, B. (2010). Free radicals, antioxidants, diseases and phytomedicines: current status and future prospect. *Int. J. pharm. Sci.* Rev. Res., 3: 91-100.

Tsakmakidis, I. Lymberopoulos, A. and Khalifa, T. (2010). Relationship between sperm quality traits and field-fertility of porcine semen. *Journal of Veterinary Science*, 11: 151-154.

THE EFFECT OF AGE AND EGG SIZE OF JAPANESE QUAILS ON FERTILITY AND HATCHABILITY

S.O. Ajide[1*], G.S. Bawa[2], T.S. Olugbemi[2], D.J.U. Kalla[3], J.O. Makinde[4] & E.S. Inape[1]
[1]Department of Animal Science, Landmark University, OmuAran, Kwara State.
[2]Department of Animal Science, Ahmadu Bello University, Samaru, Zaria.
[3]Department of Animal Science, AbubakarTafawaBalewa University, Bauchi.
[4]Department of Animal Science, Federal University, Gashua, Yobe State.
**Correspondence:ajidesolomon@gmail.com, 08038905602*

ABSTRACT
288-six weeks old Japanese quails at the point of lay were used to determine the effect of age and egg size on the fertility and hatchability of quail eggs after adjusting for three weeks. Eggs were taken daily from the birds with a mating ratio of one cock to four hens for a period of five days when the quails attained 9, 13, 17 weeks old respectively and sorted on the basis of small (<9g), medium (9-10g) and large eggs (>10g) using a sensitive electronic scale. The eggs were stored in a temperature of 15°C before setting in the incubator to inhibit embryonic development in an experiment that lasted for 12 weeks. The small, medium and large eggs collected at the corresponding ages of 9, 13 and 17 weeks were assigned into a 3 x 3 factorial arrangement in a completely randomized design having six replicates each. Results obtained revealed that percent fertility was highly significantly (P<0.01) affected by age with a fertility of 92.90% at 13 weeks followed by 89.92%, 82.91% at 9 and 17 weeks. The percent hatchability was significantly (P<0.05) affected by egg size and the best recorded in the medium eggs with 69.58% in relation to the large and small eggs having 64.95% and 63.62%, respectively. The fertility and hatchability were neither affected (p>0.05) by the interaction effects of age and egg size. In conclusion, the age of quails had significant effect on fertility of quail eggs whereas the hatchability was affected by egg size.
Keywords: Japanese quails, age, egg size, fertility, hatchability.

INTRODUCTION
Fertility and hatchability of chicken eggs is determined by an array of factors such as physiological, social, environmental and genetic makeup of the birds (Islam *et al.,* 2002). The reproductive performance of livestock particularly avian is severely affected by the age of the bird (Brillard, 2003). The author reported that the decline in fertility of the hens may be related to the inability of the hens to retain spermatozoa in the oviduct while the fertility of the cocks is a function of its ability to successfully mate and deposit adequate quality and quantity of semen in the hen's reproductive tract. A reoccurring setback observed with the commercial broiler breeders is the sharp decline recorded in its fertility at the declining phase of its laying period which occurs as the hens attain 50 weeks of age (Walsh and Brake, 1997). Munir and Mohammed (2010) reported that there was an increased percent fertility and hatchability in Arbor acre and Lohman brown hybrid layers between the ages of 24-45 weeks which was followed by a decrease in the fertility and hatchability when the birds increased in age from 50-65 weeks. The factors which affects both sexes has its peculiarity with the age of the bird. The influence of age relating it with other factors as they affect fertility and hatchability of eggs is not clearly understood (Bramwell, 2009).
In the findings of Abiola*et al.* (2008), the author opined that from the three categories of small, medium and large sized eggs of broiler chickens, the best hatchability of 96.67% was obtained in the average eggs compared with the large and small eggs. There is paucity of information regarding the factors affecting the fertility and hatchability of quail eggs. The precise causes are yet to beascertained. The predisposing factors in commercial poultry birds may also apply to quail eggs (Gonzalez *et al.,* 1999). This work was designed to substantiate the effect of age and egg size of Japanese quails on its fertility and hatchability.

MATERIALS AND METHODS
The experiment were conducted in the poultry unit, Teaching and Research Farm of Ahmadu Bello University, Samaru, Zaria and the hatchery unit, College of Agriculture, Mando, Kaduna respectively. According to Akpa*et al.* (2002), Zaria is within Latitude 11° 12^{1}N and longitude 7° 12^{1}E. The altitude is 610m above the sea level and located in the Northern Guinea Savannah zone of Nigeria. The National Veterinary Research Institute (NVRI) Vom, Plateau state, Nigeria supplied the quails used for

this study.The number of Japanese quails used for the study was 288-six week's old unsexed Japanese quails with a mating ratio of one cock to four hens which were raised in cages partitioned into $0.5m^2$ to house each group of four quails (a cock and four hens). The quails were fed a formulated diet of 23% crude protein from six to eighteen weeks of age. The management practices involved in raising the birds with regard to the feeding, lighting and watering were the same in the course of the twelve week experimental period. Eggs were taken daily from the birds for a period of five days when the quails were nine, thirteen and seventeen weeks old respectively and stored in a room with a temperature of 15^oC prior to setting in the incubator to inhibit embryonic development. The egg classification were as follows; eggs weighing below nine, nine to ten and above ten grams were classified as small, medium and large eggs using an electronic scale at the corresponding age taken. Each batch of eggs from the corresponding ages together with the different egg sizes were individually set on marked trays with six replicates and each having a minimum of 80 eggs. The eggs were further set in the incubator for 15 days and hatched on the 18th day. Candling of the eggs was carried out on the 15th day as follows; the infertile eggs were removed before onward transfer to the hatcher and the chicks were hatched on the 18th day. The fertility and hatchability were determined as follows:

Percent fertility = Total fertile eggs/Total eggs set in the incubator x 100

Percent hatchability = Total chicks hatched/ Total fertile eggs from the incubator x 100

The small, medium and large eggs collected at the corresponding ages of nine, thirteen and seventeen weeks were assigned into a 3 x 3 factorial arrangement in a completely randomized design.

Statistical Analysis

The generated data from the experiment was analyzed using the General Linear Model Procedure of SAS (1993). The least significant difference was used to separate the means in the treatment groups where significant differences were observed.

The model used for the analysis of data generated in this study is shown below:

$Y_{ijkl} = \mu + A_i + S_j + (AS)_k + E_{ijkl}$

Where: Y_{ijkl} = Response variable (fertility or hatchability) as the case were:

μ = Overall mean

A_i = Effect of i_{th} age of quail hens

S_j = Effect of j_{th} egg size

AS_k = Interaction effect of age of quail hens and egg sizes on fertility or hatchability

E_{ijkl} = Random error

RESULTS

The effect of age and egg size on the percent fertility and percent hatchability is presented on Table 1. Percent fertility was highly significantly ($P<0.01$) affected by age, whereas egg size and the interaction effect of age and egg size had no significant ($P>0.05$) effect on the percent fertility of the quail eggs. The pattern revealed that as the birds increased in age from 9 to 13 weeks, there was an increase in the percent fertility and subsequently declined at 17 weeks as the birds advanced in age suggesting that the best fertility is obtained in quails at 13 weeks of age after which there is a gradual decline. The percent hatchability was significantly ($P<0.05$) affected by egg size and was neither affected by the age or the interaction effects of age and egg size. The best hatchability was obtained in the medium sized eggs followed by the large and small sized eggs respectively.

DISCUSSION

The increase in the percent fertility as the quails increased in age could be as a result of higher sexual activity at the 9th and 13th week while the decrease at the 17th week could be as a result of decreased sexual activity as birds advanced in age. This is in agreement with the report of Bramwell (2009), that the decrease in fertility and hatchability with increasing hen age may be due to a decline in the ability of the older hens to retain sperm in the special sperm host glands of the oviduct and the ability of the cock to successfully mate and deposit adequate quality and quantity of semen in the hen's reproductive tract. The author noted that, in all avian species, as well as in other animals, increasing age has an adverse effect on reproductive performance.Abiola*et al*. (2008) reported that younger flocks in broiler parents (aged between 29 and 41 weeks) compared with older flocks (aged between 52 and 68 weeks) achieved considerably higher intensity of laying and produced more fertilized eggs. The higher percent hatchability recorded in the medium sized eggs in relation to the large and small eggs in Japanese

quails implies that hatchability of quail eggs is a function of the egg size. This is in line with the findings of Gonzalez *et al*. (1999) in a related study who suggested the setting of eggs of average weight in other to achieve good hatchability. These assertions also corroborates the findings of Abiola*et al.* (2008) who reported the highest hatchability of 96.67% in medium eggs and the lowest of 82.88% for large eggs in broilers. The range in the percent hatchability of 61.84%-72.45% obtained for Japanese quails in this study conformed to the range of 62.63 to 71.19% reported by Musa *et al*.(2007) and Bawa*et al*. (2011), respectively.

CONCLUSION AND RECOMMENDATION

It can be concluded that in Japanese quails, the peak in fertility is 9 to13 weeks with the value of 89.92-92.90% followed by a gradual decline of 82.91% after 17 weeks of age. The best hatchability is obtained in the medium sized eggs followed by the large and small eggs. In Japanese quails, age plays a critical role in the fertility of the eggs whereas hatchability is a function of the egg size. The fertility and hatchability were neither affected by the interaction effects of age and egg size respectively.

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REFERENCES

Abiola, S.S., Meshioye, O.O., Oyerinde B.O. and Bamgbose, M.A. (2008). Effect of Eggs size on hatchability of Broiler chicks. *Arch. Zootec.* 57(217):83-86.

Akpa, G.N., Asiribo, O.E., Oni, O.O., Alawa, J.P., Dim, N.I., Osinowo, O.A. and Abubarkar, B.Y. (2002). Milk Production by Agropastoral red sokoto goats in Nigeria. *Tropical Animal Health and production,* 34(6): 525 – 533.

Bawa, G.S., Lombin, L.H., Karsin, P., Musa, U., Payi, E. and Shamaki, D. (2011). Response of Japanese Breeder Quails to varying dietary protein levels in the tropics. *Nigerian Journal of Animal Production,* 38:43-54.

Bramwell, R.K. (2009). Management to minimize reduction in fertility and hatchability late in lay. Center of Excellence for poultry Science, University of Arkansas Cooperative Extension Service -Avian Advice newsletter (Volume 3, No.3).

Brillard, J.P. (2003). A practical aspect of fertility in poultry. *World's Poultry Science Journal*, 59: 441- 446.

Gonzalez, A., Satterlee, D.G., Moharer, F. and Cadd, D.G. (1999). Factors affecting Ostrich egg hatchability. *Poultry Science,* 78:1257-1262.

Islam, M.S., Howlider, M.A.R., Kabir, F. and Alam, J. (2002). Comparative assessment of fertility and hatchability of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock Hen. *International Journal of Poultry Science* (1):85-90.

Munir, M.A. and Mohammad, S.A. (2010). Effect of Ambient Temperature, flock Age and Breeding stock on Egg production and Hatchability of Broiler hatching eggs. *European Journal of Biological Science,* 2(3): 55- 66.

Musa, U., Haruna, E.S., Qadeer, M.A., Edache, J.A., Ogbe, A.O and P.D. Karsin (2007). Effects of storage period on the hatchability performance of Japanese quail eggs. *Nigerian Journal of Animal* Production 34(2):247-250.

SAS (1993). Statistical Analysis System Procedure guide for Personal computers. SAS Institute Inc. Cavy, North Carolina.

Walsh, T.J. and Brake, J. (1997). The effect of nutrient intake during rearing of broiler breeder females on subsequent fertility. *Poultry Science Journal*, 87:2408-2417.

Table 1:Effect of Age and Egg size on Percent Fertility and Hatchability of Japanese Quails

Factor	Fertility %	Hatchability %
Age(weeks)	**	NS
	LSMeans±SE	LSMeans±SE
9	89.92[a] ± 2.05	64.93 ± 1.65
13	92.90[a] ± 2.05	65.82± 1.65
17	82.91[b] ± 2.05	67.40± 1.65
Egg size	NS	*
Small	86.12 ± 2.05	65.74[b] ± 1.56
Medium	90.78 ± 2.05	69.58[a] ± 1.56
Large	88.83 ± 2.05	65.95[b] ± 1.56
Interaction	LSMeans ± SE	LSMeans ± SE
Age X Egg size	NS	NS
9 X Small	82.22 ± 3.56	63.35 ± 2.86
9 X Medium	93.33 ± 3.56	67.63 ± 2.86
9 X Large	94.22 ± 3.56	63.79 ± 2.86
13 X Small	92.82 ± 3.56	61.84 ± 2.86
13 X Medium	92.77 ± 3.56	72.45 ± 2.86
13 X Large	93.10 ± 3.56	63.17 ± 2.86
17 X Small	83.33 ± 3.56	65.67 ± 2.86
17 X Medium	86.25 ± 3.56	68.65 ± 2.86
17 X Large	79.16 ± 3.56	67.87 ± 2.86

SE=Standard error;* = P< 0.05; ** = P< 0.01; [a,b]Means with different superscript in the same column are significantly (P<0.05) different; NS=Non Significant(P> 0.05);%=Percent.

BIOCHEMISTRY, DIFFERENTIAL COUNT AND LIVER FUNCTION PROFILE OF BROILER CHICKENS SERVED DIETARY INCLUSION OF PROBIOTICS (*SACCHAROMYCES CEREVISIAE*) AND ENZYME (BIO-ENZYME)

F.U. Udeh, C.O. Osita, M.O. Onodugo, V.C.Udeh & P. Chukwudi
Department of Animal Science, University of Nigeria, Nsukka.
Correspondence Author: *E-mail: fredrickudeh11@gmail.com GSM: +2348062457193*

ABSTRACTS
This study was conducted to evaluate the biochemistry, differential count and liver function profiles of broiler chickens served dietary inclusion of probiotics (*Saccharomyces cereviasae*) and enzyme (Bio-enzyme). One hundred and twenty day-old broiler chicks of Agrited strain were used for the study. The birds were randomly allotted to four dietary treatments. Each treatment contained 30 birds replicated three times to contain 10 birds per replicate in a completely randomized design experiment. The four dietary treatments were T1 Control (no probiotics and enzyme), T2 (had both probiotics and enzyme), T3 (probiotics only) and T4 (Enzyme only). The probiotics and enzyme was included at 0.8% and 0.02%, respectively. The birds were given feed and water *ad-libitum*. The experiment lasted eight weeks. At the end of the experimental period, three birds were randomly chosen from each replicate for biochemistry, differential count and liver function profiling. The results showed that inclusion of Saccharomyces cerevisiae and bio-enzyme had significant effect ($p<0.05$) on the biochemistry, differential count and liver function profile. The dietary inclusion of probiotics and enzyme reduced total cholesterol and low density lipoprotein, gut and intestinal microoganisms and favoured the functionality of the liver of the broiler chickens. It was therefore concluded that probiotics and bioenzyme should be included in broiler diets for immunity improvement and reduction of cholesterol levels.
Key words: Broilers, probiotics, enzyme, biochemistry, differential count and liver function

INTRODUCTION
Antibiotics as a growth promoter have been widely used extensively in poultry feed for more than 50 years (Haque*et al.*, 2017), playing a crucial role in promoting chicken growth and lowering enteric diseases. However, the deleterious effect of this product on the health of the consumers cannot be overemphasized. In Europe and South Korea, growth promoting antibiotics have been banned since 2006 and 2012 respectively, and these bans are expected to affect the rest of the world (Aude*et al*., 2015). Hence, tremendous research has been geared towards finding alternatives to antibiotics that would maintain low mortality rate, good level of animal yield while preserving environment and consumer health. Several alternative strategies have been proposed with some success that mimics the function of antibiotics as growth promoters and these include the use of probiotics, prebiotics, organic acids, and exogenous enzyme, among others (Yadav and Jha, 2019).
Probiotics are living microorganisms that confer health benefits to the host when administered in adequate amounts. The most important advantage of probiotics is that they neither have any residues in animal products nor exerts any antibiotic resistance on consumption while having good impact on the poultry performance. The use of probiotics in poultry production is a recent practice which has progressed from the transplantation of feces from healthy adult hens into neonatal chicks to a more mature technology focused on developing probiotics formulation to address specific, wide-ranging issues relevant to today's modern poultry industry (Wolfenden and Hargis, 2020). In broiler nutrition, probiotic species belonging to Lactobacillus, Streptococcus, Bacillus, Bifidobacterium, Enterococcus, Aspergillus, Candida and Saccharomyces have a beneficial effect on broiler performance, modulation of intestinal flora, intestinal histological changes, immunomodulation, in addition, have an impact on specific haemato-biochemical parameters and improving microbiological meat quality of broilers Ashayerizadeh*et al*., 2009).
The role of exogenous enzymes is to fulfill the absence of endogenous enzymes, to counter the anti-nutritional factors present in conventional and unconventional poultry diet. Probiotics and exogenous enzymes can also enhance broiler productivity and likely immunity too, that may represent an alternative to the use of sub-therapeutic doses of antibiotics, meeting the growing public concerns on the contribution of this practice to the increasing antibiotic resistance (Yadav and Jha, 2019). As information on the effect of a mixture of probiotic microorganisms and enzymes on the immunity of broilers are very limited, this study intended to determine the effect of different dietary levels of a

probiotic (*Saccharomyces cereviasae*) and enzyme (bio-enzyme) inclusion to broiler chickens on their immune response, lipid profile and liver function profile.

MATERIALS AND METHODS

Study location

The experiment was conducted at the Poultry Unit, Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka, Enugu State, Nigeria. Nsukka is in Enugu state, Nigeria

Experimental design, animals and management

The study was conducted to evaluate the biochemistry, differential count and liver function profiles of broiler birds served dietary inclusion of probiotics (*Saccharomyces cereviasae*) and enzyme (Bio-enzyme). One hundred and twenty day-old broiler chicks of Agrited strain were used for the study. The birds were randomly divided into four groups and assigned to the four dietary treatments. Each treatment contained 30 birds replicated three times to contain 10 birds per replicate in a completely randomized design. The four dietary treatments were T1 Control (no probiotics and enzyme), T2 (both probiotics and enzyme), T3 (probiotics only) and T4 (Enzyme only).The probiotics and enzyme was included at 0.8% and 0.02%, respectively. The birds were given feed and water *ad-libitum* and the quantity of feed consumed each day were determined through weigh back techniques. The birds were weighed weekly throughout the experimental period and the experiment lasted for eight weeks. Vaccination and medications were provided as when due and other routine management practices were provided accordingly. At the end of the experimental period, three birds were randomly chosen from each replicate for biochemistry, differential count and liver function profiling. Blood samples were collected into EDTA containers with the aid of sterile syringes and needles and taken to the laboratory for analysis.Proximate analysis of feeds was done according to AOAC (1990). Data collected were subjected to analysis of variance (ANOVA) using Statistical Package for Social Sciences (SPSS, 2013) version 19.00. Significant different means were separated using Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The effect of probiotics (*Saccharomyces cereviasae*) and enzyme (bio-enzyme) inclusion on the lipid profile of broiler birds is presented in Table 2. The serum total cholesterol, LDL, HDL and triglyceride concentrations were significantly ($P<0.05$) reduced in broiler chickens fed treatments that were supplemented with *Saccharomyces cereviasae*and bio-enzymes when compared to the control treatment. The value of Total.Chol (3.99g/l), TG (1.61g/l) and HDL (0.79g/l) were lowest in the treatment group with only probiotics while LDL value (2.18g/l) was lowest in the treatment group with mixture of *Saccharomyces cereviasae*and bio-enzymes dietary inclusion. The value of total cholesterol and TG obtained in this work was in line with that of Haque*et al*. (2017) who reported highest serum total cholesterol, and TG level in the control group compared to all other groups supplemented with either antibiotics or probiotics. Similarly, the result concurred with the result of Shokryazdan*et al*. (2017) who observed that the supplementation of the three L. salivarius strains to broilers significantly reduced their serum LDL, but did not affect HDL levels at 21 and 42 days of age. This result is also in agreement with Saleh*et al*.(2012) who reported that the inclusion of Aspergillusawamori and Saccharomyces cerevisiae in chickens feed reduced blood saturated fatty acids and increased the polyunsaturated.

The effect of probiotics (*Saccharomyces cereviasae*) and enzyme (bio-enzyme) inclusion on the differential count of broiler birds is presented in Table 3.Neutrophil and lymphocyte were lower in treatment groups with dietary inclusion of probiotics. However, the neutrophil and lymphocyte counts were significantly ($p<0.05$) different in the control treatment groups. Monocyte and eosinophil count were significantly ($p<0.05$) different in the treatment group with a mixture of probiotics and enzyme with the value 2.33% and 3.67% for monocyte and eosinophil respectively. There were no significant differences in the basophil count across the treatment groups. This result perfectly agrees with the work of Mohamed *et al*. (2019) who reported a significant reduction in lymphocyte percentage by treatment groups with dietary inclusion of probiotics. This implies that probioticsimproves the

immune system of broiler chicken. This improvement is achieved by reducing intestinal pH, intestinal bacteria composition and digestive activity. Probiotic bacteria produce molecules with antimicrobial activities such as bacteriocins which inhibits toxins' production and pathogens' adhesion. On the other hand, probiotics stimulate the immune response and increase resistance to colonization of bacteria (Hassanein and Soliman, 2010).

The effect of probiotics (*Saccharomyces cereviasae*)and enzyme (bio-enzyme) inclusion on the liver function profile of broiler birds is presented in Table 4.AST, ALT and ALP activities were significantly ($p<0.05$) different in treatment groups with bio-enzyme compared to the control groups and the treatment group with only probiotics. The activities of Tot.Bili and D.Bili were lower in treatment groups with probiotics or enzyme. The decrease in AST, ALT and ALP value in the probiotics treated groups perfectly aligns with the work of Haque et al., 2017 who measured highest value in the control treatmentsand least value in probiotic supplemented group. These findings concur with the finding that the supplementation of probiotics lowers AST and ALT level. Mechanisms of action of probiotics include stimulation of endogenous enzymes, reduction of metabolic reactions that produce toxic substances, and production of vitamins or antimicrobial substances (Hassanein and Soliman, 2010).

CONCLUSION

Dietary inclusion of *Saccharomyces cerevisiae*significantly lowered blood cholesterol and glucose levels in broiler which are beneficial parameters to enhance broiler production. Immune response, lipid profile and liver function profile of broiler chicken were improved by the treatment with probiotics inclusion (*Saccharomyces cerevisiae*). In this regard *Saccharomyces cerevisiae*should be included in the diet of broiler chicken as alternative to the use of antibiotics growth promoters.

Table 1: The percentage composition of the experimental diets of the broiler chickens

Parameters	**Treatments**			
	T1 (Control)	**T2 (Probiotics and Enzyme)**	**T3 (Enzyme only)**	**T4 (Probiotics only)**
Maize	53.00	53.00	53.00	53.00
Wheat offal	10.00	10.00	10.00	11.00
Palm kernel cake	5.50	5.50	5.50	5.50
Groundnut cake	15.00	15.00	15.00	15.00
Soya bean meal	10.00	10.00	10.00	10.00
Fish meal	1.50	1.50	1.50	1.50
Bone meal	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Vit-Premix	0.25	0.25	0.25	0.25
Probiotics	-	0.80	-	0.80
Enzyme	-	0.02	0.02	-
Total	100.00	100.00	100.00	100.00
Calculated composition				
CP%	20.12	20.01	20.11	20.04
Energy (MJME/kg)	3.68	3.81	3.75	3.71

Table 2: Effect of Probiotics and Enzyme inclusion on the lipid profile of Broiler birds

Parameters	T1 (Control)	T2 (Prob. &Enz.)	T3 (Enzyme only)	T4 (Prob. Only)
Tot. Chol. (g/l)	5.07±0.07[a]	4.22±0.02[c]	4.40±0.06[b]	4.49±0.01[d]
Trig. (g/l)	1.90±0.00[a]	1.79±0.02[b]	1.89±0.00[a]	1.61±0.02[c]
HDL (g/l)	1.50±0.03[a]	1.20±0.00[c]	1.40±0.01[b]	0.79±0.05[d]
LDL (g/l)	3.83±0.60[a]	2.18±0.12[c]	2.78±0.10[b]	2.92±0.02[b]

Tot. Chol = Total Cholesterol, Trig. = Triglyceride, HDL = High density lipoprotein, LDL = Low density lipoprotein, Prob. = Probiotic, Enz. = Enzyme.

Table 3: Effect of Probiotics and Enzyme inclusion on the Differential count of Broiler birds

Parameters	T1 (Control)	T2 (Prob. &Enz.)	T3 (Enzyme only)	T4 (Prob. Only)
Neut. (%)	68.33±0.33[a]	56.00±2.00[b]	70.33±1.53[a]	52.00±0.00[c]
Lymph (%)	45.67±0.33[a]	38.00±1.16[b]	26.00±1.16[d]	30.67±0.33[c]
Eosi (%)	2.33±0.33[b]	3.67±0.33[a]	2.00±0.00[b]	2.33±0.33[b]
Mono (%)	0.00±0.00[b]	2.33±0.03[a]	0.00±0.00[b]	0.00±0.00[b]
Baso (%)	0.00±0.00	0.00±0.00	1.00±0.00	0.00±0.00

Neut. = Neutrophil, Lymph. = Lymphocyte, Eosi. Eosinophil, Mono. = Monophil, Baso. = Basophil, Prob. = Probiotic, Enz. = Enzyme.

Table 4: Effect of Probiotics and Enzyme inclusion on the Liver function profile of Broiler birds

Parameters	T1 (Control)	T2 (Prob. &Enz.)	T3 (Enzyme only)	T4 (Prob. Only)
AST (µl)	124.33±1.45[c]	150.67±1.45[a]	132.00±1.16[b]	114.67±0.33[d]
ALT (µl)	27.17±0.33[c]	29.03±0.03[b]	21.00±0.29[d]	280.67±0.67[a]
ALP (µl)	10.33±0.33[d]	15.67±0.03[b]	17.00±0.00[a]	12.00±0.58[c]
Tot. Bili (mg/dl)	1.47±0.03[a]	1.43±0.03[a]	1.30±0.06[b]	1.30±0.00[b]
D. Bili (mg/dl)	0.30±0.03[d]	0.41±0.01[c]	0.87±0.03[a]	0.70±0.03[b]

AST = Aspartate aminotransferase, ALT = Alanine aminotransferase, ALP = *Alkaline phosphatase*,Prob. = Probiotic, Enz. = Enzyme.

REFERENCES

AOAC (1990). Association of Official Analytical Chemists international (AOAC) Official methods of analysis, 17th edition AOAC International, Gaithersburg, MD, USA

Ashayerizadeh A, Dabiri N, Ashayerizadeh O, Mirzadeh KH, Roshanfekr H, Mamooee M (2009). Effect of dietary antibiotic, probiotic and prebiotic as growth promoters, on growth performance, carcass characteristics and hematological indices of broiler chickens. Pakistan

Aude, T., Ramanan, Laxminarayan and Thomas V. (2015).The Economic Costs of Withdrawing Antimicrobial Growth Promoters from the Livestock Sector.Report number: 78Affiliation: OECD Food, Agriculture and Fisheries Papers DOI: 10.1787/5js64kst5wvl-en

Duncan D.B. (1955).New Multiple Range Test. Biometrics. 11: 1-42.

Haque, M.I., Ahmad, N. and Miah, M.A. (2017) Comparative analysis of body weight and serum biochemistry in broilers supplemented with some selected probiotics and antibiotic growth promoters. Journal of Advanced Veterinary and Animal Research 4(3):288-294.

Hassanein SM and Soliman NK. (2010) Effect of probiotic (Saccharomyces Cerevisiae) adding to diets on intestinal microflora and performance of hy-line layers hens. J Am Sci. 6.

Mohamed et al., The use of probiotics to enhance immunity of broiler chicken against some intestinal infection pathogens. SVU-IJVS 2019, 2 (1): 1-19.

Saleh, F., Mumu, S.J., Ara, F., Begum, H.A. and Ali, L. (2012). Knowledge and self-care practices regarding diabetes among newly diagnosed type 2 diabetics in Bangladesh: a cross-sectional study. *BMC Public Health* **volume 12**, Article number: 1112 (2012)

Shokryazdan, P., Faseleh, J.M., Navidshad, B. and Liang, J.B. (2017).Effects of prebiotics on immune system and cytokine expression. Med MicrobiolImmunol 2017 Feb;206(1):1-9. doi: 10.1007/s00430-016-0481-y.

The Economic Costs of Withdrawing Antimicrobial Growth Promoters from the Livestock Sector

Wolfenden R.E. and Hargis B.M. (2014) Poultry probiotics getting specific. Feedstuff. https://www.feedstuffs.com/story-poultry-probiotics-getting-specific-53-109997 Retrieved 28th January, 2020.

Yadav, S. and Jha, R. (2019) Strategies to modulate the intestinal microbiota and their effects on nutrient utilization, performance, and health of poultry. Journal of Animal Science and Biotechnology 10:2

Animal Breeding and Genetics

EFFECT OF DURATION OF STORAGE ON EGG QUALITY

[*]Adeoye, A.A., [**]Udoh, J.E., [***]Oladepo, A.D., & [****]Ojajuni, J.B
[*]Animal Production and Health, Ondo State University of Science and Technology, Okitipupa.
[***]Agricultural Science, Adeyemi College of Education, Ondo
[**]Animal Science Department, University of Uyo, Uyo
[****]Zoology programme, Ondo State University of Science and Technology, Okitipupa
e-mail address:adeomoh@yahoo.com; Phone No. 08138273174

ABSTRACT
One hundred and twenty (120) freshly laid eggs by 36 weeks old Isa brown layers kept at the Poultry Unit, Teaching and Research Farm, Ondo State University of Science and Technology, Okitipupa were randomly collected and stored at room temperature for 21 days. At week 0, week1, week 2 and week 3 of storage, 30 eggs were broken for egg quality analysis. Data collected were subjected to statistical analysis. Duration of storage had significant effect ($p<0.05$) on all the internal and external parameters except shell index and shell thickness. The overall egg weight, egg length, egg width, shell index, shell weight, shell ratio and shell thickness were 56.82, 5.69, 4.43, 78.02, 7.45, 13.11 and 0.28 respectively, while yolk height, albumen height, yolk weight, albumen weight, albumen ratio, yolk ratio and Haugh unit were 13.55, 4.97, 16.32, 33.06, 58.11, 28.82 and 67.50 respectively. Most of the traits declined in values as the storage duration increased except yolk weight and ratio which increased as the egg aged. Duration of storage of egg had effect on the egg quality that determines acceptability by consumers.
Keywords: Eggs; Isa brown; storage duration; shell index; yolk ratio

INTRODUCTION
The egg is a complex structure distinguished by having four different parts; the egg shell, shell membrane, albumen and yolk. When eggs are for human consumption, it is important that they are suitable for this purpose (Kabir *et al.*, 2014). This is determined by both the internal and external quality (Smith, 1990). Egg quality is composed of characteristics that affect its acceptability to consumers such as cleanliness, freshness, weight, shell quality, yolk index, albumen index, Haugh unit and chemical composition (Song *et al.*, 2000). Unlike external quality, internal egg quality begins to decline as soon as the egg is laid. Variability in the quality and nutritional values of eggs have significant impact on consumers' health and welfare. Some factors affect egg quality. They include the breed and strain of layers (Kucukyilmaz *et al*., 2012), dietary composition (Goldberg *et al*., 2012), birds' health, environmental conditions and storage, processing and handling and age (Ryu *et al*., 2011 and Kabir *et al.*, 2014). The objective of this study is to determine the effect of duration of storage on the internal and external quality of eggs kept at room temperature.

MATERIALS AND METHODS
One hundred and twenty (120) freshly laid eggs were randomly collected in a batch from 36 weeks old exotic chickens (Isa Brown) kept at the Poultry Unit, Teaching and Research Farm, Ondo State University of Science and Technology, Okitipupa, 30 of the eggs were analysed for internal and external quality within 24 hours of laying. The remaining were stored at room temperature on the laboratory desk and at weekly interval 30 eggs were randomly selected till 21 days and similarly analysed.The external quality parameters included egg weight (EWt), egg length (EL), egg shell weight (ESWt), egg width (EWdt), shell index (SIdx), shell ratio (SRatio) and egg shell thickness (EST). The internal egg quality traits included albumen weight (AlbWt), albumen height (AlbHt), albumen ratio (AlbRatio), yolk weight (YlkWt), yolk height (YlkHt), yolk ratio (YlkRatio), Haugh unit (Hu).Data collected were subjected to one-way analysis of variance procedure of SAS (2003). Significant means were separated using Duncan Multiple Range Test, (Duncan, 1955). The following statistical model was employed:

$Yij = \mu + Di + eij$

Where: Yij= Individual observation, μ= Overall mean, Di= Effect of the ith duration (i= 1, 2, 3, 4) and eij= Random error.

RESULTS

Table 1 shows the summary statistics of egg quality traits. The external quality traits - egg weight, length, width and shell index, weight, ratio and thickness were 56.82 g, 5.69 mm, 4.43mm, 78.02 %, 7.45 g, 13.11 %, 0.28 mm respectively, for external traits. The internal quality - yolk height, albumen height, yolk weight, albumen weight, albumen ratio, yolk ratio and Haugh unit were 13.55 mm, 4.97 mm, 16.32 g, 33.06 g, 58.11 %, 28.82 % and 67.50 respectively.

Table 1. Summary Statistics for egg quality traits

Variables	Means	N	Minimum	Maximum	CV
Egg weight (g)	56.82 ± 0.40	109	47.3	67.96	7.37
Egg length (mm)	5.69 ± 0.03	109	5.06	6.62	6.39
Egg width (mm)	4.43 ± 0.02	109	4.06	5.28	6.12
Shell index	78.02 ± 0.50	109	64.23	92.63	6.70
Shell weight (g)	7.45 ± 0.07	109	5.60	9.14	9.39
Shell ratio	13.11 ± 0.10	109	10.91	15.52	7.58
Shell thickness (mm)	0.28 ± 0.02	109	0.01	0.49	59.40
Yolk height (mm)	13.55 ± 0.23	85	7.09	16.90	15.84
Albumen height (mm)	4.97 ± 0.15	107	2.36	10.23	30.76
Yolk weight (mm)	16.32 ± 0.19	89	12.50	22.90	10.92
Albumen weight (g)	33.06 ± 0.40	89	24.10	41.87	11.41
Albumen ratio	58.11 ± 0.37	89	46.35	65.20	6.02
Yolk ratio	28.82 ± 0.34	89	21.22	40.00	10.98
Haugh unit	67.50 ± 1.21	107	40.15	100.00	18.58

Table 2 shows the effect of duration of storage on the external traits. Significant difference ($P<0.05$) was observed in all the traits considered except shell index. In egg weight, no significant difference was observed from week 0 to 2. Egg weight reduced with age. Egg lengths across weeks were 5.72, 5.87, 5.63 and 5.49 mm. No significant difference was observed from week 0 to 2. Similar trends were observed in egg width and shell ratio. The values for shell weight were 7.72, 7.38, 7.19 and 7.43 for the weeks respectively. Table 3 shows the effect of storage duration on the internal quality traits. Significant difference ($P<0.05$) was observed in all the traits considered. For yolk height, significant difference was observed from week 0 to 3. Hence, yolk height reduced as the egg age. The values for albumen height were 6.80, 4.32, 4.30 and 3.86. Similar trend was observed for albumen ratio and Haugh unit. Albumen ratio reduced as the egg age, but yolk ratio increased with age.

Table 2: Effect of storage duration on external quality of egg

Variable	0-week	1-week	2-week	3-week	SEM
Egg weight (g)	58.48^{a}	57.38^{a}	56.29^{a}	53.94^{b}	0.40
Egg length (mm)	5.72^{ab}	5.87^{a}	5.63^{bc}	5.49^{c}	0.03
Egg width (mm)	4.48^{ab}	4.54^{a}	4.36^{bc}	4.27^{c}	0.03
Shell index	78.52^{a}	77.61^{a}	78.06^{a}	77.84^{a}	0.50
Shell weight (g)	7.72^{a}	7.38^{ab}	7.19^{b}	7.43^{ab}	0.07
Shell ratio	13.22^{b}	12.87^{b}	12.78^{b}	13.44^{a}	0.10
Shell thickness (mm)	0.24^{a}	0.30^{a}	0.26^{a}	0.33^{a}	0.02

Means with different superscript in a row are significantly different ($p<0.05$)

Table 3: Effect of storage duration on internal quality of egg

Variable	0-week	1-week	2-week	3-week	SEM
Yolk height	15.22[a]	14.37[b]	11.52[c]	10.33[d]	0.23
Albumen height	6.80[a]	4.32[b]	4.30[b]	3.86[b]	0.15
Yolk weight	15.54[b]	16.56[ab]	16.53[ab]	17.09[a]	0.19
Albumen weight	35.09[a]	33.36[ab]	32.61[b]	28.96[c]	0.40
Albumen ratio	60.10[a]	58.15[b]	57.89[b]	54.29[b]	0.37
Yolk ratio	26.71[c]	28.94[b]	29.38[b]	32.04[a]	0.34
Haugh unit	81.48[a]	61.68[b]	63.39[b]	58.98[b]	1.21

Means with different superscript in a row are significantly different ($p<0.05$)

DISCUSSION

The significant effect of duration of storage observed on virtually all egg quality traits observed in this study is in agreement with the works of earlier researchers (Akyurek and Okur, 2009; Silversides and Scott, 2001; Sekeroglu *et al.*, 2008; Sung and Kyung, 2014). The decrease in egg weight observed in this study as egg aged could be attributed to evaporation of water through the shell pores. This is in line with the observation of Sung and Kyung (2014). This could also be responsible for decrease in Haugh unit, albumin weight, yolk height, albumen height with age. However, yolk weight increased as the duration of egg storage increased,Khan *et al*. (2013) postulated the movement of water from albumen to the yolk as the possible explanation of the increased yolk weight with storage duration. This also accounted for decrease in albumen weight.During aging there is carbodioxide and oxygen exchange and water evaporates through the shell increasing the air chamber and reducing albumen height. The Haugh unit of 61.6 at the seventh day of storage is lower to 66.2 reported by Sung and Kyung, 2014 at room temperature. The discrepancies could be attributed to differences in age and breed of the layers used. The non-significant effect of storage duration on shell thickness and shell index is similar to the observation of Sung and Kyung, 2014 while the significant effect observed in shell weight is contrary to the report of the researchers. It could be concluded that storage reduces the acceptability of egg by consumers as quality is grossly affected.

REFERENCES

Akyurek, H. and A.A. Okur, (2009). Effect of storage time, temperature and hen age on egg quality in freerange layer hens. *J. Anim. Vet. Adv*., 8: 1953-195

Goldberg, E.M., Gakhar, N., Ryland, D., Aliani, M., Gibson, R.A., House, J.D., (2012). Fattyacid profile and sensory characteristics of table eggs from laying hens fed hempseed and hempseed oil. *J. Food. Sci.* 77:153-160.

Kabir, M., Sulaiman, R.O., Idris, R.K., Abdu, S.B., Daudu, O.M., Yashim, S.M., Hassan, M.R., Adamu, H.Y., Eche, N.M., Olugbemi, T.S. and Adedibu, I.I. (2014). Effects of strain, age and the interrelationships between external and internal qualities of eggs in two strains of layer chickens in northern Guinea savannah zone of Nigeria, *Iranian Journal ofApplied Animal Science*, 4 (1): 179-184.

Khan, M.J.A., S.H. Khan, A. Bukhsh, M.I. Abbass and M. Javed, (2013). Effect of different storage period on egg weight, internal egg quality and hatchability characteristics of Fayumi eggs. *Ital. J. Anim. Sci.,* 12: 51.

Kucukyilmaz, K., Bozkurt, M., Yamaner, C., Cýnar, M., Catl, A.U., Konak, R., (2012).Effect of an organic and conventional rearing system on the mineral content of hen eggs. *Food Chem*. 132:989-992

Ryu, K.N., No, H.K., Prinyawiwatkul, W., (2011). Internal quality and shelf life of eggs coated with oils from different sources. *J. Food. Sci*. 76:325-329.

Sekeroglu, A., M. Sarica, E. Demir, Z. Ulutas, M. Tilki and M. Saatci, (2008). The effects of housing system and storage length on the quality of eggs produced by two lines of laying hens. *Arch. Geflugelk*, 72: 106- 109.

Silversides, F.G. and T.A. Scott, (2001). Effect of storage and layer age on quality of eggs from two lines of hens. *Poult. Sci*., 80: 1240-1245

Smith A.J. (1990). Poultry. Macmillian press limited. page 128-133.

Song, K.T., Choi, S.H. and Oh, H.R. (2000). A comparison of egg quality of Pheasant,

Chykar, Quail and Guinea fowl. *Asian- Australia Animal Science* 13(7): 18-22.

Sung Heon Chung and Kyung-Woo Lee, (2014). Effect of Hen Age, Storage Duration and Temperature onEgg Quality in Laying Hens. *International Journal of Poultry Science* 13 (11): 634-636, 2014

WEIGHT GAINS OF FRIESIAN X BUNAJI CALVES AS AFFECTED BY FEED GRADE SELENIUM AND VITAMIN E SUPPLEMENTATION

***[1]Achi, N.P., [1]Barje, P.P. & [2]Achi, J.N**

[1]National Animal Production Research Institute/Ahmadu Bello University, Shika-Zaria

[2]Department of Animal Science, Ahmadu Bello University, Shika-Zaria

ABSTRACT

The experiment was carried out to determine the effect of supplementing feed grade selenium and vitamin -E on weight gains of Friesian x Bunaji calves. Twenty pregnant Bunaji cows inseminated with Friesian semen were used for the study. The animals were grouped into four treatments with each treatment consisting of five animals in a completely randomized design. Treatment I served as the control, treatment II Se (3mg), treatment III vitamin E (20mg) and treatment IV Se + Vitamin E (3mg + 20mg). At calving, the calves were weighed using a weighing scale and subsequently monthly until they were weaned. There were no significant differences ($p<0.05$) for the weights at calving, 1st and 2nd month after calving in all the treatments. Weight at weaning showed significant differences ($p<0.05$) in all the treatments with the control having the lowest (55.0 kg) while the Se + vitamin E treatment had the highest (65.8 kg) weight. It was concluded that selenium and vitamin E supplementation had no effect on calving weight, weight at 1st and 2nd month except at weaning with the combination of Se + vitamin E performing best.

Keywords: Selenium, Vitamin E, Friesian x Bunaji, Calves, Weight gains

*Corresponding Author: neyuachi@gmail.com. +2348065611639.

INTRODUCTION

The last months of gestation for cows represents the critical period for the selenium availability. The transfer of selenium to the fetus and subsequently to the calf occurs even when cows are deficient in selenium. Cows release selenium available to them to ensure adequate intake for newborns (Hefnawy and Tortora-Perez, 2010). This situation is explained by the fact that the renal selenium levels in the fetus remain unchanged whereas that of cows, at the end of pregnancy, decline (House and Bell, 1994). The mineral selenium is not well transferred into the milk (Pehrson *et al*., 1999), and thus is not efficient in maintaining adequate selenium status in calves. Compared to mineral selenium, use of organic selenium in foods was shown to cause better selenium transfer rates in calves (Ceballos *et al*., 2009). Nearly 70% of the selenium in the membrane is found to bind to the anion exchanger 1 (AE1) protein, which suggests that the integral protein AE1 is responsible for the membrane transport of selenium.

An increase of the immunoglobulin concentration in calves has been demonstrated to be caused by a selenium supplementation of cows before calving (Rowntree *et al*., 2004; Guyot *et al*., 2007). Indeed, strengthening of their immature immune system helps them to resist inadequate environmental conditions. At temperatures below 14.6^0C, newborn calves present sensitivity to cold (Schrama *et al*., 1993). To cope with this stress, the thermogenic response is generated by the metabolism of brown adipose tissue. The metabolism of the adipose tissue is regulated by T_3 hormone which is a seleno-dependent hormone (Rowntree *et al*., 2004). In cases of severe selenium deficiency in calves, it is advisable to administer aselenium injection incombination with a dietary selenium source as such practice helps to rapidly restore an adequate selenium status for a few months (Eversole *et al*., 1988). Selenium does not play a direct role in promoting growth in calves. However, it helps to remove all constraints that may delay or inhibit growth such as oxidative damage, stress, reactive forms of oxygen etc.

MATERIALS AND METHODS

Study Location

The study was conducted at the Dairy Research Programme farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, Nigeria. Shika is located in the Northern Guinea Savanna and lies on latitudes 110 06' 40" N and longitudes 70 43' 21"E at an elevation of 644m above sea level, with an annual maximum and minimum temperature of 31.0 ± 3.2 0C and 18.0 ± 3.7 0C, respectively. Shika has an average annual rainfall of 1100 mm, usually lasting

from May to October with a mean relative humidity of 72 %. The dry season lasts from November to April with the mean daily temperature, ranging from 15 – 36 ^{0}C and mean relative humidity ranging from 20 – 37 % (IAR, 2017).

Experimental Design and Management of Animals

A total of twenty pregnant Bunaji cows with an average weight of 300 kg in the third trimester of pregnancy were used for the study. The study consisted of four treatments with five animals per treatment in a Completely Randomized Design (CRD). Treatment I was the Control without Selenium or Vitamin E supplementation. Treatment II was supplemented with 3 mg/kg feed of feed grade Selenium, treatment III with 20 mg/kg feed of feed grade Vitamin E. Treatment IV received a combination of 3 mg feed grade Selenium and 20 mg of Vitamin E. the treatments were given once a week until calving.

The animals were grazed on free range pastures and supplemented with concentrate diet consisting of 48 % Cotton Seed Cake, 13.7 % wheat bran, 35.3 % maize, 2 % bone meal, 1 % common salt, 88 % dry matter, 15 % crude protein and 55 % total digestible nutrients after grazing. Water was provided *ad-libitum*. All the experimental animals were ear-tagged for ease of identification. The animals were dipped twice a week for effective control of ectoparasites.

Calves were weighed at calving, first and second month after calving then at weaning using a weighing scale. The animals were weighed using an Avery large weighing scale prior to calving and postpartum. Data generated was analyzed using the general linear model of SAS (2002).

RESULTS AND DISCUSSION

Calving weight, weight after first and second month were similar ($p>0.05$). Weight at weaning was significantly different ($p<0.05$) for Friesian x Bunaji calves with Se, vitamin E and Se + vitamin E supplementation as shown on Table 1.

In ruminants, the transfer of selenium from cow to the newborn is via the placenta and milk but transfer via the placenta is more efficient than that made through the milk (Enjalbert *et al*., 1999). The higher weight at weaning for supplemented calves could be attributed to the antioxidative potency of mineral and vitamin supplementation which invariably improved immune system of calves, thereby resulting in growth and development, this is agreement with Salles *et al*. (2014). The improved immune system of the calves helps them to resist extreme environmental conditions of cold and heat especially in the tropical region.

Although Se does not play a direct role in promoting growth in calves, however, it helps to remove all constraints that may delay or inhibit growth. A selenium-deficient diet causes a reduction of triiodothyronine (T_3) and an increase of the tetraiodothyronine (T_4) and a decrease in the ratio T_3/T_4 levels in blood (Thompson *et al*., 1995). The reduction in T_3 and an increase in T_4 can influence growth rates since T_3 is an active form of T_4 which is known to be involved in the growth mechanisms (Thompson *et al*., 1995).

CONCLUSION

It was concluded that calving weight, weight at 1st and 2nd month were not affected by selenium and vitamin E supplementation except at weaning weight with Se + vitamin E performing better.

REFERENCES

Ceballos, A., Sánchez, J., Stryhn, H., Montgomery, J.B., Barkema, H.W. and Wichtel, J.J. (2009). Meta-analysis of the effect of oral selenium supplementation on milk selenium concentration in cattle. *Journal Dairy Science*, 92: 324–342.

Enjalbert, F., Lebreton, P., Salat, O. and Schelcher, F. (1999). Effects of pre- or postpartum selenium supplementation on selenium status in beef cows and their calves. *Journal of Animal Science*, 77: 223–229.

Eversole, D.E., Thatcher, C.D., Blodgett, D.J., Meldrum, J.B. Kent, H.D. (1988). Repletion of blood selenium concentrations in weaned beef calves. *Cornell Veterinary*, 78: 75–87.

Guyot, H., Spring, P., Andrieu, S. and Rollin, F. (2007). Comparative responses to sodium selenite and organic selenium supplements in Belgian Blue cows and calves. *Livestock Science*, 111: 259–263.

Hefnawy, A.E.G. and Tórtora-Pérez, J.L. (2010). The importance of selenium and the effects of its deficiency in animal health. *Small Ruminant Research*, 89: 185–192.

House, W.A. and Bell, A.W. (1994). Sulfur and selenium accretion in the gravid uterus during late gestation in Holstein cows. *Journal of Dairy Science*, 77: 1860–1869.

IAR (2017). Institute for Agricultural Research Metrological station. Samaru weather report, Samaru office, Ahmadu Bello University, Zaria

Pehrson, B., Ortman, K., Madjid, N. and Trafikowska, U. (1999). The influence of dietary selenium as selenium yeast or sodium selenite on the concentration of selenium in the milk of suckler cows and on the selenium status of their calves. *Journal of Animal Science*, 77, 3371–3376.

Rowntree, J.E., Hill, G.M., Hawkins, D.R., Link, J.E., Rincker, M.J., Bednar, G.W. and Kreft, R.A., Jr. (2004). Effect of Se on selenoprotein activity and thyroid hormone metabolism in beef and dairy cows and calves. *Journal of Animal Science*, 82, 2995–3005.

Salles, M.S.V., Zanetti, M.A., Junior, L.C.R., Salles, F.A., Azzolini, A.E.C.S., Soares, E.M., Faccioli, L.H. and Valim, Y.M.L. (2014). Performance and immune response of suckling calves fed organic selenium. *Animal Feed Science and Technology*, 188, 28–35.

SAS. (2002). User's Guide Version 8.1. Statistical Analysis System Institute Inc, Cary, Nc, USA.

Schrama, J.W., Arieli, A., Brandsma, H.A., Luiting, P. and Verstegen, M.W. (1993). Thermal requirements of young calves during standing and lying. *Journal of Animal Science*, 71, 3285–3292.

Thompson, K.M., Haibach, H.and Sunde, R.A. (1995). Growth and plasma triiodothyronine concentrations are modified by selenium deficiency and repletion in second-generation selenium-deficient rats. *Journal of Nutrition*, 125:864–873.

Table 1: Effect of Selenium, Vitamin E and Selenium + Vitamin E supplementation on Fr x BJ calves' birth and weight changes.

Weight (Kg)	**Treatments**				SEM	P-Value
	Control	Se	Vit-E	Se + Vit-E		
At Calving	20.80	22.60	24.20	21.40	1.12	0.1878
1st month after calving	32.40	33.80	36.40	32.80	1.94	0.4803
2nd month after calving	40.00	44.80	49.00	45.40	2.30	0.0896
At weaning	55.00[b]	63.20[ab]	64.60[ab]	65.80[a]	2.37	0.0221

[ab]Means within the same row having different superscript are significantly (P<0.05) different. Se-Selenium, Vit-E-Vitamin E, SEM-Standard Error of Mean.

PREDICTION OF BODY WEIGHT OF TWO STRAINS OF LAYERPULLETS USING MORPHOMETRIC TRAITS

M.N. Sabo, J. Sani & R. A. Hamzat
Department of Animal Science, Federal University Dutsin-Ma, Katsina State

ABSTRACT
A total of 200-day old layer chicks comprising of 100 chicks each of Nera Black and Lohmann Brown Classic were used to determine prediction models for body weight from morphometric parameters. Data were collected on body weight and morphometric trait; breast girth, body length, wing length, shank length and thigh length. All the morphometric traits measured in chick were significantly ($P<0.05$) correlated with body weight. The breast girth has better correlation with body weight than other morphometric trait in Nera Black (0.763) and for the two strains combined (0.788). However, body length had the highest correlation with body weight in Lohmann Brown Classic chicks. Breast girth showed the highest coefficient of determination (R^2 value) of 0582 in Nera Black while body length had the highest R value of 0.715 and 0.610 for Lohmann Brown Classic and the two strains combined respectively. This study showed that morphometric trait like body length and breast girth can be used in estimation of body weight.
Keywords: Trait, prediction, correlation, regression, body weight

INTRODUCTION
Morphometric traits also called linear body measurements or conformation traits are important parameters in predicting body weight and this has been observed by commercial breeders and producers. Breeders, therefore, breed desirable sizes of chickens which also have the desirable production traits particularly body weight (Ojedapo *et al.*, 2010). Apart from body weight, a number of conformation traits are also known to be good indicators of good growth (Ibe, 1989). Such conformation traits include shank length, breast width, knee length, wing span, chicken height, body length, and head circumference (Ojo *et al.*, 2010). Linear body measurements have been used to predict live weights in poultry (Okon *et al.*, 1997), Prediction of body weight with morphometric traits in layers is therefore important.The easiest way to assess an animal's body mass is to weigh the animal. However, under some situations scale may not be available and prediction of body weight from body measurements could be preferred practically (Latshaw and Bishop, 2001). The objective of this study therefore to determine the morphometric parameters of egg strain chicks, their correlation between with body weight and develop a prediction equation for body weight from those parameters of egg strain chicks

MATERIAL AND METHODS
The experiment was conducted in the Department of Animal Science Teaching and Research Farm, Federal University Dutsin-ma. It lies within latitude 11° 7' and 13° 22' N and longitude 6° 52' and 9° 2' E (Abaje *et al.*, 2014).
A total of 200 day-old- layer chicks purchased from a reputable hatchery in Nigeria were used in the experiment.Routine management practices were carried out on the layer chicks. The chicks were fed *ad-libitum*. The data of prediction of body weight in egg layer strain chicks using morphometric traits were collected.Birds in each replicate were weighed at the beginning of the experiment and subsequently on weekly basis. Feed intakes were recorded weekly and were determined by the weigh-back technique. Feed conversion ratio was determined. The Linear Body Measurements were taken at week 10. The body parameters were taken in centimetres with the use of tape. Morphometric parameters measured include:thigh weight, shank length, breast girth, wing length and body length. SPSS (2008) Package was used to obtain estimate of correlation and regression between body weight and each of the morphometric trait. The significance of the correlation regression coefficient was determined at P-value of less than 0.05

RESULT AND DISCUSSION

Table 1 shows the comparison of means of body weight and linear body measurements of Nera Black and Lohmann Brown Classic layer strain chicks. Body weight, breast girth, wing length and thigh length were not significantly different between the strains. However, body length was significantly different with Nera Black having longer body length (23.55cm) than Lohmann Brown Classic (22.71cm).

Table 1: Comparison of means of body weight (g) and morphometric traits (cm) of Nera Black and Lohmann brown classic layer strain chicks at 10 week of age.

Trait	Near black	Lohmann brown classic	SEM
Body weight	552.24	531.68	13.55
Body length	23.55[a]	22.71[b]	0.22
Breast girth	19.87	19.73	0.27
Wing length	15.56	15.33	0.13
Shank length	6.88	6.57	0.11
Thigh length	7.25	6.99`	0.11

[a, b] Values with different superscripts differ significantly, SEM= Standard error of mean

Table 2 shows the correlation of the body weight and Morphometric traits of combined layer strain at week 10. Body weight is highly correlated to all the morphometric traits with Breast girth having the highest correlation (0.788).

Table 2: Combined correlation of body weight and morphometric traits of Nera Black and Lohmann Brown classic layer strains chicks at 10 week of age

	BW	BL	BG	WL	SL	TL
BW	1.000					
BL	0.781	1.000				
BG	0.788	0.545	1.000			
WL	0.732	0.795	0.582	1.000		
SL	0.592	0.797	0.298	0.729	1.000	
TL	0.656	0.769	0.369	0.714	0.896	1.000

BWT-body weight; BG-Breast girth; BL-Body length; WL-Wing length; SL-Shank length; TL-Thigh Length; SEM= Standard error of mean

Table 3 shows prediction equations relating the body weight and morphometric traits in combined layer strain at week 10. The R^2 values of range from 0.351 to 0.610 with Body length have the highest R^2 value of 0.610. This implies that body length could be the best predictor of body weight of layer strains.

Table 3: Combined regression of body weight of morphometric traits of Nera Black and Lohmann brown classic layer strains chicks at 10 week of age

Combined of two strain	Regression equation	R^2	SEM	LOS
Nera Black & Lohmann Brown	BWT= -55.794+47.239 BL	0.610	3.190	***
	BWT= -240.086+39.494 BG	0.606	2.693	***
	BWT= -604.590+74.230 WL	0.537	5.831	***
	BWT= 65.667+70.836 SL	0.351	8.145	NS
	BWT= -52.822+83.540 TL	0.430	8.130	NS

BWT-body weight; BG-Breast girth; BL-Body length; WL-Wing length; SL-Shank length; TL-Length; NS-Non significant; R^2- Regression square; SE-Standard error; LOS-Level of significance; ***Significant at p<0.001; **Significant at P<0.05

DISCUSSION

The high correlation between body weight and morphometric measurements in this study agrees with the earlier report of Yahaya *et al.* (2012) who obtained high correlation coefficients between body weight and morphometric traits in Hubbard and Arbor Acre broiler strains. The estimates contained in their reports were generally higher than the values obtained in the present study. The observed close relationship between body weight and breast girth in both Nera black and Lohmam brown classic agrees with the earlier findings of Adebambo *et al*. (2006) who reported that breast girth is a good indicator of predicting body weight in most poultry species.

The regression result shows that breast girth and body length could be the best predictors of the body weight of layer strain chicks. This result agreed with Udeh and Ogbu (2011) who reported that Arbor Acre strain with R^2 of 96% in breast girth and 92% in body length were the best predictors of the body weight of broiler strains. All other linear body parameters in all studied reported R^2 values above 50% which implies any of linear body parameter could also be used to predict body weight of the layer strain chicks. The result of regression coefficients of the two strains combined agrees with the observation Ubani *et al* (2011) who reported that breast girth and body length recorded the highest R^2 value among Nu-breed, Arbor, Acre and Marshall Strains between 3-5 weeks of age. The body length and breast girth are best for predicting body weight in layer chicks (Nera Black and Lohmann Brown Classic).

The result obtained from this research shows that prediction of body weight is possible from various linear body parameters. Generally breast girth and body length were found to be the best and most reliable parameter in estimates body weight. In terms of hierarchy, breast girth was significantly highest followed by body length in Nera Black and Lohmann Brown Classic at week 10. Application of linear model to all parameters at week 10 was found to be highly significant (P<0.05). All linear body parameter whose R^2 values were above 50% could be used to predict body weight of the layer strain, although the accuracy of prediction increased with an increase in the R^2 value.

CONCLUSION AND RECOMMENDATION

The present study showed that there exists strong correlation between body weight and most of the morphometric indices like body length, breast girth, wing length, shank length and thigh length of Nera Black and Lohmann brown Classic. Prediction of body weight is possible from various linear body parameters. Generally breast girth and body length were found to be the best and most reliable parameter in estimates body weight. It is therefore recommended that body length and breast girth be used in predicting body weight.

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REFERENCES

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology*; Vol. 6, No. 2; 2014

Adebambo A O, Ozoje M O, Adebambo Funmi and Abiola S S (2006). Genetic variations in growth performance of Giriraja, Indian White Leghorn and Improved Indigenous chicken breeds in South West Nigeria. *Nigerian Journal of Genetics* 20: 7-16.

Ibe, S. N. (1989). Measurement of size and confirmation in commercial broilers. *J. Anim. Breed and Genet*. vol. 106, p. 461-469.

Latshaw, J. D. and Bishop, B.L. (2001). Estimating body weight and body composition of chickens by using noninvasive measurements. *Poult. Sci*., 80: 868–873

Ojedapo, L. O., Adedeji, T. A., Ameen, S. A. and Amao, S. R. (2010). Interrelationships between body weight and other body linear measurements in Anak strain of commercial broiler. In:*Proceedings of the 15th AnnualConference of the Animal ScienceAssociation of Nigeria* (15): 61-63.

Ojo, O. A., Akpa, G. N., Adeyinka, I. A., Makinde, F. M., Iyiola,-Tunji, A. O. and Ubani, E. O. A. (2010). Prediction equation for eight weeks

Okon, B., Ogar, I. B. and Mgbere, O. O. (1997). Interrelationship of live bodymeasurements of broiler chickens ina humid tropical environment.*Nigerian Journal of AnimalProduction.,* 24 (10): 7-12.

Ubani, E. O. A., Adeyinka, I. A., Nwagu, B. I., Abeke, F. O. Sekoni, A. A. Out, M. O. and Iyiola – Tunji, A. O. (2011). Estimates of repeatability for some growth traits in naked Neck broiler chickens. *Proceeding of the 36th Conference of Nigerian Society for Animal Production* (NSAP). Univ. of Abuja. Nigeria Pp. 48 – 50.

Udeh, I. and Ogbu, C. C. (2011).Principal Component Analysis of body measurements in three strains of broiler chicken.*World Journal ofScience 6*(2): 11-14.

Yahaya, H. K. Brahim, H. and Abdul Salam, S (2012).Comparative Study of the Body Weight and Body Conformations of Two Broiler Strains under the Same Dietary Condition. *Inter. J. of Ani.and Vet. Advances* 4(3), 195-197.

EFFECTS OF SEASON, SEX AND AGE ON BODY WEIGHT, PACKED CELL VOLUME, HAEMOGOLOBIN AND FEACAL EGG COUNT IN INDEGENOUS BREEDS OF SHEEP IN GOMBE STATE

[1]Boyi, B., [2]Mbap, S. T., [2]Mancha, Y. P.,[1]Amaza, I. & [1]Maidala, A.
[1]Federal University P. M. B. 1005 Gashua, Yobe State, Nigeria
[2]Abubakar TafawaBalewa University P. M. B. 0248 Bauchi State, Nigeria.
Corresponding author email: benjaminboyi51@gmail.com

ABSTRACT
The study investigated the effects of breed, season, sex and age on body weight, packed cell volume, Haemoglobin concentration and Faecal egg count of some indigenous breeds of sheep in Gombe State between March and October, 2017. Stratified random sampling was applied to collect the 300 samples comprising of 130 Yankasa, and 73 Balami 97 Uda sheep. Faecal egg count was measured using the modified McMaster technique for faecal samples found positive forgastro intestinal parasite eggs. Packed cell volume (PCV) was determined by micro-haematocrit technique. Faecal egg count (FEC) significantly (P<0.001) differed among the breeds with highest value of 1271.65epg recorded in Uda. Balami and Uda had higher values of body weight than Yankasa. There were no breed effects on PCV and HBC recorded in this study. Seasonal effects on BWT, PCV, HbC and FEC was observed with the wet season recording higher values of 32.32kg,36.04%, 11.99g/dl and 1140.95epg.This could be attributed to the fact that wet season is the period of lush pasture which has positive influence on BWT, PCV, and HbC. Furthermore, the wet season is a suitable period for the development of the infective stages of the Gastro intestinal parasites and hence higher burden. Age of sheep affected the values of BWT, PCV, HbC and FEC significantly. The values of 45.02kg,32.43%,10.82g/dl and 725.34epg forBWT, PCV, HbC and FEC respectively were significantly higher in adult than the younger sheep. This could be attributed to the fact that these parameters normally increase with age and physiological changes.
Key note: Season, Sex, breed, Packed cell volume, Haemogolobin Concentration, Faecal egg count.

INTRODUCTION
Nigerian sheep population is estimated at 44.3 million and over 70% is found in the Savanna regions where three of the four breeds of sheep (Balami, Yankasa and Ouda) predominate. Sheep thrive in a wide variety of environments in the tropics and sub tropics and requires less capital as they can be completely maintained on pastures, browse and agricultural waste products (FAO, 2007).Gastro-intestinal infections among other variables are significant constraints to livestock production (Badran*et al*. 2012). The major factor that influences gastrointestinal parasites infection in small ruminants, especially sheep is exposure to faecal contamination of grazing land (Pathak, 2011).Greer (2008) stated that the degree of disease infection varies with the host immune response. Males are generally more susceptible than females due to the production of androgen hormone which lowers immune response (Asif*et al*., 2008). Heavy animals also show more resistance due to sufficient body fat reserves that aids immune responses (Bilbo and Nelson, 2001). During rainfall the number of infective larval stages increase and animal are also more susceptible to infection (Kantzoura*et al.*, 2012). Blood properties are indices of the physiological and pathological changes in animals (Cambell, 2007). Haemotological tests have been widely used for the diagnosis of disease and nutritional status of animals. Information gained from blood parameters substantiates physical examination and together with medical history provide the basis for judgment and decision making (Schalm *et al*., 1975). Several researches were conducted on the effects of breed, season, sex and age on PCV, HbC and FEC on sheep in Nigeria particularly the northern part however; there was scant information on that in Gombe state. This study was carried out to bridge the gap in information, provide useful information for further research and to make recommendations.

MATERIALS AND METHODS
Area of the Study
The research covered the three senatorial zones of Gombe State comprising North, Central and South. Gombe State. It is situated in North East region of Nigeria and occupies a total land area of about 20,265 Km^2. The state is located between latitude 9^0 30' and $12^0$30'N and longitude $8^0$45' and $11^0$45'E of the Greenwich Meridian (Abubakar, 1974).

Experimental Animals

Three indigenous breeds of sheep namely Yankasa, Balami and Uda commonly reared by peri urban and urban households in Gombe state were used for this study.

Study Design.

Faecal and blood samples were collected randomly from 300 sheep for laboratory analysis. Stratified random sampling was applied to collect the 300 samples comprising of 130 Yankasa, 73 Balami and 97 Uda sheep. The total sample size was calculated according to Thrusfield (2005) using 95% confidence and expected prevalence of 89.1% from previous study of James (2014) and desired precision of 5% as follows:

$n = 1.96^2 P_{exp} (1- P_{exp}) / d^2$

Where n = sample size

P_{exp}= expected prevalence (89.1% of James, 2014)

d = desired absolute precision of 5% (0.05).

$n = 1.96^2 \times 0.891 (1-0.891)/ (0.05)^2$

$n = 3.8416 \times 0.891(0.109)/ 0.0025$

$n = 0.3731/ 0.0025$

n = 150 samples approximately

The value of 150 was multiplied by 2 to avoid sampling error in accordance with (Jatau*et al*., 2011).

Faecal sample collection and analysis

Fresh faecal sample (5g) was collected using hand gloves, directly from the rectum of the sheep into clean universal containers, labeled and stored. The samples were subsequently processed for gastro-intestinal parasite presence and identification.Samples found positive were counted using the modified Mcmaster technique according to Soulsby (1986).

Blood sample collection and analysis

Blood samples (5 ml per animal) were obtained from the jugular vein using a10 ml syringeattached to 21gauge x ½ inch needle. Air was first cleared from the syringe before puncturing at 20^0 angle (Pratt, 1985) and the syringe was aspirated to confirm insertion and collection of blood. The blood sample collected was then placed in labeled tubes coated with ethylene-diamine tetra-acetic acid (EDTA) as anticoagulant. Packed cell volume (PCV) was determined at Gombe State Specialist Hospital laboratoryusing the micro-haematocrit technique (Pratt, 1985) and classified into low, normal and high.Haemoglobin concentration wasdeterminedby dividing PCV values by 3 according to (Addass, 2010) and also classified as low, normaland high whilehaemoglobin type was identified through electrophoresis (Wintrobe, 1967).

Data Analysis

Data collected were analyzed using descriptive statistics and were further subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SPSS, version 22 (Allen *et al.,* 2013) as in the following model. Significantly different means were separated using the Duncan multiple range test (DMRT).

$Y_{ijk} = \mu + B_i + E_j + e_{ijk}$

Where;

Y_{ijk}= Observations on dependent variables

μ = common mean

B_i = effect of ith breed

E_j= effects of all other factors, but taken individually; number and types (of factor) varied with the dependent variable.

e_{ijk}= random error term.

The relationships among PCV, HbC, Bwt and FEC were determined using the Pearson's product moment correlation coefficient.

Table 1: Effects of Breed, Season, Sex and Age on BWT, PCV, HbC and FEC

Factor	Parameter BWT		PCV		HbC		FEC	
	X	SD	X	SD	X	SD	X	SD
Overall	35.67	1.052	34.25	0.95	11.43	0.318	1083.446	71.602
Breed:	***		NS		NS		***	
Yankasa	28.58	1.04[b]	31.68	0.52	10.58	0.17	678.46	45.79[c]
Balami	32.80	1.57[a]	31.22	0.86	10.35	0.28	903.56	75.08[b]
Uda	36.26	1.46[a]	31.99	0.76	10.64	0.25	1271.65	88.05[a]
Season:	*		***		***		***	
Dry	30.99	0.92[b]	27.41	0.40[b]	9.14	0.14[b]	714.80	59.43[b]
Wet	33.32	1.26[a]	36.04	0.44[a]	11.99	0.15[a]	1140.95	53.33[a]
Sex:	NS		NS		NS		NS	
Male	30.81	1.00	31.31	0.55	10.42	0.18	871.13	60.30
Female	33.37	1.19	32.02	0.54	10.67	0.18	978.93	57.70
Age:	***		*		*		***	
Young	21.79	0.34	31.06	0.51	10.32	2.17	1087.07	52.37
Adult	45.02	0.80	32.43	0.59	10.82	2.28	725.34	63.60

*** =P<0.001), * =P<0.05, ** =P<0.01, NS =Not significant, PCV =Packed cell volume inpercentage, HbC =Haemoglobin concentration in gramme per decilitre (g/dl), FEC = Feacal egg count, X = Mean, SD = Standard deviation, Bwt (Body weight, in kilogramme) and values in a column within a subset with different superscripts are significantly different.

Table 2: Effects of Faecal egg count on PCV, HbC and BWT

Category	PCV	HbC	Bwt
LS	NS	NS	**
Low	1060.13	1023.97	1023.30[a]
Normal	890.42	894.43	578.93[b]
High	1126.67	1080.00	955.74[a]

LS = Level of significance, PCV = Packed cell volume (percent), HbC = Haemoglobin concentration (gramme per decilitre), Bwt= Body weight (Kilogramme), NS = Non-significant. Values in a column with different superscripts are significantly different.

RESULTS AND DISCUSSIONS

The means and standard deviations of BWT, PCV, HbC and FEC by breed, season, sex and age are presented in Table 1. The overall values of BWT, PCV, HbC and FEC were 35.67Kg, 34.25%, 11.42g/dl and 1083.45 epg.Faecal egg count (FEC) significantly (P<0.001) differed among the breeds with highest value of 1271.65epg recorded in Uda. This finding is similar to observations reported byFantu*et al*. (2012) and Hassan *et al*. (2013) but disagrees with Mbap and Chiroma (1998) who found that Yankasa breed had higher FEC values than the others. The body weights recorded in this study were similar for Balami and Uda but differed significantly from value obtained for Yankasa.Balami and Uda had higher values than Yankasa, this report corroborates with earlier findings of Mason (1997).There were no breed effects on PCV and HbC recorded in this study, similar observations was reported by Kasali*et al*. (1988). The lower FEC in Yankasa in this study could probably be due to breed difference. Significant (P<0.001) seasonal effects on BWT, PCV, HbC and FEC was observed with the wet recording higher values, and this concur with earlier reports of Kasali*et al*. (1988) and Fantu*et al*. (2012). The wet season is the period of lush pasture which has positive influence on BWT, PCV, and HbC (Pathak and Pal, 2008). Furthermore, the wet season is a suitable period for the development of the infective stages of the Gastro intestinal parasites and hence higher burden. Sex had no influence on the parameters assessed in this study, this contradicts earlier reports by (Dangnachew*et al*., 2011; Hassan *et al.*, 2013), the authors reported significant sex variation on faecal egg count. Male sheep are generally more susceptible than females due to the production of androgen which lowers immune response. Oestrogen in females increases resistance to worm burden. However, female sheep become prone to parasitism due to hormonal changes during pregnancy; especially in the later stages (Asif*et al*., 2008). Age of sheep affected the values of BWT, PCV, HbC and FEC significantly; this is in agreement with earlier report of James (2014). Body weight, packed cell volume, haemoglobinand faecal egg count are usually higher in adult than the young because these parameters normally increase with age due to physiological changes (Fantu*et al*., 2012). This is however, contrary to reports of Winkler (1982), Mbap and Chiroma (1998). The authors reported higher FEC in the younger sheep and attributed it to low innate immunity and so-called self-cure phenomenon and/or high acquired immunity which increasewith age. Table 2 shows the influence of PCV, HbC and Bwt on worm burden. There was significant influence of Bwt (P<0.01) on FEC. The value of 578.93 epg, for the medium weight category was lower than 1023.30 and 955.74 epg for the lower and higher respectively. The PCV and HbC however had no significant influence on FEC.The PCV, HbC and Bwt are all indicators of body condition and thus are related to the physical, physiological and health status of animals.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the study revealed that three indigenous breeds of sheep studied harbors gastrointestinal parasite however, the level of infection is more in Uda. Balami and Uda had higher body weights and worm burden. However, breed had non-significant effect on PCV and HbC. Body weight differed among breeds with Balami and Uda recording higher values than Yankasa. Furthermore, Balami and Uda had higher FEC than Yankasa. Season had significant influence on Bwt, PCV, HbC and FEC with the wet season recording higher values. Sex had no influence on the parameters assessed but, there were significant age differences in BWT, FEC, PCV and HbC .Proactive measures are required to sensitize farmers on the need to ensure routine deworming exercise and adherence to good husbandry practices all year round. Further study should be conducted using molecular marker to determine the genetic distance between the sheep breeds in terms of resistance to gastrointestinal parasite infection.

REFERENCES

Abubakar, Y. A. (1974). The Establishment and Development of Emirate Government Bauchi, Ph.D. Dissertation, Department of History, Ahmadu Bello University, Zaria, Nigeria. 1805-1903.

Addass, P. A., Midau, A. and Babale, D. M. (2010).Haemato-biochemical findings of indigenous goats in Mubi Adamawa State Nigeria.*Journal of Agricultural and Social Science,* **6:14**-16.

Allen, M. S., Greenlees, I. and Jones, M. (2013). Statistical Package for Social Sciences.

Asif, M., Azeem, S., Asif, S. and Nazir, S. (2008).Prevalence of Gastrointestinal Parasites of sheep and goats in and around Rawalpindi and Islamabad.*Pakistan. Journal of Veterinary Science*, **1**: 14-17

Badran, I., Abuamsha, R., Aref, R., Alqisi, W. and Alumor, J. (2012). Prevalence and diversity of gastrointestinal parasites in small ruminants under two different rearing systems in Jenin district of Palestine. *An-Najah University Journal of Research*, **26**:1-18.

Bilbo, S. D. and Nelson, R. J. (2001). Sex Steroids hormones enhance immune functions in male and female hamsters. *American Journal of Physiology*, **280**:207-213.

Campbell, T.W. (1988). **Avian Haematolgy and Cytology**. Iowa State University Press, Annes, I.A., **Pp**. 43-51.

Dagnachew, S., Amamute, A. and Temesgen, W. (2011). Epidemiology of gastro intestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia. *Ethiopia Veterinary Journal*, **15**: 57-68.

F.A.O (2007).Food and Agricultural Organization of the United Nation, Rome.Quartely Bulletin of Statistics, Volume 1.

Fantu, A. K., Yacob, H. T. and Gezahegn M. K. (2012).Experimental infection of Ethiopian highland sheep by different infective doses of Haemonchuscontortus (L3): haematological and parasitological parameters, serum protein concentrations and clinical responses. *Ethiopian Veterinary Journal*, **16** (1): 41-57.

Greer, A. W. (2008). Trade-offs and benefits: implications of promoting a strong immunity to gastrointestinal parasites in sheep. *Parasite Immunology*, **30**:123-132.

Hassan, D. I., Mbap, S.T. and Naibi S.A. (2013).Prevalence of worm infection in Yankasa sheep and West and African dwarf goats in Lafia town and Environs, *Nigeria. Journal of Agriculture and Veterinary Science*, **4**(4): 84-90.

James, G. J. (2014). Studies on Gastrointestinal Helminths of Small Ruminant Slaughtered in Dogarawa Slaughter Slab in Zaria, Nigeria, Nigeria. Msc. Thesis, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria.

Kantzoura, V., Kouam, M. K., Theodoropoulou, H., Feidas, H. andTheodoropoulos, G. (2012). Prevalence and risk factors of gastrointestinal parasitic infections in small ruminants in The Greek temperate Mediterranean environment. *Open Journal of Veterinary Medicine*.**2**:25-33.

Kasali, O., Njau, B. C. and Bekele, T. (1988).Controlling livestock diseases in the tropics breeding: A perspective. In: Thomson E. F and Thomson F. S (eds), Increasing Small Ruminant Productivity in Semi-arid Areas. 2nd edition, Oliver and Boyd Publishers, Edinburgh London.

Mason, P. C. (1997). Internal parasites of goats in New Zealand.In:**Sustainable control of Internal Parasites in Ruminants.** Ed G.K. Barrell. *Animal Industries Workshop*:10th August New Zealand, **5:57**-66.

Mbap, S. T. and Chiroma, B. Y. (1998). Breed and environmental factors on helminth infection of sheep at Bauchi, Nigeria. *Proceeding of the 6th World Congress on Genetics Applied to Livestock Production*Armidale, NSW Australia. 5:261-264.

Pathak, A. K. (2011). Nutritional status and performance of ruminants as influenced by gastrointestinal nematodes: An overview. *Veterinary World*, **13**(3):20-26.

Pathak, A. K. and Pal, S. (2008). Seasonal prevalence of gastrointestinal parasites in goats from Durg District of Chhattisgarh. Veterinary World. **1**(5):136-137.

Pratt, W. P. (1985). **Laboratory Procedures for Animal Health Technicians.**1st Edition, American Veterinary Publication Inc.

Schalm, O. W., Jain, N. C. and Carol, E. I. (1975) **Veterinary Haematology**. 3rd Ed. Lea and Fibiger Philadelphia, **Pp**. 144-167.

Soulsby, E. J. C. (1986). Helminths, Arthropods and Protozoa of Domesticated Animals, 8th EditionBailliereTindall, London, Pp. 119-218.

Thrusfield, M. (2005).Veterinary Epidemiology. 2nd Edition, Blackwell Science Limited, Oxford, United Kingdom, Pp:182-198.

Winkler, J. (1982).Gastrointestinal infection of small ruminant.*Australian Veterinary Journal*, **13**:14-15.

CONTRACTION RATE AND RE-EPITHELIALIZATION TIME OF FULL THICKNESS EXCISION WOUNDS OF RATS TREATED WITH DIFFERENT CONCENTRATIONS OF HYDROGEN PEROXIDE

Udegbunam SO[1], Ogbobe S[1], Okereke HN[1*], Udegbunam RI[1], Enejere AS[1], Ezeobialu TH[1]
[1] *Department of Veterinary Surgery, Faculty of veterinary medicine, university of Nigeria, Nsukka.*
**Corresponding Author; nnamdi.okereke@unn.edu.ng; +234803-480-6730*

ABSTRACT
The aim of this study was to validate and hence evaluate the effects of different concentrations of hydrogen peroxide on the healing of excision wounds in rats. Following wound creation, the animals in their respective groups were treated as follows; group A-0.9% normal saline (control), group B-1% hydrogen peroxide, group C-3% hydrogen peroxide and group D-5% hydrogen peroxide. Post-wounding, rate of wound contraction and re-epithelialisation time were used to assess the wound healing rate. Group C animals achieved 100% wound contraction on day 21 while 68.75%, 79.33% and 79.00% were obtained on the same day in groups A, B and D respectively. The result of this study has validated 3% hydrogen peroxide as the optimum concentration necessary for wound dressing since it provided the environment necessary for faster rate of wound contraction and healing with no visible side effect in this study.
Keywords: excision wounds, hydrogen peroxide, rat, re-epithelialisation, contraction

INTRODUCTION
A wound is a disruption in the normal continuity of tissues and metabolic function of body structures (Alam*et al*., 2011). Wound healing is the restoration of the disrupted anatomical stability and functional status of damaged tissues (Room and Ukrainsky, 2005). The process of wound healing according to Drouso*et al*. (2003) begins with wound cleansing. This has been made possible clinically by employing various methods and agents that promote healing (Drouso*et al*., 2003). The agents popularly used in wound cleansing since the nineteenth century is antiseptics. Commonly used antiseptics include povidone iodine, chlorhexidine, methylated spirit, chlorine compounds, silver compounds, hydrogen peroxide and a host of others (Zhu *et al*., 2017).
Hydrogen peroxide according to Bruno and Raynard (1994) is the most widely used among all the commercially prepared antiseptics. Zhu *et al*. (2017) proposed that hydrogen peroxide is a typical antiseptic which kills pathogens through oxidative burst and local oxygen production. In recent times, there have been arrears of controversy on the use of hydrogen peroxide as an antiseptic (Drosou*et al*., 2003). Kwakman*et al*. (2011) reported that since hydrogen peroxide is dangerous to new cells, it should not be recommended to clean every wound. Kwakman*et al*. (2011) stated that hydrogen peroxide damages cells that are needed for the wound to heal and hinder them from getting to the areas where the healing needs to take place. Hydrogen peroxide at various concentrations has been claimed by some authors to have both antibacterial and good wound healing effect. A cream containing 1% hydrogen peroxide has been reported by (Neithammer*et al*., 2009) to be effective and safe topical treatment of human *Impetigo contagiosa*caused by*staphyloccusaureus.* Thereport also said that 1% hydrogen peroxide cream showed excellent antibacterial effect and eliminated most of the bacteria from the skin. No side effect such as skin irritation or allergic reaction in human patients was noted with use of 1% hydrogen peroxide cream. A cream containing hydrogen peroxide at 1.5-3% concentration has been reported to increase circulation in ischemic ulcer and surrounding skin in a guinea pig model (Tandara and Mustoe, 2004).
Animal and human studies have also shown hydrogen peroxide to have a negative effect on wound healing at 3% concentration. Hydrogen peroxide was reported not to retard re-epithlialization in a rat model after irrigation but showed minimal bactericidal effect in-vitro (Tidhar*et al*.,2017). Kwakman*et al*. (2011) also found acceleration of re-epthlializationin wounds of rat treated with 3% hydrogen peroxide. In view of the above reports, and with the use of hydrogen peroxide as the most popular antiseptics in wound management, surprisingly few experimental studies have been conducted to examine its efficacy on wound healing process and as a wound antiseptic.
Additionally, we have observed that use of commercially available hydrogen peroxide (6 % concentration) on open wounds without dilution causing severe charring. In view of the above reports, the benefits and demerits of low and high concentrations of hydrogen peroxide on wound healing

needs to be fully investigated. The basic objective of this study was to ascertain the appropriate concentration of hydrogen peroxide which when used on open wounds will facilitate wound proliferation thereby enhance wound healing.

ANIMALS

Adult wistar rats (n=32) weighing between 170-184 g were used for this study. They were fed on commercial growers mash (Vital feeds®) and water was provided *ad libitum*. These rats were acclimatized for 2 weeks in the animal house at the Department of Veterinary Surgery, University of Nigeria, Nsukka.

WOUND HEALING STUDIES

Thirty two rats were anaesthetized by injecting intramuscularly 10 and 50 mg/kg bw of xylazine hydrochloride (Xylazine 20®, Kepro Holland) and ketamine Hydrochloride (Mark pharmaceuticals® Nigeria) respectively. Under general anaesthesia, dorsum of the rats were shaved and with mild antiseptic solution (0.5% chlorhexidine). Full thickness circular excision wound of 2cm in diameter was made on the scrubbed area of each rat and carefully dissected out. The animals were left untreated for 24 hours to allow for bacterial contamination of the wounds. Post wounding, the rats were randomly assigned into 3 groups of 8 animals per group and treated as follows: group A was treated with normal saline while groups B, C and D were treated with 1%, 3% and 5% hydrogen peroxide respectively. The animals were housed individually in clean and dust-free cages in the Department of Veterinary Surgery, University of Nigeria, Nsukka to avoid wound biting and/or licking and treated daily with their respective extract concentrations or drug until complete healing occurred.

ASSESSMENT OF WOUND HEALING

Wound healing was assessed using the percentage wound contraction rate as described by Chah*et al.* (2006) while wound re-epithelialisation was studied as described by Okoli*et al.* (2009).

RESULTS

Rate of wound contraction

Assessment of the effect of the different concentrations of H_2O_2 on the rate of wound contraction showed that increase in the percentage wound contraction was first noticed on day 4 post surgery in groups B and C rats. Day 7 post surgery, group C animals significantly ($P<0.05$) had a higher rate of wound contraction (21.50 %) than those in groups A (8.40%), B (9.33%) and D (5.00%).By day 21, 100% wound contraction was recorded in group C animals while 68.75%, 79.33%, 79.00% and were obtained in groups A, B and D animals respectively. The rate of wound contraction of group C animals remained significantly higher ($P<0.05$) when compared with those of groups A, B and D (Table 1).

Table 1: Percentage rate of wound contraction in rats post wounding.

	Groups			
Days	A(N/saline)	B (1% H_2O_2)	C (3% H_2O_2)	D (5% H_2O_2)
1	-6.86±1.32^{ab}	-5.25±1.93^{ab}	-4.13±0.79^{a}	-7.63±1.35^{b}
4	-3.00±0.79^{b}	1.75±3.22^{ab}	5.13±1.14^{a}	-2.13±0.64^{b}
7	8.40±1.81^{b}	9.33±4.85^{b}	21.50±4.19^{a}	5.00±1.21^{b}
14	48.00±6.55^{b}	57.67±0.67^{b}	71.50±3.23^{a}	55.75±2.25^{b}
21	68.75±4.59^{c}	79.33±2.6^{b}	100.00±0.00^{a}	79.00±2.35^{a}

Different superscripts$^{a, b,c}$ in a row indicate significant difference between mean at P<0.05

Wound Epithelialization

In this study, group C animals treated with 3% concentration of H_2O_2 had higher rate of wound epithelialization followed by groups A, D and B animals. Wound epithelialization occurred on days 45, 28, 19 and 32 in groups A, B. C and D animals respectively.

Table 2: Wound epithelialization time of rats post wounding.

Groups	**A (n/saline)**	**B (1%)**	**C (3%)**	**D (5%)**
Days of wound epithelialization	44.75±3.20^{b}	28.60±0.29^{ab}	19.00±0.71^{a}	32.00±2.04^{b}

Different superscripts in a ^{a,b} row indicate significant difference between mean at P<0.05.

DISCUSSION

The effects of different concentrations of hydrogen peroxide on healing of excision wound were evaluated in this study. Grossly, the effect on contraction and rate of wound epithelialization were studied. Wound contraction and epithelialization play a significant role in healing of excision wounds. According to Eichler*et al*. (2006) contraction of wound begins approximately a week after wounding when fibroblasts have differentiated into myofibroblasts. Wound contraction as documented by Sussman*et al*. (2005) peaks at 5-15 days post wounding. In this study a progressive decrease in wound size was observed on day 7 in all the groups and this finding was in agreement with the works of other researchers as documented above.

The fastest rate of wound contraction observed in 3% H_2O_2 treated group could be attributed to its content of antimicrobial properties. It kills microbes by interrupting cellular respiration of the microbes and as well prevents wound contamination by microorganisms with minimal tissue damage around the wound (Edward and Harding, 2004).

In conclusion, the result of this study validates 3% H_2O_2 as the optimum concentration of hydrogen peroxide necessary for wound dressing as it provides faster rate of wound healing with no visible side

effects while 5% concentration should not be used in wound dressing due to its damaging effects on the tissue and blood vessels thus delaying wound healing. Also, 1% hydrogen peroxide and normal saline should not be used as wound dressing agents for excision wounds probably due to their poor antimicrobial property.

REFERENCE

Alam, G., Singh, M. P. and Singh, A. (2011). Wound healing potential of some medicinal plants. *International Journal of Pharmaceutical Sciences Review and Research*.*9*(1): 136–145.

Bruno DW and Raynard RS (1994). Studies on use of hydrogen peroxide as a method for the control see lice on Atlantic Salmon. *Aquacultural International*. 2:10-18.

Chah, K. F., Eze, C. A., Emuelosi, C. E., and Esimone, C. O. (2006). Antibacterial and wound healing properties of methanolic extracts ofsome Nigerian medicinal plants. *J. Ethnopharmacol*. 104(1-2): 164-167.

Drouso A, Fallabella A, and Robert SK (2003). Antiseptic on wound area of controversy. *Wounds*. 15:149-166.

Edward R and Harding GK (2004). Bacterial and wound healing. *Current Opinion in Infectious Disease*. 17:91-96.

Eichler MJ, Carlson MA, and Margret K, (2006). Modeling dermal granulation tissue with the linear populated collagen matrix: *Journal of Dermatological Science*, 41:97-108.

Kwakman PH, TeVelde AA, de Boer L, Vandenbroucke-Grauls CM and Zaat SA (2011). Two major medicinal honeys have different mechanisms of bactericidal activity.2011; https://doi.org/10.1371/journal.pone.0017709

Neithammer P, Grabher C, Look AT and Mitchison TJ (2009). A tissue-scale gradient of hydrogen Peroxide mediates rapid wound detection in Zebrafish. *Nature* 459:996-999.

Okoli, C. O., Ezike, A. C., Akah, P. A., Udegbunam, S. O., Okoye, T. C., Mbanu, T. P., and Ugwu, E. (2009). Studies on wound healing and antiulcer activities of extract of aerial parts of *Phyllanthusniruri*L. (Euphorbiaceae) *Am. J. Pharmacol. Toxicol*. 4: 118-126.

Room TS and Ukrainsky (2005). Modulation of wound response and soft tissue in growth in synthetic allogeneic implants with platelet concentrate. *Archives of facial plastic surgery* 7:163-169.

Sussman, C. and Bates-Jensen, B. M. (2007). Wound healing physiology: acute and chronic. *Wound Care a Collaborative Practice Manual for Health Professionals*. 21–51.

Tandara, A. A. andMustoe, T. A. (2004). Oxygen in wound healing—more than a nutrient. *World Journal of Surgery28*(3): 294–300.

Tidhar, D., Keren, E., Brandin, G., Yogev, M. andArmer, J. M. (2017). Effectiveness of compression bandaging education for wound care nurses. *Journal of Wound Care*, *26*(11): 625–631.

Zhu J, Bin LI, Horby J, Friis E, Pilgaard B, and Jorgenson T (2002). Smoking as a risk factor for wound healing and infection in breast cancer surgery. *European Journal of surgical oncology*. 28:815-820.

EFFECT OF VITAMIN E FORTIFIED DIET ON SEMEN QUALITY AND BODY WEIGHT OF GUINEA COCKS

ELILE, C.F* UGWU, S.O.C & OGBONNA, O.C****
**Department of Training and Internship, Nigerian Institute of Animal Science (NIAS), Abuja, Nigeria*
*** Department of Animal Science, University of Nigeria Nsukka (UNN), Enugu State, Nigeria*
Correspondent: E-mail: franciselile4god@yahoo.com, 08033984059.

ABSTRACT
In spite of numerous advantages of guinea fowl over chicken, rearing of guinea fowl is believed to be uneconomical due to high information of PUFA that instigates poor semen quality. However, the study was designed to evaluate effect of vitamin E at different levels on semen quality and body weight of guinea cocks. Twenty-four guinea cocks were equally and randomly distributed into T1, T2, T3 and T4 of 0mg, 125mg, 250mg and 350mg vitamin E per kg diet respectively in a completely randomized design. Initial and final body weights were determined and semen samples were collected twice a week. Best values of semen volume, sperm concentration, sperm progressive motility, percentage live and dead sperm cells were obtained from cocks in T2. Reduction ($P<0.05$) in values of semen volume, sperm concentration, sperm progressive motility and percentage live were observed from cocks in T3 and T4 indicating that 250mg and 350mg vitamin E inclusion were in excess and had adverse effect on semen parameters of guinea cocks. Cocks in T2 had highest ($P<0.05$) gains in body weight than the control while cocks in T3 and T4 expressed significant ($P<0.05$) body weight lost. These results therefore prove that semen quality and body weight of guinea cocks were negatively influenced by 250mg and 375mg vitamin E inclusion while 125mg vitamin E inclusion had an improved semen quality at better body weight which is recommendable.
Keywords: Guinea fowl, guinea cock, vitamin E, semen characters, body weight,

INTRODUCTION
Increase in Nigerian population has not been marched by growth in agricultural productivity especially in the area of animal production. This has caused low intake of animal protein intake in Nigeria as reported by FAO(1989). To correct this shortfall, there is need to improve on indigenous farm animals like guinea fowl (*Numidameleagris*) which is predominantly reared in northern part of Nigeria. Guinea fowl has many advantages over chicken which include low production cost, premium quality meat, greater capacity to scavenge for insects and grains, better ability to protect itself against predators and better resistance to common poultry parasites and diseases (Microlivestock, 1991). Guinea fowl products also have numerous nutritive and socio-cultural values. In spite of these, rearing of guinea fowl is believed to be uneconomical due to their monogamous and seasonal reproductive behavours.
The use of Artificial Insemination (AI) has not been properly explored as better alternative to break the inbreeding and monogamous behaviours of guinea fowl(Aire*et al*., 1983). Rengaraj and Hong (2015) reported thatavians are rich in PUFA which instigate oxidative damages that causes infertility. These damages may be controlled by given certain minerals and vitamins to act as antioxidants which vitamin E is a well unknown one.Vitamin E is a fat soluble vitamin that accumulates in tissues like testes and other reproductive organs (Rengaraj and Hong, 2015). This trace element is necessary for effective functioning of hormonal regulation and the reproductive system (Herrera and Barbas, 2001). This element is to increase the value semen parameters like sperm concentration, sperm livability and semen volume (Danikowski*et al*., 2002).However, excessive inclusion of vitamin E has also been reported to decrease semen quality (Arscot *et al*., 1995) and body weight (Aburto and Britton, 1998)of guinea cocks.
Information on reproductive responses of chicken, turkey and quail given different levels of vitamin E has been investigated by many authors like Kling *et al*. (1987), Danikowiki *et al*. (2002), Lin*et al*. (2005), Hooda*et al*. (2007) and Biswas*et al*.(2009). Yet, no work has been done on effect of vitamin E inclusion on semenparameters and body weight of guinea cocks reared in humid tropics. Therefore, this work is designed to establish the level of vitamin E inclusion that will improve semen quality recommendable for natural and AI breeding management in guinea cocks with sustainable body fitness.

MATERIALS AND METHODS

Location and duration of the study: This study was conducted in the Poultry Unit of the Teaching and Research Farm of the Department of Animal Science, University of Nigeria Nsukka, Enugu State. Nsukka lies in the derived savannah region, and is located on longitude $6^{o}\,25^{1}$ N and latitude $07^{o}\,24^{1}$ E, at an altitude of 430m above sea level (Ofomata, 1975). The climate is a typical humid tropical type with a relative humidity range of 56.01% - 103% (Energy Centre UNN, 2008). Average diurnal minimum temperature ranges from 22.0°C–25.2°C while the average diurnal maximum temperature ranges between 33^{0}C-37^{0}C (Energy Centre UNN, 2008). Annual rainfall ranges from 1567.05mm to 1846.98 mm (Energy Centre UNN, 2008). The study lasted 18weeks in which two weeks were used to acclimatize the birds.

Procurement, distribution and management of experimental guinea cocks: A total of twenty-four mature guinea cocks of 35-37 weeks old were procured from dealers in Abuja and acclimatized to the farm environment. The cocks were randomly allotted into four treatments: T1, T2, T3 and T4 of six cocks per treatment at different levels of vitamin E: 0mg, 125mg, 250mg and 375mg inclusion respectively. Initial and final body weights of the cocks were also determined. Diet containing metabolizable energy and crude protein of 2650Kcal/kg and 16.5% respectively was formulated which met the dietary recommendation for guinea fowl breeders under tropical conditions as recommended by NRC (NRC 1994) and served at 110g/day/cock as prescribed by Embury (2001). Water was given *ad libitum*.Other procedures carried out in this study were complied with the provisions of theUniversity of Nigeria, Nsukka Ethical Committee on the use of animals for biomedical research (2005).

Collection of semen samples: The guinea cocks were trained on semen collection within the period used for acclimatizing the birds. Semen samples were obtained by massage technique as described by Burrows and Quinn (1935). Semen samples were collected twice per week i.e. Saturdays and Wednesdays and were evaluated considering the processes described by Ugwu and Oleforu (2008).

Experimental design and statistical analysis: The experimental design that was used is a completely randomized design (CRD): $\mathbf{X_{ij} = \mu + T_i + E_{ij}}$; where$\mathbf{X_{ij}}$= individual observations of (ith) guinea cock fed with (jth) different level of vitamin E; **μ**= overall mean of the experiment; **T**i= effect of vitamin E on (ith) individual guinea cock;$\mathbf{E_{ij}}$= experimental error associated with observations of guinea cock fed with (jth) different level of vitamin E. The data were subjected to analysis of variance based on a Completely Randomized Design (CRD) using Statistical Package for Social Sciences (SPSS) computer package (SPSS, 2001). Significant means were separated using the Duncan option of SPSS.

RESULTS AND DISCUSSION

Results in Table 1 showed that there were significant differences ($P<0.05$) among the cocks in semen volume, progressive motility, sperm concentration, percentage dead sperm cells, percentage live sperm cells and total sperm cells with best mean values obtained for cocks fed with 125mg vitamin E (T2).The mean values of semen volume, live sperm cells and total sperm cells obtained for cocks in T3andT4 were significantly lower ($P<0.05$) than number of dead sperm cells whencomparedwith the control.Semen of cocks in T3 and T4 had slightdecrease ($P<0.05$) in progressive motility and sperm concentration values when compared with control treatment. These resultstherefore indicate that inclusion of125mg vitamin E

Table 1: Physical semen characters of the guinea cocks fed with different dietary levels of vitamin E

Semen Characters	T1 (control) (0mg vit. E)	T2 (125mg vit. E)	T3 (250mg vit. E)	T4 (375mg vit. E)
Semen volume (ml)	0.038^{a}±0.01	0.044^{a}±0.02	0.022^{b}±0.03	0.020^{b}±0.02
Progressive motility (%	45.43^{b}±3.25	65.22^{a}±4.05	40.40^{b}±4.15	40.40^{b}±4.15
Sperm Concentration ($x10^{6}$/ml)	2.35^{b}±0.09	4.35^{a}±1.13	2.20^{b}±0.21	2.00^{b}±0.16
Live sperm cells (%)	90.12^{a}±3.34	92.56^{a}±3.40	82.28^{b}±2.28	81.53^{b}±2.21
Dead sperm cells (%)	10.34^{b}±0.04	8.29^{a}±0.22	18.77^{c}±1.58	19.56^{c}±1.50
Total sperm cells (10^{9}/ ejaculate)	0.83^{a}±0.018	0.91^{a}±0.025	0.51^{b}±0.017	0.41^{b}±0.010

a, b, c Means with different superscripts in a row are different (P<0.05).

perkg diet improved semen quality of guinea cocks.Further increase of vitamin E to 250mg and 375mg may progressively reduce values thesesemen parameters. These values were in accordancewith those of Arscot*et al*. (1995) and Danikowski*et al*. (2002) who reported that semen parameters of cocks may be negatively affected when they are given high level of 250mg vitamin E in diet.

Table 2: Daily live-weight gain of guinea cocks fed with different dietary levels of vitamin E

Body weight	T1 control (0mg vit. E)	T2 (125mg vit.E)	T3 (250mgvit. E)	T4 (375mgvit. E)
Initial weight(kg)	0.65±0.075	0.64±0.080	0.63±0.067	0.65±0.082
Final weight(kg)	0.78^{b}±0.063	0.82^{a}±0.403	0.56^{c}±0.055	0.56^{c}±0,057
Total weight gain (kg)	0.13^{b}±0.021	0.18^{a}±0.028	-0.07^{c}±0.019	-0.09^{c}±0.023
Daily Live-weight gain(g)	3.09^{b}±0.19	4.28^{a}±0.24	-1.67^{c}±0.15	-2.01^{c}±0.07

a, b, c Means with different superscripts in a row are different (P<0.05)

Results in Table 2 showed that cocks in T2 had highest (P<0.05) daily live-weight gains (4.28^{a}±0.24) while cocks in T3 and T4 had negative values (P<0.05) live-weight gains of -0.71g±0.15 and -0.92g±0.07 respectively indicating a reduction in body weights when compared to 3.98g±0.19 daily live-weight gain for the birds in control treatment. Also, similar trends were observed in final weight and individual weight gain of cocks given the different dietary levels of vitamin E (Table 2). These results agreed with the reports of Yates *et al*. (2009) that body, liver and heart weights of rats given dietary vitamin E were better at lower levels (42 IU and 242 IU) than (2042 IU and 20,042 IU). Similarly, Aburto and Britton (1998) observed that the body weights and bone ash of broilers were reduced significantly at high levels of vitamin E supplementation when compared with increased body weights and bone ash obtained forbroilers fed with lower levels of vitamin E. Dju*et al*. (1950) observed that fowls fed with excess vitamin E for a prolong period eliminate more than 75% of ingested feed through faeces. This may cause great loss of metabolizable nutrients including the energy required for production of quality semen and body development among others. In contrast, Pudelkiewics *et al.* (1960) reported that chicken receiving diet supplemented with 35g of vitamin E/kg diet defecate only 23% of ingested feed. This proves that more nutrients will be stored and utilized for production of semen of good quality and sustaining better body development among the chickens.

CONCLUSION AND RECOMMENDATIONS

These results suggest that guinea cocks required reduced amounts of vitamin E for body growth, gamete production and subsequent fertility. Deficiency or long-term omission of vitamin E in the diets of breeding guinea cocks may not significantly affect semen production, fertility and body weight

gains while excessive inclusion of 250mg to 375mg of vitamin E per kg impair semen quality with significant loss of body weight which may further cause emaciation. These results showed that 125mg of vitamin E per kg diets reduces the oxidative damages of PUFA and therefore improves the semen parameters recommendable for natural and AI operations with better body fitness essential for optimum guinea fowl production.

REFERENCES

Aburto A and W. M. Britton1998. Effects of different levels of vitamin A and E on the utilization of cholecalciferol by broiler chickens Poultry Science, **77**: 570-577.

Aire, T. A., J. S. O Ayeni and M. O. Olowo-Okorun, 1983. Some aspects of the reproductive biology of the guinea fowl *(Numidameleagrisgaleatapallas)*. In: The helmet guinea fowl (*Numidameleagrisgaleatapallas*) in Nigeria, Ayeni, J. S. O. (Ed.). Kainji Lake Research Institute, New Bussa, Nigeria. p. 189-193.

Arscott G.H., P. E. Bernier. A. Sherry and A. T. Diplock, 1995. Effects of vitamin E supplementation in fish oil on semen status of white leghorn roosters. Journalof Nutrition, 124(4): 484-94.

Biswas A., J. Mohan , and K. L. Sastry, 2009.Effect of higher dietary vitamin E concentrations on q physical and biochemical characteristics of semen in Kadaknath cockerels. Br. Poultry Science 50:733–738. doi: 10.1080/00071660903264369.

Burrows W.H. and J. P. Quinn, 1935. The collection of spermatozoa from the domestic fowl and turkey. Poultry Science, 16:19-24.

Danikowski S, R. S. Hans-Pete, I. Halle and G. Flachowsky,2002. Influence of high levels of vitamin E on semen parameters of cocks. Journal of Animal Physiology and Animal Nutrition 86(11-12):376-82. DOI:10.1046.

Dju MY, M. L. Quaife, P. L. Harris, 1950.Utilization of pure α β and ∞-tocopherols by laying hens. American Journal of physiology 160, 259-263.

Embury, I. (2001). Raising guinea fowl. New South Wales Agriculture Publications, USA, p. 4.

Energy Research Center, University of Nigeria Nsukka, 2008.Annual weather record of University of Nigeria Nsukka.

Food and Agricultural Organizations (FAO), 1989.Production year book 1989. FAO, Rome. Italy.

Herrera and Barbas C. 2001. "Vitamin E: Action, metabolism and perspectives". Journal of Physiology andBiochemistry **57** (2):43-56.

Hooda S., Tyagi P.K., Mohan J., Mandal A.B., A. V. Elangovan, K. T.Pramod, 2007. Effects of supplemental vitamin E in diet of Japanese quail on male reproduction, fertility and hatchability. Br. Poult. Sci. 2007;48:104–110. doi: 10.1080/00071660601157378.

Kling L.J and J. HSoares, 1980.Vitamin E deficiency in the Japanese quail.Poultry Science. 59:2352–2354. doi: 10.3382/ps.0592352.

Lin Y.F., S. J. Chang, J. R. Yang, Y. P. Lee and A. L. Hsu, 2005. Effects of supplemental vitamin E during the mature period on the reproduction performance of Taiwan native chicken cockerels. Br. Poultry Science.46:366–373. doi: 10.1080/00071660500098186.

Microlivestock, 1991.Little known small animals with promising economic future.Board on Science and Technology for International Development. Washington, DC: National Academy Press, Washington. p. 115-125.

National Research Council (NRC), 1994.Nutrient requirement of poultry. Ninth Revised edition. National Academy Press, Washington D.C.

Ofomata, G. E. K. 1975. Soil erosion In: Nigeria in Maps. Eastern States, Benin, Ethiope Pub. House.p 43-45.

Pudelkiewicz W.J, D.Gaudreau, J. Brown, 1960. A fat-soluble material in alfalfa that reduces the biological availability of tocopherol, Journal of Nutrition 71, 143-148.

Rengaraj D and Y. H. Hong2015.Effect of dietary vitamin E on fertility function in poultry species. Int.J Mol Sci. 16 (5): 9910-9921.

SPSS, Inc. 2001.SPSS/PC+V2.0 computer program. Chicago: SPSS Inc.3.

Ugwu S. C. O and O. Oleforu, 2008.A practical course on semen collection and processing for artificial insemination.In Manual of agricultural practical.Fegno Press Ltd.

Yates D.T., A. F. Montoya, L. J. Yates, C. A. Warner, D. M. Hallfordand T. T Ross, 2009. Effects of dietary vitamin E on daily intake, serum testosterone and epididymal Sprague-Dawley rats subjected to heat stress. Journal of Vet.Med. and Animal healthvol. 2(2) pp11-16.

INFLUENCE OF STRAIN ON HAEMATOLOGICAL VALUES, BLOOD CHEMISTRY AND CARCASS CHARACTERISTICS OF THREE STRAINS OF NOILER CHICKEN

***Ibrahim M., Y.P Mancha & D.J.U Kalla**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author:kwala_laras@yahoo.com mobile No: 08038079331*

ABSTRACT

The experiment evaluated the influence of strain on haematological values, blood chemistry and carcass characteristics of three strains (black, brown and spotted) of Noiler chicken. The experiment was conducted at the poultry section of the Bauchi State Agricultural Development Programme (BSADP) in Bauchi. A total of one hundred and thirty-six (136) eight weeks old Noiler birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system. They were randomly distributed into 3 treatment groups based on strain using a Completely Randomized Design(CRD). The experiment lasted for a period of three months from the first day of lay. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum. At 34 weeks, seventy-two (72) birds were randomly selected from three different strains (24 birds per strain) for haematology and biochemical analysis while at the end of the experiment, a total of fifty-seven (57) birds were randomly selected from different strains (19 per strain) for gut and carcass analysis.The Haemoglobin (Hb) result indicated that all the treatments were within the normal range (10.2 – 15.1g/dl), the packed cell volume (PCV) were within the normal recommended values.The result for lymphocytes fell within the normal value of 40 – 70% indicating that the birds were normal. The lymphocytes, neutrophils, Basophils, Eosinophils and monocytes were all within the normal range. The result showed that strain ($p<0.05$) significantly affected albumin glucose cholesterol and calcium. Dressing percentage, liver, large intestine pancreas and abdominal fat were also influenced by strain. This study therefore concludes that strain affected the haematological values, blood chemistry and carcass characteristics of Noiler chicken.

Keywords: Strain, Noiler, Haematological, Carcass, Blood Chemistry

INTRODUCTION

Chickens are regarded as the most important and widely spread avian species among poultry birds (Dutta*et al.,* 2013).Poultry production is an important agricultural activity of almost all rural communities in Africa and provides scarce animal protein in the form of meat and eggs, and is a reliable source of petty cash, they are said to be one of the important animal genetic resources used as a weapon for fighting poverty and malnutrition, especially in rural areas of most developing countries, which results in the growing interest on the use of chicken as a tool for poverty alleviation in villages throughout the world (Dunya *et al.,* 2015). However, chicken growth and development is a complicated life process and is subject to a significant amount of control by genetic and non-genetic factors (Pourtorabi *et al.,* 2017; Zhenqiang *et al.,* 2013).Poultry production is fast growing in Nigeria as it significantly contribute to animal protein source of the Nigeria population, Most farmers keep broilers for meat and pullets are kept for egg production. With the increasing population, there is need for a low cost feed input breed with increased output of meat and egg production.To achieve this, a dual purpose chicken breed like Noiler is unavoidable. Noiler is a dual purpose breed of chicken developed in Nigeria by a noble hatchery with the sole aim of addressing the challenges of animal food insecurity and also to solve problems of financial challenges especially of rural communities and small holder farmers as Noiler production is highly profitable and can easily substitute local chicken. The haematological profile, both in human and animals is an important index of the physiological state of the individual, the ability to interpret the state of blood profile in normal and diseased conditions is among its primary tasks (khan *et al,* 1987). Hematological indices are an index and a reflection of the status and condition of the blood available for an animal to meet its physiological, biochemical, and metabolic necessities (Euola *et al*,2004). Therefore the objectives of this study was to establish the haematological and serum biochemical values of the three strains of Noiler chicken and to determine the effects of strain on carcass yield and gut characteristics of Noiler chickens.

MATERIALS AND METHODS

The experiment was conducted at the poultry section of the Bauchi State Agricultural Development Programme (BSADP) along Yelwan Makaranta Dass Road, Bauchi State. A total of one hundred and thirty-six (136) eight weeks old Noiler birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system where they were randomly distributed into 3 treatment groups based on strain using a Completely Randomized Design(CRD). The experiment lasted for three months from the first day of lay. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum.

Data Collection and Analysis

At 34 weeks, seventy-two (72) birds were randomly selected from three different strains (24 birds per strain) for haematology and biochemical analysis. 3ml of blood samples were collected from the basillic vein of the birds into a well labelled sterile bottle containing Anticoagulants. These were used to determine packed cell volume, haemoglobin (hb), white blood cell count (WBC), and the differential counts which are Neutrophils, lymphocites, monocites, Eosinophil and Basophils. Another 3ml sample of blood was collected into sterile labelled bottles without anticoagulants to determine the serum biochemical metabolites as follows: total protein, cholesterol, Glucose, Albumin, calcium, phosphorus, uric acid.

Hematological technique

Total red blood cell count and Total white blood cell count were determined by a manual method using hematocytometer (Campbell,1995). Differential counts were made on monolayer blood films, fixed and stained with leishman – stain. Packed cell volume was measured by a standard manual technique using micro hematocrit capillary tubes and hematocrit reader. Haemoglobin concentration was measured by cyanhemoglobin method (Ritche *et al*.,1994).

Biochemical technique

Total protein, glucose, calcium, phosphorus, cholesterol, and uric acid, were determined by automatic analyzer.

Gut and Carcass Analysis

At the end of the experiment, a total of fifty-seven (57) birds were randomly selected from different strains (19 per strain). They were deprived of feed for twelve hours but provided with drinking water. The chickens were weighed and slaughtered. Slaughtered birds were scalded in hot water (about 50^0c) for 1 minute and plucked manually, offal were then eviscerated for carcass yield and organ weight determination. The carcass yield and organ weight were calculated as percentage of the live weight. Dressing percentage was calculated using the relationships: -

$$\text{Dressing percentage} = \frac{\text{carcass weight}}{\text{live weight}} \times 100$$

Statistical Analysis

Analysis of variance was carried out on data collected using the general linear model of SPSS 20.0 (2011). Where means differed, Duncan multiple range test (DMRT) was used to separate them (Duncan, 1955).

RESULTS AND DISCUSSION

The result for haematological analysis of three strains of Noiler chicken is presented in Table 1. The result showed ($p<0.05$) significant difference among some of the parameters measured. Haemoglobin (Hb) values were similar among the treatments. The Hb result indicated that all the treatments were within the normal range (10.2 – 15.1g/dl) which is in agreement with the finding of Petra *et al*, (2014). The packed cell volume (PCV) were within the normal recommended values for healthy birds in all the treatments (30 – 49%) as outlined by Petra et al, (2014). The result for white blood cell count (WBC) revealed that all the treatments were within the recommended range ($3 – 11 \times 10^9$). The result for lymphocytes fell within the normal value of 40 – 70% indicating that the birds were in a normal health status. The neutrophils, Basophils, Eosinophils and monocytes are all within the normal range for healthy birds as outlined by Petra et al.

Table 1: Haematological values of three strains of Noiler Chicken

Parameters	Black strain	Sported strain	Brown strain	LS
Hemoglobin (g/dl)	11.13	10.33	11.54	0.38827 NS
Packed cell volume%	33.33	30.13	34.13	1.17851 NS
Whiteblood cell(x10)	5.41	3.65	3.75	0.53758 NS
neutrophil%	39.50	40.25	36.45	0.75785 NS
Lymph%	55.45a	51.79b	56.33a	0.86534 *
Mono%	3.92a	2.29b	3.45a	0.17382*
Basophils	0.02	0.01	0.01	0.00000 NS
Eosinophils	0.42a	0.00b	0.00b	0.06034 *

Ls= level of significant,NS/=Not significant, a and b= means with different superscript on the same row varies significantly.

Table 2: Blood Chemistry of three strains of Noiler Chicken

Parameters	**Black strain**	**Sported strain**	**Brown strain**	**SEM**
Total protein (gl)	57.62	60.24	56.67	1.19269NS
Albumin (mmol/l)	21.62^{b}	22.00_{b}	26.19^{a}	0.46649*
Glucose (mmol/l)	1.35^{b}	2.95^{a}	1.65^{b}	0.23103*
Cholesterol (mmol/l)	4.91^{b}	3.45^{c}	6.05^{a}	0.22020*
Calcium (mmol/l)	2.26^{b}	3.00^{a}	2.40^{b}	0.07510*
Phosphorus (mmol/l)	2.42	2.11	2.30	0.13478NS

NS= not significant ($p<0.05$), SEM= standard error of mean, a, b and c= means with different superscripts on the same row varies significantly, *= significant.

The result for blood chemistry of the three strains of Noiler is shown in Table 2**.** The result showed that strain has effect on most of the serum biochemical parameters measured. The total protein was not significantly different among the three strains, but albumin values were similar in two of the treatments (Black and spotted) but differs significantly ($p<0.05$) with the brown. The result for glucose showed a similar value for the black and brown strain but differs significantly ($p<0.05$) with the spotted. All the treatments were within the normal glucose range for birds. Cholesterol levels were within the normal range but vary significantly ($p<0.05$) among the treatments. Brown strain records higher value for cholesterol compared to the Black and Spotted. Calcium and phosphorus levels were

within the normal range indicating proper metabolism of the calcium and phosphorus and also a proper functioning of the parathyroid gland.

Table 3: Carcass characteristics of three strains Noiler chicken

Parameters	Black strain	Sported strain	Brown strain	SEM
Live weight (g)	2738.5	2853.8	2638.5	0.10608
Pluck weight (g)	2509.2	2500.0	2411.5	0.10449
Eviscerated weight (g)	2249.2	2223.1	2169.2	0.10292
Carcass weight (g)	2107.7	1901.5	1960.0	0.09828
Dressingpercentage (%)	74.92[a]	66.74.[b]	72.76[a]	1.24794*
Head (%)	8.8	7.5	8.9	1.247NS
Leg (%)	8.5	7.5	7.8	4.928NS
Gizzard (%)	3.9a	3.5b	3.9a	2.617NS
Liver (%)	4.9[a]	3.4[b]	3.13[b]	9.400*
Kidney (%)	0.3	0.33	0.33	0.522NS
Small intestine(cm)	8.9	8.6	8.2	4.395NS
Large intestine(cm)	0.8[b]	0.83[b]	0.96[a]	0.220*
Pancreas (%)	0.32[b]	0.31[b]	0.38[a]	0.125*
Abdominal fat (%)	8.26[b]	8.60[a]	8.21[b]	9.85*
Spleen (%)	0.18	0.19	0.19	0.50NS
Caecum (%)	1.78	1.72	1.76	2.73NS
Lungs (%)	1.24	1.08	1.06	0.470NS
Hearts (%)	1.23	1.06	1.21	0.44NS
Testes (%)	0.71	0.73	0.78	2.211NS

SEM= standard error of mean, a and b= means with different superscript on the same row varies significantly. NS- not significant.

The result for carcass characteristics of three strains of Noiler chicken is shown in Table 3. The result showed that there were no significant difference on parameters like liver, plucked, eviscerated and carcass weight. The similarity may be as a result of uniformity in feed, environment and their genetic potentials for growth. The result for organ and gut expressed as percentage of body weight showed no significant difference in kidney, heart, testes, lungs, ceacum, spleen, gizzard, and small intestines. However, significant ($p<0.05$) difference was recorded for liver with the black strain recording the highest (42.62). Other parameters measured include pancreas, large intestine, abdominal fat which varied significantly ($P<0.05$) among the treatments.

CONCLUSION

In conclusion, strain affected the haematological values, blood chemistry and carcass characteristics of Noiler chicken.

REFERENCES

Campbel, T.W (1995). *Avian Hematology and Cytology, IOWA state university press Ames, IOWA.*

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics 11:1-42.

Dunya, A. M., Mamza, A. O., & Yusuf, S. Z. (2015). Local chicken management in rural Borno state, Nigeria.*J. of Biology, Agriculture and Healthcare*, *5*(4), 113–120.

Dutta, R. K., Islam, M. S., & Kabir, M. A. (2013). Production performance of indigenous chicken (Gallus domesticus l .) in some selected areas of Rajshahi , Bangladesh. *American J. of Experimental Agriculture*,*3*(2), 308–323.

Euola, E.O., Folayan O.A; Gbore, F. Ogunlade, J.T. and Adeneye, T.A (2004). Effects of physiological response of growing West African dwarf goats fed groundnut shell – based diets as the concentrate supplements*: Bowen J. Agric*. 1 (1): 61 – 69.

Khan, J. Mabaurl, K.R…, Humpler, H.E and Bect-jaen, F. (1987). The dose dependant effect on the oxygen carrying capacity and metabolism of RBC in human and rat. *Pakistan journal pharmacology: 4:23-36.*

Petra Hrabcakova, Eva Voslarvoa, Iveta Bedanova, Oladimira Pistekova, Janchloupek and Vladimir Vecerek (2014). Hematological and biochemical parameters during the laying period in common pheasant hens housed in cages in: *The scientific world journal vol. 2014, Article LY 364602, 6 pages.*

Pourtorabi E., N. Farzin & A. Seraj (2017). Effects of genetic and non-genetic factors on body weight and carcass-related Traits in two strains of Japanese quails *Poultry Science J., 5 (1): 17-24.*

Ritchie, B.W. Harrisson, J.G. and Harrison, R.L. (1994). *Avian Medicine wingers publishing inc. Florida.*

SPSS (2011) SPPSS Statistics for windows, version 20.0 Armonk, NY.IBM Corp.

Zhenqiang X., N. Qinghua, and Z. Xiquan (2013). Overview of Genomic Insights into Chicken Growth Traits Based on Genome-Wide Association Study and microRNA Regulation. *Current Genomics, 14: 137-146.*

EFFECTS OF VARYING DIETARY ENERGY AND PROTEIN ON EGG QUALITY PARAMETERS OF QUAILS

***Njam, R.L., **Kalla, D.J.U., **Sanusi,M.,**

**National Veterinary Research Institute, Vom, PMB 01, Plateau State, Nigeria.*

***Department of Animal Production, Abubakar Tafawa Balewa University Bauchi P.M.B 0248, Bauchi State, Nigeria.*

Corresponding author: rahilanjam@gmail.com: GSM: +234(0) 805992170

ABSTRACT

The aim of this study is to seek the effect of dietary energy and protein on the egg qualities. A total of four hundred and eighty day old un-sexed Japanese quails of about the same weight (26.56±0.02) were studied over a period of 12 weeks. After hatching, chicks were raised together during one week and fed with starting diet then divided into four dietary treatments (T1, T2, T3 and T4) with 30 quails in each replicate. Each treatment was replicated four times. T1: Control (Standard diet)SD; T2: High Energy Low Protein diet (HELP) ; T3 : High Energy High Protein diet (HEHP) andT4 : Low Energy High Protein diet (LEHP) in a completely randomized design. After 12 weeks of laying, eggs were collected from each treatment for both the external and internal egg characteristics. Data obtained were analyzed using ANOVA at $\alpha_{0.05.}$

Egg weight was higher (P<0.001) in the HEHP diet, egg height was also higher (P<0.05) in HEHP diet as well. Internal egg qualities, albumin height and albumen length had a significant influence (P< 0.05) in the HEHP diet.The albumen volume and the Yolk weight had the highest level of significance (P<0.001) in the HEHP diet. The shell weight was significant (P<0.001) with the HEHP diet having the highest values. There was also significance (P< 0.001) in the shell membrane and shell percent (P< 0.01) in the LEHP diet. The haugh unit are not significant in all the diets (P>0.05) but HEHP had the highest % of haugh unit.The results indicate that high energy and high protein (HEHP) diets is suitable for optimum performance of Japanese quail in terms of weight gain and egg quality.

INTRODUCTION

Increased poultry production has been advocated as one of the fastest means of providing quality animal protein at minimum cost (Nwachuckwu, 2015). The quail production story is more recent and also has the same characteristics that occurred in the broiler and laying hen production.

The establishment of quail production assumed importance worldwide in the last decade, not only for being a laboratory animal for poultry and biomedical research, but also because it is commercially exploited for production of meat and eggs.

Japanese quails mature in about 6 weeks and are usually in full egg production by 50 days of age. With proper care, hens should lay 200 eggs in their first year of lay. Life expectancy is only 2 to 2½ years (Randall, 2008).Quails produce up to five generations per annum (Saidu, 2014).

The optimum performance of livestock depends largely on the quality and quantity of their dietary nutrients (El-katcha, 2014). Precise nutrient supply reduces feed cost, wastage of nutrients, environmental pollution, and bad aroma in poultry house, and thus improves animal welfare (Kaur, 2015). Nutrition is by far the most important single factor under the environment in which poultry birds are reared, since it accounts for 60-75% of the inputs in poultry industry.

The aim of this study is to seek the effect of dietary energy and protein on the egg qualities.

MATERIALS AND METHODS

Location:

The experiment was carried out in the Poultry Division of the National Veterinary Research Institute Vom which is located in Plateau state ,central Nigeria in Jos South Local Government .Its geographical coordinates are on Latitude 09^0 44' 0'' North ,08^0 4' East .The trial was carried out from September to November 2018 (Maplandia.com).

Animals and management:

A total of four hundred and eighty day old un-sexed Japanese quails of about the same weight (26.56±0.02) were studied over a period of 12 weeks . The birds were sourced and raised in the Poultry Division of the National Veterinary Research Institute Vom in Plateau state. After hatching, chicks were raised together during one week and fed with starting diet then divided into four groups of 30 chicks each.

Experimental diets:

Diets were composed with local available feedstuff such as corn, soya bean cake and offered as mash (Table 1) and were randomly assigned to each treatment. The experiment included 4 dietary treatments (T1 , T2 ,T3 ,and T4) with 30 quails in each replicate. Each treatment was replicated four times.

The experiment consisted of 4 treatments designated as:

T1 : Control (Standard diet)(SD)

T2 : High Energy Low Protein diet (HELP)

T3 : High Energy High Protein diet (HEHP) and

T4 : Low Energy High Protein diet (LEHP)

Egg collections

After 12 weeks of laying ,eggs were collected from each treatment for both the external and internal egg characteristics.

Data collected

External characteristics

Internal characteristics

Statistical analysis

Data collected were analyzed using General linear model of SAS (SAS 2010). Statistical variations were observed and means were separated using Duncan's multiple range test.

RESULTS

The effect of the diets on egg quality is presented on Table 1. The Egg width and Egg shape index were similar for all the groups (P>0.05). Egg weight was higher (P<0.001) in the HEHP diet, Egg height was also higher (P<0.05) in HEHP diet as well. For the internal egg qualities, the Albumin height and the Albumen length had a significant influence (P< 0.05) in the HEHP diet .The Albumen weight was significant (P<0.01) in the LEHP diet .The Albumen volume and the Yolk weight had the highest level of significance (P<0.001) in the HEHP diet. The yolk volume was significant (P<0.01) with the HELP diet having the highest value.

The shell quality showed no significant difference (P>0.05) in the shell thickness, values in all the diets ranged between 0.10mm to 0.15mm. However, the shell weight had values ranging from 1.38g to 1.74g ,and it was significant (P<0.001) with the HEHP diet having the highest values. There was also significance (P< 0.001) in the shell membrane and shell percent (P< 0.01) in the LEHP diet.The Albumen width ,Haugh unit ,Albumen index ,Yolk percent ,Yolk height ,Yolk width ,Yolk length , Yolk colour ,Yolk index ,Yolk /Albumen ratio , were all not significant in all the diets (P>0.05).

Table 1: Effect of dietary energy and protein on egg quality parameters of japanese quails

Parameter	SD	HELP	HEHP	LEHP	±SEM
Egg weight(g)	10.60^{b}	10.42^{b}	11.73^{a}	10.07^{b}	0.12***
Egg Height(mm)	29.12^{ab}	28.43^{ab}	29.92^{a}	26.64^{b}	0.54*
Egg width(mm)	22.61	22.5	23.3	21.35	0.43^{NS}
Egg Shape Index(%)	77.76	78.98	77.7	79.68	0.34^{NS}
INTERNAL QUALITY					
Albumen Height(mm)	3.97^{ab}	3.86^{ab}	4.46^{a}	3.73^{b}	0.12*
Albumen width(mm)	34.59	32.88	34.41	33.63	0.76^{NS}
Albumin Length(mm)	39.80^{a}	37.54^{ab}	39.84^{a}	33.80^{b}	0.79*
Albumin weight(g)	4.08^{b}	4.18^{b}	5.11^{ab}	5.95^{a}	0.24**
Albumin volume(ml)	4.81^{b}	4.66^{ab}	5.61^{a}	4.23^{c}	0.09***

Albumin percent(%)	38.47[b]	39.52[b]	43.70[b]	62.17[a]	2.90*
Haugh Unit	86.86	86.64	88.74	85.44	0.67[NS]
Albumin index(%)	9.98	10.09	11.09	9.71	0.33[NS]
Yolk weight(g)	3.29[b]	3.49[ab]	3.94[a]	3.22[b]	0.07***
Yolk percent(%)	31.63	34.01	33.41	33.03	0.56[NS]
Yolk height(mm)	9.81	9.36	9.93	8.86	0.19[NS]
Yolk width(mm)	21.76	21.37	22.04	20.12	0.43[NS]
Yolk length(mm)	22.3	21.81	23.1	20.56	0.47[NS]
Yolk volume(ml)	3.64[b]	3.80[ab]	4.08[a]	3.50[b]	0.06**
Yolk colour	2.07	1.81	2.04	1.94	0.08[NS]
Yolk Index(%)	56.7	44.56	45.26	43.39	4.35[NS]
Yolk/Albumin Ratio	0.95	0.99	0.91	0.98	0.02[NS]
SHELL QUALITY					
Shell weight(g)	1.40[b]	1.38[b]	1.74[a]	1.57[ab]	0.04***
Shell Membrane(mm)	0.03[b]	0.04[b]	0.02[b]	0.12[a]	0.01***
Shell percent(%)	13.51[b]	14.18[b]	14.49[ab]	15.47[a]	0.19**
Shell Thickness(mm)	0.12	0.15	0.1	0.13	0.01[NS]

[a, b] means with different superscripts within the same row differ significantly ($p<0.05$)., SEM means standard error of mean

SD= Control (Standard diet); HELP= High Energy Low Protein diet; HEHP= High Energy High Protein diet

LEHP= Low Energy High Protein diet

This present result was in line with Muhammad (2016), who indicated that the protein levels had no significant effect on albumin weight, yolk height, yolk width, yolk weight, yolk index, yolk colour and Haugh unit ($P>0.05$). In this study all that were indicated were not significant except Albumin weight which was significant ($P<0.01$). It was concluded in his study that increasing dietary protein level of 25% will increase the egg production performance of Japanese quails. Similar results was obtained with the report of Lotfi (2018) who reported that the groups of quails that were fed more energetic feeds, significantly higher egg weights were achieved. Gunawardana (2008) reported that dietary energy had no influence on egg weight. Wu *et al.* (2005), and Sohail (2003), who reported that egg weights of hens with high protein diets were greater than of those hens with low protein diets, which is a consequence of the increase in albumen and yolk weights was in line with the results obtained in this study. This study is also in agreement with Lotfi (2018) who reported that the increase of albumen weight might be partially attributed to the improved nutrient (protein, total sulfur amino acids, or lysine) utilization with increased dietary energy. On the other hand, Novak *et al.* (2006) reported that shell quality was affected by protein and its ratio in diet, which could potentially have serious consequences for commercial egg-laying operations which is in line with this study. The work of Lotfi (2018) which stated that the shell protein matrix is comprised of 70% protein ,and also, increasing the sulfate groups existing in the shell matrix significantly increases the Ca binding ability, which in turn may increase both shell percentage and specific gravity and overall shell quality.

CONCLUSION

The results indicate that high energy and high protein (HEHP) diets is suitable for optimum performance of Japanese quail in terms of weight gain and egg quality.

REFERENCES

El-Katcha,M.I., Soltan,M.A., Sheaita,R.S., Karima ,E.N.,and El-Shobokshy ,S.A.(2014).Growth Performance, Blood Biochemical Changes, Carcass Traits and Nutrient Digestibility of Growing Japanese Quail Fed on Various Dietary Protein and Calcium Levels. *Alexandria Journal of Veterinary Sciences* . 44: 38-53

Gunawardana, P., Roland, D.A., and Bryant, M.M. (2008). Effect of energy and protein on performance, egg components, egg solids, egg quality, and profits in molted Hy-Line W-36 hens. *Journal of Applied Poultry Research*. **17,** 432-439.

Kaur,S., and Mandal, A.B.(2015).The Performance of Japanese Quail (White Breasted Line) to DietaryEnergy and Amino Acid Levels on Growth and Immuno-competence.*Journal of Nutrition & Food Sciences*.**5**(4):390

Lotfi ,E., Karimi,N., Parizadian, K. B., and Sharifi, M.R .(2018) Influence of different dietary levels of energy and protein on reproductive and post hatch growth performance in japanese quails. *Iranian journal of applied Animal Science*Volume 8, Issue (1)Pp137-145

Muhammad,N., Altine,S., A. Abubakar ,A., Chafe,U .M., Saulawa ,L.A., Garba ,M.G., Yusuf ,A. (2016). Effect of varying protein levels and preservation methods on egg production performance and internal egg qualities of japanese quails in a semi-arid environment
European Journal of Basic and Applied Sciences **3** (3) :8-19.

Nwachukwu,E.N., Ogbu1,C.C.E., and Ifeanacho,N.G.(2015). Egg Quality Characteristics and Hatchability of Two Colour Variants of Japanese Quails (*Coturnix coturnix japonica*) . *International Journal of Livestock Research. 5(11)* .

Novak C., Yakout H.M. and Scheideler S.E. (2006). The Effect of dietary protein level and total sulfur amino acid: Lysine ratio on egg production parameters and egg yield in Hy-Line W-98 Hens. *Poult. Sci*. **85,p** 2195-2206.

Saidu ,S. , Afanasyev,G. , Popova ,L., Komarchev,A., Ibrahim.U.(2014)
Dynamic of Reproductive Qualities of Japanese Quails. International Conference on Earth, Environment and Life sciences 23-24.

Sohail S.S., Bryant M.M. and Roland D.A. (2003). Influence of dietary fat on economic returns of commercial Leghorns. *J. Appl. Poult. Res*. **12,** 356-361.

Randall ,M., Gerry, B. (2008) Raising Japanese quail. January primefact 602 second edition, www.dpi.nsw.gov.au/primefacts

Wu G., Bryant M.M., Voitle R.A. and Roland D.A. (2005). Effect of dietary energy on performance and egg composition of Bovans White and Dekalb White hens during phase 1. *Poult. Sci*. **84,** 1610-1615.

ESTIMATION OF GENETIC PARAMETERS IN UNN CATTLE POPULATION

Ohagenyi, I.J., & Udeh, V. C.
Department of Animal Science, University of Nigeria, Nsukka, Nigeria.
Correspondence email: ifemma.ohagenyi@unn.edu.ng; Tel: +2348160516532

ABSTRACT
This study was conducted to estimate the variance components and heritability for birthweight and weaning weight, as well as the genetic and phenotypic correlations between these traits in N'dama and Muturu crosses at the University of Nigeria Nsukka (UNN) cattle herd. The study lasted for 6 months and the heritability and genetic correlation of the traits were estimated using Restricted Maximum Likelihood (REML) method of SAS mixed model. The direct heritability estimates obtained were 0.15±0.05 and 0.45±0.05 for birth weight and weaning weight respectively. The direct genetic correlation between the two traits was positive (0.53) between birth weights and weaning weights.
Keywords: Genetics, heritability, N'dama, Muturu and Correlation

INTRODUCTION
The beef cattle sub-sector plays important roles in the Nigerian economy, not only in terms of its contribution to the gross domestic products (GDP) but also contributes substantially to the supply of animal protein (FDLPCS, 2002 and Tewe, 2010). In the opinion of Grain de Sel (2010), Nigeria is by far the leading beef cattle producer in Central and West Africa with the cattle herds estimated at over 16 million heads, which is far ahead of Niger (8.7 million), Mali (8.2 million) and Chad (7 million).
However, Nigeria's rapidly growing population which is expected to reach 250+ million persons by 2030 (NLTP, 2019-2028), coupled with rising incomes and urbanization, are translating into increased demand for livestock products (FAO, 2018). Recent estimates suggest that, between 2010 and 2050, beef, poultry meat and milk consumption will increase by 117, 253 and 577 per cent, respectively (ASL2050 FAO, 2018). Hence, there is need to genetically upgrade the performance of our indigenous cattle species to raise the potential for higher meat yield.
Long (1980) opined that the genetic improvement of beef production systems is hinged primarily on two procedures which are; selection within breeds to enhance critical characters and selection among, and combination breeds to produce individuals that better fit production conditions and resources. N'dama and muturu which are predominant in the south eastern Nigeria produce minimally and are usually referred to as unimproved. However they have good adaptive traits that makes them hardy and resistance to certain environmental factors and diseases. Hence, they can be used in advanced beef cattle improvement programmes. Moreover, birth weight and weaning weight traits are recognized as important traits in determining economic efficiency of beef cattle (Oni et al 1988), and also an important selection criteria because of the ease with which they can be measured (Gregory 1965).
The effectiveness of breeding programmes depends on the accuracy of genetic and phenotypic parameter estimates, which include heritability and repeatability (Burrow, 2001). However, since the inception of breed improvement programmes in Nigeria, there has been no comprehensive analysis of the data generated either to obtain estimates of genetic parameters or to evaluate the genetic progress achieved in these populations. Such estimates are not only necessary for planning future breeding strategies but are also relevant for predicting response to selection and for evaluating genetic programmes. Although many genetic parameter estimates are now available in the literature from different breeds and production conditions, estimates of genetic and phenotypic parameters in pure breed indigenous cattle populations are scarce (Bosso et. al., 2002). Hence, the primary objective of this study is to estimate genetic parameters for birth weight and weaning weight of N'dama and Muturu crosses which will be used in subsequent genetic evaluation of the breed.
The objective of this study was to estimate the variance components and heritability for birthweight and weaning weight, as well as the genetic and phenotypic correlations between these traits in UNN cattle population.

MATERIALS AND METHODS

The study area

Data used in this study were obtained from the breeding and production records of beef cattle at the University of Nigeria Animal Science Farm, Nsukka. Nsukka lies within longitude 6˚45'E and 71E and latitude 7˚12.5'N (Ofomata, 1975) and on the altitude 447m above sea level. The climate of the study area is typically tropical, with relative humidity ranging from 65 – 80% and mean daily temperature of 26.8˚C (Agbagha et al., 2000). The rainy season is between April and October while dry season is between November and March with annual rainfall range of 1680 – 1700mm (Breinholt et al., 1981). The experiment lasted for three months.

Management of the herd

A total of 15 cows and 5 sires were used for the experiment. They were bred and managed properly through calving till weaning. Calving occurs all year round as no strict breeding season is enforced. Calves were weighed within 24 h of birth and thereafter weighed at bi-monthly intervals using a 100Kg capacity weighing scale. Calves were identified at birth and branded later, close to weaning. Calves were weaned at about 6 months of age. All animals were treated against ecto- and endoparasites and routine prophylaxis for trypanosomiasis and babesiosis was administered. The vegetation of the research station is described as guinea savannah type. The predominant grass species on UNN pasture are *Panicum maximum, Pennisetum purpureum* and *Cynodon dactylon* interspersed with legume species like *Centrosema pubesence, Mucuna sp., Mimosa sp.* and others.

Statistical analysis

Data were edited such that only animals with complete records on sire, dam and all fixed effects were used. The number of animals in the final data set were analysed by the MIXED model procedure of SAS (SAS University Edition 2019). The model used include the fixed effect of sex (male and female) and random effect of sire. Restricted maximum likelihood (REML) method of SAS mixed model was used to estimate the observable variance components due to sire (σ_s^2) and error (σ_w^2). Estimates of genetic correlations were obtained using varcomp procedure of Harveys computer program (Harvey, 1990). The programme also computed the genetic correlations and the appropriate standard errors of the estimated heritabilities.

$$h^2 = \frac{4\delta_s^2}{\delta_s^2 + \delta_w^2}$$

Where, h^2 is the sire heritability; δ_s^2 is the sire variance component and δ_w^2 is the error variance component.

$$rG = \frac{Cov\ (x\ y)}{\sqrt{\delta_s^2(x)\delta_s^2\ (y)}}$$

Where, *rG* is the genetic correlation; Cov (x y) is the genetic covariance of x and y components; δ_s^2 (x) is the sire variance of x component and δ_s^2 (y) is the sire variance of y component.

The detailed description of animals at UNN population is presented in Table 1 below.

Table 1: Descriptive statistics of the data

	Birth Weight	Weaning weight
No of records	15	15
No of sires	5	5
No of dams	23	23
Progeny per sire	3	3
Progeny per dam	1	1
Mean (kg)	10.77	58.29
Standard deviation	2.37	7.03
Coefficient of variation (%)	22	12.07

RESULTS AND DISCUSSION

Sex effect was not significant (P>0.05) for birthweight. However, there is significant difference (P<0.05) between male and female calf weight at weaning. Male calves weighed 6.87kg (11.8%) heavier. The result is in line with the work of Hopkins (1977), who observed an increased sex

differences with increasing growth rate, signifying that male animalse are more responsive to improvement in the environment. The levels of weight advantage of male calves recorded in this study are comparable to what can be estimated from the values of Tawah et al. (1993) in Gudali but lower compared with values estimated by Tuah and Danso (1985) for WASH and Ndama in the humid forest zone of Ghana where favourable rainfall regime allowed greater quantities of high quality forage to be produced throughout the year, thus improving the nutritional environment for greater expression of male calves' responsiveness to improved environment.

Variance components and heritability in UNN cattle population

The variance and heritability estimates for birth and weaning weights are presented in Table 3 below.

Table 2: Variance covariance components and estimates for heritability (± SD) for birth and weaning weights

	Birth Weight		Weaning weight
Variance-covariance estimates			
Additive direct variance	0.8		16.37
Error variance	4.7		19.89
Phenotypic variance	5.5		36.26
Phenotypic correlation		0.05	
Genetic correlation *rG*		0.53	
Heritability estimates			
Direct heritability	0.15 ± 0.05		0.45 ± 0.05
Total heritability	0.15		0.45

Heritability

The variance, covariance and heritability estimates for birth and weaning weights are presented in Table 2. The estimates were low to medium but are in agreement with values reported by other researchers. The heritability value of 0.15 ± 0.05 for Birthweight in this study was close to 0.149 reported by Peters *et al.* (1998) for the same breed in a similar environment but lower than 0.37 reported by Johnson *et al.*(1992). Estimates of direct additive heritability (hi) for weaning weight (0.38 + 0.18) are in agreement with results of Mackinnon et al. (1991). The increase in heritability estimate with increase in age obtained in this study follows the same trend noted by Fogarty (1995).

Correlation

Phenotypic and additive direct genetic correlation coefficients between birth weight and weaning weight were 0.05 and 0.53 respectively. While the phenotypic correlation coefficient was slightly lower than those from other studies, the genetic correlation coefficient was similar to literature values. The unweighted and weighted means obtained from a review by Koots et al. (1994), of all published studies on correlations between birth and weaning weights were 0.36 and 0.46 for phenotypic correlations and 0.47 and 0.55 for genetic correlations, respectively. The lower phenotypic correlation relative to genetic correlation is in agreement with the trend reported in the reviews by Woldehawariat et al. (1977) Mohiud- din (1993) and Koots et al. (1994). The moderate genetic correlation between birth and weaning weights indicates that selection for one trait will result in a moderate positive correlated response in the other trait.

CONCLUSION

Estimates of heritability indicate that additive genetic variance exists for these traits. Selection for these traits, therefore, is likely to result in genetic gain for growth in UNN cattle population under tsetse infection pressure in south-eastern Nigeria and in the humid zone of Africa in general. The high genetic correlations between birth weight and weaning weight indicates that birth weight could be used as a cost effective means for selecting for cattle with high post weaning weight. The differences between male and female calves for weaning was highly significant hence, it is important

for sex of calf to be correlated for in analysing preweaning calf data. Genetic improvement of indigenous West African cattle has been attempted in the past by crossbreeding with exotic breeds of cattle with little or no emphasis placed on selection. The estimates of genetic parameters obtained in this study indicate that if genetic improvement through selection for birth and/or weaning weight of indigenous cattle and their crosses is desired, there is high posibility for high genetic progress to be achieved.

REFERENCES

Agbagha, F.M., Ezema F.U. and Omeke, B.C.O. (2000) Studies of Mangaement Effects on Fertility of Purbred and Crossbred Exotic Gilts in Two Breeding Farms at Nsukka. *Nigeria Journal of Animal Production*. 28(1)Pg 20.

Breinholt, K.A., Gowen, F.A. and Nwosu, C.C. (1981). Influence of Environmental and AnimalFactors on Day and Night Grazing Activity of Imported Holstein Freisian Cows in the Humid Lowland Tropics of Nigeria. *Trop. Animal Produc*.6:4.

Ofomata, G.E.K. (1975). Nigeria in Maps. Eastern States, Ethiope Publishing Co. Ltd. Benin.

Johnson, Z.B., Wright, D.W., Brown, C.J., Bertrand, J.K. and Brow, A.H. Jr. (1992) J. Anim. Sci 70 : 78-88.

Burrow, H. M. (2001). Variances and covariances between productive and adaptive traits and temperament in a composite breed of tropical beef cattle. *Livestock Production Science*, v. 70, n. 3, p. 213-233.

FAO. (2018). ASL2050: Livestock Production System Spotlight Ethiopia Cattle Sector. Rome, Italy: Food and Agriculture Organization of United Nation.

Grain de sel (2010). Demand for Farm Animal Products in Nigeria: An Opportunity for Sahel Countries? www.inter-reseaux.org/IMG/pdf/p14-15_Animal.pdf.

NLTP (2019). National Livestock Transformation Plan (NLTP) 2019-2028. Strategy Document, National Economic Council.

Tewe, O.O. (2010). Sustainability and Development: Paradigms from Nigeria's Livestock Industry. Inaugural lecture series; University of Ibadan Press, Ibadan.

Peters, S.O., Nwosu, I.C., Ozoje, M.O. and Ikeobi, C.O..N (1998). Genetic parameter estimates for growth traits in cattle genotypes. Proc 6th WCGALP 26: 101 – 104

EFFECTS OF AGE ON EGG NUMBER AND WEIGHT IN CHICKENS

***Olanihun A.O[1].,D.J.U Kalla[2]., Igila T.T[2]., Ebule K[2]**

[1]Department of Agricultural Extension and Management Federal College of Forestry Jos
[2]Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria
**Corresponding author:adeolutu@yahoo.com mobile No: 08035317340*

ABSTRACT

The study was conducted at Federal College of Forestry, Jos. The objective of the study was to determine effects of age on egg number and egg weight in chickens. A total of 500 pullets were obtained from a reputable hatchery in Ilorin and received in Jos. They were brooded for six (6) weeks during which all recommended vaccines were and antibiotics were administered, they were further transferred to battery cage at fourteen weeks (14). Records were taken daily for total feed consumed per bird per day by weighing feed left over, mortality, egg lay, weight of egg (egg weight was measured using a digital scale) and clutch length. The experiment lasted for twenty (20) weeks from first day of lay. Birds were fed with predetermined weight of feed once a day. Commercial diet was used as the experimental diet. The result showed that a positive and strong significant ($P < 0.01$) correlation was observed between age of hen and weight of eggs ($r = 0.092$). Weak positive correlation ($P < 0.01$) was observed between age of hen and number of eggs ($r = 0.017$). From the finding of this study, it was concluded that, there was a positive relationship between age of birds and egg number. Positive relationship also exist between age of birds and egg weight. However it should also be noted that the correlation between age and egg weight was stronger than the correlation between age and egg number. Further research was recommended

INTRODUCTION

Poultry production is an important and diverse component of agriculture. Poultry are kept in most areas of the world and provide an acceptable form of protein to most people in the world. Many developed countries have adopted intensive poultry production system in order to meet protein demand for humans. Poultry are able to adapt to most areas of the world at relatively low price, they reproduce rapidly and have a high rate of productivity. Layer chicken hens are efficient egg producers.Breeds used for egg production are mostly based on leghorn and Rhode Island Red but selection and cross breeding have resulted in high productive laying hens (FAO, 1992). In Nigeria, poultry contributes about 15% of the total annual protein intake with approximately 1.3 kg of poultry products consumed per head per annum. In the past decades, there has been a recorded improvement in poultry production in Nigeria with its share of the Gross Domestic Product (GDP) increasing in absolute terms. The contribution of chicken egg and meat to the livestock share of the GDP increased from 26% in 1995 to 27% in 1999 with an increase in egg production alone accounting for about 13% during the period. In spite of the significance of the poultry industry to the national economy, poultry farms face challenges inimical to the growth of the industry. Poultry production in general is faced with low capital base, inefficient management, disease and parasite, housing and marketing problems, etc (Akintunde, *et al.,* 2015). Poultry production has become a fulltime job for many and is considered to be a commercially viable enterprise, contributing significantly to Gross National Product (GNP) (Nwagu *et al*, 2007b). Egg production is believed to have complex qualitative traits which are influenced by several factors such as breed, nutrition, age, weight of bird, management practices and environmental factors. Over the last decades, poultry management techniques in Nigeria have improved significantly, with rapidly increasing production. Under subtropical environments, growth rate as well as egg production are generally depressed by high ambient temperature (Bordas and Merat, 1984; Farooq*et al*, 2001). A significant interaction between environments and lines was found for laying traits, which indicated that the selected line was more sensitive to environmental changes than the control line for production level (Chen *et al.,* 2004). Poultry plays an important role in human nutrition, employment and income generation. Therefore the objective of the study was to determine the effects of Age on Egg number and Egg weight laying birds.

MATERIALS AND METHODS

The study was conducted at Federal College of Forestry, Jos. It is located in the central part of the Nigeria between latitude $8^{o}30^{|}$ and $10^{o}30$N and longitude $8^{o}20$ and $9^{0}30^{|}$E, with a surface area of about 9,400km^2. It has an average elevation of about 1,250 meters above sea level. A total of 500 pullets were obtained from a reputable hatchery in Ilorin and received in Jos. They were brooded for six(6) weeks during which all recommended vaccines were and antibiotics were administered, they were further transferred to battery cage at fourteen weeks (14). Records were taken daily for total feed consumed per bird per day by weighing feed left over, mortality, egg lay, weight of egg (egg weight was measured using a digital scale) and clutch length. The experiment lasted for 20 weeks from first day of lay. Birds were fed with predetermined weight of feed once a day. The experimental diet was of commercial origin.

RESULTS AND DISCUSSION

Table 1: Pearson Correlation Between Age and Weight of Eggs

		Age of birds (in weeks)	**Weight of eggs**
Age of birds (in weeks)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	4834	
Weight of eggs	Pearson Correlation	0.092**	1
	Sig. (2-tailed)	0.001	
	N	3975	3975

** Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation between age and weight of eggs was presented in table 1. A positive and strong significant ($P < 0.01$) correlation was observed between age of hen and weight of eggs ($r = 0.092$). Also, Pearson correlation between age and number of eggs was presented in table 2. A weak positive correlation ($P < 0.01$) was observed between age of hen and number of eggs ($r = 0.017$). The finding of this study were in agreement with that of Anderle *et al*. (2014) and similar to Zanon *et al*. (2006).

Table 2: Pearson Correlation Between Age and Number of Eggs

		Age of birds (In weeks)	Number of eggs
Age of birds (in weeks)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	4834	
Number of eggs	Pearson Correlation	0.017**	1
	Sig. (2-tailed)	0.227	
	N	4831	4831

** Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION AND RECOMMENDATION

From the finding of this study, it was concluded that, there was a positive relationship between age of birds and egg number. Positive relationship also exist between age of birds and egg weight. However it should also be noted that the correlation between age and egg weight was stronger than the correlation between age and egg number. Further research was recommended.

REFERENCES

Akintunde, O. K., A. I. Adeoti, V. O. Okoruwa, B. T. Omonona and A. O. Abu(2015).Effect of Disease Management on Profitability of Chicken Egg Production in Southwest Nigeria.

Anderle, V. Sonnaiya, E.M and Chawla, R. (2014). Egg quality of gene reserve, the Czech golden spotted hens. *Poultry science*. 17: 84-86

Bordas, A. and Mérat P. (1984). Effects of the naked-neck gene on traits associated with egg laying in dwarf stock at two temperatures. *Breeding Poultry Science*. Pp. 12-15.

Chen, S. E., McMurry, J. P. and Walzem, R. L. (2004). Overfeeding-induced ovarian dysfunction in broiler breeder hens is associated with lipotoxicity. *Poultry Science*.**85**: 70-81

Farooq, M., Mian, M. A., Durrani, F. R., and M. Syed (2001). Prevalent diseases and mortality in egg type layers under subtropical environment

Food and Agricultural Organisation (1992). FAOSTAT, FAO Statistics Division 1992 Viale delle Terme di Caracalla, 00153 Rome, Italy.

Nwagu, B.I., Olorunju, S.A.S., Oni, O.O, Eduvie, L.O., Adeyinka, I.A., Sekoni, A.A. and Abeke, F.O. (2007b). Response of egg number to selection in rhode Island chickens selected for part period egg production. *International Journal of Poultry Science* 6(1): 18 -22.

Zanon, A. Toritsina, E. S and Tumova , E .(2006) Physico-chemical characteristics of eggs from two Italian autochthonous chicken breeds: Modenese and Romagnolo. In *XII European PoultryConference : Book of Abstracts, Verona, Italy, 10-14 September 2006.* Beekbergen: World Poutry Science Association, Pp. 203.

SCRUTINIZING COURTSHIP ETHOGRAM OF RED SOKOTO BUCK EXPOSED TO TWO OESTRUS NULLIPAROUS DOES

[*]Gaddafi S., [*]Usman H.U., [*]Aliyu, A.M & [**]Abdulrashid, M.
[*]Department of Animal Science, Federal University Dutsin-ma, Nigeria
[**]Department of Animal Science, Ahmadu Bello University Zaria, Nigeria
corresponding author: sanigaddafi4@gmail.com: GSM: +234(0)7067212353

ABSTRACT
Raising goat requires more than knowledge of feeding, medication, breeding and various other routine management. Having a clearer understanding of buck mating behavior in the flock is necessary to ensure a good breeding program. One apparently healthy mature red Sokoto buck of 4 years old was exposed to two oestrus nulliparous does of 1 year-old to evaluate courtship behavior for 60 minutes in breeding pen. One hour video-tapping was copied into computer system and visualized to record frequencies and durations of reproductive behavioral events. Courtship behavior frequencies and durations were presented in figure 1 and 2 respectively. The result showed that foreleg kicks (12 times repeated) was the highest frequent courtship behavior displayed by the buck followed by snorts, nuzzling, chin resting and vocalization. Buck spent higher time (10.52 mins) without displaying courtship behaviors while nuzzling (6.36mins) and self-enurination (6.26 mins) was the highest courtship duration spent by buck while mounting without ejaculation (2.10 min) was the lowest time spent. The results showed that red Sokoto buck can be used to evaluate courtship ethograms and serve as a tool that will provide holistic ideas of modern reproductive behaviors for better and clear understanding of courtship behavior causes, its mechanism and complex interaction between the animals to both internal and external environments that influence such behaviors.
Key Words: Courtship, Ethogram, Buck, and Nulliparous Does

INTRODUCTION
The sexual behavior of goats is an important factor for flock breeding efficiency and productivity of goat farming. Many researchers have derived different ways and means to evaluate the breeding quality of the buck. The potential fertility of breeding males can be evaluated in the field by assessment of physical examination and genital tract examination, mating ability and semen quality evaluation (Kerketta *et al.*, 2013).

The "Ethology" is the observation and description of behavior that leads to improved understanding of its mechanism, function, development and evolution, while an "Ethogram" is a detailed description of the behavioral features of a particular species and collected behaviors that are distinguished according to their duration in "events" and "states" (McGreevy, 2004). The events are behaviors of instantaneous duration (e.g. vocalizations), which are best described by their frequency, while the states are behaviors of relatively long duration (e.g. feeding), which can be best described by their total or average duration. Therefore, a correct ethogram should include the frequency of events and the duration of states (McDonned, 2003).

OBJECTIVES OF THE STUDY
The objective of this study is to evaluate reproductive behaviors of buck exposed to two oestrus nulliparous does for 1 hour indoor breeding confinement.

MATERIAL AND METHODS
Experimental Site
The experiment was carried out in the small ruminant unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-ma. The site lies between latitude 12°27'18' North and 7°29'29' East and 605 meters above sea level with an average rainfall of 700mm within the Northern guinea Savannah zone (Gaddafi *et al.*, 2019)

Experimental Animal

A total number of three apparently healthy red Sokoto goats comprise of 1 buck and 2 oestrus nulliparous does of about 4 years old buck and 1 year old does respectively, was used in this study. The animals was housed in mating pen of about 7 x 5 mm^2 made up of blocks wells, concretized floor, metallic gate and windows with galvanized roofing sheet. Two oestrus does was identified by their behavioral displayed and introduced to the breeding pen for this trail.

Observations and Recordings

Two cameras were mounted in the well to enable 1 hour (60 minutes) video-taping. The video records was then transferred into computer and visualized for scoring frequency and durations of behavioral events of red Sokoto buck.

Sexual Ethogram for Red Sokoto Buck

Houpt, (2011) state that as the major stimulus for expressing sexual behavior is the presence of the partner, it is therefore very essential to bring a doe in estrus, near the mating pen for a limited time. Since the sampling rule is a behavioral sampling, therefore two estrus does were brought to the breeding pen and occurrence of the following mating behaviors were recorded: vocalization, self-enurination, flehmen, anogenital sniffing, foreleg kicks, tongue flicking, chin resting, snorts, mounting without ejaculation and mounting and ejaculation. The choice for video camera was to enable the animal to exhibit mating behavior naturally without observer distractions.

Table 1: Definition of Buck reproductive behaviors

Behaviors	Definition
Vocalization	Characterized by frequent louder bleating.
Self-enuranation	Downward turning of the head and shoulders towards the hindquarters and the emission of urine from the erect penis onto the face, beard and front legs.
Anogenital sniffs	Buck sniffs and licks the anal, vulva and other external genitelia.
Flehmen	When buck raise his head, curl his lip and wrinkled his nose.
Snorts	When buck forcibly produce exhalation sound/huffing.
Foreleg kicks	When buck kicked a doe`s back and shoulders with foreleg.
Nuzzling	When buck rub his nose to move the doe in cozy position.
Chin resting	Buck rises his forelegs and hanging his chest on the doe`s back.
Mounting without ejaculation	When buck chin resting properly, extrusion of penis without inserting into doe`s vagina.
Mounting with ejaculation	When resting, penis into vagina and ejaculation take place.
Non courtship behaviors	Walking, laying, feeding e.t.c.

RESULT

The courtship behavioral frequencies of red Sokoto buck exposed to two oestrus nulliparous does were presented in figure 1. The results revealed that foreleg kicks highest courtship behavior followed by snorts, nuzzling, chin resting, and vocalizations with a repetition frequencies of 12, 11, 10, 8 and 8 respectively. While anogenital sniffing (5), flehmen (4), mounting without ejaculation (4), self-enurination (3) and mounting with ejaculation (3) was the less frequent displayed behaviors observed during this study. 10 times were the frequency scores of other (non-courtship) behavior which characterized by standing without displaying any courtship behavior, lying down or walking away from the does.

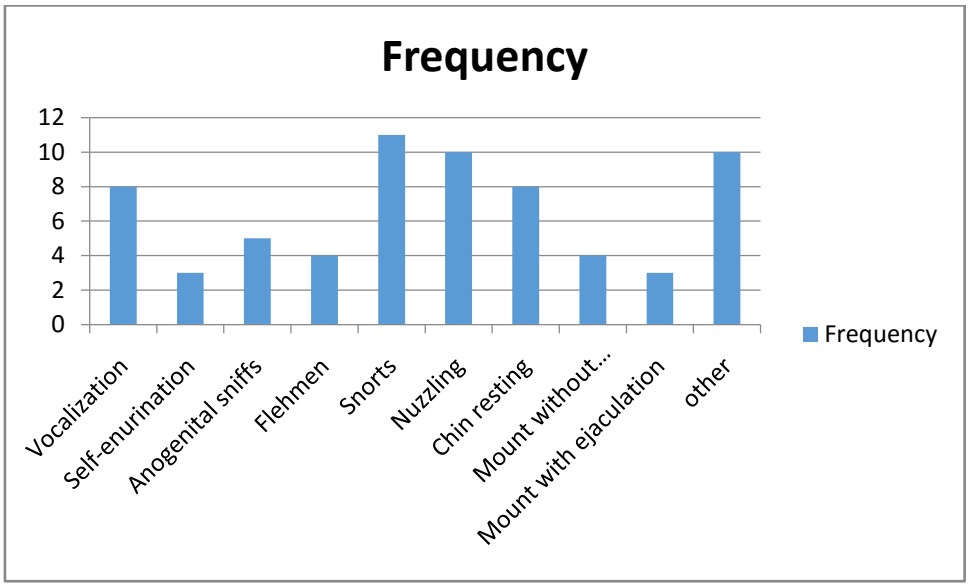


Fig. 1: Courtship Behavioral Frequencies of Red Sokoto Bucks Exposed to Two Oestrus Nulliparous Does

The time spent by buck on courtship behavior exposed to two oestrus nulliparous does were presented in figure 2. Non-courtship (other) behaviors was the highest times (10.52 minutes) by buck while the from the video recording, buck spent 6.36 minutes nuzzling, 6.26 minutes self-enurination, 4.50 minutes foreleg kicks, 4.19 minutes vocalization, 3.56 minutes chin resting, 3.15 minutes mounting with ejaculation, and 3.7 minutes anogenital sniffing. Buck spent less time displaying snorts (2.18 minutes), flehmen (2.17 minutes) and mounting without ejaculation (2.10 minutes).

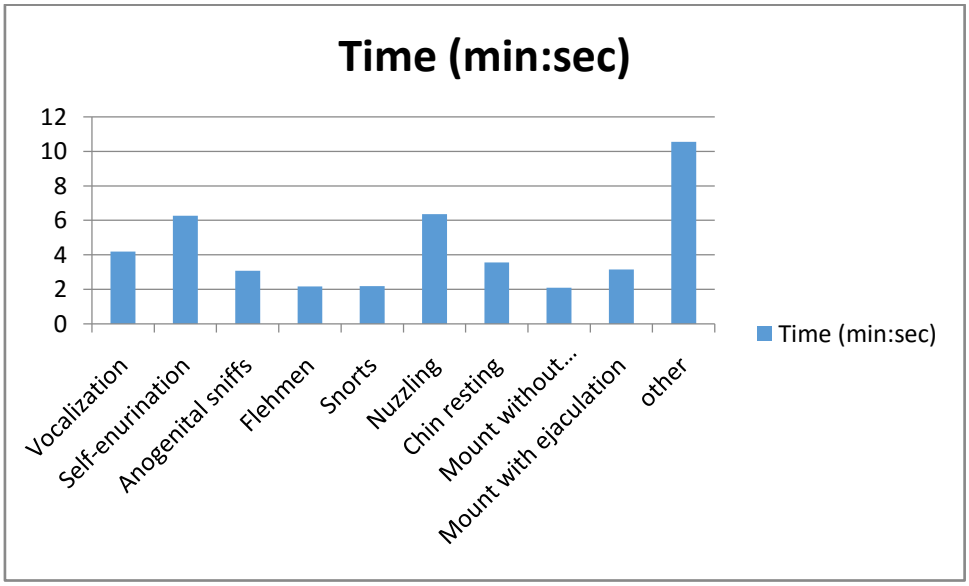


Fig. 2: Duration of Courtship behavior of Red Sokoto Buck Exposed to Two Estrous Nulliparous Does

DISCUSSION

The male domesticated goat (buck; *Capra hircus*) is popularly noted for his high libido and sexual vigor. Before mating, the male goat engages in several distinct behaviors that, as a whole, make up the courtship display (Longpre *et al.*, 2011). These behaviors include latency courting (vocalization, anogenital sniffing, nudging and flehmen) and copulatory (mounting and ejaculation) behaviors (Darwish and Mahboub, 2011). Vocalization, snorts, anogenital sniffing and flehmen are the first pre-

copulatory behaviors recorded in this study, were the buck begin by sniffing the doe`s vulva and urine. He then raises his head, extends his neck and raises his upper lip while moving his head from side to side. This is called the "Flehmen reaction". Snort and vocalization was probably a stimulator that will arouse the attention and likely induce osetrus of female goat. This agrees with the statement made by Vielma *et al.,* (2005) that buck vocalization may stimulate estrus in local anovulatory female goats during the anestrus period. From the research carried out by Delgachillo *et al.,* (2006) were one group of goats was joined with two sexually active bucks (SA groups, n= 6), the second group was exposed to buck vocalization (VOC group, n= 6) reproduced through a microphone-amplifier-loudspeaker system, the third group was isolated from any male stimulus (C group, n= 6). He concluded that those submitted to male vocalization displayed higher estrus than isolated group and similar estrus behavior with those exposed to sexually active male. He further suggests that male goat vocalization may induce estrus activity in anestrus female goats even though they do not seem to influence ovulation itself (Delgachillo *et al.,* 2006).

Flehmen and anogenital sniffing was the less pre-mating activity observed in this study which contradict Mondal *et al.,* (2005) study who reported that flehmen was the longest pre-mating activity in experienced buck. However, the flehmen and anogenital sniffings duration in this study are almost similar those reported by Kerketta *et al.,* (2013) who reported 2.18 minutes flehmen reaction and bucks treated groups with a sniffing time spent ranging from 3.44-3.58 minutes. Self-enuration behavior was observed both at the first introducing does to the breeding pen before and after copulation, this support the suggesting made by Price et al., (1986) that the self-enurination behavior is more likely to occur when the buck can view, but not breed an estrous. This may occur when the buck is separated from a female by a fence, or when the male is in the post-ejaculatory refractory period. It was also found that first contact and distance from the stimulus or the presence of another buck (especially when that buck is tending the female) increase the likelihood of self-enuration.
Buck displayed nuzzling behavior and spent more time to move and arrange the does in a comfortable and cozy position for mounting and these may be attributed to the mating inexperience nature of the does since they are nulliparous does. Similarly chin resting and mounting without ejaculation may be as a result of inexperienced nature of the does or complex interaction of buck`s internal and external environment. Because, Katz, (1987) reported that the sexual behavior of the male goat are dependent upon highly complex interaction between his internal and external environment. The buck`s external environment is comprised of his physical surroundings and social interactions. His physical environment is his surroundings, humidity, temperature, housing, topography e.t.c. His social environment is comprised of sexual, competitive, aggressive and communicative interactions with parents, siblings, other conspecifics, or animals of different species, including humans (Katz, 1987). The buck`s endocrine and nervous systems make up of his internal environment and also play a critical role in the activation of his sexual behaviors. It is, of course, both the buck`s internal and external environments that influence behaviors via highly complex interactions.
The result of this study revealed that high amount of time was spent by buck without displaying any courtship behavior, similar kerketta *et al.,* (2013) reported that the amount of time spent in standing without any activities was highest in a study with local Rottinkh goat bucks on mating behavior, libido score and semen biology.

CONCLUSION

The results showed that red Sokoto buck can be used intensively to evaluate courtship ethograms and serve as a tool that will provide holistic ideas and modern reproductive behaviors for better and clear understanding of the causes, its mechanism and complex interaction between the animals to both internal and external environments that influence such behaviors.

REFERENCE

Darwish, R.A. and Mahboub, H.D.H. 2011. Breed and experience effect on the sexual behaviours of Damascus and Egyptian-Nubian goat bucks. *Theriogenology,* 76:1386-1392.

Delgadillo, J.A., Flores, J.A., Veliz, F., Duarte, G., Vielma, J., Hernandez, H., Fernandez, I. 2006. Importance of the signals provided by the buck for the success of the male effect in goats. *Reproduction Nutrition Development,* 46(4):391-400.

Gaddafi, S., Garba, M.G., Ajibola, O.O., Alkali, M.M. and Dabai, M.I. 2019. A photo-essay of pasture establishment in Livestock tTeaching and Research Farm, Federal University Dutsin-Ma Katsina State. *Proceeding at the 3rd Biennial conference of the society for Grassland and Development in Nigeria, Held at National Animal Production Research Institute, A.B.U-Shika, Zaria. 3rd-6th Nov., 2019,* 44-49.

Houpt, K.A.2011. Domestic animal behavior. Wiley-Blackwell Oxford, Uk, Pp13.

Katz, L.S. 1987. Endocrine system and behavior. Veterinary Clinics of North America. *Food Animal Practice,* 3, 393-404.

Kerketta, S., Singh, M., Patel, B.H.M., Verma, M., Prasad, J.K., Upadhyay, D. and Bhushan, B. 2013. Study on buck`s mating mating behavior, libido score and semen biology in local goat of Rottinkh and Region, India. *Indian Journal of Animal Research,* 48(5):491-495.

Longpre, K.M., Koepfinger, M.E., and Katz, L.S. 2011. Female goats use courtship display as an honest indicator of male quality. *Hormones and Behaviour,* 60, 505-511.

McDonnell, S. 2003. A practical field guide for horse behavior: the equid ethogram. The blood-Horse inc. Lexington, Kentucky, USA. Pp 23.

McGreevy, P. and McLean, A. 2010. Equitation Science: Wiley-Blackwell, Oxford, UK.

Mondal, S.K 2005. Ph.D Thesis, Indian Veterinary Research Institutes, Izatnagar; Bareilly (U.P); India.

Padalino, B., Fatnassi, M., Monalo, D., Hammadi, M., Khorchani, T. and Lacalandra, G.M. 2013. A new ethogram for evaluating housed dromedary camel behavior and libido. In: *Proceeding of the XI congress of Italian Society of Animal Reproduction (SIRA), Ustica, Italy,* 137-142.

Padalino, B., Monaco, D. and Lacalandra, G.M. 2015. Male camel behavior and breeding management strategies: How to handle a camel bull during the breeding season?. *Emirates Journal of Food and Agriculture,* 27(4):338-349.

Price, E.O., Smith, V.M. and Katz, L.S. 1986. Stimulus conditions influencing self-enurination, genital grooming and flehmen in male goats. *Applied Animal Behaviour Science,* 16, 371-381.

Vielma, J., Hernandez, H., Veliz, F.G., Flores, J.A., Duarte, G., Malpaux, B., Dalgadillo, J.A. 2005. Buck vocalizations stimulate estrous behavior in seasonal anovulatory female goats. *Reproduction of Domestic Animal,* 40:360-367

HAEMOGLOBIN AND MORPHOMETRIC POLYMORPHISM OF FOUR STRAINS OF DONKEY (*Equus asinus L.*) IN GAMAWA LOCAL GOVERNMENT AREA, BAUCHI STATE, NIGERIA.

Anene, M.G.; Mancha, Y.P.; Ibrahim, T. & Samaila, L. M.
Correspondence email: monoskilled4life@gmail.com ;Tel:+2348060888773
Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi State.

ABSTRACT
The study was conducted in 2018 (March to July). Blood samples and some morphometric characteristic of donkeys were taken in Gamawa Local Government Area (LGA) of Bauchi State, Nigeria. The aim was to describe the haemoglobin polymorphism and to characterize the genetic pool of four commonly kept strains (*Auraki*, *Duni*, *Fari* and *Idabari*) of donkeys in the study area. Eighty (80) matured donkeys were used for this research, comprising both sexes (39 males and 41 females), with 16 donkeys from each of five agro-ecological zones (Gamawa East and West, Udubo East and West and donkey market) of Gamawa. The red lysates were subjected to cellulose acetate electrophoresis and specific staining procedure to reveal the band patterns of the haemoglobin. The results revealed the presence of three genotypes (AA, AB and BB) with BB found only in *Fari* strain. The frequencies of A and B alleles were 0.925 and 0.075, respectively. The implication is that donkeys with AA genotype are more resistant to infections. Analysis of the morphometric measurements revealed that height at withers and neck circumference were significantly ($P<0.01$) correlated (0.514). Negatively lower correlation (-0.224) was significantly ($P<0.05$) found between lengths of ear and tail. Body length and neck measurements were significantly ($P<0.01$) Correlated (0.324 to 0.497). It could be concluded that, donkeys in Gamawa LGA of Bauchi State with A gene (*Auraki*, *Duni* and *Idabari*) can be selected for resistance and performance. Further study could be undertaken to evaluate the effects of genotypes on the productivity.
Keywords: Donkey, Haemoglobin, Polymorphism and Morphometric

INTRODUCTION
Donkeys are valued for their ability to survive under harsh conditions (Blench, 1990), yet they are often regarded as animals of low social status and neglected by research (Starkey, 1995). Nigeria is estimated to have about 800,000 heads of donkey (Mabayoje and Ademiluyu, 2014). Mainlyconcentrated in the North where they are used as pack animals (RIM, 1992). In south eastern Nigeria, donkeys are used as meat animals and about 16,000 donkeys are transported annually from the northern states for this purpose and these has become a major threat to donkey population (Blench, 2014). However, there are needs to conserve the existing population to avoid exilement. To this, haemoglobin is an important erythrocyte protein inherited by co-dominance in Mendelian fashion and has been reported to be a useful marker through which many economic traits (Akinyemi and Salako, 2010).

The genetically determined system of haemoglobin polymorphous in donkey provides an opportunities for using them as genetic markers that make it possible to conduct studies related to the genetic structure (Slavov *et al.*, 2004). Although these genetic markers and their mode of inheritance were clarified in most animals, information on donkeys are rather limited. This this, the study aimed to determine the haemoglobin and morphometric polymorphism of four Nigeria indigenous strains of donkeys in Gamawa Local Government Area of Bauchi State.

METHODOLOGY
Study Area
This research study was conducted in Gamawa Local government Area of Bauchi State, Nigeria (North Eastern Nigeria) bordering Yobe State to the East and Jigawa State to the west. It lies between latitude 12.13^0N, longitude 10.54^0E of the equator and 397 meters elevation above the sea level (Maps view, 2018). It has an area of 2,925km^2 and has a population of 286,388 as at 2006 census. The annual rainfall ranges between 700mm to 1600mm which start in May and ends in October. The rainy season months are from July to September and the dry season commence fully in November and end in April. The relative humidity ranges between 20- 30 % and the mean monthly temperature ranges between 26^0C to 39^0C (BSADP, 2017).

Research Animals

The animals used for this study were obtained from several small donkey holder flocks especially four strains predominant to the dry climates of the north. A total of eighty (80) animals, twenty (20) per strain – *Auraki*, *Duni*, *Fari* and *Idabari* were used. Sampled animals from these four strain comprised both sexeswithin breeding age group. Donkey management in the study area is dominated by semi extensive production system, in which donkeys are allowed to graze freely during the day time and kept on open enclosure during the night.

Data Collection

Blood collection

5ml of blood was collected from each of the sampled animals by jugular vein puncture using needle and syringe and put into sample bottles containing Ethylene Diamine Tetra Acetic acid (EDTA) as anticoagulant, properly labelled with respect to the different strains and sex and preserved in a cooler containing ice blocks from where they were transported to immaculate medical laboratory in Minna, Niger State for analyses.

Morphometric measurements

Flexible measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by assistants in such a way that their necks, heads and ears were stretched almost in a straight line. Each measurement was taken for at least two times and recorded to the nearest centimetre. Reference marks for body measurement according to the method of Salako (2006a) were adapted.

Head Length (HL), Ear length (EL), Neck length (NL), Neck circumference (NC), Height at Wither (HW), Body length (BL) and Tail length (TL) as defined by Salako (2006a)

Laboratory Analysis of Blood Collected

Blood Preparation

The blood samples were then washed with normal saline and haemolysed with distilled water to release the haemoglobin. The supernatant was removed after centrifuging at 3000 rpm for 5 min and the sample haemoglobin stored at refrigeration temperature pending electrophoresis.

Electrophoresis

The red cell lysate was impregnated on a cellulose acetate paper with a control, placed on the electrophoresis tank using forceps and subjected to electrophoresis according to the standard. The strips were run for 5 minutes at a constant voltage of 250v until a clear separation was observed. Interpretations were made based on the relative mobility of the haemoglobin bands towards the anode. The resulting electrophoregram showed haemoglobin bands distinct movement toward anodic end of the electrophoretogram (Boyers and Hinner, 1963).The genotype migrated was labelled as described by Boyers and Hinner (1963).

Statistical Analysis

Since only two alleles (A and B) were detected; then, haemoglobin genotype and gene frequencies were estimated as follows:

$$\text{Genotype frequency AA} = \frac{\text{No of individuals with AA}}{\text{No of idividuals sampled}} \text{ X } 100$$

$$\text{Genotype frequency AB} = \frac{\text{No of individuals with AB}}{\text{No of idividuals sampled}} \text{ X } 100$$

$$\text{Genotype frequency BB} = \frac{\text{No of individuals with BB}}{\text{No of idividuals sampled}} \text{ X } 100$$

Genotype frequency was estimated with respect to breeds and sex sampled. For the estimation of Gene frequency, the equation was adopted as thus;

P = (2NAA + NAB) / 2N and

Q = (2NBB + NAB) / 2N

Data collected for morphometric traits were subjected to Special Package for Social Science (SPSS 21.0), according to the method of Steel and Torrie (1980). The difference between the means were separated using Duncan Multipe range test (DMRT).

RESULTS AND DISCUSSION

Table 1: Distribution of haemoglobin types on strains and between sex of donkeys in Gamawa

Strain	N	Sex	N	AA	AB	BB
Auraki	20	Male	15	15	0	0
		Female	5	4	1	0
		Total	20	19	1	0
Duni	20	Male	8	7	1	0
		Female	12	10	2	0
		Total	20	17	3	0
Fari	20	Male	6	5	0	1
		Female	14	12	1	1
		Total	20	17	1	2
Idabari	20	Male	10	9	1	0
		Female	10	8	2	0
		Total	20	17	3	0

Table 2: Distribution of genotype frequency on strain and sex of donkey in Gamawa

Strains	**N**	**AA%**	**AB%**	**BB%**	**Total**
Auraki	20	95.00	5.00	0.00	100.00
Duni	20	85.00	15.00	0.00	100.00
Fari	20	85.00	5.00	10.00	100.00
Idabari	20	85.00	15.00	0.00	100.00
Polled (All)	80	87.50	10.00	2.50	100.00
Sex					
Male	39	92.31	5.13	2.56	100.00
Female	41	82.93	14.63	2.44	100.00

Table 3: Gene frequency according to strain and sex of donkey in Gamawa.

Strains	N	A	B	Total
Auraki	20	0.975	0.025	1
Duni	20	0.925	0.075	1
Fari	20	0.875	0.125	1
Idabari	20	0.925	0.075	1
Polled (All)	80	0.925	0.075	1
Sex				
Male	39	0.949	0.051	1
Female	41	0.902	0.098	1

Table 4: Effect of strains on morphometric parameters of donkey in Gamawa.

	Strains					
Trait (cm)	**Auraki**	**Duni**	**Fari**	**Idabari**	**SEM**	**P- value**
HL	46.57^{b}	45.54^{c}	48.41^{a}	47.19^{b}	0.16	0.00
EL	25.36	26.15	25.10	25.01	0.28	0.49
NL	46.90^{a}	44.61^{b}	46.49^{a}	46.38^{a}	0.22	0.03
NC	64.40	63.39	62.92	62.74	0.36	0.16
HW	105.32	104.93	104.42	104.92	0.17	0.31
HG	109.93^{c}	114.03^{a}	111.42^{bc}	112.47^{ab}	0.41	0.003
BL	107.39^{ab}	108.27^{a}	106.74^{b}	106.01^{b}	0.25	0.04
TL	57.77	55.46	57.58	57.34	0.45	0.43

HL = Head Length EL = Ear Length, NL = Neck Length, NC= Neck Circumference,
HW =Height at Wither, BL = Body Length, HG = Heart Girth and TL = Tail Length
SEM: Standard error of means
abc: means with different superscript in row are significantly different (P<0.01; 0.05)
P-value: Probability level of significant.

Distribution of haemoglobin types on strains and between sex of donkey found in Gamawa Area of Bauchi State are shown in Table 1. Three haemoglobin genotypes were detected; two homozygotes (AA and BB) and one heterozygous (AB) which corresponds to the general observation of A and B alleles with their corresponding genotypes AA, AB and BB in different species (Tunon *et al*., 1989). Out of 20 from each strains, *Auraki* sampled had 19 AA Hb (15 males and 4 females), 1 AB Hb (1 female) and no BB Hb type was present. *Duni* had 17 AA Hb (7 males and 10 females), 3 AB Hb (1 male and 2 females) and no BB Hb type. *Fari* strain had 17 AA Hb (5 males and 12 females), 1 AB Hb (I female) and 2 BB Hb (1 male and I female) and *Idabari* strain had 17 AA Hb (9 males and 8 females), 3 AB Hb (2 males and 3 females) and no BB Hb type was present.

The presence of homozygote Hb BB genotypes of donkey disagreed with Salvaggi *et al.* (2015) who observed one haemoglobin types in Martina Franca donkeys and concluded that, it might not be readily apparent or is not widely distributed. Pearson and Ouassat (1996) believed that, the specific conditions of the African continent enabled donkeys to develop a typical habit thereby causing a change in its genotypes to enable them play key roles in order to survive in dry locations. Therefore, the predominant of Hb AA over Hb AB and Hb BB types among the four strains of donkey could be attributed to donkey adaptive feature for survival and genetic resistance to diseases as reported by (Wold *et al*., 2004). Donkeys appear to be less susceptible to a number of pathological conditions and diseases affecting horses and cattle. Similar report was documented by (Meutchieye *et al*., 2014).

Auraki strain had the highest genotypes frequency for AA with 95 %. *Duni*, *Fari* and *Idabari* had the same genotype frequencies of 85 % for AA. AB genotypes for the four strains showed that, *Duni* and *Idabari* had the highest genotypic frequency of 15 %, followed by *Auraki* and *Fari* with 5 %. BB genotypic frequency was not visible in *Auraki*, *Duni*, and *Idabari* but visible only on *Fari* strain with genotypic frequency of 10 %. The genotypic frequencies polled (all together) of the four strains of donkey were 87.5, 10 and 2.5 % for AA, AB and BB genotypes, respectively.

The gene frequencies A and B alleles among the four strains of donkey showed that, *Auraki* had the highest frequency (0.975) while Fari had the lowest (0.875) frequency of the A Allele. However, *Fari* had the highest gene frequency (0.125) while *Auraki* has the lowest (0.025) gene frequency of the B Allele. More so, they all obeyed Hardy Weinberg's equilibrium (P + Q = 1). Gene frequency of A allele on sex were higher on males (0.949) compared to females (0.902). More so, the B allele were higher in females frequencies (0.098) compared to males (0.051). There is not enough reason however, to conclude that sex has an effect on the disparity in B types.

Differences in the on strains among the qualitative traits of donkeys such as HL, NL, HG and BL could be attributed to genetic variations among the donkey strains. The study agreed with Ellis *et al*. (1994) who reported that, other body dimensions of the Zimbabwean donkeys as well as live weight indicated no major difference between male and female donkeys of similar maturity. However, there were no significant differences between EL, NC, SW, HW and TL in adult donkeys; this implied that, those donkeys were somewhat similar to Nigeria donkeys.

CONCLUSIONS

Gamawa donkeys haemoglobin polymorphism is defined by expression of three genotypes: two homozygotes (Hb AA and Hb BB) and one heterozygote (Hb AB). The phenotypization of the haemoglobin variants is determined by two co-dominant alleles, Hb A and Hb B. The allele Hb A registers a higher frequency than Hb B allele. Consequently, in the haemoglobin tables, the homozygotes Hb AA reaches a high incidence, the heterozygotes Hb AB have a middling frequency and the homozygotes Hb BB were less present. Finally, it could be suggested that the Hb AA type evident in the *Auraki* donkeys having the highest altitude, Gamawa local Government Area of Bauchi State, donkeys were favoured by natural selection, possibly for resistance against certain parasitic (internal and external) and some Haemo-parasitic infections.

The adult body size measurements of donkeys in Gamawa, Bauchi state Nigeria were head length (46.92cm), ear length (25.40cm), neck length (44.09cm), neck circumference (63,36cm), height at withers (104.89cm), heart girth (111.90cm), body length (107.21cm), and tail length (57.04cm).

There were some variations in the morphometric traits of the donkeys due to strain effects of which *Duni* donkey strain having the highest body length and heart girth compared with other strains.

The results of the study is however, subjected to some limitations being that the sample size for the analysis was rather too small and this is due to financial, constraints of the farmer not allow one to get access to the animals due to traditional believes, time as well as animal resources encountered during the course of this study.

RECOMMENDATIONS

The Hb type AA was predominant on the four breeds of donkey which then mean adaption in favour for hot tropical weather and tolerance to ticks and helminthic infections; in other words, hot tropical regions, farmers are therefore encouraged to take advantage of donkey production, since they highly resistance to various diseases compared to cattle and horse. More so, head length, neck length, heart girth and body length could be used in classifying donkeys into strains. Further studies could be carried out to evaluate the effect of genotype on their productivity.

REFERENCES

Akinyemi, M. O. and Salako, A. E. (2010). Haemoglobin polymorphism and morphometric correlates in the West African Dwarf sheep of Nigeria. *International Journal of Morphology,***28**(1): 205-208.

Blench, R. M. (1990). **DonkeysinNigeria**: History, Distribution and Productivity.

Blench, R.M. (2014). A history of donkeys, wild asses, and mules in Africa. In Blench and MacDonald (Eds.) The Origins and Development of African Livestock.

Boyer, S.H. and Hiner, R. (1963). Modified apparatus for starch gel electrophoresis. *Journal of Laboratory Clinical Medicine.***61**:879-81.

BSADP (2017). Bauchi state Agriculture development program metrological record for the year 2017

RIM. (1992). Nigerian national livestock Resource Survey. Report by Resource Inventory and Management Limited (RIM) to Federal Department of livestock pest control services (FDL and PCS). Abuja, Nigeria.

Ellis-Jones J, Muvirimi F, Nengomasha E. M., and Msara P, (1994). Improving the productivity of draft animals in sub-saharan Africa: A rapid rural appraisal of Semukwe., Chikwanda and Sebungwe communal farming areas (with emphasis on the use of draft animals). Project Working Document. OD/94/20.39P.

Steel, R.D.G. and Torrie, J.H. (1980). Principles and procedures of statistics, 2nd edition, McGraw-hill book co Inc, New York.

Mabayoje, A. L., Ademiluyi, Y. S. (2014). A note on animal power and donkey utilization in Nigeria. Animal Traction Network for Eastern and Southern Africa (ATNESA) p. 2.

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Meutchieye, F., Nfor, N. K., Armelle, R. and Nyock, F. (2014). Donkey Husbandry and Production Systems :https://www.researchgate.net/publication/271212674

Pearson, R. A. and Ouassat, M. (1996). Estimation of weight and a body condition scoring system for working donkeys in Morocco. *Veterinary Record*, **138**: 229-233.

Salako, A. E (2006a). Application of morphological indices in the Assessment of Type and Function in Sheep. *International morphology*, **24**: 13-18.

Selvaggi, M., Alessandro**,** A.G. and Dario**,** C. (2015). Comparative characteristics of DNA polymorphisms of κ-casein gene in the horse and donkey. *GeneticMolecular Resource*, **14**(4): 14567-14575.

Slavov, R., Slavova, P. and Laleva S. (2004). Genetic structure of Ile de France sheep breed in Bulgaria according to the transferrin and haemoglobin polymorphous genetic system. *Trakia Journal of Sciences*, **2**: 38–40.

Starkey, P. (1995). Local transport solutions: people, paradoxes and progress-Lessons arising from the spread of intermediate means of transport. Report for Sub-Saharan Africa Transport Policy Program (SSATP) and Rural Travel and Transport Program (RTTP). The World Bank. 71p.

Tunon, M.J., Gonzales, P., VallejO, M. (1989). Blood biochemical polymorphism in Spanish goat breeds. *Comp. Biochemistry and Physiology*, **2**: 513-517.

Wold, A.G., Tegegne, A. and Yami, A. (2004). Research needs of donkey utilisation in Ethiopia in Fielding & Starkey eds Donkeys, people and development: A resource book for the Animal Traction Network for Eastern and Southern Africa. *CTA, Wageningen, Netherlands*, Pp: 77-81.

PIGEON (COLUMBIA LIVIA VAR DOMESTICA) BIODIVERSITY WITHIN BAUCHI METROPOLIS

Kalla, D. J. U., Lohfa, M. M. Sale ,B., Gure, M.M. Idi,Y.

Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
Corresponding author's email: djukalla@atbu.edu.ng; 08028785578

ABSTRACT

A study was therefore carried out to assess the range of variation, within the various pigeon population in Bauchi metropolis, to ascertain the number of strains available. The data utilized from this study where generated from 58 household in Bauchi metropolises, Nigeria, between July 2016 and April 2017. Data on local names of the various strains and morphological parameters were collected. The morphological parameters measured included; Live weight (LW), breast Girth (BG), Body length (BL), shank length (SL), wing Span (WS) and Tail length (TL). Live weight was measured using an electronic weighing scale while the other body measurements were done with a measuring tape. All data collected on body measurements subjected to analysis of variance using the general linear model of IBM SPSS version 20.0 and where means differed Duncan Multiple Range Test was used to separate them. The study identified 22 unique strains of pigeons within Bauchi metropolis. Overall mean live weight of all pigeon strains was found to be 553.48g. The heaviest was the Mondain with an average LW of 1002.2g and while the Na gida strain had the least LW of 267.17g. Breast girth was also highest for the Mondain while the shantu fara had the smallest. However, the Romanian deck nail and the poulter ($p<0.05$) had the longest body. The males were heavier and had broader breast girth and longer body length than the females. Shank length was similar for all the strains. It was concluded that there is potential for future selection and breeding for intensive squab production.

INTRODUCTION

Pigeon farming is gaining popularity in the developing countries due to its ability to serve as a cheaper source of animal protein, thereby improving nutritional stability in the society. It also has the potential to enhance economic empowerment. Pigeon, apart from being extensively used for scientific research notably in genetics, parasitology, physiology and psychology, its meat has a gamy bird taste (Fajemilehin, 2017).

Apart from body weight, a number of conformity traits are known to be good indicators of body growth and market value of poultry (Ukwu *et al.,* 2014). Poultry breeders have tried to establish the relationship that exists between body weight and body linear measurements such as shank length, thigh length, keel length, body length, chest circumference and wing length. The relationships between these traits provide useful information on the performance and carcass value of the animals. The relationship between body weight and body linear measurements is important for selection in breeding programs for genetic improvement of the breed (Dzungwe *et al.,* 2018).

Over the years little attempt has been made to capture the variability in pigeons population within Bauchi metropolis. This has retarded breeding efforts as information on their potentials is lacking. This study was therefore carried out to assess the range of variation, within the various pigeon population in Bauchi metropolis, to ascertain the number of strains available.

MATERIALS AND METHODS

Bauchi State is located between latitudes 9° 3′ and 12° 3′ north and between longitudes 8°50' and 11° East of the equator with a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass. Rainy season starts between April and May and last up till October, while dry season commences in November and ends in March. The mean annual rainfall ranges from 800 to 1094mm, while the mean daily maximum temperature is about 33.5^0c. (IAR/BSADP, 1996)

The data utilized from this study where generated from 58 household in Bauchi metropolises, Nigeria, between July 2016 and April 2017. Matured pigeons were used for the study. The matured pigeons of breeding age where housed by the farmers in wooden or metallic cages or empty carton attached

externally to walls (open house type) with compartment of about 35 by 35cm usually in monogamous pairs. Supplementary feed where provided consisted of mixture of grains varying from millet, sorghum, and crushed maize to kitchen scraps once or twice a day, in some cases were highly priced birds are kept, they are fed chick mash.

Data on local names of the various strains and morphological parameters were collected. The morphological parameters measured included; Live weight (LW), breast Girth (BG), Body length (BL), shank length (SL), wing Span (WS) and Tail length (TL). Live weight was measured using an electronic weighing scale while the other body measurements were done with a measuring tape.

All data collected on body measurements subjected to analysis of variance using the general linear model of IBM SPSS version 20.0 and where means differed Duncan Multiple Range Test was used to separate them.

RESULTS AND DISCUSSION

Plates 1 to 22 shows the different strains of pigeons found within Bauchi Metropolis indicating a wide variation in the strains available. The study identified 22 unique strains of pigeons within Bauchi metropolis. Apart from the Na gida strain which is used for meat all the other strains were basically kept as ornamental birds. Table 1 show a summary of body measurements of the different strains. Overall mean live weight of all pigeon strains was found to be 553.48g which was higher than the average body weight of 283.32±1.43 g reported by Fajemilehin, (2017) but similar to the 340 - 680 g repored by NRC (1991). The heaviest was the Mondain with an average LW of 1002.2g and while the Na gida strain had the least LW of 267.17g. Breast girth was also highest for the Mondain while the shantu fara had the smallest. However, the Romanian deck nail and the poulter ($p<0.05$) had the longest body. A clear sexual dimorphism was noted; the males were heavier and had broader breast girth and longer body length than the females. The body length depicts bone growth while chest girth describes the muscularity of the birds (Fajemilehin, 2017). Shank length was similar for all the strains. The Romanian deck nail also had the widest ($p<0.05$) wing span. The Russia and England fan tail had the longest ($p<0.05$) tail length.

Table 1: Comparison of body measurements of pigeon strains in Bauchi metropolis.

STRAIN	LW(g)	BG (cm)	BL(cm)	SL(cm)	WS(cm)	TL(cm)
Tukunya	769.16±16.62^{b}	37.33±1.66^{b}	40.08±1.62^{b}	3.00±0.00	72.87±1.38^{efg}	11.50±0.52^{i}
Snake fantail	274.50±4.90^{o}	27.66±0.77^{hi}	30.33±0.49^{j}	3.00±0.00	75.75±0.75	14.41±0.51^{d}
Bullet	629.16±31.26^{e}	29.50±0.79^{f}	19.75±0.86^{n}	3.00±0.00	73.58±1.72^{e}	11.91±0.28^{h}
India	613.33±18.10^{f}	34.08±2.60^{c}	20.00±0.00^{n}	3.00±0.00	50.83±2.16^{n}	11.33±0.49^{j}
Eagle	588.41±10.00^{g}	30.08±0.79^{de}	28.58±1.24^{l}	3.00±0.00	64.08±1.62^{k}	11.00±0.00^{j}
Created	473.41±12.28^{l}	27.16±0.84^{i}	32.91±0.67^{h}	3.00±0.00	72.41±1.08^{fg}	10.00±0.00^{k}
Lahore	570.22±8.01^{h}	31.03±1.04^{d}	29.48±0.52^{k}	3.00±0.00	65.47±0.52^{j}	10.57±0.49^{k}
Umbrella	325.91±6.08^{n}	28.50±0.52^{g}	31.50±0.52^{i}	3.00±0.00	62.58±0.67^{l}	14.00±0.00^{e}
Na gida	267.16±9.83^{n}	25.66±1.30^{j}	26.75±1.37^{m}	2.90±0.00	53.83±1.94^{n}	6.750±0.86^{l}
Arch Angel	525.08±7.64^{j}	28.17±0.94^{gh}	34.05±1.03^{g}	3.00±0.00	69.14±0.95^{i}	13.96±0.00^{e}
Poulter	586.25±15.31^{g}	29.50±0.52^{ef}	41.00±1.04^{a}	4.00±0.00	75.00±1.04^{d}	15.83±0.39^{b}
Shantu para	451.41±6.99^{m}	25.33±0.42^{j}	35.08±0.99^{f}	4.00±0.00	69.41±0.67^{i}	13.71±0.60^{e}
Carporcheng	526.91±7.07^{j}	27.50±0.52^{hi}	33.33±1.04^{h}	3.00±0.00	42.16±0.39^{gh}	12.00±0.00^{g}
Frill back	540.08±3.71^{i}	28.47±0.52^{g}	38.88±0.00^{c}	3.00±0.00	72.47±0.42^{fgh}	13.96±0.00^{c}
German owl	491.23±9.48^{k}	27.47±0.52^{hi}	30.49±0.51^{j}	3.00±0.00	62.05±0.88^{l}	11.95±0.00^{g}
Romanian deck nail	670.97±8.95^{d}	30.46±0.51^{d}	41.09±1.03^{a}	3.00±0.00	80.82±0.20^{a}	14.94±0.00^{c}
Mondain	1000.28±15.85^{a}	38.07±1.03^{a}	35.05±1.03^{f}	4.00±0.00	77.84±0.60^{b}	13.96±0.00^{e}
Fantail India	701.71±14.14^{c}	28.04±0.33^{gh}	35.92±0.00^{e}	3.00±0.00	72.91±0.50^{ef}	15.98±0.00^{b}
Fantail Russian	495.64±7.83^{k}	27.46±0.51^{hi}	39.43±0.52^{b}	3.00±0.00	73.24±0.84^{e}	16.94±0.00^{a}
Fantail England	521.97±6.55^{j}	27.46±0.51^{hi}	38.09±1.03^{d}	3.00±0.00	71.24±0.83^{h}	16.94±0.00^{a}
Crested bullet cross	625.28±10.61^{e}	33.47±0.54^{c}	38.45±0.54^{c}	3.00±0.00	75.84±0.48^{c}	12.96±0.00^{g}
Jacobin	527.78±8.02^{j}	27.48±0.53^{hi}	33.04±1.06^{h}	3.00±0.00	72.17±0.48^{fg}	11.97±0.00^{g}
Overall mean	553.44± 0.55	29.53±0.06	33.32±0.04	3.17±0.00	69.34±0.06	13.03±0.02
Male	563.01±0.76	30.13±0.07	34.02±0.04	3.16±0.00	70.10±0.07	13.19±0.03
Female	543.85±0.84	28.92±0.08	32.60±0.05	3.16±0.00	68.56±0.08	12.86±0.03

CONCLUSION

Twenty two distinct strains of pigeons were identified within Bauchi Metropolis, with this wide variation in biodiversity, there is potential for future selection and breeding for intensive squab production. Sexual dimorphism was also noted in the pigeon population with the males being heavier than the females. Further studies on molecular characterization and reproductive potentials of the pigeon population can be done.

REFERENCES

Dzungwe, J. T., Gwaza, D. S. and Egahi, J. O. (2018). Statistical Modeling of Body Weight and Body Linear Measurements of the French Broiler Guinea Fowl in the Humid Tropics of Nigeria. Poultry, Fisheries and Wildlife Sciences, 6: 197. doi: 10.4172/2375-446X.1000197

Fajemilehin, S. O. K. (2017). Phenotypic Characteristics of Pigeons (Columbia livia var domestica) found in Rain Forest Zone of Nigeria. World Journal of Research and Review (WJRR) 4 (5): 30-35.

IAR/BSADP (1996). Diagnostic survey on Agriculture in Bauchi State, Executive Summary, BSADP (Bauchi State Agricultural Development Program), Bauchi, 180p.

NRC (1991). National Research Council. Micro livestock: Little known Small Animals with Promising Economic Future. National Academy Press, Washington DC.440

Ukwu, H. O., Okoro, V.M. O., Nosine, R. J. (2014). Statistical Modeling of Body Weight and Linear Body Measurements in Nigerian Indigenous Chicken. Journal of Agriculture and Veterinary Science, 7: 27-31.

MICROBIOLOGICAL EVALUATION OF FIVE COMMERCIAL BROILER SUPER STARTER FEEDS IN JOS NORTH LGA OF PLATEAU STATE

[1]Idachaba, C.U., [1]Agada, A. I., [2]Wetkum, F. and [3]Abdullahi, I.

[1]Department of Animal Production, University of Jos, Plateau State, Nigeria
[2]Department of Microbiology, University of Jos, Plateau State, Nigeria
[3] National Animal Production Research Institute, Shika Zaria, Kaduna State, Nigeria
Corresponding author: C.U. Idachaba, Email: udagbenei@unijos.edu.ng

ABSTRACT:
Animal feeds are potential reservoirs for cross contamination of microorganisms. This can lead to health concerns in animals as well as humans that consume the products. This study was conducted to analyze the microbial load in five selected broiler super starter feeds within Jos North LGA of Plateau State. Results obtained showed microbial contamination of all feed samples. Total plate count ranged from 0.88 to 1.28×10^5 CFU/g, coliform count ranged from 1.40 to 3.20×10^4 CFU/g, and fungal count 0.08 to 2.90×10^5 CFU/g. Bacteria species isolated from the feed samples were *Streptococcus feacalis, Proteus spp., Staphylococcus aureus, Pseudomonas aeruginosa* and *Salmonella paratyphi.* The presence of these pathogenic microorganisms in poultry feeds is indicative of the level of contamination. The study concluded that periodic examination of poultry feeds for biosafety can reduce or prevent cross contamination of poultry products.

Keywords: Microorganisms; poultry; feed; contamination; broiler

INTRODUCTION

Feed represents a major aspect of poultry production required for maintenance and productivity (Isiaku, 2015). Poultry feeds are contaminated during processing, handling, mixing and exposure to microorganisms. Onyeze *et al.* (2013) asserted that most poultry diseases occur as a result of consumption of contaminated feeds. Diseases such as dysentery, fowl cholera, *samonellosis*, *staphylococcosis*, *aflatoxicosis* amongst others are associated with ingestion of contaminated feeds (Aliyu *et al.*, 2016).

Irrespective of the adequacy of nutrients in formulated rations, microbial contamination can result in competition for ingested nutrients in the GIT, leading to poor performance (Idachaba, 2017). According to Aliyu *et al.* (2016), microorganisms also degrade nutritional value of feeds resulting in the production of toxins. The nature and presence of microorganisms in animal feeds should be a major concern to animal nutritionists and poultry farmers because they cause economic losses and affect animal health. Hence, this study focus on microbiological evaluation of selected commercial broiler super starter feeds in Jos North LGA of Plateau state.

MATERIALS AND METHODS

Area of Study

The study was carried out in Jos North LGA of Plateau State. It is located in Northern Guinea Savannah between longitude 8° 20'N and latitude 9° 30'E. The average temperature ranges between 21-25°C. The climate of Jos is cool due to its high altitude with average annual rainfall of 1,250 mm (Federal College of Forestry, 2017)

Sample collection

Five brands of broiler super starter feeds were purchased from retailers in Jos North LGA of Plateau State. Each feed sample was aseptically collected in triplicate in sterile plastic bags and labelled A, B, C, D and E.

Sample analysis
The feed samples were taken for analysis at the Microbiology Laboratory, Department of Microbiology, Faculty of Natural Science, University of Jos. They were cultured and isolated for bacteria species and fungal counts according to procedures described by Ochei and kolhatkar (2007).

Data analysis
Data obtained from microbial colony count was subjected to statistical analysis using the General Linear Model (GLM) procedure of SAS (2001) software for analysis of variance. Duncan multiple range test (Duncan, 1955) was used to determine differences between means.

RESULTS AND DISCUSSIONS

Microbial colony count in five (5) commercial broiler super starter feeds
Table 1 shows the microbial colony count in five (5) commercial broiler super starter feeds. All feed samples were contaminated by bacteria and fungi. Feed A showed significantly (P<0.05) lower total plate count compared to others while the highest was observed in feed sample B. Feed C showed significantly (P<0.05) lower coliform count compared to others while feed B showed the highest. Okgun *et al*. (2016) reported that broiler starter and chick mash feeds are easily contaminated by microorganisms. This according to the authors is due to their high protein contents which serve as growth factors for contaminating organisms. Uwaezuoke and Ogbulie reported that bacteria and fungi contamination of poultry feeds can result from exposure to microorganisms on field, in feed mills, during storage or poor sanitary practices in pens.

Table 1: Microbial colony count in five commercial broiler super starter feeds

Microbial count (CFU/g)	FEEDS					
	A	B	C	D	E	SEM
Total plate count (10^5)	0.88^a	1.28^d	1.11^c	1.05^b	1.12^c	0.01
Coliform count (10^4)	2.60^d	3.20^e	1.40^a	1.60^b	1.90^c	0.06
Fungal count (10^5)	0.08^a	1.21^c	2.90^d	1.00^b	1.16^c	0.03

abc = means with different superscript on the same row differs significantly, SEM- standard error of means, and CFU- coliform forming unit.

Culture media and biochemical tests for isolated bacteria species in five broiler super starter feeds
Table 2 shows the culture media and biochemical tests for isolated bacteria species in five broiler super starter feeds. Bacteria isolates of *Proteus sp.* was found in all feed samples and *Pseudomonas sp.* in feed samples A, B and D. This agree with reports of Anon (2001) and Veldman *et al*. (1995) who stated that enterobacteriaceae are common contaminants of poultry feeds. All feed samples were contaminated by *Staphylococcus aureus* while feed samples A, B and E were contaminated by *Salmonella sp.* Idachaba (2017) reported that *Staphylococcus aureus* and *Salmonella sp.* can cause acute or chronic infections in poultry and other animals. The author further stressed that microorganisms from poultry feeds can attach to intestinal epithelium, thus competing with host animals for ingested nutrients.

Table 2: Culture media and biochemical tests for isolated bacteria species in poultry feed samples.

							Triple sugar ion agar slant				
Feeds	Catalase	Coagulase	Urease	Indole	Oxidase	Motility	Slope	Butt	H_2S	Gas	Bacteria species
A	+	+	+	-	+	+	Red	Yellow	+	+	*Staphylococcus aureus, Proteus spp., Pseudomonas aeruginosa, Salmonela typhi.*
B	+	-	+	-	-	+	Red	Yellow	+	+	*Streptococcus feacalis, Proteus spp., Staphylococcus aureus, Pseudomonas aeruginosa, Salmonela paratyphi A.*
C	+	+	+	-	-	+	Red	Yellow	-	+	*Staphylococcus aureus, Proteus spp.*
D	+	+	+	-	+	+	Red	Yellow	-	-	*Staphylococcus aureus, Proteus spp., Pseudomonas aeruginosa.*
E	+	+	+	-	-	+	Red	Yellow	+	+	*Staphylococcus aureus, Proteus spp., Salmonela typhi.*

CONCLUSION

The study showed that all feed samples were contaminated by microorganisms (bacteria and fungi). This may be due to poor handling and storage practices of the feeds from field to the retail shops. Ingestion of such contaminated feeds can affect productive performance in chickens with residual effects affecting humans where meat is improperly cooked. The study concludes that there is a need to establish better quality control strategies for proper handling of feeds at retail shops and on-farm. Periodic examination of feeds for biosafety can reduce or prevent cross contamination of poultry products.

REFERENCES

Aliyu, R.M., Abubakar, M.B., Yakubu, Y., Kasarawa, A.B., Lawal N., Bello, M.B., and Fardami, A.Y. (2016). Prevalence of potential toxigenic *Aspergillus* species isolated from poultry feeds in Sokoto metropolis. *Journal of Veterinary Sciences* 14(1):39-44.

Anon (2001): *Salmonella*: Coordinating Chemical and Thermal Control. Feed International December, Pp.27-30.

Duncan, D. B. (1955). Multiple range and multiple T-test biometrics. SAS User's Guide. Version SAS Institue. Inc. Cary, NC.

FCF (2017). Federal College of Forestry, Meteorological station weather report, Jos, Plateau State.

Idachaba, C. U. (2017). Effect of Different Organic Acids with and without Phytase Supplementation on Performance and Phytate Utilization by Broiler Chickens. Ph.D Thesis, Department of Animal Science, Ahmadu Bello University, Zaria. Pp. 72-73

Isiaku, S. (2015) Analysis of production efficiency of poultry feed industries in Nigeria. M.Sc. Thesis, Ahmadu Bello University Zaria, Kaduna State, Nigeria. Pp. 43-44.

Ochei, J., and Kolhatkar, A. (2007). Medical laboratory science theory and practice. Department of microbiology, college of medicine, Sultan Qaboos University Muscat. Tata McGraw-hill publishing company limited New Delhi. 10-12.

Okogun ,G.R.A., Jemikalajah, D.J., Ebhohimen, E.V., Uwaezuoke, U. and Ogbulie, E.V. (2016).
Bacteriological evaluation of poultry feeds in Ekpoma, Nigeria. *African Journal of Cellular Pathology*, 6:6-9.

Onyeze, R.C., Onah, G.T., and Eluke, O.C. (2013). Bacterial contaminants associated with commercial poultry feeds in Enugu Nigeria. *International Journal of Life Science Biotechnology and pharma research*. 2(3): 433-437.

SAS (2001). SAS User's Guide. Version 6.11, SAS Institute, Inc. Cary, NC.

Veldman, A., Vahl, H. A., Borggreve, G. J. and Fuller, D.C. (1995). A survey of the incidence of
Salmonella species and *Enterrobacteriaceae* in poultry feeds and feed components. *Veterinary Records*, 136: 169-172.

DOSE RESPONSE AND AMELIORATIVE EFFECTS OF RESVERATROL ON TRYPANOSOMOSIS-INDUCED REPRODUCTIVE TOXICITY IN DIMINAZENE ACETURATE TREATED *TRYPANOSOMA BRUCEI* INFECTED MALE DOGS

[1]Rita I. Odo, [1]Isaac U. Asuzu, [2]Chuka Ezema
[1]Department of Veterinary Physiology and Pharmacology, University of Nigeria, Nsukka
[2]Department of Animal Health and Production, University of Nigeria, Nsukka

ABSTRACT
The study was done to assess the dose response and ameliorative effects of resveratrol on trypanosomosis induced testicular changes in diminazene aceturate (DA) treated *Trypanosoma brucei* infected male dogs. Thirty male dogs were used for the study and were assigned into six groups (n=5). Group A was infected with *T. brucei*, not treated with (DA) and not supplemented with resveratrol. Group B was presupplemented with resveratrol (50 mg/kg) for 7 days, Infected with *T. brucei* and treated with DA (7 mg/kg). Group C was presupplemented with resveratrol (100 mg/kg) for 7 days, infected with *T. brucei* and treated with DA (7 mg/kg). Group D was presupplemented with resveratrol (200 mg/kg) for 7 days, infected with *T. brucei* and treated with DA (7 mg/kg). Groups B, C and D were postsupplemented with 50, 100 and 200 mg/kg of resveratrol for 14 days respectively. Group E was infected with *T. brucei* and treated with DA (7 mg/kg). Group F was the control
There were significant decreases ($p<0.05$) in the parasitaemia level and rectal temperature of dogs in group C when compared to other supplemented groups. There were significant increases ($p<0.05$) testosterone level, testicular weight and epididymal sperm reserve of dogs in group C when compared to other supplemented groups, DA alone and the infected untreated group.
In conclusion, this study indicated that resveratrol at the dose of 100 mg/kg may constitute a promising compound for the amelioration of male reproductive toxicity in DA treated *Trypanosoma* infected male dogs.
Keywords: Trypanosomosis, reproduction, diminazene aceturate, resveratrol

INTRODUCTION
Trypanosomosis is a protozoan disease caused by pathogenic blood parasites known as trypanosomes of the genus *Trypanosoma*. It is transmitted by tsetse flies of the genus *Glossina*. The disease is unique to Africa, affecting both human (human African trypanosomosis or sleeping sickness) and animals (animal African trypanosomosis or Nagana) (Radostits *et al*., 2007). The main species of importance in livestock are *T.vivax, T. Congolense* and to a lesser extent *T. brucei* causing Animal African Trypanosomosis (AAT) (Steverding, 2008).

Its common clinical manifestations are weight loss, anaemia, anorexia, lethargy, weakness and dullness. It has been reported that trypanosomosis causes severe reproductive disorders characterized by decrease in testosterone level and testicular degeneration in males (Sekoni *et al*., 2004; Raheem *et al*., 2009). Oxidative stress induced by trypanosome is the major cause of testicular damage in trypanosomosis, due to the overproduction of reactive oxygen species (Adamu *et al*., 2006; Steverding, 2008).
Resveratrol is a natural polyphenol found in nuts, grapes and red wine (Siemann and Creasy, 1992). It is known for its anti-inflammatory, antioxidant, analgesic, cardioprotective, anti-aging and neuroprotective roles (Giovannimi *et al*., 2001; Sinha *et al*., 2002; Bradamante *et al*., 2004). Valenzano *et al*., 2006 reported that resveratrol is able to decrease germ cell apoptosis in mice and rats.

MATERIALS AND METHODS
Trans-resveratrol of analytical grade was obtained from Candlewood Stars Incorporated, Danbury, USA and carboxymethylcellulose was obtained from the Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Nigeria, Nsukka. Trans-resveratrol, due to its low solubility in water, was suspended in 10 g/L carboxymethylcellulose.

Trypanosome brucei was isolated from a dog with natural infection presented to Veterinary Teaching Hospital, University of Nigeria, Nsukka and experimental animals were infected intraperitoneally at a dose of 1.5×10^6 trypanosomes per milliliter of saline diluted infected blood.

Experimental design

Thirty male dogs were used for the study and were assigned into six groups (n=5). Group A was infected with *T. brucei*, not treated with (DA) and not supplemented with resveratrol. Group B was presupplemented with resveratrol (50 mg/kg) for 7 days, Infected with *T. brucei* and treated with DA (7 mg/kg). Group C was presupplemented with resveratrol (100 mg/kg) for 7 days, infected with *T. brucei* and treated with DA (7 mg/kg). Group D was presupplemented with resveratrol (200 mg/kg) for 7 days, infected with *T. brucei* and treated with DA (7 mg/kg). Groups B, C and D were postsupplemented with 50, 100 and 200 mg/kg of resveratrol for 14 days respectively. Group E was infected with *T. brucei* and treated with DA (7 mg/kg). Group F was the control

Determination of parameters

Parasitaemia was monitored using the wet mount method daily after infection, daily after establishment, daily after treatment for clearance and weekly post clearance up to 10 weeks for relapse. The numbers of infective trypanosomes were determined using the rapid matching method of Herbert and Lumsden (1976). Rectal temperature was determined using a digital clinical thermometer. Enzyme Linked Immunosorbent Assay Test Kit (Monobind Inc., Lake Forest, CA 92630, USA) was used for the determination of serum testosterone levels according to the method of (Dorfman and Shipley, 1956). The dogs were orchiectomized and lignocaine was the local anaesthetic used (2 mg/kg). The testicles from each dog were carefully dissected out, trimmed free of extraneous tissues and weighed with a weighing balance. Epididymal sperm reserve was determined using the haemocytometer method described by Amann, 1986.

RESULTS AND DISCUSSION

The significant decrease ($p < 0.05$) in the parasitaemia level of dogs supplemented with 100 mg/kg of resveratrol when compared to those supplemented with 50 mg/kg, 200 mg/kg and the infected unsupplemented groups suggests that resveratrol at the dose of 100 mg/kg has optimum protective effect against early establishment of trypanosomosis

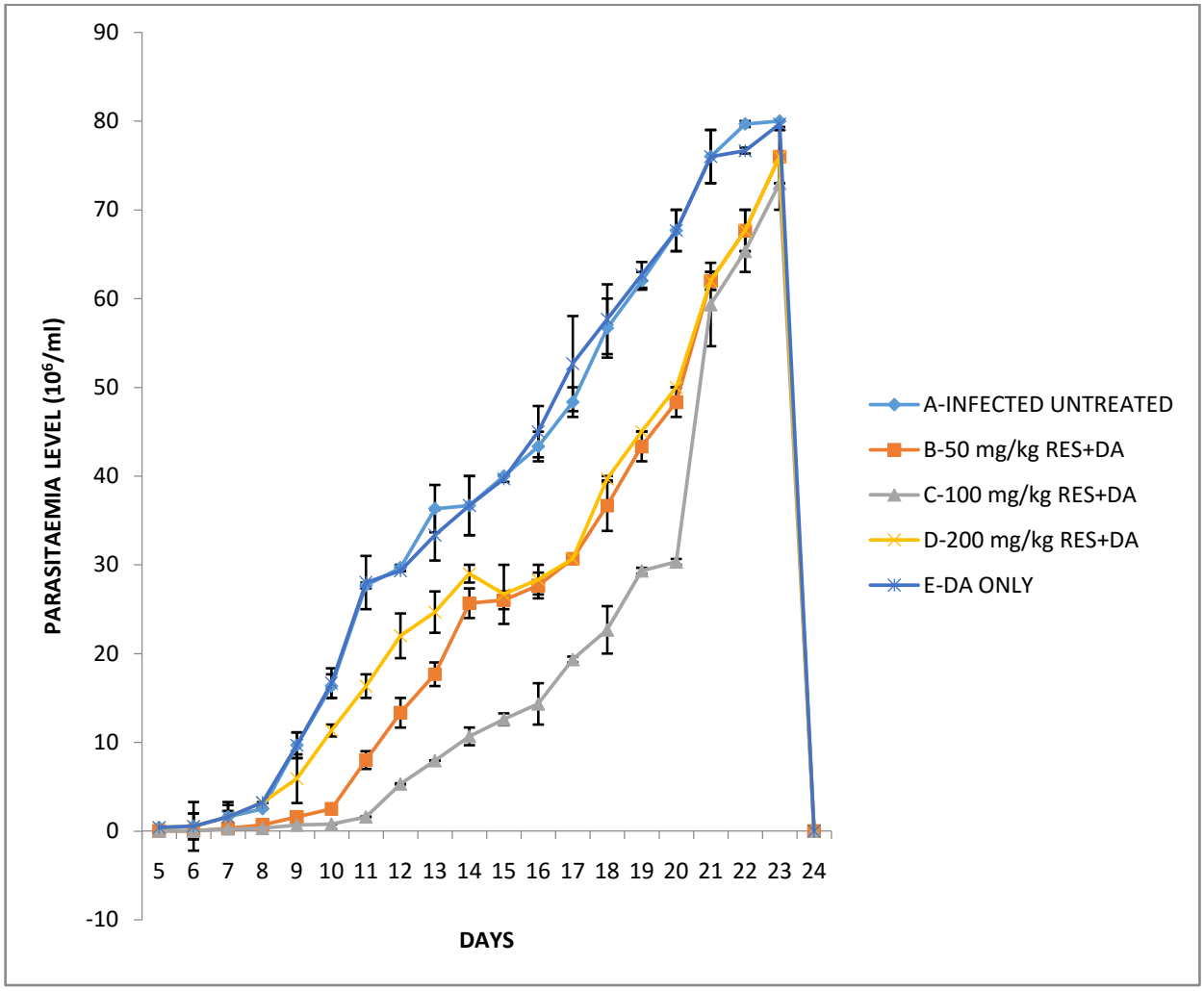


Figure 1: Effects of graded doses of resveratrol on parasitaemia levels of *T. brucei* infected male dogs
Key: RES – resveratrol, DA – diminazene aceturate

The significant increase ($p < 0.05$) in testosterone levels of dogs supplemented with 100 mg/kg of resveratrol when compared to those supplemented with 50 mg/kg, 200 mg/kg and the infected unsupplemented groups (Figure 2) may be that 100 mg/kg of resveratrol had a stimulatory effect on the secretion of gonadotrophins, the major endocrine regulators of spermatogenesis. The concentrations of FSH, which acts within the tubules to stimulate spermatogenesis, and LH, which signals the production of testosterone in Leydig cells have been reported to be enhanced by resveratrol (Juan *et al*., 2005)

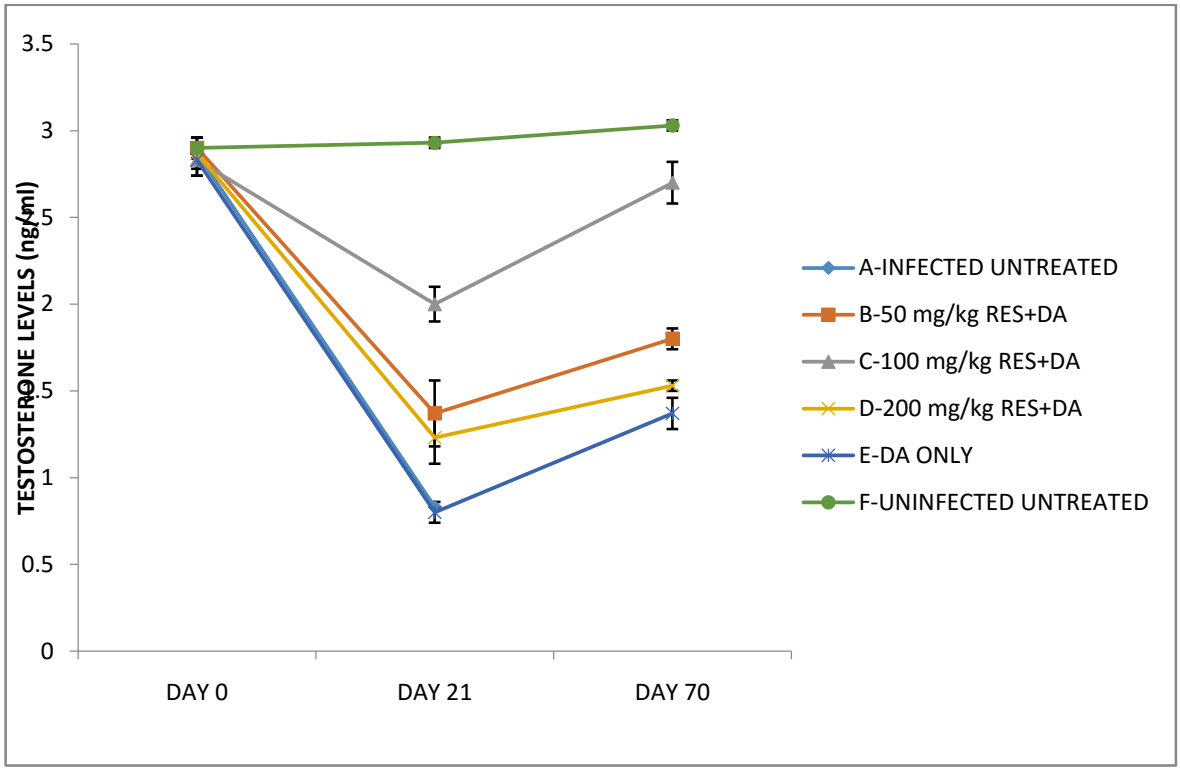


Figure 2: Effects of graded doses of resveratrol on testosterone levels of *T. brucei* infected male dogs
Key: RES – resveratrol, DA – diminazene aceturate

The significant increases ($p < 0.05$) in testicular weight and epididymal sperm reserve of dogs supplemented with 100 mg/kg of resveratrol and treated with DA when compared to those supplemented with 50 mg/kg and treated with DA, 200 mg/kg and treated with DA, treated with DA alone and the infected untreated (Table 1) may be due to significant increase in the testosterone level of 100 mg/kg supplemented group. It may also be due to antioxidant activity of resveratrol (Giovannimi *et al.*, 2001). Oxidative stress induced by trypanosome is the major cause of testicular damage in trypanosomosis, due to the overproduction of reactive oxygen species (Adamu *et al.*, 2006; Steverding, 2008; Losos and Ikede, 2012).

Resveratrol at the dose of 200 mg/kg produced negative effects in all the parameters determined which may be as a result of overdose. Resveratrol is an antioxidant and antioxidants at high concentrations have the opposite effect and act as pro-oxidants (Ramadori *et al.*, 2009; Minikawa *et al.*, 2011).
In conclusion, the findings from this study indicated that resveratrol, a phytochemical at the dose of 100 mg/kg may constitute a promising new compound for the amelioration of male reproductive toxicity in diminazene aceturate treated *Trypanosoma* infected dogs.

Table 1: Effects of resveratrol and DA on testicular weight and epididymal sperm reserve of *T.brucei* infected male dogs

Parameters	**Groups**					
	A-Infected untreated	B-50 mg/kg RESV+DA	C-100 mg/kg RESV+DA	D-200 mg/kg RESV+DA	E-DA only	F-Uninfected untreated
Testicular weight (g)	2.87 ± 0.06^{a}	3.26 ± 0.06^{b}	4.16 ± 0.13^{c}	3.06 ± 0.04^{b}	3.14 ± 0.12^{b}	3.34 ± 0.06^{c}
Epididymal sperm reserve (10^6/ml)	44.61 ± 3.17^{a}	122.59 ± 2.79^{b}	216.97 ± 8.91^{c}	100.61 ± 5.77^{d}	97.89 ± 4.05^{d}	221.93 ± 7.18^{c}

a, b, c, d - Different supercripts indicating difference between the mean ($p < 0.05$)

RECOMMENDATIONS

The findings from this study, encourages the use of moderate quantity of natural food stuff rich in resveratrol in preparing dog food.

REFERENCES

Adamu, S., Fatihu, M. Y., Useh, N. M., Ibrahim, N. D., Maman, S. M, Sekoni, V. O, Esievo, K. A. (2006). Testicular pathological changes in relation to serum concentration of testosterone in Trypanosoma vivax-infected Fulani bulls. *J Ani and Vet Advance*; 5 (12):1165-1171.

Amann RP (1986). Detection of alteration in testicular and epididymal function in laboratory animals. *Perspect Environ Heal*; 70:119–158.

Bradamante, S., Barenghi, L. and Villa, A. (2004). Cardiovascular protective effects of resveratrol. *Cardio Drug Review*; 22: 169–188.

Dorfman RI and Shipley R A (1956). The Androgens. New York: John Wiley and Sons Inc. p. 527.

Giovannini, L., Migliori, M., Longoni, B.M., Das, D.K., Bertelli, A. A., Panichi, V., Filippi, C., Bertelli, A. (2001). Resveratrol, a polyphenol found in wine, reduces ischaemia-reperfusion injury in rat kidneys. *J Cardio Pharmacol*; 37 (3): 262-70.

Herbert, W. J. and Lumbsden, W. H. (1976). *Trypanosoma brucei*: a rapid matching method for estimating the host's parasitaemia. *Exper Parasitol*; 40: 427-431.

Juan, M.E., González-Pons, E., Munuera, T., Ballester, J., Rodríguez-Gil, J.E. and Planas ,J.M. (2005). Trans-resveratrol, a natural antioxidant from grapes, increases sperm output in healthy rats. *J Nutrition;* 135: 757-760.

Losos, G. J., and Ikede, B. O. (2012). Review of pathology of diseases in domestic and laboratory animals caused by Trypanosoma congolense, T. vivax, T. brucei, T. rhodesiense and T. gambiense. *Veter Pathol*; 9(1): 1-79.

Minakawa, M., Kawano, A., Miura, Y. and Yagasaki, K. (2011). Hypoglycaemic effect of resveratrol in type 2 diabetic model db/db mice and its actions in cultured L6 myotubes and RIN-5F pancreatic β-cells. J *Clinical Biochem and Nutrition*; (3): 237–244.

Radostits O. M., Gag, C. C., Hinch-Cliff, K. W. and Constable, P. I. (2007) Veterinary Medicine. A text-book of the diseases of cattle, horses, sheep, pigs, and goats. *Philadelphia*; p 1531-1537

Raheem, K. A., Fayemi, E. O., Leigh, O. O. and Ameen, S.A. (2009). Selected fertility parameters of West African dwarf buck experimentally infected with Trypanosoma congolense. *Folia*; 12 :5-16.

Ramadori, G., Gautron, L., Fujikawa, T., Vianna, C.R., Elmquist, J.K. and Coppari, R. (2009). Central administration of resveratrol improves diet-induced diabetes. *Endocrinol*; 150(12): 5326–5333.

Sekoni, V. O., Rekwot, P. I., Bawa, E. K. (2004). Effect of Trypanosomiasis on the sperm morphology in Zebu Friesian cross breed bull. Trop *Animal Health and Prod*; 36 (1):55-64.

Siemann, E. H. and Creasy, L. L. (1992). Concentration of the phytoalexin resveratrol in wine. *Amer J Enol and Viticul*; 43: 49–52.

Sinha, K, Chaudhary, G. and Gupta, Y. K. (2002). Protective effect of resveratrol against oxidative stress in middle cerebral artery occlusion model of stroke in rats. Life Science; 71: 655–665.

Steverding, D., (2008). A new initiative for the development of new diagnostic tests for human African trypanosomosis. *Kinetopl Biol*; 5:1.

Valenzano, D. R., Terzibasi, E., Genade, T., Cattaneo, A., Domenici, L., and Cellerino, A. (2006). Resveratrol prolongs lifespan and retards the onset of age-related markers ina short-lived vertebrate. *Current Biol*; 16: 296–300.

AN ASSESMENT OF HIGH SLAUGHTER OF SMALL RUMINANT AT EARLY SET OF RAINING SEASON IN KIBIYA LOCAL GOVERNMENT AREA, KANO STATE

[*]Abdullahi, A.Y.[±], [*]Zango, M.H., [*]Madaki S., [*]Nasir M., [#]Dambatta, M.A., [∞]Bala, A.G., [€]Ghude, M.I., [+]Abubakar A., *Abubakar S.M., [*]Murtala S.K.

[*]Department of Animal Science, Faculty of Agriculture and Agricultural Technology, Kano University of Science and Technology Wudil, PMB 3244, Kano 20027, Nigeria
[#]Department of Forestry, Fishery and Wildlife, Faculty of Agriculture and Agricultural Technology, Kano University of Science and Technology Wudil, PMB 3244, Kano 20027, Nigeria
[∞] Department of Animal Science, Faculty of Agriculture, Bayero University Kano, Nigeria
[+]Kano State Agricultural and Rural Development Authority (KNARDA)
[€]Veterinary Section, Agric. Department, Nasarawa LGA. Kano, Nigeria
[±]Corresponding author. Tel: +234 8085999191; Email address: ayabdullahi@kustwudil.edu.ng

ABSTRACT

This study was conducted in Kibiya Local Government Area to assess the incidence of high slaughter of small ruminant on moribund stage especially during the early set of rainfall. Data were gathered from 100 livestock's farmers, 54 Butchers and 45 veterinary personnel through the use of structured questionnaires and visual inspection record. Majority of livestock respondents were males (92%) and married (52%) with age range of 40-60 years (67%). About 48% of the respondents were keeping animals 0-5 years, with 50% mixed flock of sheep and goats; 35% goats only and 15% sheep only. The breeds kept were Red Sokoto goats (49%) and Yankasa sheep (50%). Extensive system of management was more popular and practiced (51%). The slaughter of small ruminant on moribundity/already slaughtered was more frequent (66%) and increased during raining season (June). the number of goats slaughtered (499) were twice the number of sheep (250) slaughtered, thus indicated that goats were more frequently slaughtered during the season. Among the reasons for slaughtered were either for lack of feedstuff, urgent need or selling at will. While others were slaughtered as a result of diseases and health related issues. Mostly postmortem was not done on slaughtered animals, thus is a potential health risk to meat consumers in the area of study. Therefore, farmers are advised to preserve crop residues that can be fed at late dry season; regular postmortem and meat inspection should be performed. It is recommended that appropriate extension services, government, livestock scientists and veterinary workers be put in place the awareness of economic benefits of small ruminant production and meat hygiene for safety of consumers.

Key words: Small ruminants; Moribundity; Postmortem; Slaughter; Rainy season

INTRODUCTION

Small ruminants, sheep and goat production is an important economic activity in Africa and are among major source of animal protein in Nigeria. It was reported that Nigeria has a livestock population of 24 million goats and 13.6 million sheep (Lawal-Adebowale, 2012). They are distributed all over Nigeria, for their ability to adopt to varieties of environmental conditions. Their rearing is an important occupation for the rural people especially less privileged communities and it is profitable venture for the resources, provided and are able to sustain them on spare vegetation unsuitable for feeding to other livestock (Ajala *et al.,* 1995). The production is characterized by extensive system of management and low productivity (Otchere *et.al.,* 1986). Therefore, improve in small ruminant is likely to improve the well-being of small holder farmers. The socio economic important of small ruminants in rural communities of Nigeria among others includes usage as a sources of ready cash and meat for house hold consumption, means of exchange for ready labour and usage during ceremonies festivities, religious rites have long been recognized. It is observed that there is annual occurrence of high slaughter of small ruminant on moribund stage at early set of raining season in Kibiya Local Government, which is a potential health risk to meat consumers the area. Therefore, this study was aimed to assess and identify root of the problem and offer possible solutions as it's continued will have direct effect on meat consumers and will cause huge economic losses in small ruminant production.

Materials and method

Study area

The research was conducted at Kibiya local government area of Kano state. It is located at the south-east part of the state, about 60km away from Kano metropolitan and it has a total area of 404km². Coordinate $11^0$32N $8^0$40E/ 11.533^{0}N 8.667^{0}E. The climate is classified as dry and wet, the rainy days last from mid-June to early October approximately (120-150 days) (Olofin *et al*., 2008). The local government has ten wards. According to 2006 census population is 136,736. The people of the area are predominantly Hausa/Fulani by tribe and are farmers that keep a good number of Small ruminants and poultry in addition to arable cropping. The soil of the area is predominantly rich sandy-loam with few types of clay soil around river bank suitable for the cultivation of wide range of crops, some of the food crops cultivated are G/corn, millets; maize, rice and sorghum are local consumption while groundnuts, tomatoes are produced for export and industrial purposes. Animals that are rearing are sheep, goats, cattle Etc.

Data collection

Data was collected by using: questionnaire and visual inspection records.

A total of three hundred well structural questionnaires were designed as sample materials. And one hundred (100) from each were designed and distributed to livestock's farmers, Butchers, and Veterinarians. The procedure of collecting the data remain the same throughout the study. Regular visit was made in the morning to slaughter locations: (from 8:00am – 11:00am) over a period of 3-months. At slaughter locations small ruminants were brought and number of animals slaughtered by butchers was recorded. Attention was paid to animals on moribund condition.

Data analysis

The data generated from questionnaire and the visual inspection records from slaughter units were Microsoft excel 2007 and SPSS version 16 for simple descriptive statistics and graph.

RESULTS AND DISCUSSION

The information of livestock farmers on Socio-economic characteristics, Types of animals kept and farming experience, reasons and condition of animals during slaughter at Kibiya local area is presented in Table 1. This study has shown that majority of the respondents (92%) were male indicating that males are more actively involved in livestock farming especially small ruminant production. The highest percentage in age of respondents range between 40 – 60 years (67%) indicating most of the farmers were middle age class; and 52% were married.

Table 1. Respond of livestock farmers on Socio-economic characteristics, Types of animals kept and farming experience, reasons and condition of animals during slaughter at Kibiya Local Area

Categories	Variable	Frequency	Percentage (%)
Sex	Male	92	92
	Female	8	8
Age (years)	19 – 39	21	21
	40 – 60	67	67
	Above 60	12	12
Marital status	Single	43	43
	Married	52	52
	Divorced	5	5
Type of farming	L. Stock rearing	50	50
	Butchers	10	10
	C. farming	36	36
	Veterinary	4	4
Year (s)of experience	0-5	48	48
	6-10	33	33
	Above 10	19	19
Types of small ruminants kept	Goat only	35	35
	Sheep only	15	15
	Both sheep and Goats	50	50
Breeds of goats	Red Sokoto	49	49
	Sahel goat	20	20
	Kano brown	31	31
	WAD	0	0
Breeds of sheep	Yankasa	50	50
	Balami	22	22
	Uda	28	28
	WAD	0	0
Management system	Intensive	23	23
	Semi-intensive	26	26
	Extensive	51	51
Reason for slaughter	Feeding problem	36	36
	Health problem	22	22
	urgent need	22	22
	Selling at will	20	20
Condition during slaughter	Physically fit	34	35
	Moribund condition	36	35
	Already slaughter	30	30

Source: Field survey June 2017 – August 2017

Around 48% of the respondents had experienced on livestock rearing (0-5 years), with 50% mixed flock of sheep and goats; 35% goats only and 15% sheep only. The breeds kept were Red Sokoto goats (49%) and Yankasa sheep (50%). Extensive system of managements was more popular and practiced (51%). The slaughter of small ruminant on moribundity/already slaughtered was more frequent (65%). The reasons for slaughtered of the animals includes lack of feedstuff, urgent need or selling at will. While others were slaughtered as a result of diseases and health related issues. It was observed that postmortem was not done on slaughtered animals, which is a potential health threat to meat consumers. Abdullahi et al (2019) reported menaces in management practices, processing and transportation of meat in the semi-arid of kano metropolis abattoirs. Kebede (2010) emphasized that meat hygiene services are functions in such a way as to satisfy consumers and at the same time safeguard public health and animal hygiene.

The result of the study revealed a total number of 1524 of small ruminants were slaughter from month of June to August, where are 525 sheep and 999 were goats, respectively. Out of the total small ruminant slaughtered 549 were on moribundity; 457 were slaughtered before arrival to slaughter slab; while remaining 518 were physically fit before slaughter. Muhammad et al (2007) reported that more prominent slaughtered of pregnant animal was occurred in early wet season (May – July).

Visual inspection record

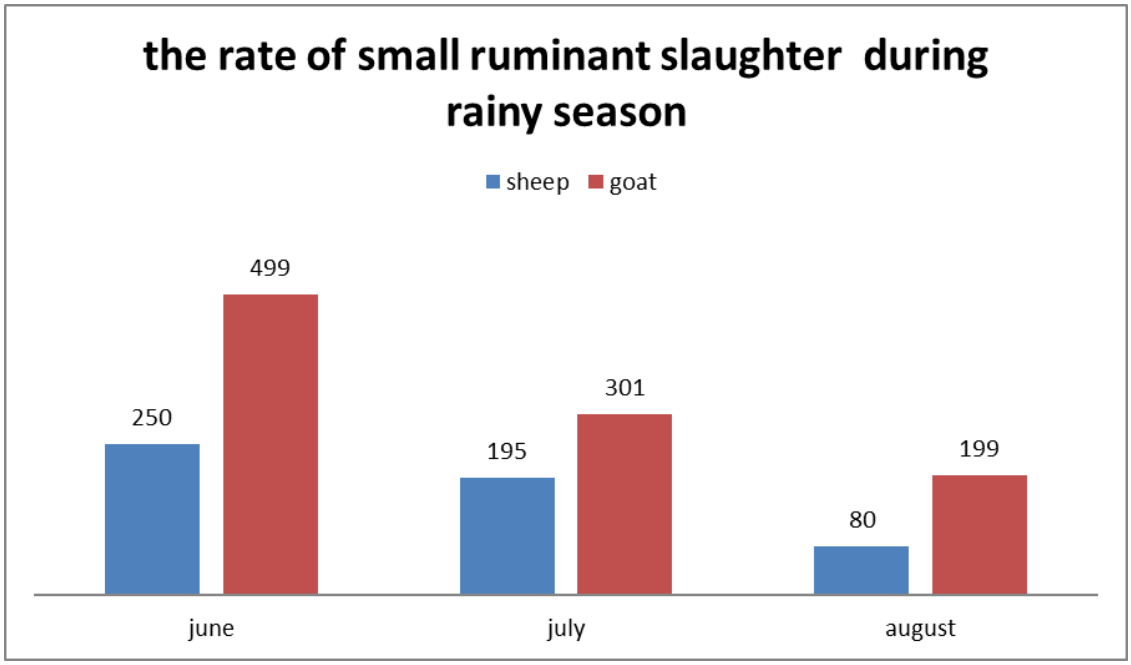


Figure 1 Number of small ruminants slaughtered in three months at Kibiya LGA of Kano State.

The chart above (figure 1) showed that at the month of June (month that rain started in Kibiya) there was high slaughter of small ruminant in the area especially goats (499), sheep (250). While in July goats (301), sheep (195) and in August goats (199), sheep (80) respectively. Kumar and Prasad (1986) and Somvashi et al (1992) reported that during the rainy season the majority of 6–12-month-old kids became dull, off-feed, weak, emaciated and anemic.

Conclusion And Recommendations

Most of the livestock's producer in the study area keeps their flock in free range system which graze on newly germinated grasses that caused diarrhea and other digestive disorder at early set of rainy seasons. It is concluded that livestock farmers in the area of study are keeping small ruminants which are facing problem of high slaughter of their stocks during raining season as a result of problem of feeding and disease as well as urgent need and selling at will of their owners.

RECOMMENDATIONS

To improve sheep and goat production in the area of study, effective extension education to farmers on animal health and production is greatly needed.

i. Livestock farmers should preserve their harvested crop residues to be used during scarcity.
ii. Livestock farmers are advised to keep their animals in intensive or semi-intensive system.
iii. Government should provide veterinary centers, livestock incentives and credit facilities.
iv. Postmortem and meat inspection should be carried out regularly for meat consumer health safety.

References

Ajala, A. A. (1995). Women's task in the management of goats in Southern Nigeria. Small Ruminant Research 15:203-208.

Abdullahi, A.Y. Zango, M.H. Madaki S. Dambatta, M.A. Muhammad, H. A. Suleiman, I. O. Bala, A.G. Ghude, M.I. Abubakar A. Muhammad, S.A. Abubakar, S.M. Murtala, S.K. (2019) Menaces in management practices, processing and transportation of meat in the semi-arid of kano metropolis abattoirs. Proc. 44th Annual Conference of the Nigerian Society for Animal Production, March 17th -21st 2019, UNIABUJA, ABUJA. Pp 769 - 773

Kebede, N. (2010) A retrospective survey of bovine hydatidosis in three abattoirs of Amhara National Regional State, North-western Ethiopia. Tropical Animal Health and Production, 42:323–325

Kumar, R. and Prasad, M.C. (1986) Mortality pattern and its causes in goats. Indian Vet. J. 63, 711 -- 714

Lawal-Adebowale, O.A. (2012) Dynamics of Ruminant Livestock Management in the context of the Nigerian Agricultural system.Tem. Pp 62-63. Federal University of Agriculture, Abeokuta, Ogun state Nigeria.

Muhammad, I.R. Ashiru, R. Abdullahi, A.Y. (2007) Implications of the slaughter of pregnant ewes and does to future stock in the semi-arid urban abattoir. Journal of Animal and Veterinary Advances. 6 (6): 819 - 822

Olofin, E.A. Nabegu, A.B and Danbazau, A.M (2008). Wudil within Kano zone Geographical synthesis, 1st edition, Adamujoji publisher. Department of Geography Kano University of Science and Technology, Wudil.

Otchere, E. O. (1986). Small ruminant production in tropic Africa. FAO Animal production and Health, paper 58. Sofia. Bulgari, A food and Agriculture Organization.

Somvanshi, R. Biswas, J.C. Sharma, B. and Koul, G.L. (1992) Are rainy season environmental stresses responsible for higher mortality in pashmina goats? Environmentalist 12 (1), 59 – 67, 1992.

MORINGA: A POTENTIAL SUBSTITUTE TO ANTIBIOTICS AND DIETARY SUPPLEMENT IN BROILER PRODUCTION- A REVIEW

Akinlade O. O*, Obi G. C. & Lawanson A. A.
The Federal Polytechnic, Ilaro, Department of Agricultural Technology P. M. B, 50, Ilaro, Ogun State, Nigeria.

** Corresponding author: Olamilekan.akinlade@federalpolyilaro.edu.ng;*

ABSTRACT
Moringa oleifera, a small size tree, which can grow to a height of 5 to 10 m. It survives in different climate of the world. It can grow under harsh climatic conditions without being much affected by drought. It tolerates different ranges of rainfall estimated at minimum 250 mm and maximum at over 3000 mm. It thrives on soil pH of 5.0 to 9.0. The trunk is soft with white corky and its branches has a gummy bark. It possesses tripinnate compound leaf with several small leaf legs. The flowers are white in colour and the three wings seeds are scattered by the winds. It is cultivated for its multiple utilities. Every part of Moringa is used for certain nutritional and/or medicinal propose. It is a good source of protein, vitamins, oils, fatty acids, micro and macro minerals elements as well as various phenolics, it was also reported to have anti-inflammatory, antimicrobial, antioxidant, and antihelmintic usefulness. Research on this precious herb may lead to the development of novel agents for various diseases to substitute the current antibiotics which are fast becoming ineffective. This review provides a brief overview about medicinal and Nutritional potentials of *Moringa oleifera* and its use as a component of modern medicine and broilers feed.
Key word: *Moringa oleifera,* anti-microbial, anti-oxidant, feed additive, broiler

INTRODUCTION
The presence of residues of antibiotics in poultry meat and meat products beyond maximum permissible limits is a matter of serious concern (Muaz *et al*., 2018). The use of antibiotics for animal products is also a global concern to world health organization (WHO, 2014) because there is increased emergence of antibiotic resistant pathogens due to sub-therapeutic use of antibiotic as growth promoters, which poses a serious hazard to human health (Torun *et al*., 2018). According to Brock Biology of Micro-organisms (2014), Antibiotic resistance (AR) is defined as the ability of an organism to resist the bacteriostatic or bactericidal effects of an antibiotic to which it was normally susceptible.

Justification
The need for the knowledge of a potential alternative to antibiotics in broiler production is consequential because its meat is usually ready for consumption at an average of 6 weeks. The avoidance of improper use of antibiotics and the prevention of its residual effect in meat is therefore the essence of this review.

Properties of Moringa Plant
Moringa oleifera is a well-known cultivated species in the genus Moringa, (family Moringaceae) under the order Brassicales. It is also known as drumstick tree, horseradish tree, and ben oil tree or benzoil tree or miracle tree (Arora *et al*, 2013). It can grow under harsh climatic conditions without being much affected by drought (Morton, 1991). It tolerates different ranges of rainfall estimated at minimum 250 mm and maximum at over 3000 mm. Palada and Chang (2003) reported that it thrives on soil pH of 5.0 to 9.0. *Moringa oleifera* trunk is soft with white corky and its branches has a gummy bark. It possesses tripinnate compound leaf with several small leaf legs. The flowers are white in colour and the three wings seeds are scattered by the winds (Anwar and Bhanger, 2003; Prabhu et al., 2011). The plant is native to South Asia and Western Africa (Alnidawi *et al*, 2016).

Nutritional properties

Moringa leaves or derivatives are not easily consumed by chickens but about half the protein content can be extracted in the form of a concentrate and added to chicken feed (Price, 2007). According to Fuglie, (2000) phytase can be added to Moringa leaves to break down phytate leading to increased absorption of phosphorusin in chicken diet.

The leaves have been seen to exhibit high contents of vitamin A, C, and E (Hekmat *et al*, 2015), on dry matter basic it contains dry matter (DM) 93.63% to 95.0 %, crude protein (CP) 17.01 % to 22.23 %, carbohydrate 63.11 % to 69.40 %, crude fiber (CF)6.77 % to 21.09 %, crude fat (EE) 2.11 % to 6.41 %, ash (total mineral) 7.96 % to 8.40 %, gross energy 14.790 (MJ/kg), and fatty acid 1.69 % to 2.31 % [58–60].

Medicinal properties of *Moringa oleifera*

Moringa oleifera has enormous medicinal potential, which has long been recognized in the Ayurvedic and Unani system (Mughal *et al*., 1999). Nearly every part including root, bark, gum, leaf, fruit (pods), flowers, seed, and seed oil have been used for various ailments in the indigenous medicine (Odebiyi and Sofowora, 1999). The seed and leaves have been broadly use in human food industry and health related issues (Fahey, 2005). Furthermore, the seed powder of M. oleifera contains polyelectrolytes, which are the most important active ingredients for water purification. Alnidawi *et al*., (2016) conducted an experiment with a view to examining the effects of *Moringa oleifera* leaf on health status in broilers.it was discovered that total cholesterol content was lower with higher level (at 15 % and 20 %) of *Moringa oleifera* inclusion in broiler diets. Similarly, high-density lipoprotein cholesterol (HDL) content in serum was increased and low-density lipoprotein cholesterol (LDL) was decreased with higher level of supplementation of *Moringa oleifera* in broiler.

Antimicrobial Effects

In a recent study, aqueous extracts of *Moringa oleifera* was found to be inhibitory against many pathogenic bacteria, including *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas aeruginosa* in dose dependent manner (Saadabi and Abu Zaid, 2011). It was also found to be inhibitory against *Mycobacterium phlei* and *B. subtilis.* Its Leaf extract was found to be effective in checking growth of fungi *Basidiobolus haptosporus* and *Basidiobolus ranarums* (Nwosu and Okafor, 1995).

Anti-inflammatory properties

According to Amit Mittal (2017), investigation shows that aqueous extract of Moringa oleifera leaves (200 mg/kg) exhibited anti-inflammatory activity in all models for inflammation. It was therefore construed that the anti-inflammatory effect might be due to active constituents (flavonoids, tannins, rhamnose, xylose, galactose, arabinose, galacturonic acid) that are present in the aqueous extract of Moringa oleifera leaves.

Anti-oxidant properties

Using different methods of extraction, it was discovered that ethanol and methanol extracts of *Moringa oleifera* exhibited the highest level of anti-oxidant property with 66.8 %, and 65.1 % respectively (Lalas and Tsaknis, 2002; Siddhuraju and Becker, 2003). Bajpai *et al*., (2005) and Siddhuraju and Becker, (2003) discovered that the bioactive compounds of phenolics (such as quercetin and kaempferol) are responsible for antioxidant activity.

Table 1: Some pharmaceutical compounds found in *Moringa oleifera*

S/N	Compounds	Method of Extraction	Application	Reference
1	Pterygospermin	Solvent extraction followed by MIC Analysis	antibacterial and fungicidal effects	Rao *et al*. 2008
2	4-(4'-O-acetyl-a-L-rhamnopyranosyloxy) benzyl isothiocyanate, 4-(a Lrhamnopyranosyloxy) benzyl isothiocyanate, niazimicin, benzyl isothiocyanate, and 4-(a Lrhamnopyranosyloxy) benzyl glucosinolate, Anthonine and Spirochin	Solvent extraction followed by MIC Analysis	Antibacterial	Fahey (2005), Busani *et al*., (2012), Nwosu and Okafor (1995)

Source: Farooq *et al*, 2012

Table 2: Role of *Moringa oleifera* on performance in broilers.

S/N	Type	Study design	Main findings	References
1	*Moringa oleifera* leaf powder	broilers (Hubbard) from 1–35 days, dose: 6,9,12, and 15 g/kg (supplementation type)	• Higher pH of breast muscle • Higher weight and diameter of breast muscle fibers • Higher water holding capacity of breast muscle • Higher ash percentage of tibia bone	Rehman *et al*., (2018)
2	*Moringa oleifera* leaf extract	broilers from 0–42 days, dose: 0, 5%, 10% 15%, 20%, (inclusion type)	• Higher body weight • Higher hemoglobin percent, and RBC number	Alnidawi *et al*, (2016)
3	*Moringa oleifera* leaf meal	broilers (Cobb-500) from 1–35 days, dose: starter (1, 3 and 5 g/kg); grower (3, 9, and 15 g/kg); and finisher (5, 15, and 25 g/kg) (inclusion type)	• Higher body weight at starter and finisher period • Lower FCR • 4No effects on feed intake • Higher dressing percentage, thigh muscle weight and bursa weight • No effects on CP, CF, DM, EE, ash, NDF, ADF digestibility	Nkukwana *et al*, (2014)
4	*Moringa oleifera* leaf meal	broilers (Ross) from 1–49 days, dose: 0, 3%, 5%, and 7% (inclusion type)	• Higher feed intake • Higher dressing percentage • Higher meat tenderness and juiciness score	Safa and Tazi (2014)
5	*Moringa oleifera* leaf powder	broilers from 1–42 days, dose: 0, 0.05%, 0.10% (supplementation type)	• Higher final body weight • Higher dressing percentage	David *et al.*, (2012)

Source: Shad Mahfuz and Xiang Shu Piao, (2019)

CONCLUSION

Herbal plants have considerable promise in health promoting effects in poultry because they contain substances which are considered potential alternatives to antibiotics. Medicinal potential of *Moringa oleifera* is difficult to cover in a single article. This review has provided a glimpse of *Moringa oleifera* applications for performing appraisal of this promising medicinal plant. Although, many bioactive compounds have been discovered from *Moringa oleifera*, these discoveries is in infancy. Future rigorous studies can lead to the detection, and commercialization of *Moringa oleifera* bioactive compounds as a remedies for several poultry broilers ailments. This review shows that *Moringa oleifera* could be successfully used as an environmentally friendly feed additive in broiler chicken to promote growth as well as boost their immune system because of its richness in essential vitamins and minerals. *Moringa* leaf meal can be used safely at levels of 5% to 20% in broiler diets without deleterious effects on their performance.
The future study should focus on the uses of *Moringa oleifera* in relation to a pathogen challenge as well as dosages. Further review on *Moringa oleifera* as an alternative for antibiotics should be considered for laying hen for the production of organic meat and egg.

REFERENCES

Alnidawi, A., Ali, F., Abdelgayed, S., Ahmed, F., and Farid, M. (2016). *Moringa oleifera* leaves in broiler diets: Effeect on chicken performance and health. *Food Science and Quality Management*, 58, 40–48.

Amit Mittal, Monica Sharma, Abhinav David, Pinki Vishwakarma, Manish Saini, Mani Goel, and K. K. Saxen (2017). An experimental study to evaluate the anti-inflammatory effect of *moringa oleifera* leaves in animal models. *International Journal of Basic and Clinical Pharmacology*, 6(2): 452-457

Anwar F, Bhanger MI (2003). Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. J. Agric. Food Chem. 51:6558-6563.

Anwar, F and Bhanger M. I. (2003). Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. J. Agric. Food Chem. 51:6558-6563.

Arora, D.S., Onsare, J.G., and Kaur, H., (2013). Bioprospecting of Moringa (Moringaceae): microbiological perspective. *Journal of Pharmacogn. Phytochem.* **2013**, 1, 193–215.

Bajpai M., Pande A., Tewari S. K., and Prakash D. (2005). Phenolic contents and antioxidant activity of some food and medicinal plants. *International Journal of Food Science and Nutrition*. **56**: 287-291.

Brock Biology of Microorganisms. 14th ed. Illinois: Pearson International; 2014. p. 1006

David, L. S., Vidanarachchi, J. K., Samarasinghe, K., Cyril, H. W., and Dematawewa, C. M. B. (2012). Effects of *Moringa oleifera* based feed additives on the growth performance and carcass quality of broiler chicken. *Tropical Agricultural Research*. **24**, 12–20.

Fahey, J.W., (2005). Moringa oleifera: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. *Trees Life Journal*, 1, 1–15.

Farooq Fozia, Meenu Rai, Avinash Tiwari, Abdul Arif Khan and Shaila Farooq (2012). Medicinal properties of *MorInga oleifera. Journal of Medicinal Plants Research*,6(**27**): 4368-4374

Fuglie L (2000). New uses of Moringa studied in Nicaragua. EDN Echo Development Notes 68: 1-8.

Hekmat, S., Morgan, K., Soltani, M., and Gough, R., (2015). Sensory evaluation of locally-grown fruit purees and inulin fibre on probiotic yogurt in Mwanza, Tanzania and the microbial analysis of probiotic yogurt fortified with *Moringa oleifera*. *Journal of Health, Population and Nutrition*,33, 60–67

Lalas S. and Tsaknis J., (2002). Extraction and identification of natural antioxidant from the seeds of the *Moringa oleifera* tree variety of Malawi. JAOSC 79:677-683.

Lowenthal J.W., O'Neil T.E., David A., Strom G. and Andrew M.E. (1999). Cytokine therapy: a natural alternative for disease control. *Vet. Immunol. Immunopathol*. **72,** 183-188

Morton, J. F. (1991). The horseradish tree, *Moringa pterygosperma* (Moringaceae)- A boon to arid lands? Econ. Bot. 45:318-333.

Muaz K., Riaz M., Akhtar S., Park S., Ismail A. (2018). Antibiotic Residues in Chicken Meat: Global Prevalence, Threats, and Decontamination Strategies: A Review. Journal of Food Protection, Vol. 81, No. 4, 2018, Pages 619–627

Mughal M. H. S., Ali G., Srivastava P. S., and Iqbal M., (1999). Improvement of drumstick (*Moringa pterygosperma* Gaertn.) A unique source of food and medicine through tissue culture. *Hamdard Medicals*. 42:37-42.

Nkukwana, T. T., Muchenje, V., Masika, P. J., Hoffman, L. C., and Dzama, K. (2014). The effect of *Moringa oleifera* leaf meal supplementation on tibia strength, morphology and inorganic content of broiler chickens. *South Africa Journal of Animal Science*. **44**, 228–239.

Nkukwana, T. T., Muchenje, V., Pieterse, E., Masika, P. J., Mabusela, T. P., Hoffman, L. C., and Dzama, K. (2014). Effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *Livestock Science*.,**161**, 139–146.

Nwosu M. O., and Okafor J. L., (1995). Preliminary studies of the antifungal activities of some medicinal plants against Basidiobolus and some other pathogenic fungi. Mycoses 38:191-195.

Odebiyi A, and Sofowora E. A., (1999). Pytochemical screenings of Nigerian medicinal plants part 11. Lyodia 44:234-246

Palada, M. C. and chang, C. (2003). Suggested cultural practices for moringa. International cooperators guide. Publication #03-545. AVRDC. Talman, Taiwan.

Palada, M. C. and Chang, C. (2003). Suggested cultural practices for moringa. International cooperators guide. Publication #03-545. AVRDC. Talman, Taiwan.

Prabhu K, Murugan K, Nareshkumar A, Ramasubramanian N, Bragadeeswaran S (2011). Larvicidal and repellent potential of *Moringa oleifera* against malarial vector, Anopheles stephensi Liston (Insecta: Diptera: Culicidae). Asian Pacif. J. Trop. Biomed., 124-129.

Prabhu K, Murugan K, Nareshkumar A, Ramasubramanian N, Bragadeeswaran S (2011). Larvicidal and repellent potential of *Moringa oleifera* against malarial vector, Anopheles stephensi Liston (Insecta: Diptera: Culicidae). Asian Pacif. J. Trop. Biomed., 124-129.

Price M. L. (2007). The Moringa Tree. Echo Technical Note. http://chenetwork.org/files_pdf/Moringa pdf.

Rehman, H., Zaneb, H., Masood, S., Yousaf, M., Ashraf, S., Khan, I., Shah, M., Khilji, M., and Rehman, H. (2018) Effect of *Moringa oleifera* Leaf powder supplementation on pectoral muscle quality and morphometric characteristics of tibia bone in broiler chickens. *Brazilian Journal of Poultry Science*.,**20**, 817–824.

Saadabi A. M., and Abu Z. A. I, (2011). An *in vit*ro antimicrobial activity of *Moringa oleifera* L. seed extracts against different groups of microorganisms. *Asian Journal of Basic and Applied Science* 5:129-134.

Safa, M. A., and Tazi, E. (2014) Effect of feeding different levels of *Moringa oleifera* leaf meal on the performance and carcass quality of broiler chicks. *International Journal of Scientific Research*. **3**, 147–151.

Shad Mahfuz and Xiang Shu Piao (2019). Application of Moringa (*Moringa oleifera*) as Natural Feed Supplement in Poultry Diets. Retrieved September 10, 2019. Available: http://www.mdpi.com/journal/animals

Siddhuraju P. and Becker K. (2003). Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam.) leaves. *Journal of Agriculture and Food Chemistry*.51:2144-2155

Torun Kumar Paul, Yousuf Ali Sarker, MoniruzzamanTarafder, Md. Asaduzzaman Rimon, Md. Anowarul Haque and Mahmudul Hasan Sikder (2018). Water supplementation of *Moringa oleifera* as a substitute for antibiotics on performance and blood parameters of broiler chickens. *Journal of Bangladesh Agricultural University*,16(**2**): 266–270.

World Health Organization, (2014). Antimicrobial Resistance Global Report on Surveillance. Geneva: 256. Retrieved from:http://www.who.int/drugresistance/documents/surveillancereport/en/ on 15th April, 2018.

HAEMATOLOGICAL INDICES OF BROILER CHICKEN FED VARYING LEVELS OF *ALOE-VERA* GEL IN WATER

Akinosun, A.A., Balogun, A.S., Shobanke, I.A., Raji, M.O., Oloko, A.B & Bako, B.A

Department of Animal Production Technology

Oyo State College of Agriculture and Technology, Igboora, Oyo State

Email – akinbola_akin2113@yahoo.com

+2348035607241

ABSTRACT

The study was conducted at the Poultry Unit of the Teaching and Research Farms of Oyo State College of Agriculture and Technology, Igboora, Nigeria.A total number of 96 day old unsexed broiler chicks were purchased from a reputable farm at Ibadan for the experiment. At 8 days of age, birds were weighed and randomly allotted into 4 feeding treatments of 3 replicates consisting of 8 birds in a completely randomized design (CRD).T1 control, T2 (30 ml of AVGE + 1 litre of water), T3 (60 ml of AVGE + 1 litre of water), T4 (90 ml of AVGE + 1 litre of water).The experiment lasted for 49 days. The results obtained show that aloe vera gel extract (AVGE) supplementation in water significantly ($p<0.05$) affected Packed cell volume (PCV) (%), haemoglobin (Hb) (g/dL), red blood cells (RBC) ($x10^9$/dl), heterophil, lymphocyte, monocyte eosinophil as well as basophil. White blood cells (WBC) **(**$x10^3$/dl) was however similar ($p>0.05$) across the treatment group. PCV was observed to be highest at T3 (24.83) while T1 (24.00), T2 (24.00) and T4 (24.17) show no difference in the means obtained. Similarly, RBC was observed to be highest at T3 (2.64) and lowest at T4 (2.39) while T1 and T2 had comparable significant means of 2.49 and 2.52 respectively. Hb was also observed to be highest at T3 (9.14) while T1 (8.79), T2 (8.79) and T4 (8.62) had comparable mean value across the treatment. Heterophil was however highest at the control T1 (42.00) while there were no differences in the means obtained in T2 (37.33), T3 (38.33) and T4 (40.67). WBC also had ranged values between 10.55 – 11.47 (T3 – T2) across the treatment groups. It can be concluded from the study that the groups treated with Aloe vera gel extract showed better significant haematological properties when compared to the control groups. It is thus recommended that farmers can adopt the use of 60 ml of aloe vera gel extract in oral supplementation as an alternative to commercial antibiotics.

Key words: Broiler, Aloe vera gel extract, PCV, WBC, RBC

INTRODUCTION

Antibiotic growth promoters have been helpful in improvement of growth performance and feed conversion ratio in poultry (Izat *et al*., 1990; Dibner and Buttin, 2002 and Miles *et al*., 2006) However, constant treatment of poultry with antibiotic may result in residues of these substances in poultry products and bacteria resistance against treatments in human body. Due to such threats to human health, use of antibiotics in poultry is banned (Hinton, 1988; Botsoglou and Fletouris, 2001; Alcicek *et al*., 2004 and Owens *et al*., 2008). Many studies have been carried out on using additives, including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal micro-flora, in poultry products (Taylor, 2001). *Aloe vera is* used as a multi-purpose medicine with anthelminthic, antimicrobial, anti-inflammatory and anti-oxidative properties. They also contain carotenoids, vitamins, terpernoids and phenols among other compounds (O'Brien *et al*., 2011). They are used in treating newcastle disease, internal parasites, fowl typhoid, coccidiosis, gall sickness and inflammation (Dold and Cocks, 2001). Apart from the above, anti-mutagenic effects and anti-hypersensitivity effects of *Aloe vera* have also been reported by some researchers (Strickland and Ulijaszek, 1993). With numerous properties, *Aloe vera* is among the most well-known herbs. Thus, the study aim to examine the use of oral supplementation of *aloe vera* gel without commercial antibiotics and multivitamin on the haematological indices of broiler chicken

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of the Teaching and Research Farms of Oyo State College of Agriculture and Technology, Igboora, Nigeria

Preparation of 50 % *Aloe vera* gel extract

Fresh Aloe leaves were harvested from Igbo-ora community and environs. Aloe gel infusion was prepared accordingly to the method of Durrani *et al*. (2008). The leaves were washed with clean water to remove dirt. Aloe Vera gel was extracted from 1kg leaves manually by making a cut on the leaves with a pocket knife. The gel was scooped out with a small spoon and drained into in a beaker. A 50% concentrated infusion was prepared by taking 500 ml of fresh gel in a glass bottle and 500 ml of boiled water at room temperature was poured on it. The bottle was then agitated for about 5-7 minutes to ensure thorough mixing, after which it was kept for 30 minutes to 40minutes at room temperature prior to use. The homogenized gel extract was prepared at intervals of two (2) days and served to the animals fresh according to treatments.

EXPERIMENTAL PROCEDURE

A total number of ninety-six (96) day old unsexed broiler chicks were purchased from a reputable farm at Ibadan for the experiment.At 8 days of age, birds were weighed and randomly allotted into 4 feeding treatments of 3 replicates consisting of 8 birds in a completely randomized design (CRD). T1 control, T2 (30 ml of AVGE + 1 litre of water), T3 (60 ml of AVGE + 1 litre of water), T4 (90 ml of AVGE + 1 litre of water).Treatment 1 served as the control which contained vitalyte and antibiotics, representing the common commercial drug supplement that is usually made available to birds.

Table 1: Composition of the basal diet (%)

Ingredient	**Starter (1-21 days)**	**Finisher(22-49 days)**
Maize	58.00	63.80
Soybean meal	34.50	28.40
Soya oil	3.30	3.70
Di-calcium phosphate	1.70	1.70
Lime stone	1.80	1.70
Salt {NaCl)	0.25	0.25
Methionine	0.15	0.15
Premix*	0.30	0.30
Total	**100**	**100**
Calculated composition (%)		
Crude protein	22.10	19.18
Energy (MEKcal/kg)	3030	3100

RESULTS AND DISCUSSION

Table 2: Effects of *aloe vera* gel extract (AVGE) on haematological indices of broiler chicken

Parameters	T1	T2	T3	T4	SEM ±
PCV (%)	24.00^{ab}	24.00^{ab}	24.17^{a}	24.83^{ab}	0.33
RBC (x10^{6}/dl)	2.49^{ab}	2.52^{ab}	2.64^{a}	2.39^{b}	0.04
Hb (g/dl)	8.79^{ab}	8.79^{ab}	9.14^{a}	8.62^{ab}	0.20
WBC (x10^{3})	10.72	11.47	10.62	10.55	0.46
Heterophil (%)	42.00^{a}	37.33^{b}	38.33^{b}	40.67^{ab}	2.13
Lymphocyte (%)	57.33^{ab}	60.33^{a}	58.33^{ab}	57.00^{ab}	2.24
Monocyte (%)	0.67^{ab}	0.33^{b}	1.33^{a}	0.67^{ab}	0.23
Eosnophil (%)	0.00^{c}	1.67^{ab}	2.00^{a}	1.33^{ab}	0.31
Basophil (%)	0.00^{b}	0.33^{a}	0.00^{b}	0.33^{a}	0.09

^{a,b,c} Means on the same rows with different superscript differs significantly ($p< 0.05$) * PCV – Pack cell volume, Hb – Haemoglobin, RBC –Red blood cells, WBC – White blood cells SEM= Standard Error of the Mean

The table shows that aloe vera gel extract (AVGE) supplementation in water significantly ($p<0.05$) affected Packed cell volume (PCV) (%), haemoglobin (Hb) (g/dL), red blood cells (RBC) (x10^{9}/dl), heterophil, lymphocyte, monocyte eosinophil as well as basophil. White blood cells (WBC) **(**x10^{3}/dl) was however similar ($p>0.05$) across the treatment group. PCV was observed to be highest at T3 (24.83) while T1 (24.00), T2 (24.00) and T4 (24.17) show no difference in the means obtained. Similarly, RBC was observed to be highest at T3 (2.64) and lowest at T4 (2.39) while T1 and T2 had comparable significant means of 2.49 and 2.52 respectively. Hb was also observed to be highest at T3 (9.14) while T1 (8.79), T2 (8.79) and T4 (8.62) had comparable mean value across the treatment. Heterophil was however highest at the control T1 (42.00) while there were no differences in the means obtained in T2 (37.33), T3 (38.33) and T4 (40.67). WBC also had ranged values between 10.55 – 11.47 (T3 – T2) across the treatment groups.

DISCUSSION

It was observed that the PCV values obtained from all treatments fell within the normal range of 24.00-45.20% for healthy chickens as reported by (Mitruka and Rawnsley, 1997) this indicates that AVGE supplementation was suitable and adequate for broiler chickens, and the birds were not anaemic and that the dietary protein is of good quality (Schalm *et al.*, 1975). Since the blood is often time used as a physiological index or indicator for diseases diagnosis, nutrition status and health condition of the birds. Olafedehan *et al. (*2010) reported that blood acts as a pathological reflector of the status of exposed animals to diseases and other conditions. Isaac *et al.*, (2013) reported that animals with good blood composition were likely to show good performance. Mhonzya (2002) reported that haemoglobin and packed cell volume levels are normally higher in a well-nourished than poorly fed animal. But since all the levels of AVGE supplementation did not fall below the range then it implies there was no case of anaemia in the birds. The values obtained in RBC indicate also that the red blood cells were not reduced by the AVGE supplementation which also shows that the diet also allows for proper oxygen and carbondioxide transport. This supports Ojhas *et al*., (2011) who stated that oral administration of aloe vera gel extract significantly increased the RBC count. As reported by Isaac *et al.* (2013), red blood cell is involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs (Ugwuene, 2011; Soetan *et al.*, 2013 and Isaac *et al*, 2013). From the findings, lymphocytes and heterophiles showed significant difference ($P<0.05$). Iraql (2014) reported improvement of broiler chicken immune system and significant increase of lymphocytes and heterophiles with garlic extract supplementation due to immune-stimulant effect of garlic. The significant effect of most parameters

measured at 60 ml of AVGE + 1 litre of water in this study suggests that it may be an appropriate level of inclusion.

CONCLUSION AND RECOMMENDATION

It can be concluded from the study that the groups treated with Aloe vera gel extract showed better significant haematological properties when compared to the control groups. It is thus recommended that farmers can adopt the use of 60 ml of aloe vera gel extract in oral supplementation as an alternative to commercial antibiotics.

REFERENCE

Alçiçek, A, Bozkurt, M and Çabuk, M. (2004). The effects of a mixture of herbal essential oil, an organic acid or a probiotic on broiler performance. *South African Journal of Animal Science*, 34: 217–222.

Botsoglu, N.A., Fletouris, D.J. (2001). Drug resistant in foods pharmacology, food safty and analysis. Marcel Dekker Inc. New York. pp.541-548.

Dibner, J. J and Buttin, P. (2002). Use of organic acids as a model to study the impact of gut micro-flora on nutrition and metaboli sm. *Journal of Applied Poultry Research*. 11: 453-463

Dold, A.R., Cocks, M.L., (2001). Traditional veterinary medicine in the Alice district of the Eastern Cape Province, South Africa. *South African Journal of Science* 97, 375–379.

Durrani, F.R., Abidullah, N., Chand, Z., Durrani and Akhtar, S. (2008). Hematological, biochemical, immunomodulatory and growth promoting effects of feed added wild mint (*Mentha longifolia*) in broiler chicks. *Sarhad Journal of Agriculture*. 24:661-664

Hinton, M.H., (1988). Antibiotics, poultry production and public health. *World Poultry Science Journal*. 44:67-69.

Iraql, Q., Amjad, M., Asi, M. R and Ariño, A. (2014) Characterization of capsaicinoids and antioxidants in hot peppers as influenced by hybrid and harvesting stage. *Plant Foods Human Nutrition* 68, 358–363.

Isaac, L.J., Abah, G., Akpan, B and Ekaette, I.U. (2013). Haematological properties of different breeds and sex of rabbits Pp. 24-27. Proceedings of the 18thing Annual Conference of Animal Science Association of Nigeria

Izat, A.L., Tidwell, N.M., Thomas, R.A., Reiber, M.A., Adams, M.H., Colberg, M., and Waldroup, P.W. (1990). Effects of a buffered propionic acid in diets on the performance of broiler chickens and on microflora of the intestine and carcass. *Poultry Science.*69:818-826

Miles, R.D., Butcher, G.D., Henry, P.R. and Littell, R.C. (2006). Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. *Poultry Science*. 85:476-485.

Mitruka, B. M and Rawnsley, H.W. (1997). Clinical biochemical and haematological references values in normal experimental animal. Masson Publishing U.S.A. Inc, New York

O'Brien, L.L., Grimaldi, M., Kostun, Z., Wingert, R.A., Selleck, R and Davidson, A.J. (2011). Wt1a, Foxc1a, and the Notch mediator Rbpj physically interact and regulate the formation of podocytes in zebrafish. *Developmental Biology Journal* 358(2): 318-330.

Ojhas, S., Golechha, M., Kumari, S., Bhatia, J and Arya, D.S. (2011). Glycyrrhiza glabra protects from myocardial ischemia-reperfusion injury by improving hemodynamic, biochemical, histopathological and ventricular function. Exp Toxicology and Pathology. 08:011

Olafedehan, C. O., Obun, A. M., Yusuf, M. K., Adewumi, O. O., Oladefedehan, A. O., Awofolaji, A. O., and Adeniji, A.A. (2010). Effects of residual cyanide in processed cassava peal meals on haematological and biochemical indices of growing rabbits (p.212). Proceedings of 35th Annual Conference of Nigerian Society for Animal Production

Owens, B., Tucker, L., Collins, M.A and McCracken, K.J., (2008). Effects of different feed additives alone or in combination on broiler performance, gut microflora and ileal histology. *British Poultry Science*. 49:202-212

Schalm, O.W., Jain, N.C and Caroll, E.J. (1975): *Veterinary Haematology*, 3rd edn. Lea and Febiger, Philadelphia. Pp. 471-538

Soetan, K. O., Akinrinde, A.S and Ajibade, T. O. (2013). Preliminary studies on the heamatological parameters of cockerels fed raw and processor guinea corn (sorghum bicolor) Pp. 49-52. Proceedings of 38th Annual Conference of Nigeria Society for Animal Production

Strickland, S.S. and Ulijaszek, S.J. (1993) Body mass index, aging and differential reported morbidity in rural Sarawak. European Journal of Clinical Nutrition, 47(1), 9-19.

Taylor, D.J. (2001). Effects of antimicrobials and their alternatives. *British Poultry Science.* 42:67- 68.

Ugwuene, M. C. (2011). Effect of Dietary Palm Kernel Meal for Maize on the Haematological and Serum Chemistry of Broiler Turkey. Nigerian Journal of Animal Science, 13, 93-103.

ANTIOXIDANT SUPPLEMENTATION EFFECTS IN ANIMALS: FINDINGS FROM PREPUBERTAL, PREGNANT, LACTATING AND NON-BREEDING RABBITS

Sikiru A.B.[1,2], Arangasamy A.[2], Alemede I.C.[1], Egena S.S.A.[1], Makinde O.J.[1] & Akinsola O.[3]
[1]*Department of Animal Production, Federal University of Technology, Minna; 920262, Nigeria*
[2]*Reproductive Physiology Laboratory, ICAR-National Institute of Animal Nutrition and Physiology, Bangalore; 560030, India.*
[3]*Theriogenology and Production, Faculty of Veterinary Medicine, University of Jos, Nigeria.*
Corresponding author: akeembaba01@gmail.com

ABSTRACT
Antioxidant supplementation can alleviate stress arising from the environment, production systems, and animal functional metabolic activities at different physiological stages. Therefore, in this study, a microalga known as *Chlorella vulgaris* was supplemented to rabbits as an antioxidant at different physiological stages while their performances and oxidative stress attenuation mechanisms were monitored. In the prepubertal and gestation phases, forty rabbits were investigated; in the lactation phase, 35 rabbits with equal number of kits were studied while in the non-reproducing phase, forty rabbits were studied. At each phase of the study, rabbits were divided into five groups and rabbits in each of the groups were individually supplemented with 0, 200, 300, 400 and 500 mg *Chlorella vulgaris* biomass per kg bodyweight as Control, T1, T2, T3, and T4 groups respectively. There was significant effect of the supplementation on the rabbits' weight gain ($p < 0.05$), reproductive index ($p < 0.05$), feed intake ($p < 0.05$), carcass traits and meat yield ($p<0.05$), antioxidant enzymes activities and gene expression patterns ($p < 0.05$). Evaluation of these outcomes led to the conclusion that the microalga supplementation led to improved performances of the rabbits and protected the rabbits against oxidative stress at different physiological reproductive stages, hence it was recommended as suitable antioxidant supplements for rabbits while its suitability as antioxidant in other food producing animals was suggested.
Keywords: Antioxidants, *Chlorella vulgaris*, gene expression, oxidative stress and rabbits.

INTRODUCTION
Reproduction is arguably a metabolic and performances burden to animals as some group of scientists agreed it is a burden while some claimed it is not; however, either agreed or disagreed, reproduction is known to increase animals' nutrients demands in breeding animals as well as the modification of the alimentary tract in response to the increase in nutrients demand and intake (Hammond, 1997). It is also agreed upon that there is always an increase in the thermoregulatory demand of breeding animals which usually get extremely higher during lactation period due to the need by animals to produce milk for consumption of the younger ones (Heldmaier *et al*. 2004).
Reproductive specific to rabbits is that there is usually a reduction in physical activities in breeding does compared with dry does (Fernandez-Carmona *et al*. 2010). It was also reported that there is bone loss due to increased calcium supply to the foetus and offspring during gestation and lactation periods (Sarli *et al*. 2005). All these complications are almost inevitable in food producing animals due to reproduction or functional production performances; however, underlying these complications is oxidative stress a condition of imbalance between prooxidant and antioxidant in animals occasioned by rigourous energy demand and other activities which occur all the time to keep an animal suitable for production; therefore exogenous antioxidant aimed at enhancing internal antioxidant defence system become modern animal production exploit. In this study, a microalga rich in antioxidant was supplemented to rabbits in fulfillment of exogenous antioxidant supplementation hypothesis.

MATERIALS AND METHODS
In the prepubertal and gestation phases, forty rabbits were investigated; in the lactation phase, 35 rabbits with equal number of kits were studied while in the non-reproducing phase, forty rabbits were studied. At

each phase of the study, rabbits were divided into five groups and rabbits in each of the groups were individually supplemented with 0, 200, 300, 400 and 500 mg *Chlorella vulgaris* biomass per kg bodyweight as Control, T1, T2, T3, and T4 groups respectively. Approval for use of the animals and the experimental protocol was obtained from joint approval of Institutional Animal Ethics Committee (IAEC) of National Institute of Animal Nutrition and Physiology, India and Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA), India. The animals fed commercial rabbits feed and provided with water *ad-libitum* (Table 1); while they were supplemented with microalgae biomass intake as antioxidant supplements. The animal house was maintained at normal room temperature while electric blowing fan was provided for emission of excess heat generated and prevention of stickiness.
The prepubertal stage lasted for 60 days, gestation 35 days, lactation 21 days, and non-breeding stage 120 days; during each of the stages, blood was obtained from each animal through puncturing of auricular vein using 26G needle and 2mL hypothermic syringes (Hindustan Syringes & Medical Devices (P) Limited, India). Blood samples were collected early morning between 6.30 and 8.30 am and the animals were hand restrained while surgical spirit was used for wiping (Om Shiva Pharma Industries, India). Blood samples collected were allowed to clot at room temperature before they were transported on ice pads to the laboratory for serum separation. Clear serums were obtained by centrifuging whole blood at 2000 rpm (Remi NEYA 16R, REMI India); the centrifuge was done at 4 ^{o}C for 15 minutes period for each sample and the serums were obtained into Eppendorf tubes packed in cryo box (Tarsons Products Pvt. Ltd, India) then stored at -80 ^{o}C for downstream analysis. Concentration of malondialdehyde in the serum was used as marker of lipid peroxidation was assayed according to procedures described by (Ohkawa *et al*, 1979). Serum biochemical parameters including enzymes such as alanine aminotransaminase (ALT), aspartate aminotransaminase (AST), creatinine, alkaline phosphatase (ALP) and bilirubin were determined using commercial kits; while antioxidant enzymes activities, gene expression patterns and other analysis were carried out as described in Sikiru *et al*, 2019a, Sikiru *et al*, 2019b and Sikiru *et al*, 2019c respectively.

RESULTS AND DISCUSSION

The supplementation of *Chlorella vulgaris* has antioxidant in this study significantly led to improvements in the rabbit production and functional performances; from feed intake, growth rate, carcass traits and oxidative stress protection via reduction of oxidative stress biomarkers and enhanced antioxidant enzymes activities as presented in the tables 2 to 6 below. The findings as revealed in this study gave a strong support to practical use of microalga *Chlorella vulgaris* as in rabbits because it improved the rabbits performance through attenuation of oxidative stress products of lipid peroxidation, enhanced antioxidant activities using its components including carotenoids and polyphenols for prooxidants scavenging, these finding agreed with earlier studies on the alga as reported (Pieretti and Meineri, 2009) who stated that it improved feed nutrients digestibility and promotion of growth rates; similarly, the microalga was also reported to improved meat qualities, reproductive performance and functional attributes of rabbits and mice models (Meineri *et al*, 2009; Kang *et al*, 2004). This study demonstrated that oxidative stress is an inevitable biochemical process in animal performance and its implications transcend beyond physiological loss to economic loss; meanwhile, supplementation of microalga *Chlorella vulgaris* in this study ameliorated the production inefficiencies as well as enhanced the animals' physiological performances and also showed molecular oxidative stress protection through up-regulation of antioxidant genes through expression modification.

Table 1: Nutritional compositions of the basal feed fed to the rabbits at all stages of the experiment

Parameters	Amount	Units
Dry Matter	90.89	%
Crude Protein	18.55	% dry matter
Total Ash	7.90	% dry matter
Crude Fibre	9.73	% dry matter
Ether Extract	2.99	% dry matter
Metabolizable Energy	2700	Kcal/kg

Parameters	Mean ± SEM	p - values
Final body weight (g)	2092.03 ± 20.74	0.01
Body weight gain (g)	1156 ± 22.54	0.003
Total feed intakes (g)	5902.84 ± 116.66	0.56
Feed conversion ratio	5.20 ± 0.01	0.003

Table 2: Effects of Chlorella vulgaris as antioxidant supplement on prepubertal rabbit performances

Table 3: Effects of *Chlorella vulgaris* supplement on oxidative stress status of the prepubertal rabbits

Parameters	Mean ± SEM	p - values
Malondialdehyde concentration (nmol/ml)	11.62 ± 2.03	0.001
Total antioxidant capacity (µmol/ml)	100.00 ± 22.4	0.003
Superoxide dismutase activity (U/ml)	79.42 ± 5.47	0.001
Catalase activity (U/ml)	28.88 ± 3.38	0.003
Reduced glutathione concentration (µmol/ml)	32.80 ± 2.04	0.001

Table 4: Effects of *Chlorella vulgaris* as antioxidant supplement on performances of the pregnant rabbits

Parameters	Mean ± SEM	p - values
Total feed intake (g)	2911.59 ± 46.78	0.08
Gestation gain (g)	362.02 ± 21.88	0.21
Litter size (count)	5.00 ± 1.00	0.67
Viability rate (%)	74.71 ± 7.14	0.20
Gestation length (days)	31.61 ± 0.27	0.03

Table 5: Effects of *Chlorella vulgaris* supplement on oxidative stress status of the pregnant rabbits

Parameters	Mean ± SEM	p - values
Malondialdehyde concentration (nmol/ml)	15.36 ± 1.23	0.003
Total antioxidant capacity (µmol/ml)	61.09 ± 10.06	0.02
Protein carbonyl (µmol/ml)	12.15 ± 13.41	0.66
Superoxide dismutase activity (U/ml)	9.06 ± 0.34	0.04
Catalase activity (U/ml)	9.59 ± 0.32	0.005
Reduced glutathione concentration (µmol/ml)	63.12 ± 1.17	0.001

Table 6: Effects of *Chlorella vulgaris* as antioxidant supplement on performances of the pregnant rabbits

Parameters	Mean ± SEM	p - values
Total feed intake (g)	2728.60 ± 53.48	0.48
Lactation loss (g)	115.54 ± 29.15	0.12
Pre-weaning litter weight (g)	574.65 ± 45.86	0.009
Milk yield (g)	1333.12 ± 77.47	0.001
Body condition score	2.30 ± 0.14	0.009

Table 7: Effects of *Chlorella vulgaris* as antioxidant supplement on performances of the non-breeding rabbits

Parameters	Mean ± SEM	p - values
Daily feed intake (g)	100.56 ± 1.22	0.01
Initial weight (g)	1060.00 ± 29.42	0.17
Final weight (g)	2383.00 ± 40.99	0.008
Feed conversion ratio	10.32 ± 0.45	0.32
Empty Carcass weight (g)	1801.74 ± 52.78	0.001
Commercial Carcass weight (g)	1419.72 ± 34.36	0.001

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REFERENCES

Fernández-Carmona, J., Solar, A., Pascual, J. J., Blas, E., & Cervera, C. (2010). The behaviour of farm rabbit does around parturition and during lactation. World Rabbit Science, 13(4), 253-277.

Hammond K.A (1997). Adaptation of the maternal intestine during lactation. *J. Mammary Gland Biol. Neoplasia*. 2:243–252.

Heldmaier G, Ortmann S, Elvert R. (2004). Natural hypometabolism during hibernation and daily torpor in mammals. *Resp. Physiol. Neurobiol*. 141:317–329.

Kang, M.S., Sim, A.J., & Chae, H.J. (2004). *Chlorella* as a functional biomaterial. *Korean Journal of Biotechnological Bioengineering*.19:1-11.

Okhawa, H., Ohishi, N., & Yogi, K. (1979). Assay for lipid peroxidation in animal tissue by TBA reaction, Anal. Biochem. 95 (1979) 35–38.

Sarli M, Hakim C, Rey P, Zanchetta J. (2005). Osteoporosis during pregnancy and lactation. Medicina—Buenos Aires. 2005;65:533–540.

Sikiru A.B., Arangasamy A., Alemede I.C., Egena S.S.A., & Bhatta, R. (2019a). Dietary supplementation effects of *Chlorella vulgaris* on performances, oxidative stress status and antioxidant enzymes activities of prepubertal New Zealand White rabbits. *Bulletin of the National Research Centre*, 43(1), 162.

Sikiru A.B., Arangasamy A., Alemede I.C., Guvvala P.R., Egena S.S.A., Ippala J.R, & Bhatta R. (2019b). *Chlorella vulgaris* supplementation effects on performances, oxidative stress and antioxidant genes expression in liver and ovaries of New Zealand White rabbits. *Heliyon* 5 (2019) e02470.

Sikiru, A., Arangasamy, A., Ijaiya, A., Ippala, R., & Bhatta, R. (2019c). Effects of *Chlorella vulgaris* supplementation on performances of lactating nulliparous New Zealand white rabbits does and their kits. *International Journal of Livestock Research*, 9 (9), 49 – 58.

COMPARATIVE STUDY OF THE PHYTOCHEMICAL, PROXIMATE AND MINERAL CONSTITUENTS OF AIR-DRIED LEAVES OF *HIBISCUS ASPER* AND *HIBISCUS SABDARIFFA*

***Arogbodo, J. O[1] & Ajayi, O. A[2].**
[1]*Department of Animal Production and Health, Federal University of Technology, Akure*
[2]*Department of Chemistry, Federal University of Technology, Akure*
**Corresponding author: GSM: 08060990115 e-mail: arogbodojos@yahoo.com*

ABSTRACT
This study was conducted on the basis of radiant hope in medicinal plants' efficacy to solve health and nutritional problems in livestock production. Standard procedures were adopted in the determination of phytochemicals, proximate and mineral constituents of *Hibiscus asper* and *Hibiscus sabdariffa*. Saponins, tannins, flavonoids, terpenoids and steroids were present in both plants. These are indispensable for the body systems and physical well being. The quantitative phytochemicals were found to be more in *H. asper* than *H. sabdariffa*. Proximate values for moisture (12.163 ± 0.060), ash (11.709 ± 0.042), fat (9.579 ± 0.090), crude protein (13.903 ± 0.086) and crude fibre (1.418 ± 0.065) in *H. asper* were higher than that of *H. sabdariffa*. The metabolizable energy in *H. asper* was 3109 Kcal/Kg while that of *H. sabdariffa* was found to be 3107 Kcal/Kg; making the plants to a veritable source of energy. *H. asper* had higher values of Sodium (27.400), Potassium (72.500), Magnesium (10.480), Iron (0.670), Copper (0.280), Zinc (1.027), Phosphorus (3.130), compared to *H. sabdariffa.* Insignificant quantity of Lead (0.010 ppm) was detected in *H. asper* and none in *H. sabdariffa,* showing that the two plants are safe from lead poisoning. It was concluded that *H. asper* and *H. sabdariffa* are medicinal plants that can be of inestimable value in livestock production if the leaves can be exploited for drug and feed formulation.

Key words: Phytochemical, proximate composition, minerals, medicinal plants, livestock

INTRODUCTION
The universe offers plethora of plants with medicinal and nutritional properties. This has given radiant hope to the scientists all over the world that medicinal plants have the potentials to solve disease and nutritional challenges in animal production. The incessant problem of antibiotic resistance in livestock production can also be mitigated through administration of medicinal plants in drinking water or incorporation into their feed. The usage of leaf meal in broiler diets was reported by Oloruntola *et al.* (2016). It was reported by Ukorebi *et al*. (2019) that 10% dietary level of *Gongronema latifolia* (Utasi) leaf meal supported normal health by enhancing the blood building capacity and performance of broiler chickens. Wumnokol *et al*. (2019) reported the inclusion of Acha (*Digitaria exilis* Staph) grains in the diet of broiler chickens as beneficial on the haematological parameters. Despite the inexhaustible well of medicinal plants, innumerable species of them are yet to be exploited satisfactorily. *Hibiscus asper* and *Hibiscus sabdariffa* are two medicinal plants of high pharmacological and nutritional value that are yet to be meaningfully tapped. They belong to the genus Linnaeus of the family Malvaceae. It was reported that the plants from this family are good source of fibres, medicine, tea and oil (Ayanbadejo *et al*., 2012). Although, many researchers have worked on the seeds and calyxes from the plants in poultry nutrition but there is a great dearth of information on the use of the leaves (leaf meal) for drug formulation or nutritional purpose in livestock production in Nigeria. Hence, the essence of studying the phytochemical, proximate and mineral constituents of air-dried leaves of these two medicinal plants.

MATERIALS AND METHODS

Plant samples collection and preparation

Fresh leaves of *Hibiscus asper* and *Hibiscus sabdariffa* were harvested from Goshen Community, off Aule Road Akure, Ondo State Nigeria in September, 2019. The plants were properly identified taxonomically at the Department of Forestry and Wood Technology of the Federal University of Technology, Akure. The leaves were gently rinsed in distilled water to get rid of dirt and thereafter air-dried for fourteen days until constant weight was achieved. Air-dried leaves were ground in Thomas Willey machine® to fine powder and stored in air tight containers prior the time of the analyses at 4^0C.

Phytochemicals, proximate and minerals analyses

The phytochemicals and proximate analyses of the plant extracts were carried out at the Chemistry Department Laboratory, School of Sciences of the Federal University of Technology, Akure (Trease and Evans, 2005; AOAC, 2006). The results were obtained in duplicates and expressed as means ± SD using IBM SPSS Statistics version 23. Metabolizable energy was determined using the Janssen formula (Janssen, 1989).The minerals analysis was done in a reputable commercial Laboratory in Akure, Ondo State with the usage of AAS Buck Scientific 210 VGP & FP 902 Laboratory instrument.

Results and Discussion

The results of the phytochemical constituents, proximate and mineral composition of the two plants are shown in Table 1, 2 and 3. As seen in Table 1, *H. asper* and *H. sabdariffa* contained saponins, tannins, flavonoids, terpenoids and steroids. Glycosides were present in *H. asper* but absent in *H. sabdariffa*. Phlobatannins, alkaloids and anthraquinonoes were absent in the two plants. This agrees with the reports of Sulaiman *et al*. (2014) and Gbadamosi *et al*. (2018), that *H. sabdariffa* contained tannins, saponins, terpenoids and steroids while *H. asper* is very rich in flavonoids, tannins, saponins and cardiac glycosides respectively. The qualitative analysis of the phytochemicals showed that *H. asper* had higher values than *H. sabdariffa* in all the phytochemicals present in them. The phytochemicals in plants give them their medicinal value that has been tapped into by man and animals over the ages. According to the report of Osuntokun and Olajubu (2014), phytochemicals have the ability to prevent diseases in man and animals. They have the potential to alleviate the possibility of urinary tract infections (Bongoni *et al*., 2013).

Table 1: Phytochemical constituents of air-dried leaves of *H. asper* and *H. sabdariffa*

Phytochemicals	***H. asper***	***H. sabdariffa***	***H. asper***	***H. sabdariffa***
Saponins	+	+	8.000±0.257	6.727±0.257
Tannins	+	+	3.845±0.000	3.153±0.008
Flavonoids	+	+	2.619±0.005	1.550±0.005
Terpenoids	+	+	39.415±0.038	25.053±0.038
Steroids	+	+	8.042±0.018	4.371±0.018
Glycosides	+	-	12.476±0.046	ND
Phlobatannins	-	-	ND	ND
Alkaloids	-	-	ND	ND
Anthraquinones	-	-	ND	ND

Where (+) = present, (–) = absent and ND = not detected. Values are expressed as means ± SD.

Table 2: Proximate analysis of air-dried leaves of *H. asper* and *H. sabdariffa*

Parameters (%)	***Hibiscus asper***	***Hibiscus sabdariffa***
Moisture	12.163 ± 0.060	9.166 ± 0.234
Ash	11.709 ± 0.042	10.594 ± 0.532
Fat	9.579 ± 0.090	8.439 ± 0.243
Crude protein	13.903 ± 0.086	8.965 ± 0.355
Crude fibre	1.418 ± 0.065	0.885 ± 0.123
Carbohydrate	51.192 ± 0.274	62.309 ± 0.333
ME (Kcal/Kg)	3109	3107

Values are expressed as means ± SD of duplicate determination. ME = Metabolizable energy

Table 3: Mineral composition of air-dried leaves of *H. asper* and *H. sabdariffa*

Minerals (ppm)	***Hibiscus asper***	***Hibiscus sabdariffa***
Sodium (Na)	27.400	24.900
Potassium (K)	72.500	58.200
Calcium (Ca)	12.940	17.100
Magnesium (Mg)	10.480	10.130
Iron (Fe)	0.670	0.420
Copper (Cu)	0.280	0.250
Manganese (Mn)	0.074	0.095
Lead (Pb)	0.010	ND
Zinc (Zn)	1.027	0.780
Phosphorus (P)	3.130	2.420

Where ppm = part per million and ND = Not detected

The proximate analysis (Table 2) revealed *H. asper* values for moisture (12.163 ± 0.060), ash (11.709 ± 0.042), fat (9.579 ± 0.090), crude protein (13.903 ± 0.086) and crude fibre (1.418 ± 0.065) to be higher than that of *H. sabdariffa*. However, *H. sabdariffa* value for carbohydrate (51.192 ± 0.274) was higher than that of *H. asper*. Metabolizable energy in *H. asper* and *H. sabdariffa* were 3109 and 3107 Kcal/Kg respectively. This is even higher than the metabolizable energy in some of the commercial feed ingredients. The ash value for *H. asper* (11.709 ± 0.042) in this study was higher (3.27±0.06) than that reported by Gbadamosi *et al*. (2018) and conversely for the crude protein and crude fibre (lower). This may be attributed to the effect of geographical location. The low crude fibre obtained from *H. asper* (1.418 ± 0.065) and *H. sabdariffa* (0.885 ± 0.123) is a factor for effective digestibility of the leaves from these plants if incorporated as leaf meal into livestock diets. Consequently, it was observed from Table 3 that *H. asper* had higher values of Sodium (27.400 ppm), Potassium (72.500 ppm), Magnesium (10.480 ppm), Iron (0.670 ppm), Copper (0.280 ppm), Zinc (1.027 ppm), Phosphorus (3.130 ppm), compared to *H. sabdariffa.* Generally the two plants are rich sources of minerals because they are found in appreciable quantities. Lead (Pb) that was found in the plants in trace amount is required by the body in little or less quantity (lead is poisonous). According to Okwu and Okwu (2004), elevated level of lead (Pb) in the body is hazardous to the body systems. This justifies one of the reasons medicinal plants are used for various purposes all over the world.

CONCLUSION

Based on the results obtained from this study (phytochemicals, proximate and mineral composition) *H. asper* and *H. sabdariffa* are medicinal plants whose potentials can be explored by phytopharmaceutical industries and animal nutritionist for drug and feed formulation respectively. The ability of the leaves of these plants' to re-grow quickly after plucking is a credited plus to them.

Recommendations

Further studies: antimicrobial and antifungal properties are to be determined *in-vitro*. Analysis of the amino-acid profile of the plants, isolation of bioactive compounds (GC-MS) and *in-vivo* experiments with animals are also very important to be carried out.

REFERENCES

AOAC (Association of Official Analytical Chemists), (2006). Official Methods of Analysis of the AOAC. In: Horwitiz, W. (Ed.). 18th Edition. Association of Official Analytical Chemists, Washington D.C., USA.

Ayanbadejo, A., Ogundipe, O. T. and Olowokudejo, J. D. (2012). Taxonomic significance of the epicalyx in the genus Hibiscus (Malvaceae). Phytologia Balcanica 18(2): 135 – 140.

Bongoni, R., Steenbekkers, L. P. A., Verkerk, R., Van Boekel, M. A. J. S and Dekker, M. (2013). Studying consumer behaviour related to the quality of food: A case on vegetable preparation affecting sensory and health attributes. *Trends in Food Science & Technology* **33**(2): 139 – 145.

Gbadamosi, I. T., Abiade, A. A. and Agbatutu, A. (2018). An assessment of the Nutritional, Phytochemical and Antioxidant Properties os Hibiscus asper Hook. F. (Malvaceae). *Afr. J. Biomed. Res.* **21**(3): 331 – 338

Janssen, W. M. M. A (1989). *European tables of energy values for poultry feedstuffs*. 3rd Ed. Beekbergen Netherlands (Spelderholt Cenrtes for Poultry Research and information Services) pp 84.

Okwu, D. E and Okwu, M. E. (2004). Chemical composition of Spondias mombin Linn. Plant parts. *J. sustain. Agric Environ* **6**(2): 140 – 147.

Oloruntola, O. D., Ayodele, S. O., Agbede, J. O. and Oloruntola, D. A. (2016). Effect of feeding broiler chickens with diets containing *Alchornea cordifolia* leaf meal and enzyme supplementation. *Archivos de Zootecnia* **65**: 489 – 498.

Osuntokun, O. T. and Olajubu, F. A. (2014). Comparative Study of Phytochemical and Proximate Analysis of Seven Nigerian Medicinal Plants. *App. Sci. Res. J.* **2**(1): 10 - 26.

Sulaiman, F. A, Kazeem, M. O., Waheed, A. M, Temowo, S. O., Azeez, I. O., Zubair, F. I., Adeyemi, T. A., Nyang, A and Adeyemi, O. S. (2014). Antimicrobial and toxic potential of aqueous extracts of Allium sativum, Hibiscus sabdariffa and Zingiber officinale in Wistar rats. *Journal of Taibah University for Science* **8**(4): 315-322.

Trease, G. E. and Evans, W. C. (2005). Pharmacognosy, 11th Edition. Brailliar Tinidel Can. Macmillian Publishers.

Ukorebi, B. A., Akpet, S. O and Gbose, P. N. (2019). Haematology, serum biochemistry and organ histopathology of broiler chickens fed graded levels of *Gongronema latifolia* (Utasi). *Nig. J. Anim. Prod.* 2019, **46**(2): 164 – 175.

Wumnokol, D. P., Guluwa, L. Y and Latu, M. Y. (2019). Performance and Haematology of broiler starter fed Acha (*Digitaria exilis* staph) grains as replacement for maize. *Nig. J. Anim. Prod.* 2019, **46**(2): 87 – 91.

PREDICTION OF HAEMATOLOGICAL PARAMETERS OF FOUR-CHICKEN STRAINS USING SIMPLE LINEAR FUNCTION

Atansuyi, A.J., Falade, O.A., Joachim, C.O., Osifeso, J.O., Chineke, C.A. & Adebayo, O.T.

Department of Animal Production and Health, The Federal University of Technology, Akure, Ondo State, Nigeria
Corresponding author: *Atansuyi, A.J.; E-mail: ajatansuyi@futa.edu.ng; Tel: +2348034832175*

ABSTRACT
The objective of the study was to establish the relationship existing between haematological parameters by predicting the packed cell volume (PCV) of chickens from the other haematological variables in a study that was conducted at the Federal University of Technology, Akure Teaching and Research Farm. A total of 120-day old chicks of four strains were purchased from reputable Farm at 30 chicks per strain and used for the study that lasted eight (8) weeks. The experiment was arranged in a completely randomized design and the birds were distributed into four treatments according to their strain. Each group was replicated three times at 10 birds per replicate. The birds were fed experimental diet *ad-libitum* containing 23% crude protein and 2685.49Kcal/kg metabolizable energy during the period of the experiment. Adequate health preventive measures were ensured during the period of the study. At the end of the experiment, blood samples were collected from 12 birds per strain and were analyzed on computer using SAS (2008). Results showed that haematological parameters were highly significant ($p<0.01$) among the four chicken strains. Coefficient of determination (R^2) was highest in Haemoglobin for Naked neck breed with the value of 99.84%. Haemaglobin had the higher accuracy of prediction. This function was best with Marshall broilers compared to other chicken strains used for the study. White blood cells generally contributed low to PCV. It was concluded that Red Blood Cell (RBC) was the best predictor of PCV from other haematological variables across the chicken strains. Haematological parameters could be used to predict PCV in chickens and they could be used to assess the well being of poultry birds. This could help to generate baseline information necessary for breeding plans and improvement of the Nigeria Indigenous chickens.

Keywords: Indigenous, relationship, prediction, haematological parameters and improvement,

INTRODUCTION

Traditional poultry production in Nigeria is practiced in rural and semi-urban areas where conditions permit settlement of life. The household poultry production system is based on scavenging indigenous domestic chickens which may be accompanied by pigeons, guinea fowls, ducks or turkeys. Indigenous birds are usually raised as scavengers in an open yard, scratching and picking on the grounds (Ravi-Kumar *et al*., 2002). Analysis of haematological parameters of chickens is essential for the diagnosis of various pathological and metabolic disorders. It can be used as a diagnostic tool in order to assess the health status of an individual and/or a flock. Haematological changes are commonly used to determine the body status and to assess the impact of environmental, nutritional and/or pathological stresses.

Haematological parameters provide valuable information on the immune status of animals (Kral and Suchy, 2000). Such information, apart from being useful for diagnostic and management purposes, could equally be incorporated into breeding programmes for the genetic improvement of indigenous chickens. It is desirable to know the normal physiological values under local conditions for proper management, feeding, breeding, prevention and treatment of diseases. Meager information about the local ecotypes of birds and their characterization are available in the literature and no reliable data describing traditional poultry production are available. However, normal haematological information on Nigerian indigenous birds is hardly available in the literature as researches on these chickens had rarely been carried out. The present study was designed to partly rectify this deficiency and to provide baseline data on haematological parameters of some indigenous chickens in Nigeria.

MATERIALS AND METHODS

The study was carried out at Teaching and Research Farm, Livestock Section (Poultry Unit) of the Federal University of Technology, Akure, Ondo State, Nigeria with Latitude 07° 16^1 and 07° 18^1 N and Longitude 05° 09^1 and 05° 11^1 E. There is a unimodal rainfall pattern which starts from April to October and average of 1556mm per annum. The average ambient temperature was about 30 - 32°C and relative humidity of 80% (Climate data, 2018).

A total of 120-day old chicks were purchased from reputable farms in Abeokuta and Ibadan, Ogun and Oyo States of Nigeria. Thirty (30) chicks of each strain were procured and used for the study that lasted eight (8) weeks. The strains were normal feather, naked neck, frizzle feather and Marshall Chickens. The experiment was arranged in a completely randomized design (CRD) and the birds were distributed into four treatments according to their strain. Each strain was replicated three times at 10 birds per replicate. The birds were fed experimental diet *ad-libitum* containing 23% crude protein and 2685.49Kcal/kg metabolizable energy. Adequate health preventive measures were ensured during the period of the experiment. At the end of the experiment, 2ml blood samples were collected from twelve (12) birds per strain and emptied into well labelled ethylene diamine tetra acetate (EDTA) bottles. These blood samples were taken to the haematology Laboratory of the Department of Animal Production and Health of the University for Laboratory analyses of haematological parameters using Lamb (1981) procedure. All blood samples were collected at about the same time. The blood collection tubes were kept on ice pack in cool containers to avoid denaturing of proteins and were taken to the laboratory within 2 hours of collection. The haematological parameters studied were: packed cell volume (PCV), erythrocyte sedimentation rate (ESR), red blood cells (RBC), haemoglobin concentration (HBC) and the differential white blood cell (Heterophils, Basophils, Eosinophils, Monocytes and Lymphocytes). The blood constants (mean corpuscular haemoglobin concentration, Mean cell haemoglobin and Mean cell volume) were determined using standard formulae.

Data generated were analyzed on computer using SAS (2008) version 13 statistical software. Where significant differences were observed, means were separated using appropriate subroutine of the same statistical package. The statistical model used was:

$Yij = \mu + Ti + \epsilon ij$

Where

Yij= Haematology of jth bird in the ith strain (j = 1- 30)

μ = General mean

Ti = Fixed effect of the ith strain (i = 1- 4)

ϵij = Residual error

RESULTS AND DISCUSSION

The estimation of PCV from other haematological parameters in Table 1 showed that most of the haematological parameters were highly significant ($p<0.01$) among the four strains with Erythrocyte Sedimentation Rate (ESR), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH), Basophils (BAS), Haemoglobin (HB), Red Blood Cell (RBC), Eosinophils (EOS) and Monocytes (MON), while the Table equally revealed that Lymphocyte (LYM), Mean Cell Haemoglobin Concentration (MCHC) and Heterophil (HET) were not significantly different ($p>0.05$). Generally, the coefficient of determination (R^2) was highest in Haemoglobin (HB) for Naked neck (NN), Normal feather (NF), Frizzle feather (FF) and Marshal broiler (MB) with the various values 99.84 %, 99.81 %, 99.97 % and 99.94 % respectively and lowest in MCHC for NN with 0.00, BAS and EOS for NF with 0.00, EOS for FF with 0.10 and HET for MB with 0.21 as shown in Table 1. The function was best described in Marshall Broilers compared to other chicken strains used for the study.

On the estimation of PCV from other haematological variables, Red blood cells (x_2) had the highest contribution to the value of PCV in all the strains used in this study. Low contribution from the White blood cells showed that the experimental birds were clinically free from infectious micro-organisms (peters

et al., 2011) during the period of the study. On the basis of coefficient of determination (R^2), Haemaglobin (x_3) had the higher accuracy of prediction. Generally, all the haematological parameters were highly significant ($p<0.01$).

CONCLUSION AND RECOMMENDATIONS

The present study showed that the estimations of PCV from the other haematological parameters were generally significant across the strains used in the study. The estimation of Packed Cell Volume (PCV) from other haematological parameters using linear function revealed that Red Blood Cell (RBC) was the best predictor of PCV among the strains. Haemoglobin (x_3) had the highest accuracy of predictions based on the values of coefficient of determination (R^2). Packed Cell Volume (PCV) could be used to determine the health and immunological status of chickens.

In general, the result showed that haematological parameters could be used to predict the PCV of poultry birds. They could also be used to assess the well being of poultry birds vis-a-vis their health and physiological status. This study would help to generate baseline information necessary for breeding plans and improvement of the Nigeria Indigenous chickens. It was recommended that government and stakeholders should provide adequate funding for researches on indigenous chicken production.

Table 1: Estimation of PCV in simple linear function fitted for PCV–other haematological parameters for the various chicken genotypes

Breeds	Functions	SE	R^2 (%)	LS
NN	$Y = 32.17 – 3.42X_1$	0.73	73.53	***
	$Y = 16.07 + 4.42X_2$	0.44	93.83	***
	$Y = 0.04 + 3.00X_3$	0.04	99.84	***
	$Y = 40.41 – 0.34X_4$	0.02	77.17	***
	$Y = 40.55 – 0.34X_5$	0.06	77.89	***
	$Y = 25.97 + 0.02X_6$	7.17	0.00	NS
	$Y = 13.54 + 0.22X_7$	0.32	5.50	NS
	$Y = 30.17 – 0.15X_8$	0.25	4.66	NS
	$Y = 25.94 + 0.06X_9$	0.23	0.23	***
	$Y = 30.43 – 1.38X_{10}$	1.42	10.51	***
	$Y = 24.00 + 1.50X_{11}$	1.64	9.45	***
NF	$Y = 29.26 – 1.85X_1$	0.36	77.16	***
	$Y = 15.13 + 5.15X_2$	0.65	88.80	***
	$Y = 0.15 – 3.02X_3$	0.05	99.81	***
	$Y = 38.65 – 0.10X_4$	0.01	84.69	***
	$Y = 38.70 – 0.31X_5$	0.04	86.01	***
	$Y = 172.26 – 4.42X_6$	5.65	7.08	NS
	$Y = 2.11 + 0.37X_7$	0.21	28.81	NS
	$Y = 34.29 – 0.44X_8$	0.18	41.38	***
	$Y = 24.86 + 0.01X_9$	0.22	0.30	***
	$Y = 25.00 + 0.00X_{10}$	2.24	0.00	**
	$Y = 25.00 + 0.00X_{11}$	2.24	0.00	**
FF	$Y = 33.28 – 2.94X_1$	0.84	66.17	***
	$Y = 14.05 + 5.83X_2$	0.23	99.11	***
	$Y = 0.16 – 3.02X_3$	0.02	99.97	***
	$Y = 49.12 – 3.02X_4$	0.02	91.22	***
	$Y = 48.81 – 0.50X_5$	0.07	90.63	***
	$Y = 621.21 – 17.81X_6$	16.25	16.68	NS
	$Y = 48.06 + 1.25X_7$	1.07	78.49	NS
	$Y = 26.72 + 0.07X_8$	0.75	12.0%	NS
	$Y = 33.87 – 0.46X_9$	0.60	86.50	***
	$Y = 22.13 + 2.00X_{10}$	3.75	45.20	NS
	$Y = 27.86 + 0.14X_{11}$	5.80	0.10	**
MB	$Y = 32.50 – 3.25X_1$	1.28	61.68	***
	$Y = 14.86 + 5.44X_2$	0.80	92.00	***
	$Y = 0.16 + 2.99X_3$	0.04	99.94	***
	$Y = 44.69 – 0.14X_4$	0.05	66.73	***
	$Y = 44.81 – 0.43X_5$	0.15	66.80	***
	$Y = 40.65 – 8.08X_6$	16.65	5.57	NS
	$Y = 22.50 + 0.09X_7$	0.30	2.29	NS
	$Y = 27.32 + 0.04X_8$	0.44	0.21	**
	$Y = 36.48 – 0.67X_9$	0.51	30.50	**
	$Y = 23.67 + 1.50X_{10}$	1.51	19.71	**
	$Y = 34.40 – 3.40X_{11}$	1.99	42.19	***

FF= Frizzled feathered, MB= Marshal broiler, NF= Normal feathered, NN = Naked neck, HB=Haemoglobin, MCV = Mean Cell Volume, MCH = Mean Cell Haemoglobin, MCHC = Mean Cell Haemoglobin Concentration, LYM = Lymphocytes, HET = Heterophils, MON = Monocytes, BAS = Basophils, PCV = Packed Cell Volume, ESR = Erythrocytes Sedimentation Rate, RBC = Red Blood Cell, EOS = Eosinophils. Y = PCV, X_1 = ESR, X_2 = RBC, X_3 = HB, X_4 = MCV, X_5 = MCH, X_6 = MCHC, X_7 = LYM, X_8 = HET, X_9 = MON, X_{10} = BAS, X_{11} = EOS. ** significant ($p<0.01$), *** significant ($p<0.001$), NS = not significant, R^2 = Coefficient of determination, LS = Level of significance, SE = Standard error.

REFERENCES

Climate Data, (2018): Akure climate information. http://end.climate-data.org/location/385339. Retrieved on 17th April, 2018

Kral, I. and Suchy, P. (2000): Haematological studies in adolescent breeding cocks, *Acta Veterinaria Brno*, 69: 189-194.

Lamb, G.N. (1981): Manual of Veterinary laboratory technique. CIBA-GEIGY, Kenya, pp 96-107.

Peters, S. O., Gunn, H. H., Imumorin, I. G., Agaviezor, B. O., and Ikeobi, C. O. (2011): Haematological studies on frizzled and naked neck genotypes of Nigerian native chickens. *Tropical J. of Anim. and Health Prod.*, *43*(3), 631-638.

Ravi-Kumar, M., Bothra, T.and Ashok, K. (2002): Backyard poultry for socio-nutritional security of rural and tribal masses, *Poult. Planner*, 4: 10-11.

SAS, (2008): Statistical Analysis System User's Guide, Version 13 for Windows. Statistical Analysis Institute, Inc., SAS Camp Drive Cary, North Carolina U.S.A.

CASE OF A SARCOPTIC MANGE MANAGEMENT IN A 6-MONTH–OLD YANKASA EWE IN A SEDENTARY FULANI HERD IN TOHU VILLAGE, ZARIA LOCAL GOVERNMENT AREA OF KADUNA STATE

[1]Danbirni[*], S., [2]Kaltungo, B.Y., [1]Onoja, I.I., [1]Abubakar, U.B., [1]Ibrahim, S., [2]Mohammed F.U. & [3]Sinkalu, V.O.

[1]Department of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria
[2]Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria
[3]Department of Veterinary Physiology, Ahmadu Bello University, Zaria, Nigeria
Corresponding Author: *[*]Danbirni, Samaila: E-mail: drdanbirni07@yahoo.com*

ABSTRACT

A case of sarcoptic mange infestation in a 6-month-old Yankasa ewe weighing 22kg was presented to the student fellows in large animal section of Medicine Speciality, College of Veterinary Surgeon of Nigeria, A.B.U Zaria study centre during a routine ambulatory visit to a sedentary Fulani herd in Tohu village in Zaria LGA, Kaduna State. The infested ewe was in a flock of 13 sheep reared alongside with a herd of cattle. Physical examination revealed crusty lesions and areas of alopecia around the face, ear and limbs. Vital parameters were within normal range. Skin scrapping, blood and faecal samples were collected and taken to the Entomology, Clinical pathology and Helminthology laboratories of the Ahmadu Bello University Veterinary Teaching Hospital for identification of mites, helminthes and haemogram respectively. The laboratory results indicated a sarcoptic mite, marked eosinophilia and hyporoteinaemia while no parasite was observed in the faecal sample. Sarcoptic mange was diagnosed and the ewe was treated twice with ivermectin at one-week interval. The ewe apparently recovered after 2 weeks and the client was advised to treat all sheep in his farm.

Keywords: Sarcoptic mange, Ewe, Ivermectin, Tohu village.

INTRODUCTION

Sarcoptic mange is highly contagious skin disease caused by a mite and is transmitted most frequently by direct contact with infected animals (Taylor *et al.,* 2007; Reichard, 2016). The mite, *Sarcoptes scabiei* var *ovis* infests sheep and is quite hardy and can survive off the host animal in a home environment at room temperature for 1-6 days (Ahmed *et al.,* 2015). The parasite, *S scabiei* var *ovis* is zoonotic (Provet, 2013) and animals in poor condition appear to be most susceptible. This mite lives permanently in the superficial layers of the skin and disease occurs as a result of the irritation caused by the presence of the parasite in the skin, or, most often, due to an allergic (hypersensitivity) reaction in the host. It infests non-wooly skin, usually on the head and face (Rahbari, 2009*).* Clinical signs do occur from 3-6 weeks after infection with the mite. The lesions manifest with formation of crusts and intense pruritus, excoriation, crusts, lichenification and secondary alopecia on face and ears and secondary bacterial infection and thickening of the skin in chronic cases (Reichard, 2016). Self-trauma is due to scratching and biting. Female mites form shallow burrows in the lower stratum corneum of the skin and lay eggs in tunnels under the skin. They hatch in 3-8 days and then develop into larvae, nymphs and finally adults. The whole of the lifecycle takes 17-21 days and is completed on the host animal (Radostits *et al.,* 2006). Affected animals have decreased reproduction, meat gain, and milk yield (Wall and Shearer, 2001). Diagnosis is made by examination of deep skin scrapings and identifying mites, eggs or mite faeces (Ogundiyi *et al.,* 2012). The itchy pruritus can be controlled using anti-inflammatory drugs (e.g. corticosteroids), antibiotics may be needed if secondary bacterial infection is present, anti-seborrhoeic shampoos are also helpful to cleanse the skin (Provet, 2013). Positive diagnosis can be made only by scraping lesions on the sheep with a scapel blade and observing the mites in the scrapings. The present case reports the natural infestation of *S. scabei* in a sheep and its therapeutic management with Ivermectin at field condition.

MATERIALS AND METHODS

History and physical examination

A 6-month-old Yankasa ewe weighing 22kg from a flock of 13 sheep with history of crusty lesion on the face was presented to the student fellows in large animal section of Medicine Speciality, College of Veterinary Surgeon of Nigeria (CVSN), Ahmadu Bello University, Zaria study centre during a routine ambulatory visit to a sedentary Fulani herd in Tohu village in Zaria LGA, Kaduna State. History revealed that the lesions were noticed about 4 weeks prior to the visit. The animal was managed on an extensive system of management and had no medical history. Physical examination revealed crusty lesions and areas of alopecia around the face, ear and limbs (Plate I). The rectal temperature was 38.8□C; pulse 108 beats per minute, and the respiratory rate was 16 breaths per minute. The differential diagnoses were: mange, dermatophilosis, pediculosis and ring worm. However, on a closer examination of the lesions, the tentative diagnosis became mange. This was due to the fact that scabs in dermatophilosis can easily be peeled off, in pediculosis, there are no crusts and the lice or their nits would have been visible. Also in ring worm, the lesions would have been circumscribed. Blood and rectal faecal samples were collected and sent to Clinical Pathology and Helminthology laboratories respectively for screening. To arrive at a confirmatory diagnosis, deep skin scrapping at the periphery of the lesion was collected and sent to the Entomology laboratory for possible mite identification. The ewe was treated with Ivermectin (Ivomec®) subcutaneously at the rate of 0.2mg/kg b. wt. and was repeated after 1 week. The animal recovered completely after 2 weeks of revisit. Thus, there was complete resolution of the mange in respect of skin texture i.e; disappearance of crusts and subcutaneous appearance of fresh and shiny skin with hairs.



Plate I. Sarcoptic mange Yankasa Ewe with crusty lesions/alopecia on the face, ears and limbs

RESULTS AND DISCUSSION

Entomology laboratory:

The microscopic examination revealed presence of *S. scabiei* mites which was differentiated by rounded mouth parts, absence of eyes/stigmata, short posterior legs, presence of empodial claws and pulvillus on first two pairs of legs, presence of transverse ridges on dorsal surface of the body (Wall and Shearer 2001).

Helminthology Laboratory:
No parasite found in the faecal sample.
Clinical pathology laboratory result
Table I: Haemogram of a 6-month–old Yankasa ewe with sarcoptic mange in a sedentary Fulani herd in Tohu village in Zaria Local Government Area of Kaduna State

Parameter	Patient's Value	Reference range
PCV %	22	24-50
Hb g/dl	7.3	8-15
WBC x 10^9/l	7.1	4-12
Neutrophils %	30	10-50
Lymphocytes %	54	40-75
Monocytes %	06	0-6
Eosinophils %	28	0-10
Total protein g/dl	5.4	6-7.9

The primary signs observed in the present case are similar with that of Murthy *et al*. (2013) and they included pruritis, excoriation, crusts, lichenification and secondary alopecia on face and ears. The affected area was intensely excoriated because of itching, scratching and biting. Treatment was carried out with two shots of Ivermectin at 1 week interval because initial injection could only kill the mites but not the unhatched mite eggs. This perhaps may be due to inability of the drug to penetrate the thick egg shell and also due to its specific site of action (nervous system), Ivermectin may not be effective against the younger stages of the parasite inside the egg because the nervous system is not yet developed. However, administration of the second injection treats any newly hatched mites (Currie and McCarthy, 2010; Sharma and Signal, 2011). Administration of ivermectin has been reported to be effective in the treatment of mange in several countries (Sargison *et al.,* 1995; Sharma and Signal, 2011). All vital parameters of the animal were within the normal range showing that there is no systemic involvement in the condition. It is worthy of note that the result from clinical pathology examination showed marked eosinophilia indicating a high antigenic stimulation by the mites due to their burrowing activities and also due to the effect of their saliva and excreta (Sharma and Signal, 2011; Ameen *et al*., 2012). The animal had a body condition score of 2 on a scale of 5 which agrees with the reports of Lughano and Dominic (2006), who reported that animals with mite infestation become emaciated and die out of exhaustion probably due to abstinence from grazing and constant scratching of body. This may explain the slightly low packed cell volume (PCV) and hemoglobin (Hb) values observed (Table 1). This finding agrees with the observation of Hafeez *et al*. (2007), who reported that Hb and PCV in mange infested animals is lower than normal. Also, poor body condition is usually associated with undernourishment which leads to decline in immunity and susceptibility to pathogens including ectoparasites (Taylor *et al*., 2007). The hypoproteinaemia observed

may be associated with protein deficiency due to malnutrition and loss of plasma protein caused by dermatitis (Ameen *et al*., 2012).

CONCLUSION AND RECOMMENDATION

The treatment of the ewe twice with ivermectin at one week interval against sarcoptic mange was effective. The ewe recovered completely after 2 weeks of treatment. The client was advised to treat the rest of the flock in the farm because Sarcoptic mange is contagious. The environment should also be treated in case mites have dropped off into bedding or floor coverings. Animal owners and veterinarians should consider mite control in sheep as part of routine control of ectoparasites.

REFERENCES

Ahmed, Y., Bersissa, K., Yacob, H. and Dinka A. (2015). Mites of sheep and goats in Oromia Zone of Amhara Region, North Eastern Ethiopia: species, prevalence and farmer's awareness. *BMC Veterinary Research*, 11:122.

Ameen, SA., Adedokun, RAM, Ajayi, JA., Oguntunde, MM. and Okewole, EA. (2012). Studies on epidemiological survey of mange infestation of small ruminants in Ogbomosho Areas of Oyo State, Nigeria. *Academic Journal of Animal Diseases*, 1(2):07-12.

Currie, BJ and McCarthy, JS. (2010). Permethrin and ivermectin for scabies. *New England Journal of Medicine*, 362:717-25.

Hafeez, UA., Zia-Ud-Din, S., Zafar, I., Abdul, J. and Zahida, T. (2007). Prevalence of sheep mange in District Dera Ghazi Khan(Pakistan) and Associated hematological/biochemical disturbances. *International Journal of Agriculture and Biology*, 9(6): 917-920.

Lughano, K, Dominic, K. (2006). Diseases of small ruminants. A handbook "common diseases of sheep and goats in Sub-Saharan Africa. International Managers of the Livestock Production Programme (LPP) funded by DFID.

Murthy, GSS., Nagesha, AM. and Hemanna, GK. (2013). Therapeutic management of Sarcoptic mange in a sheep flock. *Journal of Parasitic Diseases*, 37(2): 281-282.

Ogundiyi AI, Bemji MC, Adebambo OA, Dipeolu MA, Onagbesan OM, James IJ. (2012). Prevalence of mange among West African Dwarf sheep and goats and associated haematological and biochemical parameters. *Tropical Animal Health Production*, 44:1263–1269.

Provet, (2013). Sarcoptic mange (scabies) www.provet.co.uk/petfacts/healthtips/sarcopteshtm

Radostits, OM., Gay, CC., Hinchcliff, KW. and Constable, PD. (2006). Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pigs and goats. London: Elsevier; pp. 1608–1609.

Rahbari, S., Nabian, S. and Bahonar, AR. (2009). Some observations on sheep sarcoptic mange in Tehran province, Iran. *Tropical Animal Health Production*, 41:397–401.

Reichard, MV. (2016). Mange in Sheep and Goats. Oklahoma State University.

Sargison, ND., Scott, PR., Penny, CD. and Pirie, RS. (1995). Treatment of naturally occuring sheep scab *(Psoroptes ovis*) in the United Kingdom with ivermectin. *The Veterinary Record*, 136:236-238.

Sharma, R. and Signal, A. (2011). Topical permethrin and oral ivermectin in the management of scabies: A prospective, randomized, double blind, controlled study. *Indian Journal of Dermatology Venereol Leprol*, 77(5):581-586.

Taylor, MA, Coop, RL and Wall, RL. (2007). Veterinary Parasitology. 3rd ed. Oxford, UK: Blackwell Publishing LTD; p. 874.

Wall, R. and Shearer, D. (2001). Veterinary ectoparasites: biology, pathology and control. 2. Tokyo: Blackwell sciences Ltd.

ANTIOXIDANT STATUS OF TURKEY POULTS FED GINGER POWDER

Daramola, O.T*, Jimoh, O.A*, Oloruntola, O.D[+] & Balogun A.T*
**Department of Agricultural Technology, The Federal Polytechnic, Ado-Ekiti*
[+] Department of Animal Science, Adekunle Ajasin University, Akungba Akoko, Ondo-State
Corresponding Author: olajumoke.daramola2016@gmail.com

ABSTRACT
This study was carried out to investigate the effect of ginger (*Zingiber officinale)* on antioxidant status of turkey poults. A total number of ninety-six (96) two-weeks old American Bronze turkey poults were divided into four treatment groups in completely randomized design with a total of 12 experimental unit. The poults were assigned at the rate of 24 per treatment in 3 replicates of 8 poults per replicate. Ginger was washed, sliced, sundried and ground into fine particles. The test ingredient was used to compound the diets at different inclusion levels of 0, 0.2, 0.4 and 0.6%. A basal diet (turkey starter) was compounded for the period of the experiment (14day to 56day). Blood samples (3 turkey poults per treatments) were collected through the jugular veins at the termination of the experiment into heparinized bottle for antioxidant enzymes determination. The glutathione peroxidase (GPx) activity significantly ($p<0.05$) increased in the turkey poults fed diets supplemented with 0.2, 0.4 and 0.6% ginger. Significant ($p<0.05$) increased superoxide dismutase (SOD) activity was recorded at 0.2, 0.4 and 0.6% ginger when compared to 0% (control diet). Catalase (CAT) activity significantly ($p<0.05$) increased in turkey poults fed 0.6% ginger supplemented diets when compared to the other diets. It can be concluded that ginger when used as supplement in turkey poults diets at the rate of 0.6% can combat oxidative stress by enhancing the SOD, GPx and CAT activities.

Keywords: Ginger, Turkey poult, Antioxidant, Herbs, Growth promoters

INTRODUCTION
The use of antibiotic growth promoters in livestock and poultry production has been in vogue for many years due to the emergence of drug resistance microorganisms, side effects of antimicrobials and the harmful residual toxicity effect of drugs observed in food chain (Mahima *et al*., 2013). The valuable sources of medicines are currently in increasing demand and popularity on which about 80% of people in developing countries still rely for their primary health care (Verma and Singh, 2008).People are now aware of the limitations of synthetic drugs and chemicals in terms of higher cost, anticipated toxicity and adverse effects (Adu *et al*., 2009). On the other hand, the natural medicines are more suitable for animal health care with the benefits of total safety. In this era of food safety concern, emerging antibiotic resistance and residual effects in food products can play wonderful role for safeguarding health of humans and animals (Hashemi and Davoodi, 2012). Nowadays, there has been an increase in demand for natural antioxidants in food due to its health benefits against oxidative stress and several diseases. Plant derived antioxidants are gaining more demand in poultry nutrition because their meat has high content of polyunsaturated fatty acid and susceptible to lipid oxidation (Christaki, 2012). Spices like cinnamon, nut meg, ginger etc have been shown to have antioxidant properties as they contain the compounds such as polyphenolics, flavonoids and terpenoids (Botsoglou *et al.*, 2013). Studies showed that the active ingredients of herbs (ginger) have strong antioxidant effects including neutralization of superoxide, hydrogen peroxide and nitric oxide either by scavenging radicals or by increasing the production of glutathtion peroxidase (GPx), superoxide dismutase (SOD) and catalase (CAT) (Yarru *et al*., 2009). Ginger contains some important metabolites and alkaloids like gingerol, shogaol, gingerdione and other phenolic compounds which have antioxidant properties (Zhao *et al*., 2011). Ginger is the rhizome of the plant *Zingiber officinale* consumed as a delicacy, medicine or spice (Botsoglou *et al*., 2002). (Al-Amin *et al*.,2006) reported that a study conducted in-vitro tests show that the ginger extract might control the quantity of free radicals and the peroxidation of

lipids. The aim of the present study was to evaluate the role of ginger on the antioxidant enzyme status in turkey poults.

MATERIALS AND METHODS

The test ingredients ginger powder (*Zingiber officinale*) used for this study was purchased at the local market, Ado-Ekiti. The test ingredient was washed, sliced, sundried and ground into fine particles. It was used to formulate the diet at different inclusion levels of 0%, 0.2%, 0.4% and 0.6%. A basal diets (turkey starter) was formulated for the period of the experiment (14day to 56day) to meet the NRC (1994) requirements for turkey poults. Thereafter, the basal diet was divided into four (4) diets. Diet 1 contained 0% of ginger supplementation, diet 2 was supplemented with 0.2% of ginger, diet 3 was supplemented with 0.4% while diet 4 was supplemented with 0.6%. Ninety-six, two (2) weeks old American Bronze turkey poults breed were randomly distributed to four dietary treatments (8 turkey poults per replicate); 24 poults per treatments) in a completely randomized design (CRD).Eight (8) birds were housed in their respective pen, they were fed ad-libitum throughout the period of the experiment (42days). On the last day of experiment (42day), blood samples collection (3 turkey poults per treatments) was done in the morning after the birds were starved overnight into a heparinized tube which was kept in ice to provide hemolysate for determination of activity of antioxidant enzymes superoxide dismutase (SOD) (Misra and Fridovich, 1972), glutathione peroxidase (GPx) (Rotruck *et al*., 1973) and catalase (CAT) (Aebi, 1974). All data collected were subjected to analysis of variance using SPSS version 20. Duncan's Multiple Range Test of one way ANOVA was used to analyse the mean differences of the same parameters, significant differences were considered where necessary at a level of ($P<0.05$**).**

RESULTS AND DISCUSSION

The effect of dietary ginger on antioxidant parameters of turkey poults is presented in Table 1. The Glutathion peroxidase (GPx) value was significantly ($p<0.05$) higher in birds on diets 2,3,4 than the values recorded for birds on control diet suggesting that ginger supplementation at 0.2, 0.4 and 0.6% significantly increased the activities of GPx. There was a significant ($p<0.05$) increase in the values of superoxide dismutase (SOD) in birds fed the test ingredients (diets 2,3 and 4). The highest value of SOD was recorded for birds on diet 4 while the lowest value of SOD was recorded for birds on control diet. The catalase (CAT) values recorded for birds on diet 4 was significantly ($p<0.05$) higher than the values recorded for birds on other diets. Ginger contains some important metabolites and alkaloids like gingerol, shogaol, gingerdione and other phenolic compounds which have antioxidant properties (Zhao *et al.*, 2011). In addition, the positive effects of antioxidants properties of phytochemicals to poultry on oxidative status parameters was reported by Akbarian *et al*. (2016).

Table 1: Effect of ginger on antioxidant parameters of turkey poults fed experimental diets

	Diets				
	1	2	3	4	± SEM
	Ginger inclusion				
Parameters	Control diet				
GPx (µ/mol)	4.47^{c}	10.73^{b}	11.04^{b}	11.71^{a}	0.88
SOD (%)	40.50^{d}	44.88^{c}	55.66^{b}	60.21^{a}	0.05
CAT (mg/g)	225.31^{a}	257.02^{b}	261.24^{b}	285.18^{a}	0.62

GPx: glutathione peroxidase; SOD: superoxide dismutase; CAT: catalase.Means with different superscript on the same row differ significantly (P<0.05)

REFERENCES

Adu, O.A., Akingboye, K.A and Akinfemi, A. (2009).Potency of pawpaw (*Carica papaya*) latex as an anthelmintic in poultry production. Bot. Res. Int., 2:139-142.

Aebi, H. (1974). Catalase estimation In: H.V Bergmeyer (ed). Methods of enzymatic analysis. Verlag chemic, New york Academic Press, New york USA.

Akbarian, A., Michiels, J., Degroote, J., Majdedding M., Golian, A. and De Smet, S. (2016). Association between heat stress and oxidative stress in poultry; mitochondrial dysfunction and dietary interventions with phytochemicals. Jrn. Anim. Sci. Biotech., 7: 37-56.

Al-Amin, Z.M., Thomson,M., Al-Qattan, K.K, Peltonen-Shalaby, R. and Ali, M. (2006). Anti-diabetic and hypolipidaemic properties of ginger (in Streptozotocin-induced diabetic rats. Br. Jrn. Nutr. 96; 660-666.

Botsoglou, N.A., Florou-Paneri, E., Christaki, E., Fletouris, D.J and Spais B.A (2002). Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. Brit. Poult. Sci. 43: 223-230.

Botsoglou, E., Govaris, A., Fletouris, D. and Iliadis S. (2013). Olive leaves (O lea europeal.) and α-tocopheryl acetate as feed antioxidants for improving the oxidative stability of α-linolenic acid-enriched eggs. Jrn. Anim. Physiol. Anim. Nutr. 97: 740-753.

Christaki, E. (2012). Naturally derived antioxidants in poultry nutrition Res. Jrn. Biotechnol.7: 109-112.

Hashemi,S.R and Davoodi, H. (2012). Herbal plants as new immune-stimulator in poultry industry: A review. Asian Jrn. Anim. Vet. Adv., 7: 105-116.

Mahima, A., K.Verma, R. Tiwari, K. Karthik, S. Chakraborty, R. Deb and K. Dhama (2013). Nutraceuticals from fruits and vegetables at a glance: A review Jrn. Biol. Sci., 13: 38-47

Misra, H.P and Fridovich, I. (1972). The univalent reduction of oxygen by flavins and quinines. Jrn. Biol. Chem.247: 188-192.

NRC (1994). Nutrient requirements of poultry, 9th Revised Edition. National Academy Press. Washington DC.

Oloruntola, O.D., Ayodele, S.O., Agbede, J.O and Oloruntola, D.A (2016b). Effect of feeding broiler chickens with diets containing *Alchornea cordifolia* leaf meal and enzyme supplementation. Arch.de.zootech., 65: 489-498.

Rotruck, J.T., Pope, A.L., Ganther, H.E., Hafeman, D.G and Hoekstra, W.G (1973). Selenium: Biochemical role as a component of glutathione peroxidase Sci., 179: 588-590.

Verma, S. and S.P Singh (2008).Current and future status of herbal medicines Vet. World, 1: 347-350.

Yarru, L.P., R.S Settivari, N.K. Gowda, E. Antoniou, D.R Ledoux and G.E Rottinghaus (2009). Effects of turmeric (*Curcuma longa*) on the expression of hepatic genes associated with biotransformation, antioxidant and immune systems in broiler chicks fed aflatoxin Poult. Sci. 88: 2620-2627.

Zhao, X., Z.B Yang, W.R Yang, Y. Wang, S.Z Jiang and G.G. Zhang (2011). Effects of ginger root (Zingiber officinale) on laying performance and antioxidant status of laying hens and on dietary oxidation stability. Poult. Sci., 90: 1720-1727.

EFFECT OF ACTIVATED CHARCOAL ON DIFFERENT ASPECTS OF POULTRY PERFORMANCE: REVIEW

S.N. Okey[1], A.U.C. Ohanaka[2], B. B. Okafor[1], C.C. Ogbu[1], S.C. Akomas[1] & I.C.Okoli[2]
[1]Department of Veterinary Biochemistry and Animal Production, College of Veterinary Medicine, Michael Okpara University of Agriculture Umudike, Nigeria
[2]Department of Animal Science and Technology, Federal University of Technology, Nigeria
***Corresponding author:** S.N. Okey; E-mail: nnamuokey@yahoo.com*

Abstract
This paper presents a short review of the effects of activated charcoal (AC) on different aspects of poultry performance. Activated charcoal is a solid, porous, tasteless and black carbonaceous material prepared from a variety of carbon containing materials, including agricultural residue. In powder form it acts as adsorbent for many toxins according to physical and chemical nature of the precursor. Several studies reviewed showed AC, as a non-digestible and cheap substance that may be of benefit to poultry gut health, growth and laying performance, especially in the tropics where microbial degradation of feed is a major threat.

Keywords: Activated charcoal, poultry performance, broilers, layers

INTRODUCTION

Feed remains the most important component of the cost of production in the intensive poultry sector. Several biotechnology techniques are currently being used to reduce cost and increase poultry productivity. One of the viable methods has been the use of growth promoters such as prebiotics to improve feed efficiency and poultry health. These substances do not contribute to the nutrient needs but are rather used to control pathogenic organisms in the gut. This is desirable in view of the fact that the gut is one of the major organs determining the performance of birds and the economics of production, with the profile of intestinal microflora playing a significant role in gut health. However, most of these substances or natural growth promoters are not readily available to Nigerian poultry farmers who are mostly small-scale producers. Therefore, cheaper alternative additives like activated charcoal and clay minerals (Thacker, 2013) which could be produced on the farm or supplied from a nearby cottage industry will be of value to farmers.

Activated charcoal also called activated carbon or biochar is a solid, porous, tasteless and black carbonaceous material prepared from a variety of carbon containing materials, including agricultural residues. Activated charcoal when ground into fine powder acts as an adsorbent for many toxins with the absorbance being dependent on pore size, surface area, concentration and chemical nature of the precursor (Yahya *et al.*, 2015). Awad *et al.* (2009) reported that adding activated charcoal to poultry diet can help recover the intestinal integrity, improve gut health and thus increase nutrient availability and absorption. Currently, the use of activated charcoal in poultry production is an emerging research area that is still generating the needed literature for ultimate on-farm application. There is therefore the need to articulate what is currently known, especially as it applies to poultry production in the tropics.

This paper presents a short review of the effects of activated charcoal on different aspects of poultry performance.

EFFECT ON GROWTH, HAEMATOLOGY AND SERUM CHEMICAL PROFILES

Growth is an increase in mass of a living substance and so, weight change can be considered an index of growth. Odunsi *et al.* (2007) supplemented wood charcoal into broiler starter and finisher diets and reported that body weight gains and feed conversion ratio (FCR) were significantly better in the control group than those fed charcoal based diets. This is in agreement with the report of Kutlu *et al.*(2001) that charcoal supplementation reduces feed intake and feed conversion ratio, with the reduction being attributed

to higher bulk density of charcoal supplemented feed (Evans *et al.*, 2015). Majewska and Zaborowski (2003) however reported that AC supplemented birds were 1- 6.5% heavier, 5.9% better in their FCR and 1.6% better in their survival rate than the control group. Dim *et al.* (2018) reported that the final body weight, average daily weight gain and FCR were better in birds on 6% AC inclusion than other groups after 56 days trial period similar to the reports of Kutlu *et al.* (1999).

Dim *et al.* (2018) also noted that WBC count and PCV were not affected at both the starter and finisher phases, while haemoglobin concentration (Hb) and RBC count were significantly improved while cholesterol and lipoprotein levels were significantly reduced, probably due to the ability of the birds on AC to maximally utilize the vitamin-mineral premix in the diet. No significant differences in high density lipoprotein (HDL) and triglycerides were observed across the treatment groups. Majewska *et al.* (2009) reported that dietary supplementation of AC at 0.3% did not significantly affect RBC, WBC, Hb and PCV values of broilers fed aflatoxin-B1 contaminated feeds. Majewska *et al.* (2002) had used charcoal as feed additive to raise turkeys and reported non-significant differences in the serum biochemical indices.

EFFECT OF ACTIVATED CHARCOAL ON CARCASS QUALITY

.Kutlu *et al*. (2001) reported that wood charcoal significantly increased the carcass weight, carcass yield and carcass ash and fat contents in broiler chickens. However, charcoal inclusion to the diet did not affect carcass dry matter and protein contents significantly. Majewska and Zaborowski (2003) reported that carcass yield, liver, spleen and kidney weights did not show any major variations among the treatment groups though the broiler fed 7.5% wood charcoal had the least percentage carcass yield and abdominal fats. While cut-up parts did not vary across the groups, the lung, heart and gizzard showed slight changes among the treatment groups when compared with the control. This showed that wood charcoal used in the study had no major physiological effects on tissue and organ development and functions when compared with the control. However, a positive development in the reduction of abdominal fat deposition in broilers fed wood charcoal based diets was noticed when compared to the control group. These results with respect to subcutaneous and abdominal fat deposition could indicate lower intake of dietary energy with charcoal inclusion in the diet (Kutlu *et al.*, 2001). This means that as the charcoal level in the diet increases, FCR and fat excretion increases, while fat deposition also reduces.

EFFECT OF ACTIVATED CHARCOAL ON LAYING PERFORMANCE AND EGG QUALITY

The addition of beneficial feed additives such as AC to the diet can help recover the intestinal integrity, improve gut health and thus increase nutrient availability and absorption (Awad *et al.*, 2009) which result to increased laying performance. A mixture of bamboo charcoal powder and bamboo vinegar has been shown to induce a significant increase in egg production by stimulating intestinal functions of laying hens in the early phase of production (Yamauchi *et al.*, 2010). These were attributed to the beneficial effects of the product in promoting intestinal functions which may help to absorb and assimilate more nutrients. In late phase of production, Rattanawut *et al.* (2017) supplemented with the commercial bamboo vinegar, SuperBob® at 0, 0.5, 1.0 and 1.5% inclusions to the basal diet. They reported no significant differences between the groups with respect to egg shell weight, yolk colour and Haugh (an index of albumen quality).

Kutlu *et al.* (2001) studied the effects of dietary oak charcoal on laying performance using Hyline breed fed a standard commercial layer diet and supplemented with 0, 10, 20 and 40g ground wood charcoal per kg. There was no effect on egg weight, albumen weight, yolk weight, shell weight, shell thickness and shape index. However, AC supplementation reduced the number of cracked eggs in a dose-related manner which is attributed to the absorption capacity of charcoal for dietary fat and its excretion. Increased fat excretion promoted by charcoal probably enhanced mineral utilization, particularly calcium which promotes shell formation in the shell gland. Charcoal supplementation induced a non-significant reduction in feed intake, egg production and FCR. The lower feed intake was possibly due to higher bulk density and blackening of the diets by charcoal and decrease in palatability (Jindal *et al.*, 1994).

EFFECT OF ACTIVATED CHARCOAL ON EXCRETORY PRODUCTS

Studies by Plank *et al.* (1990) revealed that wood charcoal increased fat excretion which is expected in view of its binding effect on fat, fat soluble substances and noxious substances that may interfere with digestion. This increased fat excretion could be beneficial in preventing the malfunctioning of the GIT associated with poor fat digestion as a result of limited bile synthesis in young birds. This result in addition to reduced carcass fat content and abdominal fat weight suggest reduced intake of dietary energy sources with charcoal inclusion in diet (Kutlu *et al.,* 2001). In other words, as the charcoal level in the diet is increases, the FCR and fat excretion increases, while fat deposition in the body decreases.

Activated charcoal inclusion in the diet reduces nitrogen free extract excretion while markedly increasing fiber excretion in a dose-dependent manner (Duke, 1986). This means that increased levels of AC in high fiber diet will increase fiber consumption and excretion. The major constituents of dietary fibre are cellulose, hemicellulose and lignin which are poorly digested by birds (Kutlu *et al.,* 2001). Activated charcoal also increases carcass ash content in a dose-dependent manner and this is a reflection of the increased mineral intake (Duke, 1986).

Effect of activated charcoal on gastrointestinal tract histomorphology and Ecology

Activated charcoal as an adsorbent has the potential to condition the cell membranes, reduce surface tension by eliminating gases and toxins in the GIT to improve absorption and utilization of nutrients (Majewska *et al.,* 1999). Broiler chickens fed 1% bamboo charcoal diet recorded the highest body weight with the jejunal villus height and area being higher than those of other groups (Xia *et al.,* 2004). Increased villus height is indicative of a greater absorptive surface area and a better capacity of absorbing available nutrients. Villus height is increased by enhanced efficiency of digestion and absorption in the small intestine due to increased population of beneficial bacteria that supply nutrients and stimulate vascularization and development of the intestinal villi (Gilmore and Ferreti, 2003). Choct (2009) reported a shorter villus when the counts of pathogenic bacteria increased in the GIT, which results in fewer absorptive and more secretory cells. It has been suggested that there is a strong correlation between gut structure and type of feeding materials and that villus height can be used to predict weight gain. A commercial charcoal product, Nekka-Rich®, was fed as prebiotic to leghorn chickens and it was able to significantly reduce the Salmonella recovered from the large intestine and faecal samples.

CONCLUSION

Activated charcoal, a non-digestible and cheap substance may be of benefit to poultry gut health, growth and laying performance, especially in the tropics where microbial degradation of feed is a major threat.

REFERENCES

Awad, W. K. G. and Bohm, J. (2009). Intestinal structure and function of broiler chickens on diets supplemented with a synbiotic containing *Enterococcus faecium*and oligosaccharides. *International Journal of Molecular Sciences*, 9: 2205 - 2216.

Choct, M. (2009). Managing gut health through nutrition. *British Poultry Science*, 50: 9 - 15.

Chu, G. M., Jung, C. K., Kim, H. Y., Ha, J. H., Kim, J. H., Jung, M. S., Lee, S. J., Song, Y., Ibrahim, R. I. H., Cho, J. H., Lee, S. S. and Song, Y. M. (2013). Effect of bamboo charcoal and bamboo vinegar as antibiotic alternatives on growth performance, immune responses and faecal microflora population in fattening pigs. *Animal Science Journal*, 84: 113-120.

Dim, C. E., Akuru, E. A., Egom, M. A., Nnajiofor, N. W., Ossai, O. K., Ukaigwe, C. G. and Onyimonyi, A. E. (2018). Effect of dietary inclusion of biochar on growth performance, haematology and serum lipid profile of broiler birds. *Agro Science*, 17(2): 8-16.

Duke, G.E. (1986). Alimentary canal: secretion and digestion, special digestive functions, and absorption. In: Sturkie, P.D. (Ed.), *Avian Physiology Springer*, New York, Pp: 289-302.

Evans, A. M., Loop, S. A. and Moritz, J. S. (2015). Effect of poultry litter biochar diet inclusion on feed manufacture and 4-21-d broiler performance. *Journal of Applied Poultry Research*, 24: 380-386.

Gilmore, M. S. and Ferretti J. J. (2003). The thin line between gut commensal and pathogen. *Science*, 299: 1999-2002.

Jiang, S., Cui, L., Shi, C., Ke, X., Luo, J. and Hou, J. (2013). Effect of dietary energy and calcium levels on performance, egg shell quality and bone metabolism in hens. *Veterinary Journal*, 198: 252-258.

Jindal, N., Mahipal, S.K. and Mahajan, N.K. (1994). Toxicity of aflatoxin B_1 in broiler chicks and its reduction by activated charcoal. *Research Veterinary Science*, 56: 37-40.

Kutlu, H.R., Unsal, I. and Gorgulu, M. (2001). Effect of providing dietary wood (Oak) charcoal to broiler chicks and laying hens. *Animal Feed Science Technology*, 90: 213-226.

Kutlu, H. R., Unsal, T., Gorgulu, M. and Baykal, I. (1999). Effect of prosviding dietary wood charcoal to broiler chicks of different ages. *British Poultry Science*, 40: 34-36.

Majewska, T. and Zaborowski, M. (2003). Charcoal in the nutrition of broiler chickens. *MedycynaWeterynaryjina*, 59: 81-83.

Majewska, T. D. and Pryrek-Faruga, A. (2002). A note on the effect of charcoal supplementation on the performance of big 6 heavy tom turkeys. *Journal of Animal Feed Science.*, 11: 135-141.

Majewska, T., Zaborowski, M. and Zaewski, K. (1999). Effect of feed supplementation with charcoal on production results of broiler chickens (In polish). *ZeszNaukPrzHod*, (45): 371-378.

Majewska, T.D., Mikulski, D. and Siwik, T. (2009). Silica grit, charcoal and hardwood ash in turkey. Journal of food Science, 11:135 – 141.

Odunsi, A. A., Oladele, T. O., Olaiya, A. O. and Onifade, O. S. (2007). Response of broiler chickens to wood charcoal and vegetable oil based diets. *World Journal of Agriculture Science*, 3(5): 572-575.

Plank, G., Bauer, J., Grunkemeier, A., Fischer, S., Gede, B. and Berner, H. (1990). The protective effects of adsorbents against ochratoxinA in swine. *Tierarztl.Prax*, 18: 483-489.

Rattanawut, J., Todsadee, A. and Yamauchi, K. (2017). Effects of bamboo charcoal powder including vinegar supplementation on performance, eggshell quality, alterations of intestinal villi and intestinal pathogenic bacteria populations of aged laying hens. *Italian Journal of Animal Science*, 16 (2): 259-265.

Thacker, P.A. (2013). Alternatives to antibiotics as growth promoters in swine production: A review. *Journal of Animal Science and Biotechnology*, 4(10): 4-35.

Xia, M. A., Hu, C. H. and Xu, Z. R. (2004). Effects of copper bearing montmorillonite on growth performance, digestive enzyme activities and intestinal microflora and morphology of male broilers. *Poultry Science*,83: 1868-1875.

Yahya, M.A., Al-Qodah, Z. and Ngah, C.Z. (2015). Agricultural bio-waste materials as potential sustainable precursors used for activated carbon production. A review. *Renewable and Sustainable Energy Review*, 9: 851 – 855.

Yamauchi, K., Ruttanavut, J. and Takenoyama, S. (2010). Effect of dietary bamboo charcoal powder including vinegar liquid on chicken performance and histological alternations of intestine. *Journal of Animal Feed Science*, 19: 257-268.

ORGAN AND CARCASS WEIGHT VARIATION IN *EIMERIA TENELLA* INFECTED BROILER CHICKENS TREATED WITH METHANOL EXTRACT OF *PARKIA BIGLOBOSA* ROOT BARK

Garba M. U.

[1] Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Nigeria Nsukka, Enugu, Nigeria; matthias.ugwuoke@unn.edu.ng (*Corresponding Author)*

ABSTRACT

The experiment was designed to evaluate the effect of methanol extract of *Parkia biglobosa* root in *Emeria tenella* infected broilers. One hundred and fifty broilers grouped into 6 groups (n = 25) were used for the study as follows: infected treated with extract (A), infected treated with amprolium (B), infected untreated (C), uninfected untreated; (control) (D), uninfected treated with extract (E), and uninfected treated with amprolium (F). Each broiler was infected at 28 days of age with 20,000 infective *Eimeria tenella oocysts* and treated at day 7 post infection with either extract or Amprolium at a dose rate of 200 mg/ml in drinking water for 7 days. Carcass and Organ weights were measured at 35 days of age. The results showed significant difference in the carcass and organ weights (P>0.05) between the groups. This study proved that the root bark of *Parkia biglobosa* has no adverse effects on organs of treated broilers, instead improved carcass weight and ameliorated clinical signs of bloody diarrhea associated with *Eimeria tenella* infection in broilers.

Keywords

Broilers, Coccidiosis, Organs, *Parkia biglobosa*, Weight.

INTRODUCTION

Coccidiosis is one of the most economically important prevalent parasitic diseases which has adversely affected the growth and fortune of poultry farmers worldwide (Gharekhani et al., 2014). Coccidiosis affects virtually all domestic and wild species, causing signs such as paleness, diarrhea with or without blood, poor feed conversion, weight loss, and in severe cases even death. *Eimeria*, protozoan parasites of the Phylum Apicomplexa are considered the main risk to avian production since they are the causative agent of avian coccidiosis (Blake *et al*., 2015). Avian coccidiosis is caused by seven species of *Eimeria*, which parasitize chickens intestine. According to a recent estimate, the global cost of the protozoan to the poultry industry is estimated to be over USS 2.4 billion per annum (Ola-Fadunsin *et al*., 2017). In Nigeria, the disease is caused by *Eimeria tenella, E. necatrix, E. bruneti, E. acervulina, E. mitis* and *E. praecox* (Jatau *et al*., 2012). These species have predilection sites in the different parts of gastrointestinal tract.The management comprises of ionophorous compounds (ionophores) and synthetic drugs (chemicals). However, the increased occurrence of resistance against routine anticoccidial drugs, the toxic effects of these chemicals on poultry and the development of drug residues in poultry meat and egg (Goetting et al., 2011) have left the poultry industry with a renewed challenge for coccidiosis prevention and control. These have propelled the search for alternative strategies among which plant products provide a good alternative. Some of these plants are indigenous to Nigeria and may serve as a source of foreign revenue when exported to developed economies where people are becoming more aware of the toxic effects of using chemotherapeutic agents in producing animal protein. *Parkia biglobosa* is one of such plant alternatives. The stem bark of *P. biglobosa* has been reported to have some coccidiostatic activities (Maikai *et al*., 2007) and antimalarial effects (Traore *et al*., 2013). The stem bark is used for treating hypertension (Karou *et al*,, 2011) and listed as having wound healing properties in South-Western Nigeria (Adetutu *et al.*, 2013). A decoction of the root is used in the treatment of coccidiosis by natives in western Nigeria (Olanipekun, 2014). There is no data on the anticoccidial activity of the root bark extract of *P. biglobosa* in

broiler chickens. In this study, the anticoccidial activity and the effect of methanol extract of *P. biglobosa* root bark was evaluated in broiler chickens experimentally infected with *Eimeria tenella* oocysts.

RESULT

Carcass yield and organ weight

Data on body weight, carcass weight/dressed and parts of the broilers are shown in Table1. It is observed that among the infected groups, the body weight was higher in the *P. biglobosa* treated group A (3.2 kg/broiler) and the amprolium treated group B (3.2 kg/broiler). The infected but untreated group C had the least body weight (2.7 kg/broiler). In the uninfected broilers, group E (*P. biglobosa* treated) recorded a higher body weight (3.4 kg/broiler), followed by the amprolium treated group F (3.3 kg/broiler) and lowest the untreated group D (3.1 kg/broiler). In the results, it was also observed that among the infected groups the carcass yield was higher in group A (2.8 kg/broiler), followed by B (2.6 kg/broiler) and lowest C (2.4 kg/broiler) (Table1). Among the uninfected groups, D (untreated) recorded 2.5 kg/broiler, E (P. biglobosa treated) and F (amprolium treated) recorded 2.6 and 2.8 kg/broiler, respectively.

DISCUSSION

The slight difference observed by the decrease in weight of the carcass parts (thigh, back and neck, wings) in group C and D (Table 1) may be due to the lack of treatment of the broilers with either the *P. biglobosa* or amprolium. Also significant weight difference ($P < 0.05$) existed in group B among the weight of the organs, where the liver (1.8%), heart (0.6%) and the spleen (0.2%) weighed more than those in the other groups as shown in Table 1. The variation in weight of the organs in group B may be due to a compensatory mechanism in relation to treatment with amprolium and the coccidian infection. *Eimeria tenella* is a very pathogenic chicken coccidia that parasitize caecum of young chickens and is characterized by acute onset manifested by clinical signs of bloody diarrhea due to invasion of the mucosal lining of the caecae by the second generation merozoites and the associated microscopic changes due to coccidiosis which include congestion of the mucosa of the intestine, diffuse or patchy haemorrhagic enteritis, lymphocytic and mononuclear cells infiltration of the intestinal mucosa and sloughing of epithelial lining (McDougald and Reid,1997). Also, it is a known fact that the weight of organs in broilers is indicative of the response of birds to the feed intake in relation to their age or growth of broilers. The weight of organs in broilers also reflects the anatomical response of broilers to the type of diets consumed, such as the use of whole grains in feed or large high fibre particles (Atteh, 2004).

Table 1: Organ and Carcass body weight (%) of broiler chickens treated with *Parkia biglobosa* and Amprolium after infection with *Eimeria tenella* oocysts

Group Parameters	A Infected	B Infected	C Infected	D Uninfected	E Uninfected	F Uninfected
Average live Body weight (Kg/broiler)	3.2[b]	3.2[b]	2.7[a]	3.1[b]	3.4[b]	3.3[b]
Carcass/dressed weight (kg/broiler)	2.8[b]	2.6[b]	2.4[a]	2.5[b]	2.6[b]	2.8[b]
Carcass/live body weight ratio (%)						
Breast/chest	23.3[b]	22.2[b]	23.1[b]	23.2[b]	23.1[b]	23.2[b]
Thigh/legs	22.4[b]	22.0[b]	22.5[c]	20.8[a]	22.7[b]	23.2[b]
Back/neck	21.8[b]	21.1[b]	20.8[a]	22.2[b]	22.1[b]	22.3[b]
Wings	11.1[b]	11.3[b]	9.6[a]	9.5[a]	10.0[b]	9.6[b]
Shanks	6.4[b]	6.3[b]	6.1[b]	5.2[a]	5.7[b]	6.0[b]
Organs and live body weight ratio (%)						
Gizzard	2.0	2.1	2.0	2.0	2.2	2.4
Liver	1.7	2.0	1.7	1.7	1.8	1.6
Heart	0.6	0.8	0.4	0.6	0.5	0.6
Spleen	0.2	0.3	0.2	0.2	0.1	0.2
Intestines, etc.	8.3	10.2	12.1	11.3	10.7	9.2

*****Means within the horizontal line, followed by different lower-case superscripts are significantly different ($P < 0.05$). Group A- treated with *P. biglobosa* extract, B-treated with amprolium, C and D- not treated, E- treated with *P. biglobosa* extract, F- treated with amprolium.

CONCLUSION

In conclusion, this study has shown that the methanol extract of *Parkia biglobosa* root bark may have improved the carcass yield of broilers and also ameliorates clinical signs of bloody diarrhea consistent with *Eimeria tenella* infections in broiler chickens. The root bark of *P. biglobosa* has no harmful or adverse effect on the organs of treated broilers with or without *Eimeria tenella* infection. It is recommended that further research on the potential use of the root bark of *P. biglobosa* for the control of coccidiosis in broiler chickens be carried out. *P. biglobosa* root bark may be recommended to poultry farmers in the absence of conventional anticoccidial drugs.

REFERENCES

Adetutu A, Morgan W, Corcoran O (2013). Ethnopharmacological survey and in vitro evaluation of wound-healing plants used in South-western Nigeria. *Journal of Ethnopharmacol* 137 (1): 50 - 56.

Atteh J.O (2004). Critical review of the activities of feed enzymes in Nigeria. *Bio-ingredients (Nig.) Ltd Seminar* held on 21st May, 2004 at Airport Hotel, Ikeja, Lagos State.

Blake D.P, Clark E.L, Macdonald S.E, Thenmozhi V, Kundu K, Garg R …Fiona M (2015). Population, genetic, and antigenic diversity of the apicomplexan *Eimeria tenella* and their relevance to vaccine development. *Proceedings of the National Academy of Sciences of the United States of America* 112 (38): 5343 – 5350.

Gharekhani J, Sadeghi-Dehkordi Z, Bahrami M (2014). Prevalence of coccidiosis in broiler chicken farms in western Iran. *Journal of Veterinary Medicine*, 1-4.

Goetting V, Lee K.A.,Tell L.A (2011). Pharmacokinetics of veterinary drugs in laying hens and residues in eggs: a review of the literature. *Journal of vet. Pharmacol. Therapeutics*.34, 521–556..

Jatau I.D, Sulaiman N.H, Musa I.W, Lawal A.I, Okubanjo O.O, Isah I, … Magaji Y (2012). Prevalence of Coccidia Infection and Preponderance *Eimeria* Species in Free Range Indigenous and Intensively Managed Exotic Chickens during Hot-wet Season, in Zaria, Nigeria. *Asian Journal of Poultry Science* 6: 79 - 88.

Karou S.D, Tchacondo T, Tchibozo M.D, Abdoul-Rahaman S, Anani K, Koudouvo Komlam B, …. Comlam D (2011). Ethnobotanical study of medicinal plants used in the management of diabetes mellitus and hypertension in the Central Region of Togo. *Pharmacological Biology* 49 (12): 1286 – 1297

Maikai, Victor, Adeiza, Abubakar, Maikai B.V (2007). Preliminary Studies of Anticoccidial Effect of Mahogany (Khaya senegalensis) and African Locust Beans Tree (Parkia biglobosa) Aqueous Bark Extracts on Chicken Infected with Coccidia. *Savannah Journal of Agriculture* 2: 43 – 51.

McDougald L.R, Reid W.M (1997). Coccidiosis in Chickens. In: Diseases of Poultry, Calnek, BW, HJ Barnes L.R McDougald, Saif Y.M (Eds.). Iowa State University Press, Ames, Iowa, USA. 865 - 878.

Ola-Fadunsin S.D, Ademola I.O (2013). Direct effects of *Moringa oleifera* Lam (*Moringaceae)* acetone leaf extract on broiler chickens naturally infected with Eimeria species. *Tropical Animal Health and Production* 45 (6): 1423–1428.

Olanipekun M.K (2014). Survey And Chemical Composition Of Plants Used As Herbal Remedies In Managing Poultry Animal Diseases In Ekiti State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science* **7** (11): 10 -16.

Traoré M, Baldé M, Oularé K, Magassouba F, Diakité I, Diallo A,…. Balde A.M (2013). Ethnobotanical survey on medicinal plants used by Guinean traditional healers in the treatment of malaria.. *Journal Ethnopharmacology* 150 (13) 1145 – 1153.

THE CONCEPTS OF ANIMAL WELFARE AND ITS CURRENT SITUATION IN TRADE CATTLE MANAGEMENT IN NIGERIA: AN OVERVIEW

I.E. Eze, C.C. Nwokeocha, C.C. Achonwa, C.P.Ukwu, I.F. Etuk & I.C. Okoli
Department of Animal Science and Technology, Federal University of Technology, P.M.B 1526 Owerri, Imo State, Nigeria
Corresponding author: *I.E. Eze; E-mail:geovanni1892@gmail.com*

ABSTRACT
Animal welfare has arisen in society to express ethical concerns about the quality of life experienced by animals, particularly animals used in production agriculture.Although animal welfare studies originate more in developed countries, the topic is also emerging in developing nations. Animal welfare could be determined in terms of biological functioning that measures reactions to stress, including plasma levels of glucocorticoids, catecholamines, prolactin and endorphins, as well as heart rate and brain levels of neurotransmitters. Geographical and human conditions in sub-Saharan Africa suggest the welfare of trade animals for slaughter are negatively affected and that this also negatively affects meat quality and hence have economic impact. Nigeria has a Criminal Code which includes regulations on animal protection, that regulat markets bodies and road check points to monitor the welfare of trade cattle. Field reports indicate that these regulations are rarely – if ever – enforced.

Keywords: Animal welfare, trade cattle, agriculture, Nigeria

INTRODUCTION

Animal welfare concerns the state of an animal relative to the environment in which it lives. In recent times, animal welfare as a term, has arisen in society to express ethical concerns about the quality of life experienced by animals, particularly animals that are used in production agriculture. The term is therefore not one that necessarily expresses a scientific concept, nevertheless, because scientific methodsare used to identify, interpret and implement societal concerns about animal quality of life issues, animal welfare has become established as a scientific field (Duncan, 2004).

Thus, animal welfare has now become measurable characteristics of an animal at a particular time or during a period (Grandin, 2015).Still animal welfare remains a complex and emotional topic which is difficult to define and assess. For example, the handling, loading, transporting and unloading of animals can have very substantialeffects on their welfare and meat quality, which may be given different interpretations by different stakeholders. Therefore, there is the need to monitor welfare issues associated with trade animal handling and transportation, especially in developing countries were such topics are considered novel.

This paper reviews the concept of animal welfare and the current situation in trade cattle in Nigeria.

SCIENTIFIC PERSPECTIVES OF ANIMAL WELFARE

Animal welfare concern has become well established in many industrialized countries, particularly in the last 50 years. Increased ethical concerns about animal farming for food production and increased attention to animal rights drive these developments safeguard animal welfare (Fraser *et al.*,1997) that has led to regulations on the production, transport, and slaughter of farm animals (Caporale*et al.*, 2005). Scientific research on animal welfare issues has also increased, especially in response to public concerns about intensive production systems (Grandin, 2015). Although animal welfare studies originate more in developed countries, the topic is also emerging in developing nations (Mugande and Croney, 2019). In applying animal welfare approaches developed in industrialized countries in developing countries, theremay need to consider the economic, cultural and religious peculiarities of such countries (Mugande and Croney, 2019).

The scientific assessment of animal welfare involves measurements that capture different viewpoints on what constitute a good quality of life for animals. Development of scientific disciplines relevant to animal welfare has a long history and has been summed to include animal husbandry, animal science, veterinary

medicine and behavioral science, which contribute to the understanding of welfare problems of transport of farm animals to slaughter location (Grandin, 2015). Welfare is affected by many factors, as expressed by the five Freedoms (freedom from fear and distress; freedom to express normal behavior; freedom from hunger and thirst; freedom from discomfort; and freedom from pain, injury and distress) (Widowski *et al.,* 2016). It is also affected by the fact that people vary in the emphasis that they place on physical aspects, mental aspects and naturalness. Therefore, science has to cope with this complexity by applying a systematic approach to the asking of questions, and yielding answers that, as information accumulates from one or more comparable situations, are increasingly reliable and generalizable (Smith and Grandin, 2004). Similarly, scientific measurements of animal welfare have been shown to include health and biological fitness, the motion or subjective experiences of animals as well as ability to perform natural or specie-typical behavior pattern (Widowski *et al.,* 2016).

It is now understood that welfare and product quality are related and that poor welfare practices will result in inferior meat quality. Welfare varies on a scale from very good to very poor. Health is also an important part of welfare, while feelings, such as pain, fear and various forms of pleasure, are components of the mechanisms for attempting to cope and so should be evaluated where possible in welfare assessments (Broom, 2008). Where an individual is failing to cope with a problem, it is said to be stressed. Stress is an environmental effect on an individual, which overtaxes its control systems and reduces its fitness or appears likely to do so (Broom and Johnson, 2000). Welfare may be considered in terms of the subject experiences of animals or in terms of biological functioning that measures reactions to stress including plasma levels of glucocorticoids, catecholamines, prolactin and endorphins, as well as heart rate and brain levels of neurotransmitters(Broom, 2008).

Animal Transportation and Welfare

Around 60 billion animals are reared for food each year worldwide, most of which are transported for slaughter, often for long distances, both within and between countries. This massive movement of live animals takes place against a background of increasing concern and understanding of factors that affect animal welfare during transportation and increasing awareness that animal welfare may be correlated with food safety and quality. Physical welfare problems caused by transportation include injury, disease and stress which may be detected from behavior and from physical effects such as failure to grow or from physiological measurements (Ukwu, 2013). Transported animals may die or mortality may be increased by high or low temperatures, by long journey times and by transporting very young animals(Hong *et al.,* 2019).

Evidencesof mental welfare are usually based on whether animals have what they want and whether they are suffering. For example, many preferences of animals may be frustrated by transport, both to avoid conditions such as vibration and noise, and to express normal behavior(Hong *et al.,* 2019). Forms of suffering caused by transport include hunger, thirst, discomfort, pain, frustration, fear and distress (Appleby *et al.,* 2008), which generally increase with time of deprivation or exposure, such as during long-distance transport. In order to reduce the adverse effects on food animals and the economic losses encountered during animal transportation, The EU developed the Welfare of Animal Transport Order 1997, which allows a maximum journey time of 19 hours that must include a one-hour break for food, water and rest after each 8-9 hours.

EFFECTS OF TRANSPORTATION ON TRADE ANIMAL WELFARE

The necessity of transportation in trade animal production for meat cannot be over emphasised as the need to transport food animals occurs essentially in commercial agriculture and to a lesser extent in the rural or subsistence sector. Animals areusually moved due to marketing, slaughter, re-stocking, and drought areas to better grazing and change of ownership. It involves several stages starting with gathering of animals from farms, driving or trekking them to markets, where they are gathered in corrals and pens, loading them

into vehicles, transporting them to the slaughterhouse, unloading them, and then driving them to lairage pens and to slaughter (Gallo *et al.,* 2018). For trade animals that go through livestock markets, the whole processes get repeated several times as they are not directly from farm to slaughter(Appleby *et al.,* 2008). According to Minka and Ayo(2009), geographical and human conditions in sub-Saharan Africa suggest that in many occasions, the welfare of trade animals for slaughter are negatively affected and that this also negatively affects meat quality and hence have economic impact. Therefore, animal welfare improvement is necessary to reduce suffering in food animals, which will better the conditions of the livestock and the safety of the handlers.

EFFECT OF ANIMAL HANDLING ON TRADE ANIMAL WELFARE

Inappropriate handling of trade cattle during the entire transport operation as loading, journey time and unloading can be more stress-inducing than the transportation itself. Arney and Aland(2010) reported that improper handling due to poor welfare causes impairment of meat quality, not only through mechanical damage to the carcase, but also through chemical changes in the meat, such as reduced pH and the consequences of high levels of cortisol, which is released during periods of stress. The risk of injury and stress during handling of livestock can be high, causing financial loss to producers, transporters and the slaughterhouse (FAO, 2002).

Gallo *et al.* (2018) reviewed the standard regulation for handling trade animals in South America countries that cover production systems, transport and slaughter, with the general aim of acknowledging that farm animals are sentient beings and that there is a need to reduce pain and unnecessary suffering in them. The regulation for industrial production systems as outlined by the EU includes indicationsregarding feeding, health, and housing conditions; with specific prohibitions during handlinglike hitting, pricking, or grabbing animals as well as trainingobligations. These make it compulsory to have at least one person trained as an animal handler ineach productive system (Gallo *et al.,* 2018).

Loading of animals into a transport vehicle has been reported as one of the most stressful procedures and a critical point within the general transport process, which interfere with animal welfare (Miranda *et al.,* 2009). The standard for maintaining welfare is that the stockmen are trained in animal handling, understanding when the animals are calm and that the infrastructure is adequate, particularly loading ramps (Gallo *et al.,* 2018).

WELFARE OF TRADE CATTLE IN NIGERIA

The welfare of trade cattle in Nigeria is an issue worth reviewing because the livestock production approach employed by the farmers is usually the traditional system of production. This system involves traditional methods of production, including health and marketing. (Okoli*et al.,* 2005). Livestock is exchanged not only between northern markets but also between the northern and southern parts of Nigeria (Okoli and Kalla, 2008). The welfare concerns of trade cattle in Nigeria therefore rise from ativities in the local markets in the north, handling and disease management as well as the long distance journey during road transportation to the markets in the South (Minka and Ayo, 2009). These processes expose trade cattle to environments that cause injuries, sickness, fear agitations and in some cases death.

Nigeria has aCriminal Code (amended 1991), which includes regulationson animal protection that regulations markets bodies and road check points to monitor the welfare of trade cattle (Appleby *et al.,* 2008). Owners guilty of cruelty to animals are first given the option of a fine, and arenot liable to imprisonment unless they are unable to pay the fine. Field reportsindicate that these regulations are rarely – if ever – enforced (Appleby *et al.,* 2008).

REFERENCES

Appleby, M.C., Cussen, V., Garcias, L., Lambert, L.A., and Turner, J. (2008). *Long distance transport and welfare of farm animals.* CABI Publishing, Wallingford, Oxfordshire,UK.

Arney, D. and Aland, A. (2010). Humane transport and slaughter of farm animals. *Sustainable Agriculture,* 147: 344 – 348.

Broom, D.M. (2008). the welfare of livestock during road transport. In: M Apple by, V Cussen L, Garcés L Lambert, J Turner (Eds.), *Long distance transport and the welfare of farm animals.* England, UK. Pp: 157-181.

Broom, D. and Johnson, K. (2000). *Stress and animal welfare.* Chapman and Hall, London.

Caporale, V., Alessandrini, B., Villa, P.D. and Del Papa, S. (2005). Global perspectives on animal welfare: Europe. *Revue Scientifique et Technique-Office International des Epizooties*, 24(2): 567.

Duncan, I.J.H. (2004). A concept of welfare based on feelings. In:G.J. Benson & B.E. Rollin, (eds.). *The well-being of farm animals: Challenges and solutions*.Blackwell, Ames.Pp: 85 – 101.

FAOSTAT (2002). Statistical database of the United Nations' Food and Agricultural Organisation (FAO), assesses through http://apps.fao.org in September 2002.

Fraser, D., Weary, D.M., Pajor, E.A. and Milligan, B.N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*,6: 187 – 205.

Gallo, C.,Tarumán, J. and Larrondo, C. (2018). Main factors affecting animal welfare and meat quality in lambs for slaughter in Chile. www.mdpi.com/journal/animals

Grandin, T. (2015). *Improving animal welfare: a practical approach*. CABI, Publishing, Wallingford, Oxfordshire,UK.

Hong, H., Lee, E., Lee, I.H. and Lee, S.K. (2019). Effects of transport stress on physiological responses and milk production in lactating dairy cows. *Asian-Australasian Journal of Animal Sciences*, 32(3): 442 – 451.

Minka, M. S. and Ayo, J. O. (2009). Physiological responses of food animals to road transportation stress. *African Journal of Biotechnology*, 8 (25): 7415 – 7427.

Miranda de la Lama, G., Villarroel, M., Olleta, J., Alierta, S., Sañudo, C. and María, S. (2009). Effect of the pre-slaughter logistic chain on meat quality of lambs. *Meat Science*, 83: 604 – 609.

Mugenda, L. and Croney, C. (2019). Factors affecting perceptions of animal welfare in developing countries. Animal Sciences, ag.purdue.edu/ansc

Okoli, I.C., Aladi, N.O., Etuk, E.B., Opara, M.N., Anyanwu, G.A.and Okudo, N.J. (2005). Current facts about the animal food products safety situation in Nigeria. *Ecology of Food and Nutrition,* 44: 359 - 373.

Okoli, I.C. andKalla, D.J.U. (2008). Regional response is key to mitigating the impact of environmental change on livestock production in West Africa. In:*Food Security and Environmental Change-Linking Science, Development and Policy for Adaptation. An International Conference,* 2nd to 4th April 2008. University of Oxford, UK

Ukwu, C.P. (2013). Influence of selected stressors on day old chicks development in the hot humid tropical environment of southeastern Nigeria. MSc Thesis, Federal University of Technology, Owerri, Nigeria.

Widowski, T.M., Hemsworth, P.H., Barnett, J.J. and Rault, J.L. (2016). Laying hen welfare, social environment and space. *World's Poultry Science Journal,* 96: 3816 – 3823.

AFLATOXIN CONTAMINATION ACROSS SOME SELECTED POULTRY FARMS AT MALUMFASHI LOCAL GOVERNMENT AREA OF KATSINA STATE

[1]Jinadu, L.A. & [1]Salihu, L.I.
[1]Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria.
[*]***Corresponding Author***: Luqman.jinadu02@gmail.com, +234(0)8063956048

ABSTRACT
This study was conducted to assess the level of Aflatoxin B_1(AFB1) contamination in poultry eggs, feeds and litters collected from six (6) randomly selected farms at Malumfashi Local Government Area of Katsina State. A total of number of 36 samples were analysed for AFB_1. This comprised of three (3) feeds samples and three (3) eggs samples were collected from each farm. The AFB_1concentrations (µg/kg) in all the samples was analysed using ELISA kits. The *Aspergillus flavus* was the most prevalent Fungus followed by *Aspergillus niger*. The mean concentration of AFB_1 in poultry feeds was 15.93±1.53 µg/kg and the least was 5.27±1.31 µg/kg. Approximately 83% of the feed samples were having AFB_1 contamination above 5.00 µg/kg as recommended by FAO for animal feeds. Thus, farmers should frequently test their livestock feeds for aflatoxins and eggs should also be properly screened before consumption.

Keywords: Fungi, Aflatoxin, Poultry eggs, Malumfashi

INTRODUCTION
Mycotoxins cause illness and mortality in domestic animals fed moldy feedstuffs. These acute intoxications can have devastating effects and are difficult to diagnose and treat because the suspect feed may be consumed before it can be tested (CAST, 2003). It has been estimated that more than five billion people in developing countries worldwide are at risk of chronic exposure to aflatoxins through contaminated foods (Strosnider *et al*., 2006). In many parts of Africa, the need to eat outweighs other considerations such as food safety, and as such, this has made food-borne intoxications to be a serious problem in many respects. It was reported that about 40% of the productivity in birds was lost to diseases in developing countries but was most likely due to diseases exacerbated by aflatoxins (Bennett, 2003). Darwish *et al*.(2014) reported that aflatoxins are the most common mycotoxins (43.75%) in Africa followed by fumonisin (21.87%), ochratoxins (12.5%), zearalenone (9.38%), deoxynevalenol (6.25%) and beauvericin (6.25%). Darwish *et al*.(2014) reported that there is high levels of aflatoxin in samples collected from several African countries including South Africa, Lesotho, Egypt, Tunisia, Morocco, Sudan, Tanzania, Zambia, Uganda, Kenya, Ethiopia, Nigeria, Ghana, Benin, Mali, Togo and Bourkina Faso. Aflatoxin B_1 have been given considerable attention because of their demonstrated carcinogenic potential and hepatotoxic effects in both humans and animals (Fouad *et al*., 2019; Negash, 2018; Daodu and Adebowale, 2016). There has not been sufficient report on aflatoxin contamination in poultry feeds and eggs at Malumfashi local government area of Katsina State. Thus, this study provided a baseline data on aflatoxin contamination in poultry feeds and eggs produced by poultry farmers in Malumfashi Local Government Area of Katsina State.

MATERIALS AND METHODS
Study location
Malumfashi is one of the notable Local Government Areas of Karadua Zone, Katsina State of Nigeria. It is located at 11°48′N 7°37′E11.800°N 7.617°E, with a total area of 674 km2 (260 and a population of 182,920 (NPC, 2006).

Sampling method
In this study 18 industrial eggs and 18 feeds samples from 6 different poultry farms (randomly selected out of 66 farms) with 3 replicates (in each replicate 3 eggs and 3 feed samples). Aflatoxin-B1 concentration in these samples was determined via ELISA techniques.

Aflatoxin b_1 determination procedures materials used
Microplate of 96 wells; Micropipette; Weighing balance; Incubator with in-build digital shaker; Laboratory Blender; Conical flasks; Beakers; pH meter; Measuring cylinder; Filter paper; Voxtex mixer; Pipette tips; ELISA Reader (BIO-RAD); Magnetic Stirrer; Orbit-Shaker

Aflatoxin B_1 quantification procedures
The quantification of aflatoxin B_1 was done using ELISA technique following the protocol.

RESULTS AND DISCUSSION
The distribution of the fungal isolated from the feed samples is presented in Table 1. The result showed that the feed samples were infected more with Aspergillus *flavus* with 94.4% followed by *Aspergillus niger with* 61.1% while the occurrence of *Penicillium* was found to be the least (33.3%). These findings are similar with those reported by D'Mello (2004) and Sivakumar *et al*. (2014). This might be due to the use of infected feed ingredients and feed storage system. *Aspergillus spp* are known to thrive better in high temperature and humidity (D'Mello, 2004).

Table 1: Distribution of isolated fungi from feed samples across the selected farms

Farms	No of samples	Fungi Isolated from feed samples				
		Aspergillus niger	***Aspergillus flavus***	***Fusarium***	***Penicillium***	***Rhizopus***
A	3	1	3	2	1	2
B	3	1	3	2	1	0
C	3	1	3	1	2	2
D	3	2	2	3	1	0
E	3	3	3	0	1	2
F	3	3	3	0	0	2
Total	18	11	17	8	6	8

Figure 1 above shows the level of AFB_1 contamination across the feed samples that were analysed. The highest mean concentration of AFB_1 was detected in Farm A with about 15.93µg/kg (±1.53 µg/kg) and followed by Farm C with a mean concentration of 15.47 µg/kg (±2.46 µg/kg). Farm F has the least AFB_1 concentration with a mean of 5.27 µg/kg (±1.31 µg/kg). These variations might be as a result of differences in the feed ingredients and their feed management systems. Similar levels of AFB_1 contamination in animal feeds have been reported from different parts of the world (Pereira *et al.*, 2019). Kana *et al*. (2013) also reported AFB_1 concentration of 2 – 23 µg/kg for layer feeds and 2 – 52 µg/kg for broiler feeds in Cameroun.

Figure 1: **shows the level of AFB_1 contamination across the feed samples**

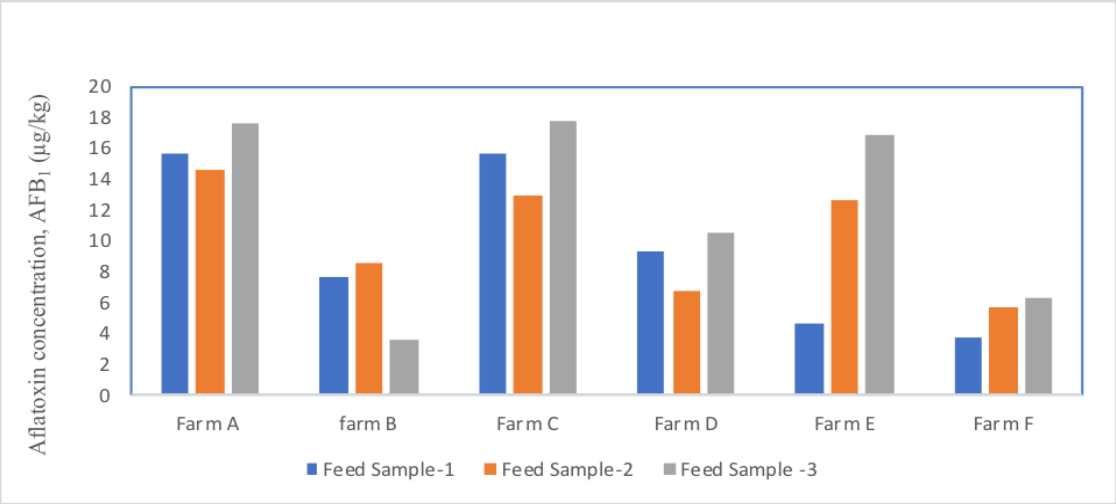


Table 2 shows the distribution of isolated fungi from egg shell swabs across the selected farms in Malumfashi. *Aspergillus flavus* had the highest occurrence (88.9%) in the egg shell while the least obtained was *Penicillium* with 16.7%. This contamination of the egg shells might be as a result of the contact between the eggs and feeds after laying. Similarly, Eggshell contamination may be initiated due to the conditions of egg acquisition, that is, the quality of straw and feed, the presence of dust, temperature and moisture (Lukasz *et al.,* 2018). We can suppose that the eggs produced in the deep litter indoor housing, free-range or even organic systems are at the highest risk of contamination with microscopic fungi

Table 2: Distribution of isolated fungi from egg shell swabs across the selected farms in Malumfashi

Farms	No of samples	Fungi Isolated from egg shell swabs				
		Aspergillus niger	**Aspergillus flavus**	**Fusarium**	**Penicillium**	**Rhizopus**
A	3	2	3	3	1	0
B	3	3	2	2	1	2
C	3	1	2	1	0	0
D	3	1	3	2	1	0
E	3	0	3	0	0	3
F	3	1	3	0	0	3
Total	18	8	16	8	3	8

CONCLUSION AND RECOMMENDATIONS

Aspergillus flavus was found to be the most predominant Fungus contaminating poultry feeds and commercial table eggs. The highest mean concentration of AFB_1 obtained in this study was 15.93µg/kg (±1.53 µg/kg) and the least was 5.27 µg/kg (±1.31 µg/kg) for the poultry feed samples. Poultry farmers should check their feeds for moulds before offering them to their livestock and eggs should be properly screened for aflatoxin contamination before selling them to consumers. More research is still needed to developed a general regulation template for an acceptable level of Aflatoxin in eggs and poultry feeds.

REFERENCES

Bennett, J.W. and Klich, M. (2003). Mycotoxins Clin. Microbiology Review, 16: 497–516, No. 30893-8512/03/$08.000 DOI: 10.1128/CMR.16.3.497–516.200.

CAST (2003). Mycotoxins: risks in plant, animal and human systems, Task Force Report No. 139 CAST, Ames, IA.

D'Mello, J.P.F. (2004). Microbiology of animal feeds. Retrieved December 6, 2019, from http://www.fao.org/tempref/docrep/fao/007/y5159e/y5159e03.pdf

Daodu, O. B., and Adebowale, T.K. (2016). Aflatoxin in Commercial Poultry Feeds and Clinico-Pathological Manifestation of Aflaxoxicosis in Poultry in Southwest, Nigeria. *Nigerian Veterinary Journal*, 37(2):109–116.

Darwish, W.S., Ikenaka, Y., Nakayama, S.M.M. and Ishizuka, M. (2014). An overview on mycotoxin contamination of foods in Africa. *Journal of Veterinary Medical Science*, 76(6):789–797. https://doi.org/10.1292/jvms.13-0563

Fouad, A.M., Ruan, D., El-senousey, H.K.., Chen, W., Jiang, S. and Zheng, C. (2019). Harmful Effects and Control Strategies of Aflatoxin B 1 Produced by Aspergillus flavus and Aspergillus parasiticus Strains on Poultry :Review 1,1–21. https://doi.org/10.3390/toxins11030176

Kana, J.R., Gbemenou, B., Gnonlonfin, J., Harvey, J., Wainaina, J., Wanjuki, I. and Teguia, A. (2013). Assessment of Aflatoxin Contamination of Maize, Peanut Meal and Poultry Feed Mixtures from Different Agroecological Zones in Cameroon. Pp.884–894. https://doi.org/10.3390/toxins5050884

Łukasz, T., Łukasz, S., Monika, U., Tomasz, S., Renata, C. and Kinga, S. (2018). Characterisation of the Mycobiota on the Shell Surface of Table Eggs Acquired from Different Egg-Laying Hen Breeding Systems. *Oxins Baseline*, 10(7): 293.

National Population Commission (NPC), *(2006). Population Census of the Federal Republic of* Nigeria (Abuja, Nigeria: NPC, 2006): 6.

Negash, D. (2018). Journal of Applied Microbiological Research A Review of Aflatoxin : Occurrence , Prevention , and Gaps in Both Food and Feed Safety, 1.

Pereira, C.S., Cunha, S.C. and Fernandes, J.O. (2019). Methods, Prevalent Mycotoxins in Animal Feed: Occurrence and Analytica. MDPI, 11(5):290. https://doi.org/doi:10.3390/toxins11050290

Sivakumar, V.K., Singaravelu, G. and Sivamani, P. (2014). Original Research Article Isolation , Characterization and Growth Optimization of Toxicogenic Molds from Different Animal Feeds in Tamilnadu. *International Journal of Current Microbiology and Applied Sciences*, 3(9):430–445.

Strosnider, H., Azziz-Baumgartner, E., Banziger, M., Bhat, R.V., Breiman, R., Brune, M., DeCock, K., Dilley, A., Groopman, J., Hell, K., Henry, S.H., Jeffers, D., Jolly, C., Jolly, P., Kibata, G.N., Lewis, L., Liu, X., Luber, G., McCoy, L., Mensah, P., Miraglia, M., Misore, A., Njapau, H., Ong, C., Onsongo, M.T.K., Page, S.W., Park, D., Patel, M,, Phillips, T., Pineiro, M., Pronczuk, J., Schurz Rogers, H., Rubin, C., Sabino, M., Schaafsma, A., Shephard, G., Stroka, J., Wild. C., Williams, J.T. and Wilson, D. (2006). Workgroup Report: Public health strategies for reducing aflatoxin exposure in developing countries. *Environmental Health Perspectives*, 114: 1903-1989.

UNETHICAL SLAUGHTERING PRACTICES AT THE TRANSIENT ABATTOIR OF THE INTERNATIONAL CATTLE MARKET, IBADAN, NIGERIA.

[$]*Komolafe, P. L., *Babayemi, O. J. & K. A. Thomas**

*Department of animal science, University of Ibadan, Nigeria**

*Department of Agricultural Extension and Rural Development***

[$] Corresponding author: prisyem2008@yahoo.com

08036106690

ABSTRACT

Unethical practice in handling and slaughtering of cattle is on the increase in Nigerian abattoirs. Proper handling and prevention of stress in animals prior to slaughter avails good carcass. The study was carried out at Akinyele international Cattle Market abattoir in Ibadan for a period of five consecutive weeks. information were gathered on the restraining methods, slaughtering style, slaughtering interval and processing interval from 7.00am – 7.00pm daily using direct observation with the aid of checklist. Data were subjected to descriptive statistics using frequencies and percentages. Out of the 1839 slaughtered cattle observed at the facility during the period of the study, a total number of 1584 cattle (87.2%) were slaughtered without restraining while 255 were restrained before slaughter. A total of 1635 cattle (89%) were bled by slashing through the neck while 11% were slaughtered by piercing narrowly with knife. Most cattle (72.2%) were slaughtered within the first 5 minutes of arrival at the abattoir while a larger number of cattle slaughtered were also processed within the first 1-5 minutes. It could be concluded that cattle handling and slaughtering practices at Akinyele International Market were unethical. Slaughtering should therefore be done humanely, cattle should be properly restrained before bleeding and allowed to bleed well before the commencement of singeing or further processing.

INTRODUCTION

In the recent time, there is an increasing concern on the unethical practices in Nigerian abattoirs especially the way animals are handled before slaughtereing. Cattle marked for slaughtering are handled with little or no human feelings. Akinyemi *et al*. (2013) reported that some cattle handlers are of the opinion that cattle intended for slaughter should require little or no care since they will eventually end up slaughtered. This mentality is uncalled for, because how animals are handled will eventually have effect on the quality of meat obtained from such animals. Voisinet *et al.* (1997) reported that agitation and excitement of cattle during handling results in significant lower weight, tougher meat and more border line dark cutters. Such carcass might also not command consumer's preference.

Cattle are often slaughtered without restraining during exsanguination which could result in animal struggling and stress. However, Tenneseen and Morrigan (1999) noted the advantages of restraining before slaughtering to include effective physical appraisal of body conformation of animals marked for slaughter, efficiency of livestock handling and processing facilities. Also, different slaughtering styles that could inflict pain on animals are used during slaughtering exercises in the abattoirs.

There is limited information on pre-slaughtering handling and pattern of slaughtering in most Nigerian abattoir. The study was therefore designed to observe the slaughtering handling processes of cattle at Akinyele International Cattle Market, Ibadan.

MATERIALS AND METHODS

The transient-abattoir located within Akinyele International Cattle Market, Ibadan (AICM) was used for the study. This study was carried out from 7am-7pm for a period of five consecutive weeks (Monday to Sunday). Data were collected on the restraining methods, slaughtering style, slaughtering interval and processing interval. Direct observation with the aid of check list was used to obtain relevant data. Data obtained were analysed using descriptive statistics of SPSS 2020.

RESULTS AND DISCUSSION

Presented in Table 1 is the restraining and slaughtering methods of cattle at the AICM market. The study revealed that most of the cattle brought for slaughtering were not restrained before slaughter. The high

population of cattle slaughtered without restraining might be that most of the butchers are either ignorant or negligent of the ethics and importance of restraining or careful handling of animals prior to slaughter. It could also be that most of the cattle brought for slaughtering are weak and recumbent in nature with limited ability to struggle during slaughtering as observed on the field. Voisinet *et al*. (1997) reported that agitation and excitement of cattle during handling results in significant lower weight, tougher meat and more border line dark cutters. Slashing was the slaughtering method mostly used which is commendable. It was recorded that some butchers bled cattle by piercing narrowly the throat (Fig 3) as against the general practicing of slashing, such practice is unethical as the event is stressful and could inflict severe pain on the animals. Cattle were directly observed to be struggling for life over a period of time. Warris (1984) reported that animals should be rendered unconscious prior to bleeding and that bleeding should be with severe cut.

Table 1: Slaughtering pattern of cattle at Akinyele international cattle market, Ibadan

	Restraining methods (%)				Slaughtering style (%)			
	Restraining		Unrestrained		Slashing		Piercing	
Breeds	Frequency	%	Frequency	%	Frequency	%	Frequency	%
White Fulani	118	6.4	676	36.8	698	38.0	96	5.2
Red Bororo	92	5.0	552)	30.0	585	31.8	59	3.2
Gudali	42	2.3	323	17.6	319	17.4	46	2.5
Kuri	3	0.1	33	1.8	33	1.8	33	0.2
	255		1584		1635		204	

Source : Field survey 2018

The time interval between arrival of cattle and slaughtering at the AICM market is as shown in Figure 2. Most Slaughtering occurred within the first 1-5 mins of cattle arrival at the abattoir all through the period of the study. It was observed that the cattle were not fasted overnight and rested in the lairage and there was no stuning to render them unconscious. It was also observed that butchers were in a hurry to slaughter the weak and recumbent cattle that were about to give up so as to prevent economic loss on the part of the owner. Komolafe *et al*. (2019) reported that butchers are mostly in a hurry to slaughter several animals in order to make more money. Also, butchers might also want to quickly display meat for sale so as to prevent left over of meat as means of preservation are not readily available. Wolterdorf and Troeger (1987) encouraged that the time interval to move from lairage and slaughtering should be as short as possible as long waiting times are stressful., This is consistent with the observation in this study where most

slaughtering activities were done within a short period, although there was no presence of lairage in the study area.

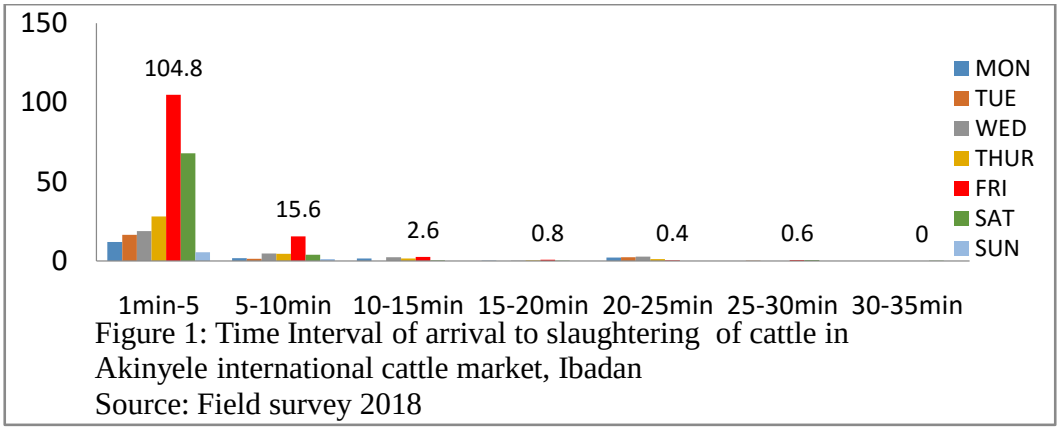


Figure 1: Time Interval of arrival to slaughtering of cattle in Akinyele international cattle market, Ibadan
Source: Field survey 2018

The time interval between slaughtering and processing is presented in Figure 2. It was observed that processing of cattle slaugtered began within the first 1-5 minuite of slaughtering. Proper bleeding and animals complete quietness was not achieved before singeing commences. This practice is unethical and a serious height of cruelty as cattle were mostly observed to struggle for life when set ablazed (Singeing with kerosene) before they eventually die.. The likely reason for this cruel act might be as a result of the general believe among cattle handlers that animals can be handled without special care since they are not humans. Warris (1984) however reported that no animal should be bled when conscious and no carcass processed until nervous reflexes disappear.



Plate 1: A picture showing slashing and piercing methods of cattle slaughtering at Akinyele abattoir
Source: Field survey 2018

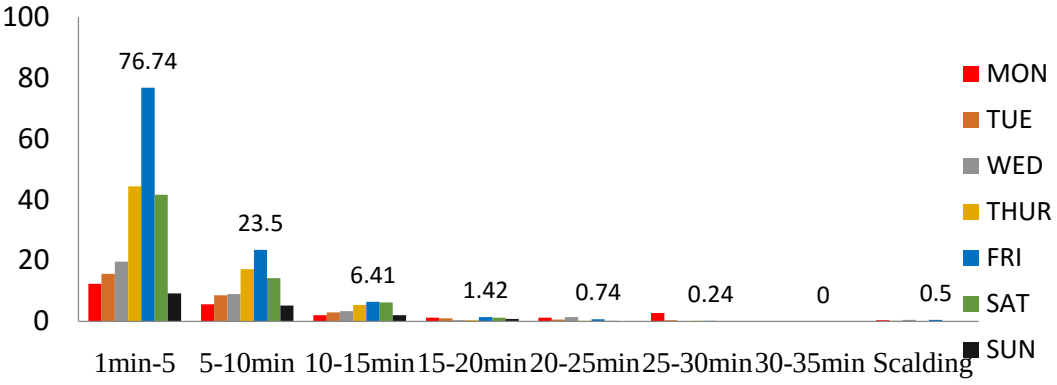


Figure 2: Interval between slaughtering and processing of cattle in Akinyele international cattle market, Ibadan
Source: Field Survey 2018

CONCLUSION

The study showed that most of the cattle brought into Akinyele Cattle Market were not restrained and while some were unethically slaughtered. The study also revealed that the time interval between arrival and slaughtering and slaughtering to processing was 1-5 minute.

RECOMMENDATION

Cattle is expected to be slaughtered humanely, properly restrained before bleeding and allowed to bleed well before the commencement of processing

REFERENCES

Akinyemi, P. L., Babayemi, O. J., Abu, O. A. and Bamikole, M. K. (2013). Unethical evidence against cattle dignity during loading, transportation and off-loading by livestock marketers in Ibadan metropolis, Nigeria. *Nigerian Journal of Animal Production*. 40 (1): 144-151.

Komolafe P. L., Babayemi, O. J., Thomas, K. A. and Ewuola, E. O. (2019). Population dynamics of cattle slaughtered in a Transient slab of the international cattle market Ibadan, Nigeria. In: Editors: RP.A. Oluwafemi, O.A. Olafadehan, B.Y. Abubakar, A.A. Adeniji and A. Jubril Repositioning the livestock Industry for sustainable Economic Development in a Diversifying Economy. *A proceeding of Nigerian Society for Animal Production in March* 17th-21st 2019. Pp 988-992.

IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

Tennessen, T.; Morrigan, J. (1999). Welfare of cull Holstein cows at an abattoir. Can. J. Animal Science. 1999, 79, 586.

Voisinet, B.D., T. Grandin, S.F. O'Connor, J.D. Tatum and M.J. Deesing. 1997. Bos indicus cross feedlot cattle with excitable temperaments have tough meat and a higher incidence of borderline dark cutters, *Meat Science*. 46:367-377

Warris, P. D. (1984). Exsanguination of animals at slaughter and the residual blood content of meat. *Veterinary. Rec.*, 115, 292-295.

Woltersdorf W. and Troeger K. (1987). - Slaughter technique to reduce proportion of PSE pigs. *Fleischwirtsch.*, 67 (10), 1248-1251.

DETECTION OF ANTIMICROBIAL DRUG RESIDUES IN MEAT FROM BUNAJI CATTLE SLAUGHTERED IN MINNA MODERN ABATTOIR

***L.L Mande, J.Y. Adama, A. Usman**

Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology P.M.B 65, Minna, Niger State Nigeria

Corresponding authors E-mail; mandelawal46@gmail.com

ABSTRACT

Antimicrobial drug residues are of global health concern in many countries of the world, with Nigeria reporting occurrence of residue contamination of edible animal products beyond FAO and WHO permissible levels. The occurrence of antimicrobial drugs residues in meat in Minna modern abattoir was investigated during this study, 56 meat samples were collected from 56 Bunaji cattle slaughtered in the abattoir at 2weeks intervals for period of 4months (April – August 2019) . Antimicrobial inhibition test was adopted with zone of inhibition measured in millimetres (mm), samples below 1mm were considered negative. 29(51.78%) samples were tested positive with zone of inhibition at various levels of residue (12mm, 13mm, 15mm, 17mm, 19mm and 20mm), which signified high levels of residue. Samples from female's cows had the highest number 20(68.90%) and values at 20mm. Ages between 6-10 years had 17(58.62%) while the lowest residue was recorded at older animals above 10 years 5(17.24%). This result indicated that consumers in Minna metropolitan are predisposed to health hazards due to the presence of antimicrobial residue, this emphasis the need for effective prevention of infectious diseases, general enlightenment on the withdrawal periods, and establishment of antimicrobial residues monitoring unit in Minna.

Keywords – Antimicrobial residue, Meat, Microbial inhibition test, Abattoir, Minna

INTRODUCTION

Drug administration to domestic animals requires not only consideration of its effect on the animals but also the effect on humans who consume the product from such animals. Antibiotics are natural product of microorganisms or identical synthetic products or similar semi-synthetic products that inhibit the growth of or destroy microorganisms (Karbis, 2007). In animal health practice, antibiotics are widely used as therapeutic prophylactic or as growth promoting agents (Donoghue, 2003). Antibiotics are of different types, with various pharmacokinetic activities which often neglected during slaughter, and hence become potential hazard to human. The presence of antibiotics in meat and other food of animal origin is one of the most important indices for their safety to human consumers (Kozanova *et al.*,2001). Many livestock farmers administer antibiotics indiscriminately for purposes of treating or preventing an ailment or as growth promoters without cognisance of the need to consult an expert for necessary advice, such animals are often slaughtered without recourse to the withdrawal period, even if they used the same drugs as animal health personnel's. The Indiscriminate use of antibiotics in livestock has raised serious public health concern globally, especially in sub-Sahara Africa and particularly Nigeria (Shehu, 2018).

Drug residue arises when treated animals are slaughtered without recourse to pharmacokinetics of the specific drug administered, this situation usually occur with prolonged administration and over dosage of antimicrobial agent, especially if these animals are slaughtered immediately,(vinedresser, 1989)as cited by (Gabriel *et al.* 2012). Toxic level of antimicrobial residues in food animals are known to cause divers health hazards to susceptible unsuspecting human consumers. (Gabriel *et at.*,2012).

Cattle command a prominent position in our meat supply which constitute of about 45% of meat industry. Presently cattle population in Nigeria has been estimated as 15.3million (Umar, 2007).

Bumaji cattle are the most predominant and wide spread of all Nigeria cattle breed, they represents 37% of the national herd (Alphosus,Akpa, Barje and Adamu, 2012). About 800-1000 cattle, sheep and goat are slaughtered daily across Niger state (Dukku, 2018), the abattoir where these animals are largely slaughtered and processed for public consumption, contributed immensely to the economic development of states. In Nigeria as in many other countries, the veterinary structure are not strong (Fau, 2004) and are characterised by indiscriminate usage of veterinary drugs such as antibiotics, which are readily avaailable and obtainable over the counter as well as every rural cattle market, which make it easily accessible to different categories of livestock handlers including the nomadic pastoralist and the middle men. With this development it implies that correct dosage and withdrawal period are not usually adhered to, and hence meat safety quality assurance cannot be granted, Olatoye and Ogundipe, (2009).

MATERIALS AND METHOD

EXPERIMENTAL SITE

The samples were collected from Minna abattoir located along Tayi village in Minna Niger state of Nigeria. Minna the capital city of Niger state is situated on a latitude 9 3105 and longitude 7 421 north, with annual rainfall of 1,200-1,300mm and mean temperature of 38-40c the area has an altitude of 1,46m above sea level in the northern guinea savannah vegetation zone of Nigeria it is characterised by two season, the wet season (April - October and dry season November -march). NSFCO/ ADP.,(2015).

SAMPLES COLLECTION

Fifty six (56) Beef samples weighing 50g were collected from 56 slaughtered white Fulani cattle in Minna modern abattoir for a period of 4 months, (April - August 2019) at 2 weeks intervals, with emphasis to breed, age sex and time intervals, Samples were properly packed and labelled in a polyethylene and refrigerated at -20^0C

SAMPLE ANALYSIS;

MICROBIAL INHIBITION TEST

An adapted microbial inhibition test was employed to screened samples for evidence of antimicrobial drug residues as described by Huber et al, (1969). Mueller Hinton Agar (MHA) was prepared in plates according to manufacturer`s instruction. *Bacillus subtilis* ATCC 6633 was used as test organism. Plates were inoculated with the test organism by dipping sterile cotton swab sticks into the suspension of test organism until saturated. The MHA plates were then gently but thoroughly swabbed uniform to achieve a lawn of confluent growth and allowed to dry for 5 minutes. The extract from the sample were tested by dipping sterile 1.2 mm diameter *whatmann* filter paper disc into the juice extract, until saturated, excess sample were allowed to drained, then, *whatman* filter paper disc containing 30ug of oxytetracycline Hcl was used as control discs, placed at the centre of the plates with test discs at the periphery of the plate and incubated at 37 degree for 18 – 20 hrs, after which presence or absence of zone of inhibition and that of the disc was calculated. Any disc with a difference of >1mm was considered positive.

DATA ANALYSIS;

The data obtained was subjected to descriptive statistical analysis, for the variations between occurrence of drug residues between sex and Age groups, using SPSS version 16.0, (2010)

RESULTS AND DISSCUSSION

Out of the 56 meat samples from 56 cows of different sex and age that were screened for antimicrobial drug residues during this study, 29(51.78%) tested positive under zone inhibition test ranging from 13mm to 20mm, indicating presence of antimicrobial drug residue in the samples; 27(48.21%) were tested negative less than 1mm. All samples were collected from Bunaji cattle in Minna abattoir. The overall results from this study indicated a high incidence (51.78%) of antimicrobial residues in the meat consumed by the public in Minna metropolitan The results is higher than the reported incidence of 46% residue in beef in Oyo state, (Akinwumi, 2012); 16.11% reported by (Dipeolu and Alonge 2002); 33.1% obtained in

broilers (Kabir *et al*,.2004); 25% reported in milk (Yusuf *et.al*., 2017). However the result is lower than 89.3% reported from kidney and urine (Gabriel *et. at.*, 2012) and 79.74% in edible beef (Olatoye and Ogundipe, 2009). **Table 1** Shows distribution of residue on Sex of the cows that were tested positive, 9(31.02%) were males, 3 samples had highest value of 19mm while 1 sample had lowest value of 12mm, females recorded highest antimicrobial residue of 20(68.96%), 2 samples had highest zone inhibition value of 20mm while 1 had lowest of 12mm, the study recorded high incidence of residues on females (68.9%) than males (39.01%), 2 females had high zone inhibition value of 20mn. **Table 2** shows variation on Age, 7(26.3%) were between 1-5 years, 17(53.62%) were between 6-10 years and 5((17.24%) where above 10 years. At 1-5 years 2 samples had highest value of 19mm and the lowest value of 13mm, highest value of 20mm was found at 6-10years and above 10 years respectively, From the result 6-10 years shows 58% residual values than other age groups the result agreed with that reported by (Zeenatudeen, 2015) on milk.

Table 1 Distribution of antimicrobial drugs residue based on Sex of cow under zone inhibition above 1mm detectable limit

Sex	**Meat sample**	**12mm**	**13mm**	**15mm**	**17mm**	**19mm**	**20mm**	**Total**
Male	9	1	1	4	1	3	0	9(31.02%)
Female	20	1	4	4	6	3	2	20(68.96%)
Total	29	2	5	8	7	6	2	29(100%)

Table 2; Distribution of antimicrobial drugs residue based on Age of cows under zone inhibition above 1mm detectable limit

Age years	**Meat sample**	**12mm**	**13mm**	**15mm**	**17mm**	**19mm**	**20mm**	**Total**
1-5	7	Nil	Nil	3	2	2	0	7(24.13%)
6-10	17	1	4			3	1	17(58.52%)
Above 10	5	Nil	1	3	5	1	1	5(17.24%)
				2	Nil			
Total	29	1	5	8	7	6	2	29

CONCLUSION;

The high percentage of meat with antimibrial residues obtained from this study indicated that, consumers in Minna metropolitan are predisposed to health hazards due to the presence of antimicrobial residue in meat in slaughtered animals from the abattoir, this emphasis the need for the enforcement of antimortem inspection, effective prevention of infectious diseases, general enlightenment on the withdrawal periods, and establishment of antimicrobial residues monitoring unit in Minna.

REFERENCES

Akinwumi, A. O., Adunsi, A. A., Ojola, A. B., Rafiu, T. A., (2012). Effect of Antibiotic Residue on the physical qualities of Beef in Oyo State Nigeria. *4th International Com. on Agriculture and Ani. Sci. DOI: 10.7763/IPCBEE. V47-15*

Alphonsus, C., Akpa, G. N., Barje, P. P., Finangwai, H. I., & Adamu, B. D. (2012). Comparative evaluation of linear udder and body conformation traits of bunaji and friesian x bunaji cows. *World Jour. of Life Sci. and Med. Res.*, 2 (4), 134 - 140. .

Dipeolu, M.A. and Alonge D.O. (2002). Residues of streptomycin antibiotic in meat sold for human consumption in some states of south-western Nigeria. *Arch. Zootec.* **51**, 477-480.

Donoghue, D.J. (2003). Antibiotic residues in poultry tissuesvand eggs: Human health concerns. *Yozrlt. Sci., 82: 618-621.*

Dukku, U., (2018). How antibiotics in livestock farming places all at risk, Daily trust Newspaper, published *December 27, 3:26 am*.

Gabreil, k. O., Ajayi, I. E & Ode, O. J.,, (2012). Assessment of antimicrobial drugs residue in beef in Abuja Federal Capital Territory, Nigeria, *Veterinaria italiana ,48(3) 283-289.*

Huber, W. G., Caslon M. B. And Lepper M. H. (1969). Pennicillin and antibiotic residues in domestic animals at slaughter. *Food microbiology, 154; 1590-1595*

Kabir, J., Umoh,V. I. Audu-Okooh, E., Umoh, I. U., and Kwaga.J.K.P, (2004**).** Veterinary Drug use in poultry farms and determination of antimicrobial drug residues in commercial eggs and slaughtered chicken in Kaduna State, Nigeria. *Food Control. 15:3-10*

Kirbis, A. (2007). Microbiological screening method for Detection of aminoglycosides, B- lactomas, macidider, tetracyclines and quinolones in meat samples. *Slow vet.res. 44(2): 11-48.*

Kozarova, L., Mate, D. and Cabadaj, R. (2001). Methods for the determination of sulphonamides residues in milk and animal n products In: *Proceeding of Lectures and Posters of the Imtern. Conf. Hygiena Alimentorium XXIII.*

Niger state Fadama Coordition Office (NSFCO)/Agricultural Development Project (ADP) Minna (2015). Annual report.

Olatoye, O. I & Ogundipe, G.A.T., (2009). Preliminary screening of beef consumed in Ibadan, Nigeria for antimicrobial residue. *Afr. J. bsiomed res. vol. 12, no.3*

Shehu, (2018). How antibiotics in livestock farming places all at risk, Daily trust Newspaper, published *December 27, 2018, 3:26 am.*

SPSS.(2010). Statistical Package for the Social sciences, *Version 16.0 IBM USA.*

Umar, A. S. S. (2007). Financial analysis of small scale beef fattening enterprise in bama local government area of Borno state. M.Sc. Thesis, Ahmadu Bello University, Zaria, Nigeria.

Yusuf, M. S., Kabir, J. And Babashani, M. (2017). Occurrence of Tetracycline Residue in Milk from Diary Farms in Kano state Nigeria. *Proceedings of 54th Annual Congress of the Nigerian Vet. Med. Ass. (Kano, 2017)*

Zeenatudeen M. (2015) Dissertation submitted to the postgraduate school Department of Veterinary public Health and preventive medicine, Ahmadu Bello University Zaria.

KAEMPFEROL IMPROVED LIVER ENZYMES IN TWO WEEKS OLD BROILER CHICKENS WITH EXPERIMENTAL *EIMERIA TENELLA* INFECTION

***Muhammad, Y[1]., Jatau, I. D[2]., Chiroma, M. A.[3] Umar, A.M[1]., & Dahiru, M[1]**

[1]Department of Animal Health and production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State.
[2]Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria.
[3]Department of Veterinary Pathology, University of Maiduguri, Borno State, Nigeria.
Corresponding author: Email: yamohad@gmail.com, phone number: 07063249774

ABSTRACT

The effect of kaempferol on the concentration of liver enzymes in two weeks old broiler chickens with experimental *Eimeria tenella* infection was evaluated in this study. Sixty day old broilers were randomly allotted into six groups (I-VI) of ten broilers each and brooded for two weeks. At exactly two weeks of age, broilers in group I served as non-infected control. Broilers in groups II- VI were infected with *Eimeria tenella* sporulated oocyst (10^4/ml) via oral inoculation. After infection was established, broilers in groups II-IV were treated *per os* with 1 mg/kg, 1.5 mg/kg and 2 mg/kg of kaempferol respectively. Broilers in group V were treated for five days with amprolium, 1.25 g/Lin drinking water. Broilers in group VI served as infected untreated control. Five days post infection; all broilers were sacrificed by severing their jugular veins. Blood sample was collected from each broiler in a plane sample container devoid of anticoagulant so as to harvest serum for serology. Concentration of liver enzymes (ALT, AST and ALP) in the serum was determined. Data obtained were analyzed using pad prism version 5.0. There were statistically significant ($P<0.05$) reductions in the mean values of liver enzymes (ALT AST, ALP) in groups II, III and IV in a dose dependent manner when compared to group VI. It was observed in this study that kaempferol improved the serum level of liver enzymes and reduced the level of pathology in the liver and caecum of broilers infected with *Eimeria tenella* in this study, and therefore recommends that it should be incorporated in bird's feed.

Key words: Amprolium, Broilers, Diminazene aceturate *Eimeria tenella*, kaempferol, liver enzymes,

INTRODUCTION

Each year, over 50 billion chickens are raised as a source of meat, accounting for over one-third of protein food for humans (Bampidis *et al*., 2005), however, this practice is often confronted by so many problems of avian coccidiosis (Coccidia subclass) (Chapman *et al*., 2010). So far, nine Eimeria species, *E. acervulina, E. brunetti, E. maxima, E. necatrix, E. praecox, E. mitis, E. tenella, E. mivati, and E. hagani,* have been identified from chickens (Chapman *et al*., 2010). These parasites can infect and multiply within the mucosal epithelia in different parts of bird guts, which cause severe gut damage (i.e., inflammation, hemorrhage, diarrhea, etc.), morbidity, and mortality (Calderon-montana *et al.,* 2011). It also causes a global loss of over 2.4 billion US dollars in the poultry industry, including poor growth performance, replacement of chicks, and medication (Lilleheoj and Trout, 1996). Anticoccidial chemicals, coccidiocides, coccidiostats, and ionophores, have long been used as a mainstream strategy to control avian coccidiosis in modern poultry production and birds have developed resistance to them (Chapman, 2014)

Antioxidant compounds like kaempferol are well known to have a cellular protective action against oxidative stress and reduce the severity of *Eimeria tenella* infection by altering the degree of intestinal lipid peroxidation[1].(Allen *et al.,* 1998). Most of the antioxidants occur as dietary constituents[3], as shown by many researches, antioxidants deposited in broiler meat following oral ingestion delay lipid peroxidation in the muscles and improve it quality (Bampidis *et al*., 2005),, these important role, made us conduct this study with aim of determining the ameliorative effect of kaempferol in stress induced by experimental *Eimeria tenella* infection in two weeks old broiler chickens.

MATERIALS AND METHODS

Study area

This research was conducted in the Departments of Animal Health and Production (poultry unit), Binyaminu Usman Polytechnic, Hadejia, Jigawa State, Nigeria ($10^0$02' 28.14'' E Longitude and $12^0$27' 12.49 N Latitude)

Drugs, Sources and Preparations

Kaempferol was sourced from whitehead scientific (pty) limited, South Africa, it came along with the following details; CAS number (520-18-3), Catalog number (3603), EC number (208-287-6) and batch number (3).

Eimeria tenella Isolate

The *Eimeria tenella* isolate used in this study was obtained from the parasite bank of the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria. The oocysts were propagated in two week-old coccidian-free chickens before use. The unsporulated oocysts collected from the caecal content on the seventh day post-infection was purified and preserved in 2.5% potassium dichromate solution to induce sporulation at 28° C. The sporulated oocysts were kept at 4° C until use.

Experimental birds and grouping

Sixty day old broiler chicks obtained from a reputable hatchery were used in this study. The chicks were randomly allotted into six groups (I-VI) of 10 birds and brooded for 2 weeks on concrete floor (using wood shaven as litter material) under strict biosecurity measures and as routine were adequately vaccinated against Newcastle disease and infectious bursal disease. They were fed with commercial broiler feed (Vital feed®) and water which were provided *ad libitum*.

Experimental infection and treatments

At exactly two weeks of age, birds in Groups II-VI were orally inoculated with 10^4 sporulated oocysts of the *E.tenella* isolate, and then treated as follows:

Group I: Birds in this group served as non-infected control.
Group II: Birds in this group were treated with 1 mg/kg of kaempferol *Per os* for 5 days.
Group III: Birds in this group were treated with 1.5 mg/kg of kaempferol *Per os* for 5days.
Group IV: Birds in this group were treated with 2 mg/kg of kaempferol *Per os* for 5 days.
Group V: Birds in this group were treated with 1.25 g/L of amprolium in drinking water for 5 days.
Group VI: Birds in this group served as infected untreated control.

Determination of Serum level of liver enzymes

Serum level of alanine amino transferase (ALT), aspartate amino trasferase (AST) and alkaline phosphatase (ALP) were determined using chemical auto-analyzer (Bayer® Clinical Chemistry Analyzer, Germany) as described by manufacturer.

Statistical Analysis

Data obtained were expressed as means ± standard errors of mean (S.E.M), subjected to one-way analysis of variance (ANOVA) and compared with Tukey post-hoc test. The level of significance was set at $p< 0.05$.

RESULTS

Effect of Kaempferol on the Activities of Liver Enzymes

Figure 1 shows the effect of kaempferol on the activities of liver enzymes in two weeks old broilers challenged with *Eimeria tenella.* There were significant ($P < 0.05$) increases in mean AST, ALT and ALP

values in the infected untreated broilers (group VI) when compared with the infected broilers and treated with different doses of kaempferol (group II, III and IV) and those that were treated with Amprolium (group V). But no significant (P>0.005) difference in the mean values of AST, ALT and ALP was observed in broilers treated with 2 mg of kaempferol and those that were treated with amprolium.

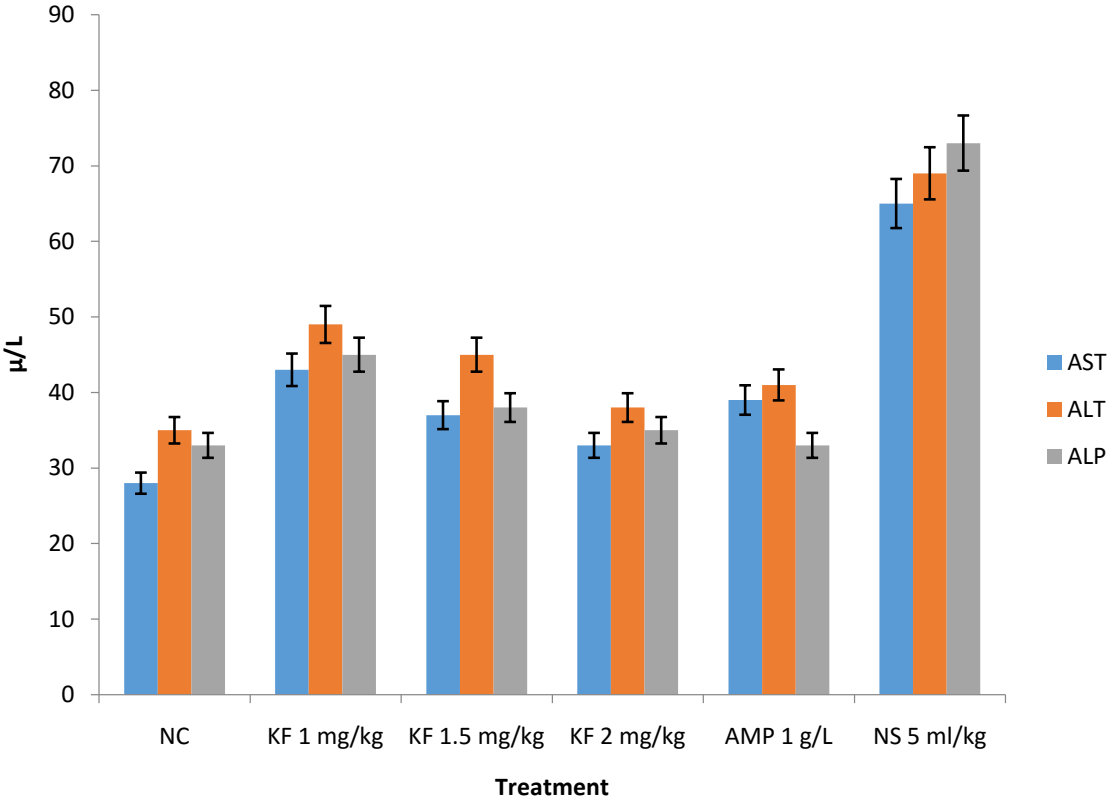


Figure 1: Effect of kaempferol on the activities of liver enzymes (ALT, AST, ALP).

Key: NC=Neutral control, KF=Kaempferol, AMP= Amprolium and NS=Normal Saline
P≤0.05 considered significant.

DISCUSSIONS

The present study revealed significant reduction in the concentration of liver enzymes (ALT, AST and ALP) in groups (II, III and IV) treated with kaempferol when compared to infected untreated broilers (group VI). No significant difference in the concentration of liver enzymes (ALT, AST and ALP) was recorded between group III, IV and V.

The increased levels of ALT, AST and ALP in the infected untreated broilers agrees with the earlier reports of Srivastava *et al.*,2012, who attributed the elevation of ALT, AST and ALP to inflammation in the host, particularly of the liver. Another possibility of increased levels of ALT and AST is the activities of free radicals generated at different stages of the infection (Murali, 2014). Therefore, serum levels of ALT and AST are two of the most useful indications of liver cell injury, although the AST is less liver specific than is ALT (Kim and Choi, 2013). Oyewale 1991) attributed the increase in the liver enzymes to inflammatory condition involving liver and gatro-intestinal tract[18]

CONCLUSION AND RECOMMENDATION

It was therefore concluded in this study that, the oral administration of kaempferol had ameliorated stress induced by the experimental *Eimeria tenella* infection in two weeks old broilers via improving the serum level of liver (ALT, AST and ALP) enzymes

REFERENCES

Allen, P. C., Danforth, H. D. and Augustine, P. C .(1998). Dietary modulation of avian coccidiosis.*International Journal of Parasitology*, 28: 1131-1140.

Bampidis, V.A., Christodoulou, V., Florou-Paneri, P., Christaki, E., Spais, A. B. and Chatzopoulou, P.S. (2005). Effect of dried oregano leaves supplementation on performance and carcass characteristics of growing lambs. *Animal Feed Science Technology*, 121: 285-295.

Chapman, H. D (2014).“Milestones in avian coccidiosis research: a review,” Poultry Science, vol. 93, no. 3, pp. 501–511.

Chapman, H.D., Jeffers, T.K. and Williams, R.B. (2010). Forty years of monensin for the control of coccidiosis in poultry, *Poultry Science*, vol. 89, no. 9, pp. 1788–1801.

Calderon-Montano, J.M., Burgos-Moron, E., Perez-Guerrero, C. and Lopez-Lazaro, M.A. (2011). Review on the dietary flavonoid kaempferol. *Mini-Reviews in Medicinal Chemistry*, 11: 298–344.

Kim, S.H. and Choi, K.C. (2013). Anti-cancer Effect and Underlying Mechanism(s) of Kaempferol, a Phytoestrogen, on the Regulation of Apoptosis in Diverse Cancer Cell Models. Journal of Toxicology Research, 29 (4): 229–234.

Lillehoj, H. S. and Trout,J. M. (1996) “Avian gut-associated lymphoid tissues and intestinal immune responses to Eimeria parasites,” *Clinical Microbiology Reviews*, vol. 9, no. 3, pp. 349–360.

Oyewale, J.O. (1991). Osmotic fragility of erythrocytes of guinea-fowls at 21 and 156 weeks of age. *Veterinarski Archive*, 61: 49-56.

Pietta, P, and Simonetti, P. (1998). Dietary flavonoids and interaction with endogenous antioxidants. *International Journal Of Biochemistry and Molecular Biology*, 44: 1069-1074.

Srivastava, P., Yadav, N., Lella, R., Schneider, A., Jones, A. and Marlowe, T. (2012). Neem oil limonoids induces p53-independent apoptosis and autophagy. *Carcinogenesis*, 33: 2199-2207

Murali, R.A. (2014). Liver Test Interpretation - Approach to the Patient with Liver Disease: A Guide to Commonly Used Liver Tests.*Journal Centre for Continuing Eeducation.*

Misra, H.P. and Fridivich, I. (1972).The role of superoxide union in auto-oxidation of epinephrine and sample assay for superoxide dismutase.*Journal of Biological Chemistry*, 247: 3170-3175.

IMPRUDENT ANTIBIOTIC USAGE IN POULTRY FARMS ACROSS NIGERIA: IMPLICATIONS FOR POULTRY PRODUCTION AND DISEASE MANAGEMENT

***Njoga EO[1], Ogugua JA[1], Nwankwo IO[1], Oyeleye FA[1],Njoga UJ[2], Okoli CE[3], Ajibo FE[4], Okafor SC[5]**

[1]Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Nigeria, Nsukka; Enugu State, Nigeria

[2]Department of Veterinary Obstetrics and Reproductive Diseases, University of Nigeria, Nsukka; Enugu State, Nigeria

[3]Department of Veterinary Public Health and Preventive Medicine, University of Abuja, Federal Capital Territory, Nigeria

[4]Department of Animal Health and Production, Enugu State Polytechnic, Iwollo; Enugu State, Nigeria

[5]Department of Veterinary Pathology and Microbiology, University of Nigeria, Nsukka; Enugu State, Nigeria

**Corresponding author: Njoga Emmanuel Okechukwu; Email: njoga.emmanuel@unn.edu.ng*

ABSTRACT

Prudent antibiotic usage in poultry boosts productivity and limits emergence and spread of antibiotic-resistant organisms, especially zoonotic pathogens, transmissible through the food chain. A nation-wide survey to determine the pattern of antibiotic administration in poultry was conducted among 2,402 randomly selected poultry farmers,in12 of the 36 States ofthe federation; using structured questionnaire.Finding showed thatcritically important antimicrobials, belonging to the WHO lists of '*Highest'* and '*High'* priority antibiotics, were administered sub-therapeutically; for prophylaxis and growth enhancement purposes. Many diseases that warranted the antimicrobial administration were of viral etiology. Only 64.2% of the farmers administered the drugs based on veterinary doctors' prescription while62.3% of them did not observe recommended withdrawal period after the drug administration. Enlightenment of the farmers on the benefits of prudent agricultural use of antimicrobials is imperative; for sustainable poultry production and to curtail development and dissemination of antimicrobial-resistance pathogens.

KEYWORDS: antibiotics, antibiotic-resistance, poultry diseases, poultry farms

INTRODUCTION

The poultry subsector is the most commercialized and the fastest growing agribusiness in Nigeria.The growth in the poultry industry may be attributed to prudent use of antimicrobials in combating most infectious diseases, inimical to poultry production in the tropics (Njoga*et al.,* 2018). Good antibiotic steward in food-animal production has also curtailed spread of zoonotic pathogens and transmissible through the food chain. Prudent agricultural use of antibiotics involves administration of the appropriate drug, for the right disease, at the appropriate dose, all through the recommended period of time. Chemotherapeutic and prophylactic uses of antibiotics in poultry production are well recognized; but use of sub-therapeutic doses for growth promotion purposes, is rapidly gaining popularity in Nigeria(Chinwe*et al.,* 2014). Upsurge in demand for foods of animal origin, occasioned by boom in human population and increase in middle class income in most developing countries, aredriving the sub-therapeutic usage; to cater for the shortfall in available animal protein, in a record short time.

Sub-therapeutic use of antibiotics to fast-track poultry production is associated with emergence and spread of antimicrobial-resistant pathogens, which may worsen the animal's health problem or may be transmitted to humans via the food chain. Adebowale*et al.* (2016) reported that poultry farmers incur up to 35%

additional cost of production, due to treatment of antibiotic-resistant bacteria. Other imprudent antibioticusage such as non-observance of withdrawal period (WP) facilitates accumulation of antimicrobial residues in poultry products, which could reach the human populations through the food chain (Njoga*et al*., 2018). Consumption of antimicrobial residues in edible animal products predisposes to health problems including, allergy in sensitized individuals, bone marrow depletion or aplastic anemia, disruption of normal intestinal flora infavour of pathogenic bacteria, toxicity and carcinogenicity (Nisha, 2008; Njoga*et al.*, 2018).

This nation-wide study was therefore carried out to determine the antibiotic usage pattern in poultry farms in Nigeria. This will guide policy formulation for preservation of the therapeutic efficacy, for sustainable poultry production and to safeguard public health.

MATERIALS AND METHODS

Structured and pretested open-ended questionnaire was used to obtain information ontypes and pattern of antimicrobial drug usage in poultry; as well as the diseases that warranted the drug administration.

A total of 12 states, 24 agricultural zones (AZ) and 2, 402 poultry farms were randomly selected and surveyed. At first, four of the six geopolitical zones, namely Southeast, Southwest, North-central and Northwest were purposively selected for the study, based on the history of high poultry production activities. In each selected zone, three states and two AZs per state were selected by simple random sampling. The same sampling method was used to select at least 100 poultry farms from each selected AZ, based on the consent the farm owners to participate in the study and accessibility of the farm.

RESULTS

The classes of antimicrobials administered and percentage of farmers involved were: tetracycline (25.4%), aminoglycosides (18.5%), macrolides (14.8%), quinolone and fluoroquinolone (14.8%), chloramphenicols (11.3%), sulfonamides (8.5%) and penicillin and betalactam (6.8%).The diseases that 'necessitated' antibiotic treatment in farms surveyed were not only of bacterial etiology and included: Newcastle (31.7%), coccidiosis (21.3%), gumboro (26.4%), salmonellosis and colibacillosis (13.4%).Only 64.2% of the farmers administered the drugs based on veterinary prescription. On the purpose of the drug administration, 36.2% used the drugs for treatment, while 36.7% and 27.1% administered it for prophylaxis and growth promotion purposes respectively. Majority (62.3%) of the farmers who administered these drugs did not observe the recommended WP thereafter.

DISCUSSION

The high rate of antibiotic administration (63.8%) for non-therapeutic purposes in this study is in tandem with the 68.5% found in South Africa (Eagar *et al.*, 2013). Farmers may have resorted to non-therapeutic use of antibiotics as a 'quick fix' or compensation for poor management practices observed in the farms surveyed. This may explain why critically important antibiotics, including second generation fluoroquinolone (ciprofloxacin) were used for prophylaxis in some farms.

Occurrence of antibiotic-resistant bacteria due to non-chemotherapeutic use of antibiotics has been reported in chicken in Nigeria (Chinwe*et al.*, 2014). Sub-therapeutic administration of antibiotics, is an important factor in the epidemiology of emergence and dissemination of antibiotic-resistant bacteria (Njoga*et al.*, 2018), transmissible through the food chain. Cognizant of the fact that egg is sometimes consumed raw in Nigeria (Onyenweaku*et al.*, 2018); these resistant-organisms can easily reach the human population via consumption of infected raw eggs or undercooked poultry products. Even when the

emerged antibiotic-resistant organism is not zoonotic, it may transfer its resistance genes to zoonotic organisms; for onward transmission to humans (Van den Bogaardand Stobberingh, 2000).

The practice of administering un-prescribed antibiotic drugs in poultry farms is unethical and may be to save cost of veterinary services, in order to probably maximize profit. This 'cost saving' habit, without recourse to the negative implications on human and animal health is counterproductive. When people who are not formally trained in veterinary clinical practice administer un-prescribed antibiotics to food animals, the likelihood of incorrect doses and other chemotherapeutic errors; that may adversely affect the pharmacokinetics of the drugs is most probable. These, no doubt, facilitate emergence and spread of antibiotic-resistant bacteria, and accumulation of antibiotic residues, beyond safe levels in poultry products or the environment.

The continued use of chloramphenicol in poultry, after over two decades of its prohibition for systemic administration, due to its complicity in aplastic anaemia, is most unfortunate. Easy access to veterinary antibiotics in Nigeria, exemplified by its sell as over-the-counter, including those classified as '*Highest'* and '*High'* priority antibiotics, may be contributory to the continued use. Most importantly, lack of legislation against this practice and obvious inadequate implementation of the available veterinary drug laws in Nigeria are to be blamed.

CONCLUSION AND RECOMMENDATION

There is extensive imprudent administration of antibiotics in poultry in Nigeria. Thisunderscores the urgent need to enlighten the farmers on the benefits of prudent use of antibiotics inpoultry production and disease management. Discontinuation of sale of essential antibiotic as over-the-counter drug and strict implementation of veterinary drug laws is imperative; to safeguard the therapeutic efficacy for sustainable poultry production and to preserve public health.

REFERENCES

Adebowale O.O., Adeyemo O.K., Awoyomi O., Dada R. andAdebowale O. (2016). Antibiotic use and practices in commercial poultry laying hens in Ogun State Nigeria. *Rev. Elev. Med. Vet. Pays Trop*., 69, 41-45

Chinwe N., Ayogu T., Iroha I., Ejikeugwu C., Nwakaeze E., Oji A. *et al.(*2014). Cloacalfeacal carriage and occurrence of antibiotic resistant *Escherichia coli* in chicken grown with and without antibiotic supplemented feed. *Journal of Veterinary Medicine and Animal Health,* 6, 91-94.

Eagar H., Swan G. and Van-Vuuren M.A. (2013). Survey of antibiotic usage in animals in South Africa with specific reference to food animals.*Journal of South African Veterinary Association,* 83, 1-8.

Nisha A.R. (2008). Antibiotic residues- A global health hazard, *Veterinary World,* 4, 375-377

Njoga E.O., Onunkwo J.I., Chinwe C.E., Ugwuoke W., Nwanta J.A. andChah K.F (2018).Assessment of antibiotic drug administration and antibiotic residues in food animals in Enugu State, Nigeria.*Tropical Animal Health and Production,* 50, 897-902.

Onyenweaku E., Ene-Obong H., Williams I. andNwaehujor C. (2018). Comparison of nutritional composition of bird egg varieties found in Southern Nigeria: A preliminary study. *Food and Nutrition Sciences,* 9, 868-879

Van den Bogaard A.E. andStobberingh E.E. (2000). Epidemiology of resistance to Antibiotics - links between animals and humans. *International Journal of Antibiotic Agents,* 14, 327-335.

WHO (2016). Critically important antibiotics (CIA) list 5th review. http://who.int/foodsafety/publications/antibiotics-fifth/en/. Accessed December 2, 2019.

ASSESSMENT OF CHANGES IN PHYSIOLOGICAL PARAMETERS AND IMMUNE MARKER LEVELS IN ANIMALS PRESENTED FOR SLAUGHTER AT IKPA NSUKKA SLAUGHTER ABATTOIR

Ogbanya K.C., Eze C. A., Okereke N. H. & Chukwu C. C.
Department of Veterinary Surgery, Faculty of Veterinary Medicine
University of Nigeria, Nsukka
Corresponding author e-mail: kenneth.ogbanya@unn.edu.ng (08036027640).

ABSTRACT

The objectives of the study were to determine the changes in physiological parameters such as heart rate, pulse rate, respiratory rate and rectal temperature) and to assess the changes in immune marker levels like total leucocyte count, differential leucocyte count and neutrophil/lymphocyte ratio) of animals presented for slaughter at Ikpa slaughter slab. Physiological parameters of the cattle were determined using conventional methods. Blood was collected from 40 cattle at two stages: 1) pre-slaughter and 2) during slaughter. A significant increase in the physiological parameters at slaughter compared to the pre-slaughter in the both sex groups of the bovine species was noted. A slight increase in the neutrophil/lymphocyte ratio in the different sex groups at pre-slaughter and slaughter were observed. However, the increase was not statistically significant. It can be concluded from this study that changes in vital parameters (heart rate, pulse rate and respiratory rate) are more indicative of acute stress which is associated with slaughter processes in Ikpa abattoir

Keywords: stress, haematology, cattle, slaughter, physiological parameters.

INTRODUCTION

Stress is defined as the biological response elicited when an animal perceives a threat to its homeostasis (Moberg, 2000). Stress can also be defined as adverse effect in the environment or management system which forces changes in the animal's physiology or behavior to avoid physiological malfunctioning and assist the animal in coping with its environment (Ferguson and Warner, 2008). Stress leads to fight or flight response, so an animal can experience faster pumping lungs, increase heart rate, higher blood pressures and endorphins flooding the body. Also appetite, libido and immune system is shut down in order that energy is diverted to muscle to prepare for flight (Ranabir and Reetu, 2011). Animals can be stressed by either psychological factors (hunger, thirst, separation from group, mixing with unfamiliar group or novelty), physical factors (such as restraint, handling, fatigue or injury) and environmental factors (temperature and noise) (Etim and William, 2013). The main stressors in an animal's life are danger, illness, pain, accident, synthetic chemicals, inappropriate diet, weaning, confinement, isolation, overcrowding, change in routine, change in environment and over-stimulation (Etim and William, 2013).

Biological response to a stressor is used as an indicator of stress (Kumar *et al.*, 2012). Vocalisation, restlessness, fight, pain, refusal to move, increase in heart, blood pressure variability and increase in respiratory rate as behavioural indicator for stress (Broom, 2003). Endocrine Indicators used in determining acute stress level include corticotrophin-releasing hormone, catecholamine (epinephrine and norepinephrine), cortisol, adrenocorticotropic hormone, oxytocin, vasopressin, prolactin, glucagon, serotonin, opiates and gonadotrophins (Sapolsky, 2000).

Immune indicators that can be used in determining stress include increase in neutrophil/lymphocyte ratio and blood monocyte count (Sapolsky, 2000). Biochemical markers used in determining the level of acute stress in animals include urea level, glucose level, packed cell volume (PCV), total protein albumin,

creatinine kinase level (CK), aspartate transaminase (AST), lactate level, alkaline phosphatase (ALP) and blood potassium level (Calamari *et al*., 2003; Lay and Wilson, 2004; Abeni *et al*., 2007).

The objectives of the study were to evaluate the changes in physiological parameters (heart rate, pulse rate, respiratory rate and rectal temperature) and to assess the changes in immune marker levels (total leucocyte count, differential leucocyte count and neutrophil/lymphocyte ratio) of animals presented for slaughter at Ikpa slaughter slab.

MATERIALS AND METHODS

The rectal temperature was measured using a clinical thermometer (Naylor *et al*., 2010).

The heart rate was measured using a stethoscope (David and Dumitrascu, 2017).

The pulse rate of the animals was determined by placing the thumb on superficial arteries and the pulsating effect of the vessel was counted as beat in a minute (Tibballs and Russell, 2009). The respiratory rate of each animal was determined by calculating the number of movements of the flank in a minute (Legates *et al*., 1991).

Blood sample was collected from the jugular vein using sample bottle containing ethylene diamine tetraacetic acid (EDTA) from the animals 48 hrs before slaughter and during slaughter at the abattoir. Total white blood cell count was obtained using the haemocytometer counting method and while thin blood smear made on clean grease-free glass slides for differential leukocyte count were stained following the Leishman technique and enumerated by the meander counting method (Thrall and Weiser, 2002).

RESULTS

Changes in values of heart rate, pulse rate, respiratory rate and rectal temperature at pre-slaughter and at slaughter in the different sex groups of Bovine were reported in the table 1.

Table 1: Mean table 1: Changes in Bovine vital parameters (pre and at slaughter).

PARAMETER	Group	48 hr pre-slaughter	Slaughter
Heart rate (bpm)	**Male**	80.00±7.48[a]	**112.50±2.87[b]**
	Female	51.33±1.76[a]	**64.00±2.31[a]**
Pulse rate (bpm)	**Male**	79.00±6.61[a]	**113.50±9.00[b]**
	Female	49.33±2.67[a]	**74.67±7.42[b]**
Respiratory rate (cpm)	**Male**	33.00±2.52[a]	**47.00±1.00[b]**
	Female	30.67±1.33[a]	**41.33±3.53[b]**
Rectal temp (°C)	**Male**	37.55±0.09[a]	**38.48±0.13[b]**
	Female	38.63±0.18[a]	**38.60±0.06[a]**

Different superscript [a, and b] in rows indicate a significant difference at $p<0.05$.

Changes in value of total leucocytes, neutrophils, lymphocytes, monocytes, eosinophils and neutrophil/lymphocyte ratio in the male and female groups of Bovine at 48 hr pre-slaughter and at slaughter were shown in the table 2.

Table 2: Mean changes in Total and Differential WBC at pre-slaughter and at slaughter (Bovine).

PARAMETER	Group	48 hr pre-slaughter	Slaughter
Total leucocyte (*10^3/µl)	**Male**	8.10±0.85[a]	**8.24±0.47[a]**
	Female	6.93±0.75[a]	**8.63±0.85[a]**
Neutrophils (*10^3/µl)	**Male**	3.67±0.56[a]	**4.05±0.31[a]**
	Female	3.24±0.30[a]	**4.16±0.35[a]**
Lymphocytes (*10^3/µl)	**Male**	3.73±0.20[a]	**3.80±0.11[a]**
	Female	3.51±0.63[a]	**4.14±0.59[a]**
Monocytes (*10^3/µl)	**Male**	0.55±0.11[a]	**0.33±0.13[a]**
	Female	0.18±0.10[a]	**0.28±0.05[a]**
Eosinophils (*10^3/µl)	**Male**	0.17±0.07[a]	**0.07±0.04[a]**
	Female	0.00±0.00[a]	**0.05±0.05[a]**
Neutrophil / Lymphocyte ratio	**Male**	0.97±0.10[a]	**1.07±0.08[a]**
	Female	0.97±0.16[a]	**1.02±1.31[a]**

Different superscript [a, and b] in rows indicate a significant difference at $p<0.05$.

DISCUSSION

The significant increase in the physiological parameters (heart rate, pulse rate, respiratory rate and rectal temperature) in the both sex groups of the bovine species at pre-slaughter and slaughter could be as a result of fear perceived by the animals during handling and restraint at slaughter. These changes also were observed by Apple *et al*. (2005) in a work done on the effect of handling and restraint on cattle. Catecholamine and cortisol are released during stressful conditions and they will lead to an increase in levels of vital parameters in other to maintain homeostasis (Sontag *et al*., 2010). The significant variation in the heart and pulse rates and rectal temperature between the male and female groups of the bovine specie could be as a result of sex differences in stress response. Bale and Epperson (2015) reported that sex differences in stress response can be found at all stages of life and these differences is related to the organizational and activational effects of gonadal hormones (testosterone and estrogen) and also to the various genes found on the sex chromosomes. In this study, the male group responded more to stressors associated with slaughter than the female group. This was also observed in the work done on pigs by Morta-Rojas *et al*. (2006) who showed that male animals are more susceptible to changes in vital signs associated with stress than the female because the male animals are more excited and aggressive.

The increase in neutrophil/lymphocyte ratio in the different sex groups at pre-slaughter and slaughter in this study could be as a result of increase in level of neutrophil and decrease in level of lymphocyte. Elevated levels of glucocorticoids have been reported to lead to an increase in the level of neutrophils and a decrease in level of lymphocytes resulting in variations in total leukocyte level (Davis *et al*., 2008).

CONCLUSION

It can be concluded from this study that changes in vital parameters (heart rate, pulse rate and respiratory rate) are more indicative of acute stress which is associated with slaughter processes in Ikpa abattoir. From this study there was no significant changes in total and differential leukocyte counts.

RECOMMENDATION

Animals should be given enough rest while they are kept in lairage before slaughter to avoid stress in these animals. Also proper handling of animals should be adopted by Butchers during slaughter to avoid stressing them which could affect the quality of meat.

REFERENCE

Abeni, F. Calamari, L and Stefanini, L. (2007). Metabolic conditions of lactating Friesian cows during hot season in Po valley, Blood indicators of heat stress. *International Journal of Biometeorology* 52 (2): 87-96.

Apple, J. Kegley, E. Galloway, D. Witsuba, T and Rakes, L. (2005). Duration of Restraint and Isolation Stress as a Model to Study the Dark-Cutting Condition in Cattle. *Journal of Animal Science* 83(5): 1202-1214.

Bale, T and Epperson, C. (2015). Sex differences and stress across the lifespan. *Nature Neuroscience* 18(10): 1413- 1429.

Broom, D. (2003). Transport Stress in Cattle and Sheep with details of Physiological, Ethological and Other Indicators. *Journal of Deutsche Tierarztliche Wochenschrift* 110 (3): 83-89.

Calamari, L. Maianti, M and Stefanini, L. (2003). Effect of space availability at feed bunk and rest area on metabolic conditions and productive responses in dairy cows. *Italian Journal of Animal Science* 2(1): 281-283.

David, L and. Dumitrascu, D. (2017). The bicentennial of the stethoscope: *A Reappraisal. Clujul Medical Journal* 90 (3): 361–363.

Davis, A. Maney, D and Maerz, J. (2008). The use of leukocyte profiles to measure stress in vertebrates: a review for ecologists. *Functional Ecology* 22 (5): 760-772.

Etim, N. Williams, M. Evans, E and Effiong, E. (2013). Physiological and Behavioral Responses of Farm Animals to Stress, Implications to Animals Productivity. *American Journal of Advanced Agricultural Research (AJAAR)* 1(2): 53-61.

Ferguson, D and Warner. D. (2008). Have we underestimated the impact of pre-slaughter stress on meat quality in ruminants? *Journal of Meat science* 80 (1):12-19.

Kumar, B. Manuja, A and. Aich, P. (2012). Stress and its Impact on Farm Animals. *Journal of Frontiers in Bioscience* 1 (4): 1759-1767.

Lay, D and Wilson, M. (2004). Considerations When Using Data in Assessing Animal Well-Being. *Journal of Animal and Veterinary Advances* 3: 614-626

Legates, J. Farthing, B. Casady, R and Barrada, M. (1991). Body temperature and respiratory rate of lactating dairy cattle under field and chamber conditions. *Journal of Dairy Science* 74 (8): 2491-2500.

Moberg, G. P. (2000). The Biology of Animal Stress. 3rd ED. CABI publishing, UK.

Morta-Rojas, D. Becerril, M. Lemus, C. Sanchez, P. Gonzalez, M. Olmos, S. Ramirez, R and Alonso-Spilsbury, M. (2006). Effects of mid-summer duration on pre- and post-slaughter performance and pork quality in Mexico. *Meat Science*. 73: 404–412.

Naylor, J. Streeter, R and. Torgerson, P. (2010). Factors affecting rectal temperature measurement using commonly available digital thermometers. *Research in veterinary science* 92(7): 121-130.

Ranabir, S and Reetu, K. (2011). Stress and Hormones. *Indian Journal of Endocrinology and Metabolism* 15 (1): 18-22.

Sapolsky, R. Romero, L and. Munck, A. (2000). How do Glucocorticoids Influence Stress Responses? Integrating, Permissive, Suppressive, Stimulatory, and Preparative Actions. *Journal of Endocrine Reviews* 21 (1): 55-89.

Sontag, T. Tucha, O. Walitza, S and. Lange, K. (2010). Animal models of attention deficit / hyperactivity disorder (ADHD): A Critical Review. *Journal on Attention Deficit Hyperactivity* Disorder. 2 (1): 1-20.

Tibballs, J and Russell, P. (2009). Reliability of pulse palpation by healthcare personnel to diagnose paediatric cardiac arrest. *Resuscitation* 80(1): 61-64.

Thrall MA, Weiser MG, 2002. Haematology. In: Hendrix CM, editor. Laboratory procedures for veterinary technicians. 4th ed.Missouri: Mosby Inc; p. 29–74.

GROSS AND RADIOGRAPHIC ASSESSMENT OF THE FOOT WITH CLAW DISORDERS IN CULLED CATTLE AT NSUKKA ABATTOIR

Ogbanya K.C., Eze C. A. and Nnaji T. O.
Department of Veterinary Surgery, Faculty of Veterinary Medicine
University of Nigeria, Nsukka
Corresponding author e-mail: kenneth.ogbanya@unn.edu.ng

ABSTRACT
The main objective of this descriptive and cross-sectional study was to determine the common radiographic features of claws with gross disorders using abattoir samples. A total of 40 claws were collected from Nsukka abattoir. The claws were examined for identification of different types of gross lesions. Two radiographic exposures, dorso-plantar and lateral views of each of the claws were taken and evaluated for radiographic changes. The prevalence of infectious and non-infectious claw disorders was 55% and 45% respectively. White line disease (WLD), sole ulcer and horn heel erosion were the most prevalent gross lesions with 35%, 30% and 20% prevalent rates respectively while bulb ulcer and wall fissure were the least occurred claw disorders with 5% and 5% occurrence Infectious claw disorders (55%) had a relatively higher occurrence than the non-infectious disorders (45%). The most prominent radiographic abnormalities were noted in the second (PII) and third phalanxes (PIII) region. The radiographic changes were: increase in joint width (10%) subluxation of pedal bone joint (5%), exostoses (5%) of the pastern (PII) bone, sinking pedal bane (15%) in which the bone was displaced slightly ventrally away from the dorsal wall of the claw. Concurrent appearance of more than one radiographic feature in a single claw was noted in the claw samples.

Key words: cattle, foot, claw disorder, radiograph

INTRODUCTION
Claw disorders are either infectious or non-infectious (Greenough, 2007). Claw disorders in dairy animals cause a great deal of economic loss in terms of milk production and reproduction losses (Booth *et al.*, 2004; Garbarino *et al*., 2004; Singh *et al*., 2011). Claw disorders have been found to be the cause of more than 90% of all lameness cases observed in dairy cattle (Murray, *et al.,* 1996). Lameness in animals has emerged as the most severe problem in recent years, at organized farms. It is considered to be the third most expensive health problem of dairy animals after mastitis and infertility (Esslemont, 1990), having adverse effect on their welfare. Lameness is considered to be a major welfare and economic problem both in beef and dairy farming. Economically, lameness due to lose in milk yield, weight and fertility and increases the risk of culling (Reyher *et al*., 2011; Hogeveen *et al.,* 2011). Because of the low level of farmer's knowledge, training and awareness, the risk of claw disease not being discovered until the clinical condition becomes very obvious. The chances of restoring the productivity of the animal, its milk yield or weight gain, depend largely on rapid medical or surgical treatment, the course of which relates directly to accurate diagnosis and appropriate treatment (Hogeveen *et al*., 2011). Radiography as a diagnostic tool is often necessary and in most cases, useful to reach to a diagnosis (Ahmed and Shekidef, 2012). The objectives of the study were to macroscopically and radiographically examine claw disorders of the culled cattle at Nsukka Abattoir.

MATERIALS AND METHODS
The Ikpa Nsukka market abattoir and the slaughter slab was purposively selected because the abattoir maintains a regular slaughter of cow. Post-mortem hindlimb digits with gross claw disorders were amputated and collected for assessment. The choice of hindlimbs was based on the fact that hindlimbs have been reported to be responsible for a higher percentage of foot lameness in cattle (Hernandez *et al.*

2002). A total of 20 cow-feet of the hindlimbs (40 claws) with claw-related lesions were macroscopically and radiographically examined.

Macroscopic examination of the claw

The claws were thoroughly washed, assessed for macroscopic lesions identification. The weight-bearing surface of the claws were examined for any gross claw lesions. Excessively overgrown claws were trimmed using hoof knife to effectively reduce their sizes. The horn of the sole was trimmed with a hoof knife to expose any underlying claw lesions and any observable claw lesions recorded accordingly.

The claw lesions were photographed using a digital camera (Sony DSC-S80, 4.1Mega Pixels).

Radiographic assessment of the claws disorder was using standard radiographic techniques (Beige and Bakir, 2005).

Radiographic examination of the claw

The collected feet were transported to the Radiology Unit of the Department of the Veterinary Surgery and Radiology, UNN for radiographic examination. Lateromedial and dorsoplantar views were obtained using exposure factors of 20 mAs, 80-88kV and FFD of 70 cm. The obtained radiographs were interpreted properly.

Data management and analysis

Presence or absence of a particular lesion were recorded as "1" (meaning "Yes" for presence of a claw lesion), and "0" (meaning "No" for absence of a claw lesion). Percentage distribution of the lesions were computed as: Proportion of the number of positive observations of each lesion type divided by the total number of feet sampled, multiplied by 100 to express it as a percentage.

Results

A total of 20 cows had been enrolled at the end of the study period and had complete data observations. White line disease (WLD) sole ulcer (SU) were the most prevalent claw disorders with 35% (7/20) and 30% (6/20), respectively, while bulb ulcer and wall fissure were the lest occurred claw disorders with 5% (1/20) and 5% (1/20) occurrence (table 1). Infectious claw disorders (55%) had a relatively higher occurrence than the non-infectious disorders (45%) (table 2).

Radiographic changes

The most prominent radiographic abnormalities were noted in the third phalanx (PIII) region of the culled cows. The radiographic changes were: increase in joint width (10%), subluxation of pedal bone joint (5%), exostoses (5%) of the pastern (PII) bone, sinking pedal bane (15%) in which the bone was displaced slightly ventrally away from the dorsal wall of the claw. Pedal bane changes were observed to be more severe in the lateral claws than medial claws. Concurrent appearance of more than one radiographic feature in a single claw was noted in the law samples. Prevalent rate of various radiographic features and cows with laminitis were summarized in tables 3 and 4.

Table 1: Prevalent rate of different claw disorders in 20 abattoir feet (40 claws) samples.

Claw Disorders	No of Occurrence	Percentage of Occurrence
White line disease (WLD)	7	**35%**
Sole Ulcer (SU)	6	**30%**
Horn Heel Erosion (HHE)	4	**20%**
Wall fissure (WF)	1	**5%**
Digital dermatitis (DD)	2	**10%**
Bulb Ulcer (BU)	1	**5%**
Total	**20**	**100**

Table 2: Prevalent rate of infectious and non-infectious claw lesions.

Type of claw infection	Number of occurrence	Percentage of Occurrence
Infectious	11	**55%**
Non-infectious	9	**45%**
Total	**20**	**100**

Table 3: Prevalent rate of radiographic features of 20 abattoir feet (40 claws) with claw disorders

Radiographic lesion	Occurrence	Prevalence X/20 x 100/1
Increase joint width	2	**10%**
Subluxation of the pedal bone	1	**5%**
Sinking pedal bone	3	**15%**
Exostosis of the pastern bone	1	**5%**
Total	7	**35%**

Table 4: Prevalent rate of laminitic and non-laminitic cows

Animal	No of occurrence	Prevalent (6/20 x 100/1
Laminitic cow	6	**30**
Non-laminitic cow	14	**70**
Total	20	**100**

DISCUSSION

Claw lesions such as heel erosion, white line separation and sole ulcer have been incriminated as major underlying predisposing cause for development of laminitis in cattle (Nocek, 1997; Beige and Bakir, 2005). The high prevalence rate of white line disease (35%), sole ulcer (30%) and heel horn erosion (20%) observed in this current study almost proportionally compares with the 30% prevalence rate of laminitis seen among the examined cows. This observation supports works of other researchers who have previously employed presence of, heel erosion, white line separation and sole ulcer for the diagnosis of laminitis in cattle (Greenough and Vermunt, 1991; Bergsten, 1994; Beige and Bakir, 2005).

In this study, all the cows with sole ulcer and horn heel erosion were radiographically confirmed to be laminitic. This linkage is likely to be attributed to the fact that the initial phase of the pathogenesis of

laminitis involves changes in pododermal microvasculature, which results in vascular tissue damage and subsequently manifest as ulcer in the sole (Nocek, 1997; Hirschberg and Plendl, 2005). Sole ulcer is probably the main sign that can be used to diagnose subclinical phase of claw lesions particularly laminitis. The results of this study indicated that cows with laminitis have more than one associated claw lesion and deformity. This report is consistent with the previous findings which stated that laminitis is a predisposing cause of lesions such as sole ulcers, white line separation, heel erosion and double soles (Nocek, 1997, Beige and Bakir, 2005).

White line separation was mostly found on the lateral claw of the hind limbs. White line separation has been reported previously to be attributed to the fact that white line is the weakest point of impact which is likely to succumb and fissure under pressure insults (Baggott and Russell, 1981).
High prevalence rate of infections of the claw observed in this study might be attributed to poor environmental hygiene in the cattle environment. Presence of infectious digital dermatitis (10%) which is also known as digital papillomatosis or "hairy warts" in cows suggested a managemental factor in its aetiological predisposition. Unhygienic environment would promote development and spreading of this contagious lesion (Weaver, 1993). Results of this study indicate that laminitis in cows can tentatively be predicted by presence of some claw deformities. This predictive association between claw deformities and laminitis is supported by findings of others (Greenough, 1987; Ebeid, 1993; Weaver, 1993).
Claws affected with infectious digital dermatitis had narrowed medial pedal bone. This finding is related to the findings of Nguhiu-Mwangi *et al.* (2007) who reported narrowing of pedal bones in extremely deformed chronic laminitic claws of dairy cows. However, narrowing of the pedal bones could be due to an osseous dissolution resulting from osseous necrosis (osteosis). One of the causes of osteosis is associated with nutrition and oxygen especially when there is compromise of local blood supply (Jubb *et al*., 1993). Exostosis of the pastern bone was also observed in the claws affected with digital dermatitis. Similarly, Maclean (1970), reported in the exostosis of the pedal bone in claws with chronic laminitis. The cause of exostosis could be attributed to periostitis (inflammation) of the pedal bane following prolonged inflammatory stimuli in chronic laminitis. The outgrowths or projections seen on the pastern bone could be a result of exostosis (Jubb *et al*., 1993).

The cause of rotation of phalanges (mainly third phalanx) in this study could be attributed to damage of the laminar tissue attaching the pedal bone to the dorsal aspect of the claw. Rotation of phalanges usually leads to joint angulation.

In conclusion, radiographic examination revealed that typical changes of chronic laminitis were among the most common pathological features recorded.

REFERENCE

Ahmed, I.H. and Shekidef, M.H. (2012). Incidence and management of bovine claw affections and their economic impact: A field study on dairy farms. *J. Am. Sci*.**, 8(**6): 46-61.

Baggott, D. G and Russell, A. M. (1981). Lameness in cattle. *British Veterinary Journal* **137:** 113-132.

Belge, A. and Bakir, B. (2005). Subclinical laminitis in dairy cattle: 205 selected cases. *Turk. J. Vet. Sci.* **29**: 9-15.

Bergsten, C. (1994). Haemorrhages of the sole horn of dairy cows as a retrospective indicator of laminitis. an epidemiological study. *Acta Vet. Sccotd*. **35.** 55-66.

Booth, C. J., Warnick, L. D., Grohn, Y. T., Maizon, D. O., Guard, C. L and Janssen, D. (2004). Effect of lameness on culling of dairy cows. *Journal of Dairy Science*, **87**(12): 4115– 4122.

Belge, A. and Bakir, B. (2005). Subclinical laminitis in dairy cattle: 205 selected cases. *Turk. J. Vet. Sci.* **29**: 9-15.

Ebeid, M. (1993). Bovine laminitis: a review. *Vet. Bulletin* **63**: 205-213.

Esslemont, R. J. (1990). The costs of lameness in dairy herds. In: R. D. Murray (Ed), Proceedings of Vlth International Symposium on Diseases of the Ruminant Digit, British Cattle Veterinary Association, Liverpool, pp 237-251.

Garbarino, E.J; Hernandez, J.A.; Shearer, J.K.; Risco, C.A. and Thatcher, W.W. (2004). Effects of lameness on ovarian activity in postpartum Holstein cows. *Journal of Dairy Science*, **87**: 4123-4131.

Greenough, P R. (2005). Heel erosion, sole erosion (bruising), double soles, sole foreign bodies and horizontal ridges of the dorsal wall, www.cowdoc.net.

Greenough, P R. and Vermunt, J.J. (1991). Evaluation of subclinical laminitis in a dairy herd and observations on associated nutritional and management factors. *Vet. Rec*. **128:**11-17.

Greenough, P. (2007). Infectious diseases and other conditions affecting the interdigital space. In: Greenough, P., editor. Bovine Laminitis and Lameness. 1st ed. WB Saunders/ Elsevier, Philadelphia, PA. p199-220.

Hernandez, J., Shearer, J.K. and Webb, D.W. (2002). Effect of lameness on milk yield in dairy cows. *J. Am. Vet. Med. Assoc.,* **220:** 640-644.

Hirschberg, R.M. and Plendl, J (2005). Pododermal angiogenesis and angioadaptation in the bovine claw. *Microsc. Res. Tech***. 66**: 145-155

Hogeveen, H., Huijps, K. and Lam, T.J. (2011). Economic aspects of mastitis: New developments. *N. Z. Vet. J.*, **59**: 16-23.

Jubb, K.V.F., Kennedy, P C. and Palmer, N. (1993). In: Pathology of Domestic Animals, 3nJ Ed, Vol. 1. Academic Press, New York, Inc. Harcourt Brace Jovanovich Publishers, pp 61-63.

Maclean, C.W. (1970). A post-mortem X-ray study of laminitis in barley beef animals. *Vet. Rec*. **86**: 457-462.

Murray, R.D., Downham, D.Y., Clarkson, M.J., Faull, W.B., Hughes, J.W., Manson, F.J., Merrit, J.B., Russel, W.B., Sutherst, J.E. and Ward, W.R. (1996). Epidemiology of lameness in dairy cattle, description and analysis of foot lesions. *Vet. Rec*., **138**: 586-591.

Nguhiu-Mwangi, J., Mbithi, P. M. F., Wabacha, J. K. and Mbuthia, P. G. (2007). Radiographic features of laminitic claws of dairy cows around Nairobi. *A Journal of the Kenya Veterinary Association*: *The Kenya Veterinarian* **31**(2): 72 – 78.

Nocek, J.E. (1997). Bovine acidosis, implications on laminitis. *Journal of Dairy Science* **80**: 1005-1028

Reyher, K.K., Dufour, S., Barkema, H.W., Des Coteaus, L., DeVries, T.J., Dohoo, I.R., Keefe, G.P., Roy, J.P. and Scholl, D.T. (2011). The national cohort of dairy farms - A data collection platform for mastitis research in Canada. *Journal of Dairy Science*, **94**: 1616-1626.

Singh, Y., Lathwal, S. S., Chakrabarty, A. K., Gupta, A. K., Mohanty, T. K., Raja, T. V., Dangi, R. L and Roy, B. K. (2011). Effect of lameness (hoof disorders) on productivity of Karan Fries crossbred cows. *Animal Science Journal* **82**: 169–74.

Weaver, A.D. (1993): Aseptic laminitis of cattle. Interdigital and Digital dermatitis, indicator of laminitis. an epidemiological study. *Acta Vet. Sccotd*. **35:** 55-66.

HAEMATOPOEITIC POTENTIALS OF METHANOLIC EXTRACT OF *TETRAPLEURA TETRAPTERA* PODS IN MALE ALBINO RATS

C. O. Okorie-Kanu[*1], F. M. Ojigwe[1], S. O. Onoja[2], O. J. Okorie-Kanu [3]

[1]*Department of Veterinary Pathology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.*

[2]*Department of Veterinary Physiology and Pharmacology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.*

[3]*Department of Veterinary Public Health and Preventive Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.*

**Correspondence: okorie-kanu.christian@mouau.edu.ng Phone +2348038993506.*

ABSTRACTS

This study was carried out to determine the haematopoietic potential of the methanolic extract of *Tetrapleura tetraptera* in male albino rats. Twenty five rats weighing between 147 and 166 g were used for the study. Anaemia was induced by daily removal of 2ml of blood per 100g body weight for ten days. Thereafter, the animals were administered with the extract for seven days. The rats were treated with 50mg/kg, 100mg/kg and 200mg/kg respectively for groups A - C while groups D (negative control) and E (positive control) received 5 ml/kg of water. Results showed successful induction of anaemia. There were significant increases in the erythrocytic parameters after administration of the methanoloic extract of *T. tetraptera*. The concentration dependent increase in the PCV, HBC, RBC, MCH and MCHC in the groups treated with the extract when compared with the untreated groups suggests that the extract possesses some haematopoietic potentials.

Key words: Anaemia, haematopoitic, *Tetrapleura tetraptera*, haematology, rats.

INTRODUCTION

Anaemia is a decrease below normal of the erythrocyte count and/or haemoglobin concentration. It is not a disease in itself, but a sign of disease (Coles, 1986; Fry and Mc Gavin, 2012). The daily production of erythrocytes in healthy individuals equals their destruction with the result that circulating red blood cell (RBC) values are always within the normal range for the species. Anaemia occurs due to inability to maintain this equilibrium as a result of excessive destruction or loss. Anaemia is one of the major syndromes commonly encountered by veterinarians in practice especially in Africa due to the abundance of the causative agents in the environment, climatic factors that favour their proliferation and survival, and poor management practices which favour the spread of infectious disease agents. Clinical manifestations of anaemia include pallor of the mucus membranes of the mouth and pharynx, the conjunctivae and lips, cyanosis and dilation of peripheral vessels as occurs in shock, tachycardia and polypnea, mainly after exercise, weakness, poor stamina and fever if caused by infectious agents especially bacteria (Coles, 1986). The severity of the anemia is determined by the nature of blood loss. It is acute if a large volume of blood is lost within a short period of time as occurs in trauma and chronic when small amount of blood is lost over a long period of time due mainly to gastro-intestinal parasites, ectoparasites, ulcerations of the gastrointestinal tract and neoplasm. Also, anaemia can result from destruction of erythrocytes or reduced erythrocyte lifespan. Destruction of red blood cells can be due to toxins, chemicals, haemoparasites or immune reactions while decreased red blood cell production may be due to nutritional causes such as iron deficiency, lack of vitamin B12 and bone narrow neoplasm (Kerr, 2002).

Herbal medicines are presently becoming popular in treatment of diseases because conventional medicines are expensive and associated with side-effects (Atawodi *et al*., 2014). Several plants have been found to exhibits haematinic effects (Muriithi *et al*., 2015).

Tetrapleura tetraptera is a medicinal plant of the *Fabaceae* family. It is generally found in low land forest areas of tropical Africa. The fruits consist of a fleshy pulp with small brownish black seeds. It is used traditionally as spice and in management of convulsions, leprosy, inflammation and rheumatism (Ojewole

and Adesina, 1983; Nwawu and Akali, 1986; Okwu, 2003; Aladesanmi, 2007). It also exhibited antibacterial activities as well as good wound healing effects (Ekwenye and Okorie, 2010; Effiong *et al*., 2014; Oguoma *et al*., 2015). It has also been shown to be very potent against larvae of *Anopheles gambiae* (Aina *et al*., 2009). However, while some reports recorded good haematopoietic potentials (Muriithi *et al*., 2015), others claimed that the plant is haemolytic (Odesanmi *et al*., 2010). This study was therefore designed to further evaluate the effects of the methanolic pod extract of *T. tetraptera* on haemorrhagic anaemia in rats.

Materials and Methods

Twenty five male albino rats were used for the study. They were obtained from a laboratory animal house in Osisioma L.G.A. of Abia State. They were randomly divided into 5 groups of 5 rats each. The rats were kept in metal cages in the laboratory animal house of the Department of Veterinary Pathology, MOUAU for two weeks and feed (Vital feed) and water given *ad libitum.* After acclimatization, anaemia was induced by daily removal of 2ml of blood per 100g body weight for ten days (Ihedioha and Daniel-Igwe, 2014).

Dried fruits of *T. tetraptera* were purchased from a local market (Orie Ugba) in Umuahia, Abia State. The fruits were washed with distilled water and dried for 7 days. They were later ground into small coarse particles and stored in airtight containers prior to extraction.

Extraction: Extraction was by cold maceration. Ground fruit (500 grams) was soaked in one litre of absolute methanol and was agitated every 3 hours for 3 days (72 hours). It was filtered with Whatman's filter paper into a beaker and oven dried at 39°C with a yield of 90.2g crude extract.

Yield was calculated as follows:

$$\text{Percentage yeild} = \frac{19.2g}{20.500g} \text{ x } 100 = 18.04\text{g}$$

Haematological analyses were carried out immediately after collection and standard procedures were followed for the assay of all parameters. Packed cell volume (PCV) was determined by the microhaematocrit method, while haemoglobin concentration (HBC) was determined by the Cyanomethaemoglobin method (Schalm et al., 1975; Coles, 1986). Red blood cell (RBC) and total white blood cell (WBC) counts were carried out by the haemocytometer method while the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using the standard formulae and the differential WBC count was determined by the Leishman method (Schalm *et al*., 1975; Coles, 1986).

Data Analysis

Data generated were subjected to analysis of variance (ANOVA) and variant means were separated using the least significant difference (LSD) method using SPSS statistical package version 16.0. Significance was accepted at (P<0.05) probability level.

Results

The results are presented in table 1. After induction of anaemia, the mean PCV, HBC and RBC count of groups A - D were significantly lower ($p< 0.05$) when compared with group E (control). The mean corpuscular volume (MCV) of groups A - D were significantly higher ($p< 0.05$) when compared with group E (control). However, the mean HBC count of group C was significantly higher ($p< 0.05$) when compared with groups B and D. The mean corpuscular haemoglobin (MCH) of groups A - D were significantly lower ($p< 0.05$) when compared with group E (control) but group C was significantly higher ($p< 0.05$) when compared with groups A and B. The mean corpuscular haemoglobin concentration (MCHC) of groups A, B and D were significantly lower ($p< 0.05$) when compared with groups C and E (control) and no significant difference ($p> 0.05$) between groups C and E. There were no significant ($p> 0.05$) variations in all the white blood cell values in all the groups. Also, there were no significant ($p> 0.05$) variations in the mean values of the plasma protein except group C that was significantly higher ($p< 0.05$) when compared with groups B and E (control). There were no significant ($p> 0.05$) variations in the

mean body weights of all the groups. After administration of the extract, the mean PCV of all the groups were higher when compared with group D but only group A was significant ($p< 0.05$). The mean HBC values of groups C and D were lower when compared with other groups but were only significant ($p< 0.05$) when compared with groups A and B. The mean red blood cell count (RBC) of all the groups were higher when compared with group E (control) but only group D was significant ($p< 0.05$). The MCV values of groups A - D were all higher when compared with group E but only group D was significant ($p< 0.05$). There were no significant ($p> 0.05$) variations in the MCH and MCHC, white blood cell and mean plasma protein values. Also, there were no significant ($p> 0.05$) variations in the mean body weights of all the groups.

Table 1 Haematological profile and body weight (Means ± Standard error) of the rats after 1 week administration of methanolic extract of *T. tetraptera* pods.

	After Induction of Anaemia				**E**	**A**	After 1 week Administration of extract			
	A	B	C	D			B	C	D	E
PCV (%)	25.50 ± 0.22^{a}	25.30 ± 0.20^{a}	26.13 ± 0.83^{a}	24.80 ± 0.58^{a}	38.75 ± 1.30^{b}	42.50 ± 0.57^{a}	42.00 ± 1.70^{ab}	39.00 ± 1.00^{ab}	38.30 ± 1.91^{b}	39.25 ± 0.95^{ab}
HBC (g/dl)	8.88 ± 0.16^{ab}	8.47 ± 0.33^{a}	10.02 ± 0.41^{b}	8.73 ± 0.28^{a}	14.87 ± 0.70^{c}	16.95 ± 0.38^{a}	16.09 ± 0.39^{ac}	14.87 ± 0.25^{b}	14.69 ± 0.26^{b}	15.52 ± 0.37^{bc}
RBC (10^{6}/µl)	3.47 ± 0.06^{a}	3.35 ± 0.11^{a}	3.54 ± 0.11^{a}	3.33 ± 0.06^{a}	7.02 ± 0.33^{b}	6.70 ± 0.68^{ab}	6.81 ± 0.38^{ab}	6.68 ± 0.40^{ab}	5.53 ± 0.22^{b}	7.46 ± 0.67^{a}
MCV (fl)	73.59 ± 1.00^{a}	75.69 ± 2.09^{a}	73.72 ± 2.19^{a}	74.46 ± 1.11^{a}	54.61 ± 3.04^{b}	65.35 ± 6.03^{ab}	62.09 ± 3.06^{ab}	58.72 ± 2.04^{ab}	69.56 ± 4.08^{a}	53.53 ± 3.56^{b}
MCH (pg)	25.65 ± 0.69^{a}	25.30 ± 0.99^{a}	28.25 ± 0.46^{b}	26.22 ± 0.66^{ab}	20.81 ± 0.70^{c}	26.22 ± 2.90	23.86 ± 1.32	22.50 ± 1.40	26.72 ± 1.18	21.35 ± 2.10
MCHC (g/dl)	34.94 ± 0.88^{a}	33.50 ± 1.43^{a}	38.70 ± 0.89^{b}	35.23 ± 1.01^{a}	38.23 ± 1.12^{ab}	39.95 ± 1.14	38.44 ± 1.10	38.23 ± 1.37	38.65 ± 1.53	39.62 ± 1.44
WBC (10^{3}/µl)	12.50 ± 0.49	12.34 ± 0.63	10.71 ± 1.56	11.22 ± 0.89	12.79 ± 0.43	14.60 ± 1.52	15.05 ± 1.24	13.46 ± 0.43	13.53 ± 1.49	13.86 ± 0.95
Neutrophil (%)	19.80 ± 1.83	19.80 ± 2.96	21.25 ± 2.95	18.80 ± 2.15	21.00 ± 1.70	19.40 ± 3.46	22.40 ± 1.89	25.50 ± 5.91	21.80 ± 4.51	21.50 ± 1.19
Lymphocyte (%)	78.80 ± 2.06	79.40 ± 2.98	78.25 ± 3.20	80.40 ± 2.06	77.60 ± 1.69	78.60 ± 3.56	76.00 ± 2.10	73.75 ± 6.09	76.40 ± 4.82	76.75 ± 1.38
Monocyte (%)	0.80 ± 0.37	0.60 ± 0.40	0.25 ± 0.25	0.80 ± 0.20	0.60 ± 0.40	1.40 ± 0.40	1.60 ± 0.60	0.75 ± 0.25	1.60 ± 0.81	1.25 ± 0.48
Eosinophil (%)	0.20 ± 0.20	0.00 ± 0.00	0.25 ± 0.25	0.00 ± 0.00	0.40 ± 0.24	0.40 ± 0.24	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.50 ± 0.29
Basophil (%)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.20 ± 0.20	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.25 ± 0.25
Protein (g/dl)	8.04 ± 0.21^{ab}	7.68 ± 0.27^{a}	9.20 ± 0.93^{b}	8.20 ± 0.50^{ab}	7.72 ± 0.14^{a}	9.00 ± 0.06^{a}	8.64 ± 0.19^{a}	7.75 ± 0.13^{bc}	7.88 ± 0.27^{b}	7.30 ± 0.21^{c}
Bodyweight (g)	153.16 ± 9.63	160.20 ± 9.90	147.30 ± 3.34	155.34 ± 6.71	166.36 ± 7.61	153.16 ± 9.63	160.20 ± 9.90	147.30 ± 3.34	155.34 ± 6.71	166.36 ± 7.61

*Different superscripts in a row indicate significant difference between the groups ($p<0.05$).

PCV - Packed cell volume; HBC - Haemoglobin concentration; RBC - Red blood cell; MCV - Mean corpuscular volume; MCH - Mean corpuscular haemoglobin; MCHC - Mean corpuscular haemoglobin concentration, WBC- White blood cell.

DISCUSSION

The significant reduction in PCV, HBC and RBC in all the groups bled indicated that anaemia was successfully induced. This is in agreement with Ihedioha and Daniel-Igwe (2014) who reported daily removal of 2 ml of blood per 100g for 10 days for successful induction of anaemia with minimal or no mortality. The increase in MCV values after induction of anaemia indicates presence of macrocytes which are mainly reticulocytes (Coles, 1986; Kerr, 2002). This also shows bone marrow response to the anoxic condition created by the continual removal of blood (Chulilla, 2009). The decreased values of PCV, HBC, RBC and MCHC and increased MCV indicates a macrocytic normochromic anaemia. The significant increase in the PCV. HBC , RBC, MCH and MCHC in the groups treated with the extract when compared with the untreated group (D) suggests that the extract possesses some haematopoietic potentials.

Tetrapleura tetraptera had been reported to contain abundance of iron which is used by the bone marrow for haemoglobin production (Aladesanmi, 2007). Iron also helps many enzymes that are essential for growth, healing, immune function and DNA synthesis (Basta, 1979). This finding supports the folkloric usage by women after delivery in most parts of Africa including Nigeria.

REFERENCES

Adesina, S. K., Adewumi, C. O. and Marrquis, V. O. (1980). Phytochemical investigations of the molluscicidal properties of *Tetrapleura tetraptera* (Taub). *Journal of African Medicinal Plants* 3:7 - 15.

Aina, S. A., Banjo, A. D., Lawal, O. A., Okoh, H. I., Aina, O. O. and Dedeke, G. A. (2009). The toxicity of extracts of *Tetrapleura tetraptera* (Aridan), *Delonix regia* (Flame of the forest) and *Raphia vinifera* (Raffia palm) on the larvae of *Anopheles gambiae*. *Academic Journal of Entomology*, 2 (2): 67 - 70.

Aladesanmi, A. J. (2007). *Tetrapleura tetraptera*: Molluscicidal activity and chemical constituents. *African Journal of Traditional and Complementary and Alternative Medicine*, 4(1):23 - 36.

Atawodi, S. E., Yakubu, O. E., Liman, M. L. and Iliemene, D. U. (2014). Effect of methanolic extract of *Tetrapleura tetraptera* (Schum and Thonn) Taub leaves on hyperglycemia and indices of diabetic complications in alloxan-induced diabetic rats. *Asian Pacific Journal of Tropical Medicine*, 4(4): 272-278.

Basta, S. S.; Soekirman; Karyadi, D. and Scrimshaw, N. S. (1979). Iron deficiency anemia and the productivity of adult males in Indonesia. *American Journal of Clinical Nutrition*, 32(4), 9 16 - 925.

Chulilla, J. A. M.; Colas, M. S. R. and Martin, M. G. (2009). Classification of anaemia. *World Journal of Gastroenterology*, 15(37): 4627 - 4637.

Coles E. H. (1986). Determination of packed cell volume In: Coles E. H Ed, Veterinary Clinical Pathology 4thed. W. B Saunders Co; Philadelphia, p. 17-19.

Effiong, G. S.; Udoh, I. E.; Essien, G. E.; Ajibola, D. O and Archibong, K. O. (2014). Effects of aqueous extract of *Tetrapleura tetraptera* on excision wounds in albino rats. *International Research Journal of Plant Science*, 5 (4): 57 - 60.

Ekwenye, U. N. and Okorie, C. F. (2010). Antibacterial activity of *Tetrapleura tetraptera Taub.* pod extracts. *International Journal of Pharmaceutical and Biosciences*, 1(4): 734 - 741.

Fry M. M. and Mc Gavin M. D. (2012). Bone marrow, blood cells and lymphatic system. In: Zachary, J. F., McGavin, M. D. (Eds). Pathologic basis of veterinary disease. 5th ed. St. Louis, USA: Mosby. p. 698 - 770.

Ihedioha, J. I. and Daniel-Igwe, G. (2014). Development ofexperimental albino rat (*Rattus norvegicus*) model for studies on sub-acute blood loss anaemia. *Animal Research International,* 11(1): 1889 - 1898.

Kerr, M. G. (2002). Clinical Laboratory Medicine (3rd ed.) Blackwell Science Ltd, Paris, France.

Muriithi, N. J., Maina, G. S., Maina, M. B., Kiambi, M. J., Kelvin, J. K., Umar, A., John, M. K., Ann, N. W., Piero, N. M. and Eliud, N. N. M. (2015). Determination of haematological effects of methanolic leaf extract of *Veronia lasiopus* in normal mice. *Journal of Lymph and Blood*, 5(3): 1-6.

Nwawu, J. I. and Alkali, P. A. (1986). Anticonvulsant activity of the volatile oil from the fruit of *Tetrapleura tetraptera. Journal of Ethnopharmacology,* 18: 103-107.

Odesanmi, S. O., Lawal, R. A. and Ojokuku, S. A. (2010). Haematological effects of ethanolic fruit extract of *Tetrapleura tetraptera* in male Dutch white rabbits. *Research Journal of Medicinal Plant*, 4(4): 213 - 217.

Oguoma, O. I.; Ezeifeka, G. O.; Adeleye, S. A.; Oranusi, S. and Amadi, E. S. (2015). Antimicrobial activity, proximate and amino acids analysis of *Tetrapleura tetraptera. Nigerian Journal of Microbiology*, 27 (1): 2709 - 2718.

Ojewole, J. A. O. and Adesina, S. K. (1983). Cardiovascular and neuromuscular actions of scopoletin from fruit of *Tetrapleura tetraptera*. *Plant Medicine*, 48: 99 - 102.

Okwu, D. E. (2003). The potentials of *Ocimum gratissimum, Penrgularia extensa* and *Tetrapleura tetraptera* as spice and flavouring agents. *Nigerian Agricultural Journal* 35: 143 - 148.

Schalm, O. W., Jain, N. C. and Carroll, E. J. (1975). Veterinary Haematology 3rd ed. Lea and Febiger, Phaladelphia p. 27.

EVALUATION OF THE RELATIONSHIP BETWEEN SERUM BIOCHEMICAL MARKERS OF LIVER DISORDERS AND BODY CONDITION SCORES IN GOATS

P.E Aba[1*], J.I Ihedioha[**] I.C Nwaogu[***]

[*]*Department of Veterinary Physiology and Pharmacology, University of Nigeria, Nsukka, Enugu State, Nigeria*

[**]*Department of Veterinary Pathology & Microbiology, University of Nigeria, Nsukka, Enugu State, Nigeria*

[***]*Department of Veterinary Anatomy, University of Nigeria, Nsukka, Enugu State, Nigeria*

**Corresponding author email: P.E Aba, Patrick.aba@unn.edu.ng, Phone:+2348062730072*

ABSTRACT

Body condition score (BCS) is an important tool used for the assessment of health status of goats. This study evaluated the relationship between varied body condition scores of goats and the activities and levels of certain serum biochemical markers of liver disorders (SBMLD). The study was a cross sectional survey of slaughter goats in Ikpa abattoir, Nsukka, Enugu state, Nigeria. Each goat was tagged and evaluated for body condition. Prior to slaughter, blood samples were collected and sera obtained for assay of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, gamma glutamyltransferase activities, and albumin and cholesterol levels. After clinical examination, 114 (94.21 %) of the goats were considered apparently healthy while 7 (5.79 %) were not healthy. Correlation of BCS with SBMLD indicated that cholesterol correlated positively and strongly ($r = 0.861$, $p = 0.028$).The cholesterol values of goats with body condition scores of 2.5 - 4 were significantly ($p<0.05$) higher than those with body condition scores of 1. It was concluded that the body condition score was directly related to the serum cholesterol values.

Keywords: Biochemical markers of liver disorder; Body condition scores; Nigerian breeds of goats

Body condition scores (BCS) assessment is a very critical tool in evaluating the body conditions of goats. It shows the available fat reserves that can be utilized in time of stress, suboptimal nutrition and high energy demand (Villaquan *et al.,* 2008). Body condition scores assess the extent of fatness or thinness with the use of a scale based on 5-point (Edmondson, *et al.,* 1989). The BCS can be useful in management of feed (Gillund *et al*., 2001). It affects health, reproduction and production (Dechow *et al*., 2002).

Nigerian breeds of goats are mainly Red Sokoto goats and relatively smaller proportion of Sahel goats and West African Dwarf goats (Ngere *et al*., 1984). Goats are veritable source of milk, meat and fur. Ill health occasioned by both infectious and non-infectious agents has been a major challenge in the livestock industry. Some of these ailments may lead to emaciation and changes in body conditions and these will ultimately affect production and reproduction (Heinrich and Isler, 1989).

Serum biochemical markers of liver damage are those parameters assayable from serum and can aid in diagnosis of liver disorders. These analytes include AST, ALT, ALP, GGT, albumin, cholesterol e.t.c (Ozer *et al*., 2008). The parameters such as AST and ALT are enzymes resident in hepatocytes. They ooze out into the circulation upon hepatic injury, and serve as indication of liver damage. In the same vein, enzymes such as ALP and GGT reveal damages to the hepatobilliary system since they (GGT and ALP) are ubiquitous in the epithelial lining cells of hepatobilliary system. Their increased serum activities therefore are a pointer to hepatobilliary disorder (Friedman *et al,* 2003). However, analytes such as cholesterol and albumin are synthesized by liver. Reductions in their serum levels indicate defective production by hepatocytes (Thapa and Walia, 2007).

There is dearth of information on the possible relationship between the BCS and liver damage in Nigerian breeds of goats. The aim of this study was to evaluate a relationship between these serum biochemical markers of liver disorder and body conditions of the goats and by extension, their health status.

Materials and Methods

Animals
Nigerian breeds of trade goats presented for sale and slaughter at the Ikpa Abbatoir Nsukka, Enugu State, Nigeria were used for the study.

Study design
The study design was a cross sectional survey. Research visits to the Abbatoir were made 2 times a week for period of 12 weeks (January-March, 2019). Before slaughter, the goats were physically examined to determine the body condition score and the health status using the method of Villaquiran *et al*., (2008).

Sample collection
Blood samples were collected from the jugular veins of the goat at the point of slaughter into clean test tubes devoid of anticoagulant. Sera were harvested by centrifugation at 3, 000 g for 10 mins. Thereafter, the clear supernatants were aspirated with the aid of clean syringe.

Body condition score assessment
The method of Villaquiran *et al*., (2008) was used to determine the body condition scores of the goats. The method uses a 5-point scale with 0.5 increments. Score of one (1) represents a very thin goat devoid of fat reserves while a score of five (5) shows an overweight goat. The goats were firstly visualized to determine whether they were emaciated or not, strong or weak. The state of the backbone and whether the flank was hollow and the ribs clearly visible or not were all determined. The amount of muscle and fat were determined in the lumbar area by running fingers on the lumbar processes attempting to grasp the fingertips. Attempts were also made to pinch fat covering the sternum, rib cage and the intercostals spaces.

Assay of biochemical parameters
The serum aspartate aminotransferase activity was determined by the Reitman-Frankel spectrophometric method (Reitman and Frankel, 1957; Colville, 2002). The serum alanine aminotransferase activity was determined by the Reitman-Frankel spectrophometric method (Reitman and Frankel, 1957; Colville, 2002). The serum alkaline phosphatase activity was determined by the phenolphthalein monophosphate method (Klein *et al.*, 1960; Colville, 2002). Gamma glutamyltransferase (GGT) activity was done following a Spectrophotometric method according to Theodorsen and Strømme, 1976 and Colville, 2002. The serum albumin was determined by the bromocresol green method (Doumas *et al*., 1971; Colville, 2002). The serum cholesterol was determined by cholesterol oxidase-perioxidase method (Allain *et al*., 1974; Colville, 2002). The AST:ALT ratio (De Ritis ratio) was calculated by dividing the AST activity with the corresponding ALT activity.

Data analyses
One-way analysis of variance (ANOVA) was used to compare data on the serum biochemical markers of liver disorders of the goats with varied BCS. Duncan's Multiple Range post hoc test was used to separate the variant Means. Spearman Rank correlation was used to correlate the BCS and the serum biochemical markers of liver disorders. Probability levels were set at $p<0.05$. Results were presented in tables and charts as means± standard error of the mean.

Results

Table 1: Serum biochemistry parameters of goats with varied body condition scores

PARAMETERS	BODY CONDITION SCORES					
	1 (N=9)	2 (N=31)	2.5(N=17)	3(N=31)	3.5(N=20)	4 (N=13)
AST(U/L)	77.26 ± 7.71^{b}	57.84 ± 4.30^{a}	52.079± 4.46^{b}	63.56± 5.01^{ab}	56.15 ± 5.33^{a}	69.38 ± 9.27^{ab}
ALT (U/L)	14.07± 2.13^{a}	11.59 ± 1.40^{a}	10.65± 0.95^{a}	13.83 ± 2.04^{a}	11.58 ± 1.17^{a}	19.35 ± 8.02^{a}
AST:ALT	6.13 ± 0.76^{a}	5.73 ± 0.36^{a}	5.36± 0.99^{a}	5.29 ± 0.36^{a}	4.88 ± 0.27^{a}	5.11 ± 0.47^{a}
ALP (U/L)	59.48 ± 23.98^{a}	75.27 ± 16.28^{a}	75.93 ± 30.61^{a}	30.40 ± 4.24^{a}	72.49 ±13.99^{a}	75.07± 22.63^{a}
GGT (U/L)	33.38 ± 9.7^{b}	17.37± 1.90^{a}	26.15 ± 5.31^{ab}	18.11 ± 1.88^{a}	19.80 ± 2.44^{a}	18.34 ± 2.38^{a}
ALB (g/dl)	3.13 ± 0.21^{a}	3.217± 0.07^{a}	3.22 ± 0.09^{a}	3.42 ± 0.07^{a}	3.44 ± 0.07^{a}	3.30 ± 0.09^{a}
CHOLES (mg/dl)	64.57 ± 3.88^{a}	73.71 ± 2.63^{ab}	75.92 ± 2.61^{b}	90.38± 3.13^{c}	84.07 ± 2.53^{bc}	90.47± 4.99^{c}

Different superscripts a, b, c across the same row indicates significant difference at P< 0.05.

Persistent and significant increases were observed in cholesterol values as the body condition scores improved from thin to obese while specified trends were not observed in other parameters measured.

Key: AST=Aspartate aminotansferase; ALT= Alanine aminotransferase; AST:ALT= Ratio of AST to ALT; ALP=Alkaline phosphatase; GGT=Gamma glutamyl transferase; ALB=Albumin; CHOL=Cholesterol. 1-Emaciated, 2=Thin, 3-Moderate, 4-Fat, 5-Obese

DISCUSSION

Gamma glutamyltransferase activities and cholesterol levels showed significant differences (P<0.05) in relation to body condition scores. Cholesterol showed consistent and significant increases as the body condition scores improved. The goats that were rated 4 and 3 (Normal) had significantly higher cholesterol levels compared with those rated 1, 2 (thin) and 2.5 (normal). Similar results had earlier been reported in a study by Roche *et al*., (2009) and Duricic *et al.*(2017). However, the results of this study are at variance

with those of Barbosa *et al*., (2009). Body condition score has been accepted as an effective, simple and reliable method to help assess reproductive efficiency (Duricic *et al*., 2017). Some researchers have noted that breed, age, sex, nutrition and environmental condition are among the key factors that affect body condition scores (Aktas *et al*., 2011;Samardzija and Vince, 2013). The effect of GGT revealed that the goat with score of 1 (thin goats) had a statistically higher activity of GGT. There is dearth of information on the relationship between body condition scores and the level of activity of GGT. GGT is a marker enzyme for hepatobiliary dysfunction (Thapa and Walia, 2007). It is thought that probably the goats with body score of 1 (thin or emaciated) may probably have some level of hepatobiliary dysfunction.

CONCLUSION

The results of this study showed that goats with high body condition score indices had higher serum cholesterol levels compared to the thin goats implying that the body condition score in goats could give a rough estimate of cholesterol levels.

REFERENCES

Aktas MS, Ozkanlar S, Ucar O, Ozkanlar Y, Kaynar O, Aytekin,I (2011). Relationship between body condition score and some metabolic blood parameters in early lactating dairy cows. *Revue de Medecine Veterinaire*, 162 (12): 586-592.

Allain CC, Poon LS, Chan CS, Richmond W, Fu PU (1974) Enzymatic determination of total cholesterol. *Clinical Chemistry* 20:470-475.

Barbosa LP, MT, Rodrigues JD, Guimarães VV, Maffili lS, Amorim AF, Garcez N (2009) Body condition and metabolic profile of Alpine goats at the onset of lactation. *Revista Brasileira de Zootecnia* 38:2007-2014.

Colville J (2002) Blood Chemistry. In: Hendrix CM (ed) Laboratory Procedures for Veterinary Technicians. 4th edn. Mosby, St. Louis, pp 75 – 103.

Dechow CD, Rogers G, Clay JS, (2002). Heritability and correlations among body condition score loss, body condition score, production and reproductive performance. *Journal of Dairy Science* 85:3062-3070.

Doumas BT, Watson WA, Biggs HG (1971). Albumin standards and the measurement of serum albumin with bromocresol green. *Clinica Chimica Acta* 31:87-96.

Duricic D, Gelli R, Turk R, Folnozic I, Suran J, Gracner D, Valpotic H, Butkovic I, Samardzija M (2017) The influence of body condition score on serum metabolic profiles in Boer does before and after parturition. *Veterinarski Arhiv* 87(5): 543-557.

Edmondson AJ, Lean IJ, Weaver LD, Farver T, Webster G, (1989). A body condition scoring chart for Holstein cows. *Journal of Dairy Science*,72: 68–78.

Friedman SF, Martin P, Munoz JS (2003). Laboratory evaluation of the patient with liver disease. Hepatology, a textbook of liver disease. Philedelphia; Saunders publication, 1 : 661-709.

Gillund P, Reksen O, Grohn YT, Karlberg K, (2001). Body condition related to ketosis and reproductive performance in Norwegian dairy cows. *Journal of Dairy Science* 84,1390–1396.

Heinrichs AJ, Isler VA, (1989). Body-Condition Scoring as a Tool for Dairy Herd Management. Penn State University. *Extension Circular* 363. 10p.

Klein B, Read PA, Babson AL (1960). Rapid method for the quantitative determination of serum alkaline phosphatase. *Clinical Chemistry* 6:269-275.

Ngere LO, Adu IF, Okubanjo IO (1984). The indigenous goats of Nigeria. *Animal Genetic Resources Information* 3: 1–9.

Ozer J, Ratweb M, Shawe M, Vanhaelen-Fastre R, Declercq JP and Van Meerssche M (2008). The current state of serum biomarker of hepatotoxicity. *Toxicity* 245: 194-205.

performance. *Journal of Dairy Science*, 85: 3062–3070.

Reitman S, Frankel S (1957) A colorimetric method for determination of serum glutamic oxaloacetic and glutamic pyruvic transaminase. *American Journal of Clinical Pathology*, 28:56 - 62.

Roche JR, Friggens NL, Kay JK, Fisher MW, Stafford JK, Berry DP (2009) Invited review: Body condition score and its association with dairy cow productivity; health and welfare. *Journal of Dairy Science,* 92: 5769-5801

Samardžija MS Vince DĐ (2013). Association of parity, fecundity and body condition score with blood serum concentration of some metabolites during pre and post parturient period in German Improved Fawn goats. *Veterinarski. arhiv* 83: 469-477.

Thapa BR, Walia A (2007). Liver function tests and their interpretation. *Indian Journal of Padiatrics*, 74: 663-671.

Theodorsen L, Strømme JH (1976). Gamma-Glutamyl-3-carboxy4-nitroanilide: the substrate of choice for routine determinations of gamma-glutamyl-transferase activity in serum? *Clinica Chimica Acta,* 72(2): 205-210.

Villaquiran M, Gipson TA, Merkel RC, Goetsch AL, Sahlu T (2008). Body condition score in goats. American Institute for goat Research. Langston University, pp1-8.

ASSESSMENT OF TYPES AND UTILIZATION OF ETHNO-THERAPEUTIC REMEDIES ON SOME DISEASES OF SHEEP IN MAIYAMA LOCAL GOVERNMENT AREA

Ribah, M. I.,*[1] Muhammad, A. M[1].,Muftau, M. A. [1],Bello, S. and Kwaido, A. A. [1]

[1]Department of Animal Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, PMB 1144 Birnin kebbi, Nigeria.

Corresponding author: ibrahim.ribah73@gmail.com

ABSTRACT

The study surveyed the types and utilization of ethno-therapeutic remedies on some diseases of sheep in Maiyama Local Government Area. Sixty (60) sheep keepers were interviewed from four (4) districts in the study area using a structured questionnaire. Results on demography, experience and flock size indicated that majority of the sheep keepers are males (91.67%) and are between the age of 61 and above, with 1 – 5 years rearing experience. Results on ethno therapeutic practice indicated that most of thesheep keepers use both traditional and conventional remedies (45%) for the treatment of livestock diseases have practiced for the past 11-20 years (38.34%). Results on alternative therapeutic remedies indicated that the majority of sheep keepers use conventional remedies (83.34%) more than traditional remedies. Result shows that the sheep keepers source their ethno therapeutic remedies from the market. The common diseases affecting livestock in the study area were identified to include diarrhoea, foot and mouth disease, milk reduction, placenta retention, ecto-parasites, muscular weakness, worm or internal parasites, dysentery, mange, catarrh, pox, contagious ecthyma, mastitis, constipation, respiratory disorder, and foot pain. The ethno-therapeutic remedies commonly used were *Khaya senegalensis*, roasted maize ,salt and warm water ,*Grewia mollis, Hibiscus esculentus, Balanites aegyptraca,* dried grasses, *Poliostigma thoningi,Azadiracta indica,Guirrea senegalensis, Parkia biglobossa (*locust bean*),* wood ash, cow dung , donkey faeces, groundnut oil, shea butter, *Citrus aurantifolia, Carica papaya, Mangifera indica* and *Adansonia digitata*. It was concluded that though the sheep keepers in the study area practice ethno-therapy, they however utilize more conventional drugs for treating their animals.

Keywords: Utilization, Ethno-Therapeutic, Remedies, Diseases, Sheep

INTRODUCTION

Ethno-therapeutic research is defined by Carkle (2005) as the systematic investigation and application of animal or veterinary folk knowledge of curing, healing and managing livestock. Traditional veterinary drugs are very important in developing countries, where conventional remedies for animal health care are inaccessible or unaffordable to poor rural farmers (Mc Carcle,2005). About 80% of the people in the world today rely on folk (or traditional medicine) for treating both human and animal diseases and infections (Sindhu *et al*., 2010).

According to the United States or United Nations food and Agricultural organization (FAO) the lack of drugs to treat diseases and infections results in losses of 30 – 35% in the breeding sector of many developing countries where poor animal health remains the major constraint to increase production (FAO, 2002). Problem of service delivery of conventional veterinary drugs to such locations in developing countries are often exacerbated by multitude of other factors and that these factors have contributed to maintaining traditional veterinary treatment practices in these countries (Muhammad *et al.,* 2005). The extension of conventional medical veterinary service is particularly different and costly in developing world nations where necessary infrastructure (roads, clinics, labs, cold chains etc.) is poorly developed and where much of the populace and its livestock reside, in remote rural areas or may be nomadic or transhumance (Carkle and Green, 1998).

Nonetheless, much effort is needed in research and integration of the ethno-therapeutic practice activities in developing countries (Mathians *et al*.,, 1997). In many native and local stock raising communities, if not all, a considerable proportion of useful ethno – knowledge and traditional animal health delivery system is available for a wider use by rural and peri – urban communities (Wabzala *et al.,* 2005). However, there is still a wide gap Because traditional native medical practices have been in most cases either discontinued or greatly modified, there is much about them that will never be known (Lawrence, 1998). There is scarce documented information on the traditional medicine used in treating some sheep disease in this part of the country. Hence, the main aim of this research is to evaluate the ethno-therapeutic remedies of sheep in Maiyama Local Government area, Kebbi stste, Nigeria.

Materials and Methods

The experiment was carried out at Maiyama Local Government Area in Kebbi state Nigeria .In this study, a survey method was used. Structured questionnaires were administered to solicit responses from the respondents. A population of this study included sixty (60) sheep keepers drawn from four (4) districts in Maiyama Local Government area. The purposive sampling technique was used to select sixty respondents across Maiyama local government area. The questionnaires were administered to the respondents in order to aid responses on the ethno-therapeutic remedies of some diseases of sheep in the study area.

Data Collection

Data were collected on demographic characteristics, years of experience and practice of ethno therapeutic remedies, level of utilization of traditional medicine, methods of utilization, types of ethno-therapeutic remedies and their mode of utilization, common diseases found and other necessary information useful to the study.

Data analysis

The data collected from respondents was analyzed through the use frequency distribution tables, and sample percentage.

RESULTS AND DISCUSSION

Demography, Experience and Flock size of sheep keepers in Maiyama Local Government Area

Results on Table 1 shows the distribution of respondents according to demographic characteristics, experience in sheep keeping and flock size. The result indicated that majority (91.67%) are males and they are within 61 and above years (33%). Most of them have 1-5years experiences in sheep keeping (31.67%) and the people that possess sheep are (35%) and they are within 11-20 years of experience in sheep keeping.

Table 1: Demography, Experience and Flock size of sheep keepers in Maiyama Local Government Area

S/N	Question	Responses			
1.	Gender	Male	Female		
		55(91.67%)	5(8.34%)		
2.	Age	20-30years	31-40years	41-60years	61and above
		10(16.67%)	13(21.67%)	17(28.34%)	20(33.34%)
3.	Years of experience in sheep keeping	1-5years	6-10years	11-20years	21 and above
		16(31.67%)	14(23.34)	19(35%)	14(23.34%)
4.	Numbers of sheep possessed	1-5years	6-10years	11-20years	21 and above
		12(20%)	14(23.34%)	21(35%)	13(21.67)

Source: Field survey, 2019.

From the result, it was observed that male (91.67%) were involved in sheep rearing more than female. This might be as a result of the scarcity of the income and resources of female. The 11-20 years (35%) experience could indicate that sheep keeping has been an old practice of most households in the communities. Majority of the respondents having 21 sheep might be as a result of lack of or the scarcity of income and resources of farmers to ncrease flock size which conforms to the claim that most animals are owned by resource poor farmers (Dharani *et al.,* 2015)..

Ethno Therapeutic Practices of Sheep Keepers in Maiyama Local Government Area

The results on able 2 indicated that the majority of respondents are using conventional remedy (35%) better than traditional remedy and they have been using it for 11-20 years (38.34%) and the effect of the traditional remedy are quick recovery (55%) and their sources of traditional remedies are free (51.67%) when treating their animals.

Table 2:- Ethno-therapeutic practice of sheep keepers in Maiyama local government area.

S/N	Question	Responses		
1.	With what do youuse in treating you sheep orsick sheep?	Traditional remedy 12(20%)	Conventional remedy 21(35%)	Both 27(45%)
2.	For how long have you been using traditional remedies?	1-10years 18(30%)	11-20years 23(37.34%)	>12 19(31.67%)
3.	What are the results of using trationalremedies?	Quick recovery 31(51.67%)	Not recovery 27(45%)	
4.	What is your source of traditional remedies	Free 31(51.67%)	market 29(48.28%)	

Source:Field Survey, 2019

The respondents used both traditional and conventional remedy for disease treatment. This might be as a result of lack of awareness on ethno-therapy. While majority of respondents have been practicing ethno-therapy for up to 11-20 years (37.34%), they reported that quick recovery (51.67%) is usually observed when they used traditional remedy. Majority of respondents reported that the traditional remedies are sourced free (51.6%) probably as a result of its natural existence in the study area.

Alternative Therapeutic Remedies of Sheep Diseases in Maiyama Local Government Area.

The results on Table 3 shows that the majority (83.34%) of the respondents uses conventional remedies. And also utilizes conventional remedy (55%) better than traditional remedies in treating sheep diseases.

Table 3: Alternative therapeutic remedies of sheep keepers in maiyama local government area.

S/N	Question	Responses	
1.	Do you use conventional remedies?	Yes 50(83.34%)	No 10(16.67%)
2.	Between traditional and conventional remedies which one do you used regularly?	Traditional remedy 27(45%)	Conventional remedy 33(55%)

Source: Field survey, 2019

Based on the findings of the current research, most of the respondents in the study area are using conventional remedies to cure or prevent sheep from various diseases. This might be as a result of complicated mode of utilization of traditional remedies since there is no standard composition or dosage which could limit its utilization. The respondents also reported that they utilize conventional remedies regularly (55%) more than ethno-theraphy which could be as a result of lack of its complete reliability (Jacob *et al*., 2004).

Common Diseases and their Ethno therapeutic Remedies in Maiyama Local Government Area.
The results in Table 4 indicated that the most common diseases affecting livestock in the area are diarrhea, foot and mouth diseases (FMD), milk reduction, placenta retention and ecto-parasite (like lice, tick, mites) Muscular weakness worm/Intestinal parasite (i.e. endo-parasite (Haemanchus, worms. Helminthes), catarrh, contagious ecthym (Orf), conjunctivitis, mastitis, foot pain, respiratory disorder, mange infestation and constipation. The ethnotherapeutic remedies that respondents are using in curing, treatment and preventing disease and illness of their animals are *Khaya senegalensis*, (Mahogany) roasted Maize, salt and warm water, *Grewia mollis* (Kamomowa), *Hibiscus esculentus* (Okra), *Balanites aegytraca* root (aduwa) dried grasses *Poliostigma thonigil* (camels foot), *Azadirachta indica* (Neem tree), *guirrea senegalensis* (sabara) *Pakia bigiobossa* (locust bean tree), wood arsh, cow dung, donkey faeces, ground nut oil, shea butter, *citrus aurantifolia* (lime oranges) *carica papaya* (paw paw), *Mangifera indica* (mango tree) and *Adansonia digitata* (Baobab tree).

Table 4: Common Diseases and their Ethno therapeutic Remedies in Maiyama Local Government Area.

S/N	Name of Diseases	Ethno therapeutic remedies and they are used
1.	Diarrhoea	* Using *Khaya senegalensis* bark (mahogany) and drench the animal. * Using *Adansonisa digitata* (baobab tree and give to the animal in fresh or dried form. * Using *citrus aurantifolia* (lime orange) leaves * By using *Magnifera indic*a and drench the animal give to the animal.
2.	Foot and mouth disease	*By roasting of maize and give to the animal. *By washing the affected area with warm water and salt.
3.	Milk reduction	*By using *Grewia molllis* leaves (Kamomowa) and pound and extracts are drench to the animal. *By giving small amount of fresh maize to the animal.
4.	Placenta retention	*By *using Hibiscus esculentus* (okra) pound and dry the stem and extracts are drench to the animal. *By using *Balanites aegyptraca* roots (aduwa) and extracts are drench to the animal.
5.	Ectoparasite (lice)	*By burning the dried leaves of *carica papaya* (pawpaw) and pour on the body of infected animal. *By burning the leaves of *Guirea senegalensis* (sabara) and smoke the animals with fumes.
6.	Muscular weakness	*By tie of the affected area with the twigs of polistigma thoningii (camel's foot Kalgo)
7.	Internal parasites	*By using Azadirachta indica bark (neem tree or dogonyaro) and drench the animal.
8.	Dysentery	*by using *Azadirachta indica* tree (neem tree) leaves and bark and drench the animals.
9.	Mange	*By rubbing of engine oil on the affected area 0f the body. *By using shea butter oil on the affected area.
10.	Catarrh	*By smoking the fumes of *Azadiracta indica*(Neem tree) in the animal premises.
11.	Pox	*Mix half a cup of salt with I litre of warm water and wash the affected area. *By using seed of *Azadirachta indica* and make paste and aply to the affected area.
12.	Contagious ecthyma	*By using salt and warm water to wash the affected area. *By using *Acacia nilotica* pods and mix with water and wash the affected area.
13.	Mastitis	*By making paste of non-poisonous wood ash and rub to the affected udder and massage. *By burning dung of cattle and donkey faeces and apply to the udder and massage.
14.	Constipation	*By drenching small amount of groundnut oil.
15.	Respiratory disorder	*by sucking a rhizome of a *Zingiber officinale* (ginger) in water and drench the animals
16.	Foot pain	*By using locust bean seed and make paste and rub the affected area properly.

Source: Field survey, 2019

CONCLUSION

The majority of sheep keepers were male (91.67%) with 1-5yaers working experience, having between 11 – 20 heads of sheep. The ethno-therapeutic remedies identified were *Khaya senegalensis (*mahogany*),* roasted maize ,salt and worm water ,*Grewia mollis (*kamomowa*), Hibiscus esculentus (*okra *), Balanites aegyptraca (*aduwa*),* dried grasses, *Poliostigma thoningi (*camels foot*) ,Azadiracta indica (*neem tree*)* ,*Guirrea senegalensis (*sabara*), Parkia biglobossa (*locust bean*),* wood ash, cow dung ,donkey faeces, groundnut oil , shea butter , *Citrus aurantifolia (*lime oranges*), Carica papaya (*pawpaw*) , Mangifera indica (*mango*)* ,and *Adansonia digitata (*baobab tree*).* The sheep keepers practices ethno-therapy but are utilizing more conventional drugs for treating their animals.

References

Dharani, N. Y., Enesew, A., Anyekulu, E., Tuei, B. and Jamnadas, R. (2015). Traditional ethno-veterinary medicine in east Africa: a manual on the use of traditional ethno-veterinary medicinal plants. Dawson, i. k., ed. The world agroforestry center, Nairobi, kenya.

FAO (2002). Genetic and animal health-spotlight, first edition, rome: 32p.

Jacob, M. O., et al. (2004). The basis of masai ethno veterinary diagnostic skills. *Journal of human ecology*, 16:43-48.

Lawrence, E. A. (1998). Human and horse medicineamong some native American groups. *Agriculture and humanities*, 15:133-138.

Mathias, E., Clerck, M. C. and Perenzygrovas, R. (1997). Application of ethno veterinary: where do we stand? International conference on ethno veterinary medicine alternatives for livestock. Pune, india development research foundation.

Clerkle, M. C. (2005). Ethno veterinary medicine in Africa.*J. inter AFR inst*, 62:59-93.

Clerkle, M. C. And Green E. C. (1998). Intersectoral health care delivery.*Agriculture and humanities*, 15:105 – 114.

Muhammad, G., Khan, M. Z., Hussaini, M. H., Iqbal, Z., Iqbal, M. and Athar M. (2005).Ethno veterinary practice of owners of pneumatic-cart pulling camels in faisalabat city.*Pakistan journal of pharmacology*, 97:241-246.

Sindhu, Z. U. D., Iqbal, Z., Khan, M. N., Johnson, N. N. and Siddiqui, A. (2010).Documentation of ethno veterinary practices used for treatment of different illness in a selected hilly area of *Pakistan. International journal of agriculture and biology*, 12:353-358.

Wabzala, W., Zessin, K. H., Kyule, N. M., Bawmann, M.P.O., Mathias, E.And Ali, A. (2005). Ethno veterinary medicine,a critical review of its revolution, perception,understanding and the way forward. *Livestock research and rural development*, 17:1-29.

PREVALENCE, ECONOMIC IMPACT ANALYSIS AND VIABILITY OF HYDATID CYSTS IN BOVINE SLAUGHTERED IN SELECTED ABATTOIRS WITHIN KADUNA METROPOLIS

Vantsawa P. A., Dibal D. M. & Ossai E. I.
Department of biological sciences, Nigerian Defence Academy, Kaduna.

ABSTRACT
A cross sectional study aimed at determining the prevalence, cyst characteristics and estimating the financial loss due to cystic echinococcosis (hydatidosis) in cattle slaughtered at Tudun-wada abattoir, Kakuri (Makera) abattoir, Kawo abattoir and Sabon–Tasha abattoir, all within Kaduna metropolis, was carried out from January to July, 2019. Out of the 160 cattle examined (40 from each abattoir), 21 (12.2 %) were found to harbor visible hydatid cysts. Significantly higher infection ($p < 0.05$) was detected in cattle with moderate body conditions than animals with forward and fat body condition score. No significant variation was observed with regards to sex of animals. Cysts were found to be distributed in the lung, liver, kidney, spleen and heart as follows 42.9%, 38.0%, 4.76%, 9.50% and 4.76% respectively. Out of 36 hydatid cysts examined, 17 (47.22%), 14 (38.88%) and 5 (13.88%) were found to be small sized, medium-sized and large- sized respectively. Likewise, out of 36 cysts assessed, 18 (50%) were fertile, 4 (11.11%) sterile and 14 (38.8%) were calcified. Of the 18 fertile cysts subjected for viability test, 12 (27.7%) were viable while 8(22.2%) were non viable. Moreover, assessment of annual economic loss due to bovine hydatidosis in Kaduna metropolis from organ condemnation and carcass weight loss was estimated at 17,862,348(NGN).Despite the moderate magnitude of infection detected currently, there seems to be an existing socio economic situation favorable for hydatidosis and hence it remains one of the most important diseases warranting serious medical and veterinary attention.

Keyword: Echinococcosis, cysts, abattoir, fertile, viability.

INTRODUCTION
Hydatidosis is a parasitic zoonotic disease caused by the metacestode of the tapeworm *Echinococcus spp* (Magaji *et al.,* 2011). It is one of the limiting factors in food animal production and hampers the realization of adequate meat supply to meet the ever increasing demand of animal protein by human population (Ogunsan *et al*., 2000).

Three broad morphological forms of *Echinococcus* are recognized clinically; *Echinococcus granulosus* which causes cystic Echinococcosis; *E. multilocularis* which causes alveolar Echinococcosis and *E. oligarthrus* which cause polycystic Echinococcosis. The definitive hosts of *E granulosus* are the dogs while the intermediate hosts are the domestic ungulates and man (Luka, 2009). The adult hydatid worm which resides in the small intestine of a definitive host produces gravid proglottids which release eggs that are passed out in feces of the host (mostly dogs). The eggs are then ingested by an intermediate host (cattle). The eggs then hatch in the small intestine of the cattle, releasing an oncosphore that penetrates the intestinal wall and moves through the circulatory system into organs such as lungs, liver, kidney, spleen and the heart where they develop into cyst which then slowly enlarges, creating protoscolices and daughter cyst. (Schantz,1990; Biu and Abagwe, 2001). Hydatidosis has a worldwide distribution and causes considerable economic losses and public health problems in many countries including Nigeria and other pastoral range and areas of the world (Tijani *et al*., 2010; Jenkins, 1998).

Lack of adequate control policy, uncontrolled movement, trading of animals and their product and difficulties in early diagnosis enhance the distribution of the disease (NAHIS, 2004).

Infection is often associated with economic losses due to livestock mortality, morbidity, and organ and meat condemnation at meat inspection. It also poses a serious threat to public health where close association exists between dogs, man and food animals (Kebede *et al*., 2009).

Many tropical countries are hydatitosis endemic and this poses a threat to development. There is paucity of information on hydatidosis in domestic livestock and most of the documented reports are based on postmortem findings from abattoirs, thus mitigating public health intervention measure in this regard. The aim of this research is to determine the prevalence of cystic hydatidosis in bovine slaughtered in four selected abattoirs within Kaduna metropolis.

Materials and Methods

This study was conducted in four selected abattoir within Kaduna metropolis: Tudun Wada, Kakuri, Sabon Tasha and Kawo. The animals comprise of cows slaughtered in the abattoirs. The information on the breed of the cow, age, sex and body count score were obtained through the administration of questionnaires. Sample size was determined using the formula of Thrusfield (2005) as follows:

$$N= \frac{(1.96)^2\ (pexp\ )(-pexp\ )}{d^2}$$

Where Pexp = expected prevalence

N= Total number of sample size

D = Required precision.

A total of 160 that is 40 from each abattoir were randomly sampled and examined for the presence of the hydatid cysts. All organs harboring hydatid cysts were partially or totally condemned and judged according to guideline on meat inspection for developing countries.

According to their size, hydatid cysts were then classified as small (<4cm), medium (4-8cm) and large (>8cm). The cysts was considered fertile when the protoscolices were present and seen as white dots on the germinal epithelium, direct and indirect losses were considered in the determination of economic loss due to hydatidosis. The direct loss was calculated based on condemned organs (lungs, liver, heat, spleen and kidney) and the indirect loss was obtained on the basis of live weight reduction due to hydatidosis. All data obtained were subjected to statistical analysis using SPSS and Chi Square. All value of ($P<0.05$) is considered significant.

RESULTS

The result of relative distribution of the cysts in different organs of the cattle is shown in table 1. The relative prevalence of the cysts is more in the lungs followed by the liver with 42.9% and 38.0% respectively. The least occurrence was in the heart and spleen with 4.76% each.

The status of cysts from different organs of the cattle slaughtered in the four abattoirs is presented in table 2. In the lungs there were eight cases of fertile viable cysts which represent 47.05% , non–viable were six which represents 35.2%, two cases of sterile which represent 11.76% and one case of calcified which represent 5.8%.

Only one case of viable cysts in the liver occurred which represent 7.14%. No case of non –viable and sterile cyst was found in the liver. There were 13 calcified cases which represent 92.8%. All the cases occurred at 33.3 % in the kidney which the exception of the calcified. In the spleen and heart, one case each of non- viable and sterile occurred respectively.

The economic loss due to *Echinococcus* infestation was estimated to be N17, 862,348. This was as a result of organ condemnation and weight loss by animal. In this study a total of 17 lungs averaging 1.2kg; 14 livers with average of 3.5kg; three kidneys with an average of 0.6kg and one heart with an average of 0.7kg were discarded due to infestation with hydatid cysts. These constitute a loss to the farmers as the average cost of 1kg of meat in the market was N1350.00.

DISCUSSION

The prevalence of hydatidosis of 12.2% in this study is closer to the 15.4% reported by Dada *et al*., (1980). However lower than the findings of 20.5% reported in Kano by Luka *et al*., (2009) and 24.3% reported from southwest Nigeria by Oyeduntan (2014). Differences in culture, social activity, animal husbandry system, lack of proper removal of infectious carcasses and attitude to dogs in different region could be factors that contributed to the variation in prevalence in different areas of the country. The higher prevalence of cysts in lungs and liver in this study agree with the work of Njoroge *et al*., (2002) and Eckert (2004) who observed hydatid cysts in domestic animals. This could be due to possession of great capillaries which is usually encountered by the migrating echonococus onchosphere which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. It is also possible that the hexacanth embryo can enter the lymphatic circulation and be carried through the thoracic duct to the lungs in such a way that the lungs may be infected before the liver. The fertile cyst of 50% observed in this study is in agreement with the study by Kebede *et al*., (2009). This higher fertility rate highlights the hazard that these animals perpetuate in the cycle of hydatidosis when slaughtered and the raw offal fed to dogs and other wild carnivores. The economic loss of N17, 862,348 due to hydatidosis is enormous and could be curtailed to boost the profit merging farmer.

CONCLUSION AND RECOMMENDATION

From this study, hydatidosis is an important disease of cattle in Kaduna metropolis and its surroundings, causing substantial losses due to condemnation of organs and weight loss in infected livestock. Much attention and resources should be channeled to research in order to curtail the mode of transmission of this parasites from definitive host to intermediate hosts and vice – versa.

Health workers should be empowered to enlighten the abattoirs operation on the claim of transmission of hydatitosis. They should also increase inspection visits and monitoring of abattoirs activities to avoid illegal consumption of hydatid infected organs. Anti–helminthic drugs should be made available to bovine farmers in order to eliminate the parasites.

REFERENCES

Biu**, A.A. &** Abagwe**, S. A. (**2001**).** Prevalence of hydatidosis amongst food animals in semi-arid Northeastern Nigeria. *Bioscience Research Communication*. Pp85-91.

Dada, B. J. O. (1980). Taeniasis, cysticercosis and echinococcosis/hydatidosis in Nigeria: III- prevalence of bovine and porcine cysticercosis, and hydatid cyst infection based on joint examination of slaughtered food animals. *Journal of Helminthology*, 54: 293-297.

Eckert, J., Gottstein, B., Health, D. & Liu, F.J. (2001). Prevention of echinococcosis in humans and safety percussion. In: WHO/OIE Manuel on Echinococcosis in humans and animals; a public health problem of global concern. (J Eckert, MA Gemmell, FX Meslin & ZS Pawlowski, editors). World Organization for animal Health, Paris, Price. Pp 238-247.

Jenkins, J.D. (1998). Hydatidosis; a zoonosis of unrecognized increasing importance. *Journal of Medical Microbiology. 47: 282-282.*

Kebege,N ., Mitiku, A.,Tilahun G., (2009). "Hydatidosis of slaughtered animals in Bahir Dar Abattoir North-western Ethiopia" *Tropical Animal Health and Production*, vol 4,no1:43-50

Luka S.A., Ajogi, I., Nock, I., Kudi, C., & Umorh, J. (2009). Evaluation of enzyme linked immunosorbet assay (ELISA) and western blotting for the immunodiagnosis of hydatid diseases in sheep and goats. *The internet Journal of Veterinary Medicine. 5(2): 3-5.*

Luka, S.A., Ajogi, I., Nock, I.H., Umoh, J.U., & Kudi, A.C. (2011). Serodiagnosis of hydatidosis in camels slaughtered in Kano abattoir, northern Nigeria. *Pan – African Journal Series, 39:1.*

Magaji, A. A., Oboegulem, S.I., Daneji, A.I., Garba, H.S., Salihu, M.D., Junaidu, A.U., Mohammed, A.A., Lawal, M., Aminu, S., Yakubu, Y., & Mamuda, A. (2011). Incidence of hydatid cyst disease in farm animals slaughtered at Sokoto central abattoir, Sokoto State, Nigeria, *Veterinary World, 4(5): 197-200.*

National animal Health Information System (NAHIS) (2004). Echinococcosis. *Animal Health Australia*. http://www.aahc.com.au/nahis/disease/dislist.as, retrieved 2020-01-28

Ogunsan, E.A., Umar, I.O., Bannor, T.T., Majyagbe, K.A., (2000). Hydatidosis in slaughtered camels in Sokoto State., Nigerian. *Nigerian Veterinary Journal*. *21 (1-9): 1-9.*

Oyeduntan A A, Temitope U K, Emmanuel C U (2014). *Echinococcus granulosus* prevalence in dogs in Southwest Nigeria. *Journal of parasitological research* Volume 2014. http://dx.doi.org/10.1155/2014/124358.

Schantz, P.M.(1990). Parasitic zoonosis in perspective. *International Journal of Parasitology*, (2):165-166.

Tijjani, A.O., Musa, H.I., Atsanda, N.N., & Mamman, B.(2010). Prevalence of hydatidosis in sheep and goats slaughtered at Damaturu abattoir, Yobe state , Nigeria . *Nigerian Veterinary Journal*. 31(1):71-75.

Thrusfield, M.V. (2005) Veterinary Epidemiology, (3rd edition). Wilery pp. 584

Table 1. Relative distribution of cysts in different organs of the cattle

Organ	No positive	Percentage prevalence
Lung	9	42.9
Liver	8	38.0
Spleen	1	4.76
Kidney	2	9.50
Heart	1	4.76
Total	21	100

Table 2: Status of cysts in different organs of the cattle slaughtered in the four abattoirs.

Organs	No. of cysts examined	Viable cysts	Non-viable cysts	Sterile	Calcified
Lung	17	8(47.05)	6(35.2)	2(11.76)	1(5.8)
Liver	14	1(7.14)	-	-	13(92.8)
Kidney	03	1(33.3)	1(33.3)	1(33.3)	-
Spleen	01	-	1(100)	-	-
Heart	01	-	-	1(100)	-
Total	36	10(27.8)	8(22.22)	4(11.11)	14(38.9)

GROWTH PERFORMANCE AND BEHAVIOUR OF WEANLING PIGS RAISED IN MAIZE STRAW ENRICHED PEN

Adebiyi O. A, Kadiri I., Idahosa P. O., Tolno Haly, Famakinwa A. A., Bankole T. O., Adebiyi F. G. & Muibi M. A.

Department of Animal Science, University of Ibadan, Ibadan, Nigeria
Corresponding Author: Bankole T. O. E-mail: bankole0988@yahoo.com Tel: 07057167189

ABSTRACT
Straw used as bedding materials serves both as recreational and nutritional substrates for pigs and has been reported to improve swine welfare. The aim of this study was to investigate the influence of maize straw on the growth performance and behaviour of weaner pigs. Thirty-six (large white x Landrace) weaner pigs were randomly distributed into four treatments (concrete floor, maize straw at 0.1m, 0.2m and 0.3m depth) with each treatment having three replicates and three pigs per replicate. Data were collected on growth parameters and behavioural indices. There was significant ($p<0.05$) difference in interaction effect on feed conversion ratio (FCR) across the bedding types and depth. Pigs on concrete floor had FCR of 4.72 that was significantly ($p<0.05$) greater than 3.83, 3.53 and 3.49 found in pigs on 0.1, 0.2 and 0.3m depth of maize straw bedding, respectively. There were significant ($p<0.05$) differences between pigs on concrete flooring and those on maize straw enriched bedding for final body weight (FBW), weight gain and feed conversion ratio (FCR). Overall levels of measured behavioural activity differed between the treatments; where animals on maize straw spent significantly higher time on exploratory behaviours, while they spent considerably lower time on manipulative oral behaviours. It can be concluded that pigs reared on maize straw bedding, particularly at 0.3m depth performed more exploratory behaviour, less aggressive behaviour, and had better welfare.
Keywords: Behaviour, Enrichment, Growth Performance, Maize Straw, pigs.

INTRODUCTION
Animal welfare jointly with environmental and food safety are the major challenges of agriculture (Hotzel *et al*., 2005). Intensive indoor-systems are often made up of barren slatted concrete floors with no rooting material. These systems promote boredom and frustration for pigs by precluding the expression of behaviours, which are exhibited, by pigs under normal circumstances (Studnitz *et al*., 2007). In pig farming, welfare conditions should be especially observed at critical stages such as weaning, when piglet performance may be affected by behavioural, physiological, immunological and microbiological changes (Molino and Balbino, 2010). Environmental enrichment by provision of objects or substrates capable of satisfying the behavioural needs of pigs is a major method to combat animal welfare problems. These objects or materials have the ability to reduce the amount of time pigs spend on harmful social behaviours. The effects of enrichment can be examined in different approaches such as behaviour and performance of pigs in enriched environments compared to those in barren environments. These aspects all offer insights on how environmental enrichment improves pig welfare. This study therefore explored existing knowledge concerning environmental enrichment and its effect on behaviour and growth performance of weaner pigs housed in maize straw enriched pen.

MATERIALS AND METHODS
The experiment was carried out at the Piggery Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State. Thirty-six (Land race X Large white) weaner pigs were used for a 35-day research. Pigs were randomly distributed into four treatments (concrete floor, maize straw at 0.1, 0.2 and 0.3m depth) with each treatment having three replicates and three pigs per replicate. Data were collected on the growth performance of the pigs. Behavioural activities of pigs in each pen were also recorded at day 2 and 34 using direct observation method. Time spent on different activities was observed 3 times for 2 hours, starting from 1000h and ending at 1200h. In each pen, 1 focal pig was selected. The same focal pig

was observed throughout the trial. Data obtained were analyzed using descriptive statistics and analysis of variance (ANOVA) as described by (SAS, 1990), while means were separated using Duncan Multiple Range Test of the same statistical package.

RESULTS

Table 1: Effect of floor type and depth on growth performance of weaned pigs raised on concrete and maize straw enriched floor

Floor type	Depth	Initial weight(kg)	Final weight (kg)	Weight gain (kg)	Feed intake (kg)	FCR
Concrete	0	5.21	8.55	3.34	15.73	4.72[a]
Maize	0.1	5.30	9.43	4.13	15.71	3.83[b]
	0.2	5.33	9.58	4.25	14.97	3.53[b]
	0.3	5.25	9.41	4.16	14.51	3.49[b]
SEM		0.43	0.33	0.21	0.49	0.17

[a,b] Means of treatments along a column with different superscript differed significantly (P<0.05). SEM- standard error of mean, FCR- Feed Conversion Ratio

The performance characteristics of growing weaners housed in maize straw bedded pens are as shown in Table 1. There was significant ($p<0.05$) difference in feed conversion ratio (FCR) of weaned pigs. Pigs on concrete floor had FCR of 4.72 that was significantly ($p<0.05$) greater than 3.83, 3,53 and 3.49 found in pig on 0.1m, 0.2m and 0.3m maize straw bedding depth, respectively. There was no significant ($p>0.05$) different among the FCR of pigs on maize straw bedding.

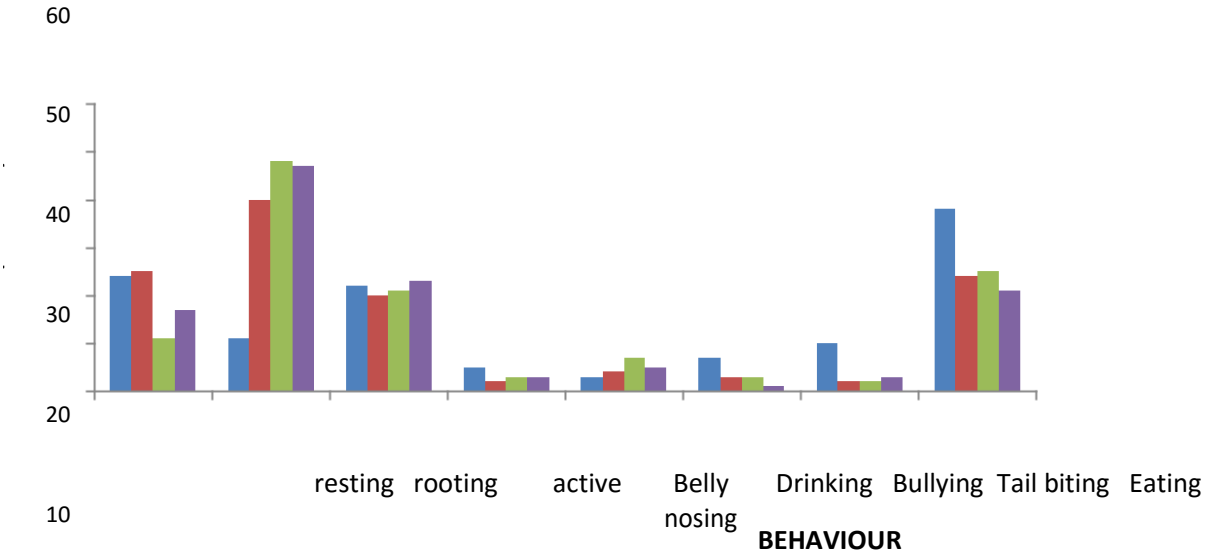




Figure 1: Behavioural activities of weaned pigs on concrete floor and maize straw bedding at 0.1, 0.2 and 0.3m depth at Day 2.

Figure 1 shows behavioural activities of newly weaned pigs on concrete floor and enriched floor with maize straw at 0.1, 0.2 and 0.3m depth at day 2. There was a variation in behavioural activity across the treatments.

Resting time of 24mins, 25mins, 11mins and 17mins was noted for pigs on concrete floor and enriched floor with maize straw at 0.1, 0.2 and 0.3m depth respectively. Pigs on concrete floor spent 11mins rooting which was considerably lower in comparison with pigs on maize straw bedding of 0.1m, 0.2m, 0.3m which spent 40mins, 48mins and 47mins respectively. Belly nosing frequency of 5mins, 2mins, 3mins and 3mins were noted for weaned pigs on concrete floor, and 0.1m, 0.2m and 0.3m, maize straw bedding depth, respectively.

Drinking and bullying activities frequency varied across the treatments from concrete floor, and 0.1m, 0.2m and 0.3m, maize straw bedding depth with 3mins and 7mins; 4mins and 3mins; 7mins and 3mins; and 5mins and 1mins, respectively.

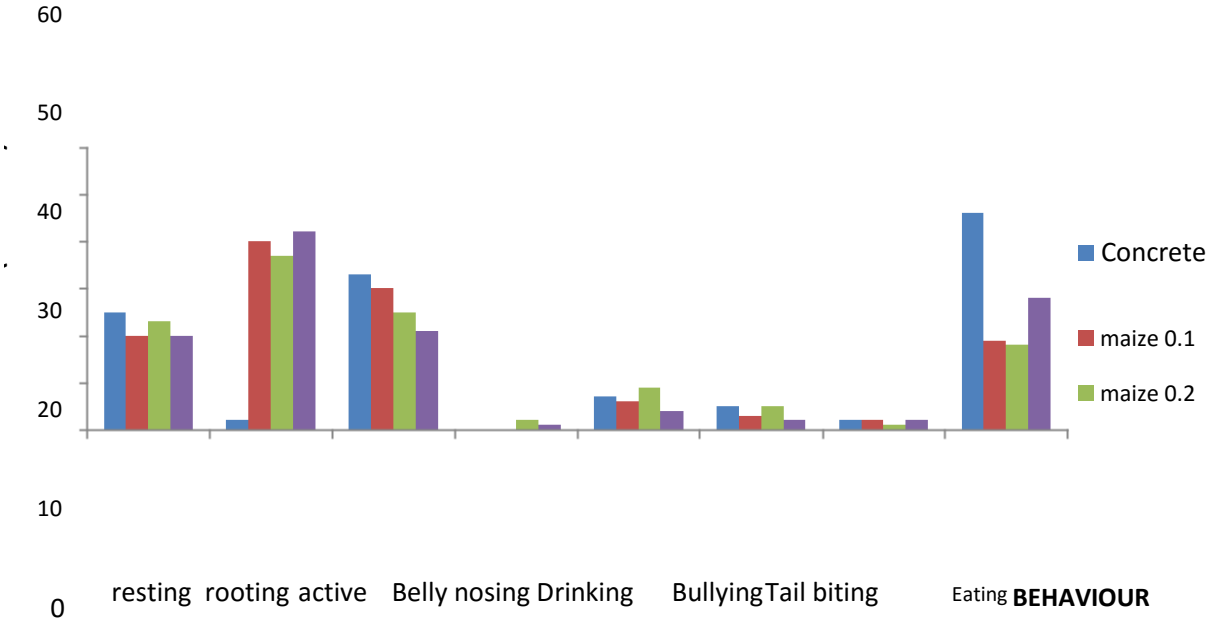


Figure 2: Behavioural activities of weaned pigs on concrete floor and maize straw bedding at 0.1, 0.2 and 0.3m depth on day 34.

Shown in figure 2 is the behavioural activities of weaned pigs on concrete floor and enriched floor with maize straw at 0.1, 0.2 and 0.3m depth for day 34. There was variation in the frequency of time spent on behaviour of weaned pigs on concrete floor and 0.1m, 0.2m and 0.3m depth of maize straw bedding.

Weaned pigs on concrete floor spent 25mins resting, while those on 0.1m and 0.3m maize straw bedding spent 20mins resting and pigs on 0.2 maize straw bedding spent 23mins. Less than 10mins was observed to have been spent by pigs on concrete floor to engaging in rooting activity, while those on 0.3m. 0.2m and 0.1m depth of maize straw bedding spent 42mins, 37mins and 40mins, respectively on rooting activity.

Active time was observed to be on the decline from 33mins, 30mins, 25mins to 21mins for pigs on concrete floor, maize straw enriched bedding of 0.3m, 0.2m and 0.1 depth, respectively.

Pigs on 0.2m maize straw enriched bedding spent 9mins of the observation time drinking and those on concrete floor spent 7mins, while those on 0.1m and 0.3m depth of maize straw bedding had 6mins and 4mins of the observation time drinking.

Pigs on concrete floor and 0.2m depth of maize straw bedding had 5mins of their observation time on bullying activity while those on 0.1m and 0.3m depth of maize straw bedding had 3mins and 2mins spent on bullying activity respectively.

Pigs on concrete floor had 46mins spent on eating activity while those on 0.1m, 0.2m and 0.3m had 19mins, 18mins and 28mins, respectively on eating activity.

DISCUSSION

The lack and absence of manipulation materials with the lack of space is a unique source of poor welfare and low production in intensive system of pig rearing (Studnitz *et al*., 2007). This reflects high frequency of behaviour redirected to objects and other animals in the pen causing pigs severe problem like skin lesion (Turner *et al*., 2006), cannibalism (van de weerd *et al*., 2005), physiological stress (Chaloupkova *et al.*, 2007) and lower product quality (Beattie *et al*., 2000). Maize straw as environmental enrichment substrate seems to comply with several of the characteristics necessary to maintain the interest of pigs for a relatively long period, such as being ingestible, chewable, odorous and rootable (van de Weerd *et al*., 2003).The choice of maize straw for this study was due to its availability and easy access as crop residues due to maize being an important and staple food in the country.

Feed conversion ratio (FCR) was found to be better than in pigs reared on maize straw beddings compared to those on concrete floor. Some differences, though, were found in the behaviour of the animals reared on concrete floor and the three different maize straw depths. Pigs kept on maize straw enriched bedded pens were found to have better weight changes compared to those on concrete floors. The performance of pigs is crucial as it reflects their response particularly to feed given and their living environment. Beattie *et al.* (2000) observed that pigs in enriched environments had higher growth rates, which was attributed to higher average daily feed intake. Furthermore, pigs in an enriched environment had a better feed conversion ratio (FCR) than their counterparts from barren environments. The predisposition to increase stress levels on concrete floor could be the reason why these pigs had lower performance rates than pigs in enriched environments. Barnett *et al*. (1992) reported that higher levels of stress adversely affected FCR. At high temperature, pigs reduce their feeding time (Collin *et al*., 2001). Feeding behaviour differ between pigs on concrete floor and those on maize straw bedding. Furthermore, there were differences in the time spent resting as influenced by temperature differences between floor types and bedding depth as this would be expected to influence the animals' thermal comfort (Hyun *et al*., 2005). Fraser (1985) found that while under cool conditions growing pigs prefer to lie on straw, at higher temperatures they prefer bare floors. Thus because of the tropical condition of the study, pig exhibit higher frequency of resting on concrete floor while lesser time resting on maize straw bedding that raise thermal stress in the animal as a result of heat of fermentation from the decomposing maize straw. Excessive temperature, as a result of fermentation of the substrate, could result in heat stress, reducing voluntary feed intake and weight gain of pigs (Quiniou *et al*., 2000)

CONCLUSION AND RECOMMENDATION

Maize straw helped in manipulating the behaviour of weaned pig which is important in welfare improvement of the pigs. It was revealed that the maize straw is a good rooting and welfare-friendly material that has a larger capacity to stimulate explorative behaviour of pigs. Also, it is a good absorbent material providing dry surface for pigs. Better pig production performance with improved weight changes and feed conversion ratio was noted with pigs on maize straw enriched pens. It can be recommended that pigs should be reared on 0.3m depth maize straw enriched pen as it improves exploratory behaviour of pigs and promotes better welfare of the pigs by reducing or eliminating aggressive behaviour.

REFERENCES

Barnett, J. L., Hemsworth, P. H., Cronin, G. M., Newman, E. A., McCallum, T.H., Chilton, D. (1992). Effects of pen size, partial stalls and method of feeding on welfare-related behavioural and physiological responses of group-housed pigs. *Applied Animal Behaviour Science* 34: 207–220.

Beattie, V. E., O'Connell, N. E., and Moss, B. W. (2000). Influence of environmental enrichment on the behaviour, performance and meat quality of domestic pigs. *Livestock Production Science*, 65: 71–79.

Chaloupková, H., Illmann, G., Bartoš, L. and Špinka. M. (2007). The effect of pre-weaning housing on the play and agonistic behaviour of domestic pigs. *Applied Animal Behavioural Science* 103:2534.

Collin, A., van Milgen, J. and Le Dividich, J. (2001) Modelling the effect of high, constant temperature on food intake in young growing pigs. *Animal Science* 72 (In the Press).

Fraser, D. (1985). Selection of bedded and unbedded areas by pigs in relation to environmental temperature and behaviour. *Applied Animal Behaviour Science*, 14: 117–126.

Hotzel, M. J., Machado Filho, L. C. M.and Dalla Costa, A. O. (2005). Behaviour of pre parturient sows housed in intensive outdoor or indoor systems. *Pesqui. Agropecu. Bras*., 40: 169-174.

Hyun, T. T. T., Aarnink, A. J. A, Gerrits, W. J. J, Heetkamp, M. J. H, Canh, T. T, Spoolder, H. A. M, Kemp, B. and Verstegen, M. W. A. (2005). Thermal behaviour of growing pigs in response to high temperature and humidity. *Applied Animal Behavioural Science,* 91:1–16.

Molino, J. P. and Balbino, E. M. (2010). Lactose em rações para leitões desmamados. *Rev. Eletr. Nutr.*,103: 1133-1149.

Quiniou, N., Renaudeau, D., Dubois, S. and Noblet, J. (2000). Influence of high ambient temperatures on feed intake and feeding behaviour of multiparous lactating sows. *Animal Sciences* 70:471–479.

Studnitz M, Jansen M. B. and Pederson L. J. (2007). Why do pigs root and in what will they root? A review on the exploratory behaviour of pigs in relation to environmental enrichment. *Applied Animal Behavioural Science*; 107:183-97.

Turner, S. P., Farnworth, M. J., White, I. M., Brotherstone, S., Mendl, M., Knap, P., Penny, P. and Lawrence, A. B. (2006). The accumulation of skin lesions and their use as a predictor of individual aggressiveness in pigs. *Applied Animal Behavioural Science*, 96: 245–259.

Van de Weerd, H. A., Docking, C. M., Day J. E. L and Edwards S. A. (2005). The development of harmful social behaviour in pigs with intact tails and different enrichment backgrounds in two housing systems. *Animal Sciences*; 80:289-98.

Van de Weerd, H. A., Docking, C. M., Day, J. E. L., Avery, P. J. and Edwards, S. A. (2003). A systematic approach towards developing environmental enrichment for pigs. *Applied Animal Behavioural Science* 84:101-108.

INCIDENCE OF FOETAL WASTAGE IN CATTLE SLAUGHTERED AT THE BAUHI ABATTOIR, BAUHI STATE

***Samaila, L. M; Sanusi, M.; Mbap, S. T & Anene M. G.**
Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi.
Correspondence authors email: lulumaje@gmail.com; 08141198458

ABSTRACT
A total of 10,201 foetuses were wasted within a seven year period studied (2011 – 2017). Majority of the foetuses encountered were in 2013 (1,848) followed by 2011(1,818). The year 2016 had the lowest rate of foetal wastage. Monthly increase at the abattoir arise in the months of September, July, January and December 922, 929, 950 and 968 respectively with the highest peak in June1013 throughout the study period. The late rainy season (July-September) had the highest rate of foetal wastage while the late dry season had the lowest. The results indicated a high level of slaughtering of pregnant cows in the abattoir studied. Therefore concerted efforts like routine veterinary checks and interventions among trade animals is needed in order to reduce the high level of foetal wastage in the country. Also, livestock owners should be educated on the seasonal breeding patterns of cattle in order to avoid selling cows during the calving season. It also gave insight to need for strategic planning and decision-making on animal food security in Bauchi State.

Keyword*: Foetal wastages, cattle, Bauchi abattoir, slaughtered.*

INTRODUCTION
Selling of cattle to livestock market is a common practice to farmers for the purpose of getting income. To get good prices, farmers always select animals by visual assessment, looking at body size (well-nourished and fat animals) and sell them to cattle traders in livestock markets. Because of limited veterinary and extension services in rural areas, farmers just sell animals without knowing their pregnancy status. The majority of cattle traders buy animals for slaughter and sell meat. Studies in many African countries show that many local cattle slaughtered in different slaughter-houses are pregnant (Zulu *et al*., 2013; Nantongo *et al*., 2013; Bakari, 2016 and Hassan *et al*., 2016). This leads to foetal wastage which otherwise would have increased the cattle herds that ultimately increase the protein supply to the ever increasing human populations in African countries like Nigeria.

The attendant embryonic and foetal wastages due to this practice consequently query the efficiency of *ante-mortem* and the rationale for converting pregnant animals to beef, mutton, chevon, pork, offal and other meat types. It also challenges the ethical or moral act of slaughtering pregnant animals in situations where there is no law supporting the practice. In most cases, meat consumers are even unaware or denied the right to know the status of the animal that is converted to meat they eat. In Nigeria, there is lack of legislation strictly regulating abattoir construction and operation. In many states of the federation there are no modern abattoirs where proper ante-mortem examination of slaughtered animals is practiced to eliminate slaughtering of pregnant cows. The greatest effects about slaughtering pregnant cows lies in the fact that herd population sizes are reduced and enormous economic wastages are involved, leading to colossal reduction in the national herd, loss of dairy products as well as supply of poor quality meat product to the general public (Alhaji, 2011; Ardo *et al*., 2013;Hassan *et al*., 2016 and Bakari, 2016). This study was carried out to investigate the incidence of foetal wastage in cattle slaughtered at the Bauchi Abattoir, Bauchi State for the period of 7 years.

MATERIALS AND METHODS

Study area

The study was conducted in Bauchi abattoir, Bauchi district of Bauchi state, Nigeria. Bauchi is the state capital of Bauhi state, located at latitude 9° 3′and $12^0$3'N and longitude 8° 5′and 11^0E.The geographical area is largely inhabited by people whose main occupation is subsistence agriculture including the rearing of animals(ruminants) others are artisans and civil servants.

Data processing and statistical analysis

The primary raw data was collected and processed by the use of descriptive statistics (percentage and ratio). Chi-square test was also employed to test association between foetal wastage and years, months and seasons using SPSS version 21.

RESULTS AND DISCUSSION

The result of this investigation showed that 19.17% of slaughtered cattle were pregnant in Bauchi abattoir, that is, for every five slaughtered cows, one could be pregnant; this showed the extent of reproductive loss. The proportion of cows slaughtered pregnant varied considerably among countries and breeds; 22.1% in Cameroon cows (Ndi *et al*., 1993), 15 % in Mali (zebu cows) (Wilson and Traore, 1988), 38.7% in New Zealand (dairy cows) (Lawton *et al*., 2000), and 23.5.% in UK (dairy cows) (Singleton and Dobson, 1995; Sheldon and Dobson,2003) respectively. and States; 2.6% in Kano (Bakari, 2016) and 40.70% in Lafia (Hassan *et al*., 2016). However, the incidence of pregnant cows slaughtered in Bauchi abattoir was higher in comparison with some countries' reports. Singleton and Dobson, (1995) reported that, the reasons why so many pregnant cows were slaughtered at abattoirs might include disease eradication schemes, economic factors such as the calf price, the cash flow of an individual farm, nutritional factors such as the availability of pasture and the effects of a dry season. However, these factors may be different among livestock production situations, breed and area.

Table 1 shows the annual incidence of foetal wastage in Bauchi abattoir. A total of 10,201 foetuses were wasted within ten year period. Majority of the foetuses encountered were in 2013 (1848) followed by 2011 (1818). The year 2016 had the lowest rate of foetal wastage (905). The possible reason for the peak in foetal wastages in 2013 and subsequent fall could not be easily ascertained but often cattle are sold to meet the need for money to send children to school and meet some other domestic needs. The implication of this finding was that 19.17% of the future productive herd was lost to this practice which would adversely affect the development of cattle production in and around Bauchi. The higher percentage observed in this study could be associated with lack of enforcement of legislation against slaughtering of pregnant cows. The percentage of foetal wastage 19.17% in this study was higher than 8.2% obtained by Nwakpu *et al.* (2007), 9.15% by Fatemi *et al*. (2008), 9.87 by Ardo *et al*. (2013) and 2.6% by Bakari (2016).

The findings in this study also showed that one foetus was wasted for every five cows slaughtered. This ratio is higher than the findings of 1:14 by Fayemi *et al.* (2012) at four abattoirs in Ogun State, 1:11 by Nwakpu*et al.* (2007) in Ebonyi State of Nigeria.The unnecessary disposal of many pregnant cows represented a major economic loss and an important source of herd wastage to the industry (Sheldon and Dobson, 2003)

Table 1: Annual incidence of foetal wastage in cows slaughtered at Bauchi Abattoir, Bauchi State, Nigeria from 2011-2017

Years	TCTS	TBS	TCS	TFW	POFW (%)	TCS:TFW
2011	14926	7065	7861	1818	23.13	4:1
2012	19390	9074	10316	1653	16.02	6:1
2013	15318	7597	7721	1848	23.93	4:1
2014	16882	8847	8035	1543	19.20	5:1
2015	15367	7704	7663	1431	18.67	5:1
2016	12752	6537	6215	905	14.56	7:1
2017	10970	5562	5408	1003	18.55	5:1
X^2	576.76					
P value	0.003					
Total	**105605**	**52386**	**53219**	**10201**	**19.17**	**5:1**

Keys: TCTS = Total number of Cattle slaughtered, TBS = Total bulls slaughtered, TCS = Total cows slaughtered; TFW= Total number of foetuses wasted, POFW=Percentage of foetal wastage.

Table 2 shows the monthly increase of slaughtered animals at the abattoir, there was a rise in the months of July, January, December and June 929,950,963 and 1013 respectively with the highest peak in June 1013. The rise in the months of June and July showed that the rains were just about to begin and these periods are usually characterized by drought, hunger which expose animals to poor nutrition, diseases especially gastrointestinal parasitism and as such to forestall losses due to natural death or diseases, farmers prefer to sell their animals. Many authors have reported that most cattle sold for slaughter during the dry season were females (Abdulkadir *et al.*, 2008; Alhaji and Odetokum, 2013). The rise in wastage in December and January of most of the years may be related to the festivals and ceremonies during this period. There was a peak of foetal wastage in June with a significant difference between months and foetal wastage at $P \leq 0.05$.

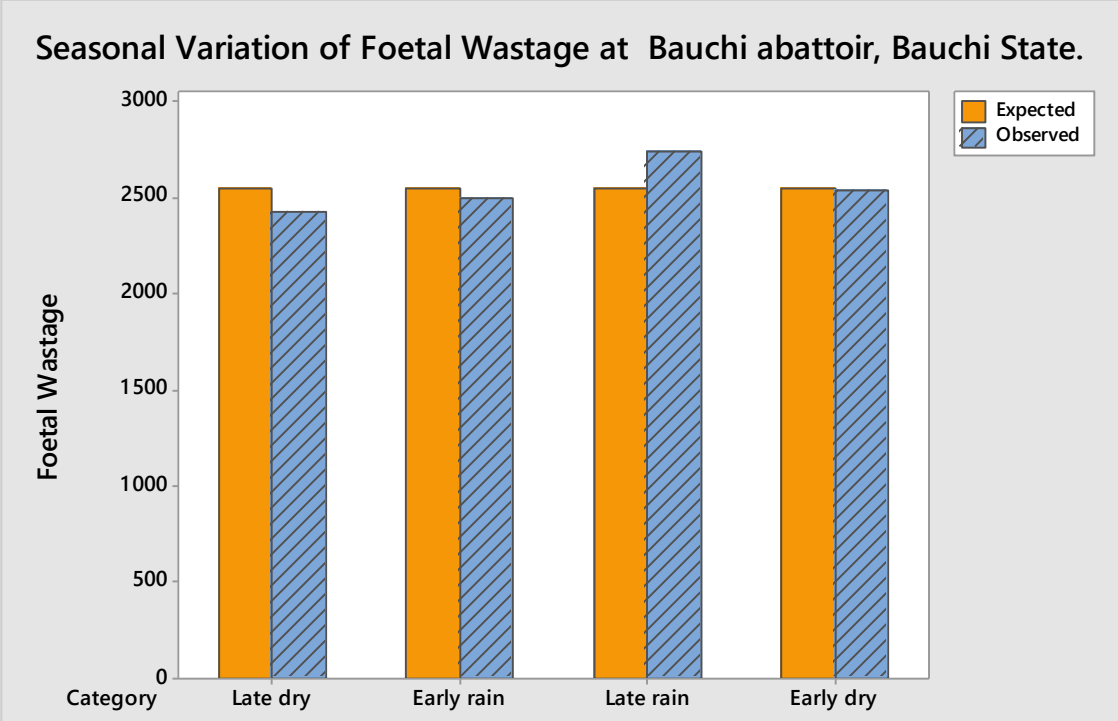
Table 2: Monthly Distribution of Foetal Wastage in Cattle Slaughtered at Bauchi Abattoir, Bauchi State, Nigeria from 2011 - 2017

Months	11	12	13	14	15	16	17	Total	Mean	X^2	Pvalue
Jan	185	128	246	80	174	94	43	950	136	769.048	0.002
Feb	163	136	113	79	130	115	39	775	111		
March	174	118	147	63	110	42	44	698	100		
April	133	126	109	86	98	51	88	691	99		
May	171	116	200	81	72	77	74	791	113		
June	146	168	286	126	115	59	113	1013	145		
July	123	131	147	164	117	123	124	929	133		
Aug	105	130	111	188	130	85	141	890	127		
Sept	116	128	152	233	174	62	57	922	132		
Oct	117	132	190	150	46	59	96	690	99		
Nov	182	157	118	138	125	79	90	889	127		
Dec	203	183	129	155	140	59	94	963	138		
Total	1818	1653	1848	1543	1431	905	1003	10201	1460		

Key: *11-17 means 2011 - 2017*

Table 3 shows the seasonal variation in the rate of foetal wastage in this abattoir. The incidence of foetal wastage was more in late rainy season than others and a significant difference between Seasons and foetal wastage was observed at $P \leq 0.05$.The highest incidence in the late rainy season could be due to disease especially gastrointestinal diseases or shortage of money during this periodas much has been invested in farming.

Table 3: Seasonal Variation of Foetal Wastage at Bauchi abattoir, Bauchi State 2004 -2013



CONCLUSIONS

This showed that the foetal wastage was quite alarming and effort should be geared towards instituting routine veterinary checks including pregnancy diagnosis at cattle control posts and abattoirs. In addition adequate infrastructural facilities including ultra-scanners that will ensure adequate pregnancy diagnosis should be provided to aid quick detection of pregnant animals during inspection. Drastic efforts should be made to increase future domestic meat supply in order to reduce or halt the incidence of slaughtering pregnant cows.

REFERENCES

Abdulkadir, U., Jiya, E.Z. and Kosu, S.A. (2008). Survey of foetal wastages: a case study of Makurdi abattoir in Benue State from 1997 to 2002. *Pakistan Journal of Nutrition*, 7: 450–452.

Alhaji, N. B. (2011). Prevalence and economic implications of calf foetal wastage in an abattoir in North Central Nigeria. *Tropical Animal Health Production*, 43(3): 587-590.

Ardo, M. B., Lawal, H. and Aliyara, Y.H. (2013). Economic implication of bovine foetal wastage in yola modern abattoir, Adamawa State, Nigeria. *International Journal for Agro Veterinary and Medical Sciences*, 7(2): 57-64.

Bakari, N. A., Umoh, J. U., Kabir, J., Otolorin, G. R., Ehizibolo, P. O., Jibril, Y. J. and Yahaya, R. J. (2015). A case study of Yola Modern Abattoir (YMA), Adamawa State Nigeria. *Journal of Veterinary Advances*, 5(6): 995-1003.

Fayemi, A.O., Taiwo, B.B.A., Okubanjo, A.O. and Adekunmisi, A.A. (2008). Frequency of slaughtering gravid cows in some selected parts of Ogun State. *In proceedings of the 33rd Annual Conference of the Nigeria Society of Animal Production*, pp: 234-237.

Hassan, D.I., Adua, M.A and Yusuf, N.D. (2016).Incidence of Foetal Wastage in Cattle Slaughtered at Lafia abattoir, Nasarawa State. *Nigerian Journal of Agriculture, Food and Environment.*12(2):200-202.

Nwakpu, P.E. and Osakwe, I.I. (2007). Trends in volume and magnitude of foetal waste of slaughtered Animals (2000 -2005) in Ebonyi State of Nigeria. *Research Journal of Animal Science*, 1: 30-35

Ndi, C., Tambi, N.E. and Agharih, A.E. (1993).Reducing calf wastage from the slaughtering of pregnant cows in Cameroon. World Anim. Rev., 77, 38-43

Sheldon, I. M. and Dobson, H. (2003).Reproductive challenges facing the cattle industry at the beginning of the 21st century. Reproduction, Suppl. 61, 1-13.

Singleton, G. H. and Dobson, H. (1995).A survey of the reasons for culling pregnant cows. Vet. Rec., 136, 162165.

Wilson, R.T. and Traore, A. (1988). Livestock production in central Mali : Reproductive performance and indices

Zulu R.T and Nantongo S. A (2013). A review of Cattle Foetal Wastage during slaughter and its impact to the future cattle herd in Tanzania.

HEALTH CONDITION OF LIVESTOCK RAISED BY CROP FARMERS IN FASHOLA FARMING COMMUNITY, OYO STATE, NIGERIA

***Ajayi Modupe O., Olanipekun Oyindamola O and Usman Shakirat** O.
Animal Production and Management Unit,
Department of Animal Science, University of Ibadan, Nigeria.
Corresponding author email: moajayi5@gmail.com; +2348066116150

ABSTRACT
Good health management fosters high productivity in animal husbandry; the study looked at the health condition of livestock raised by crop farmer in Fashola farming community, Oyo, Nigeria. Fifty–eight well structured questionnaire were administered using a snowball sampling techniques to crops farmers that raised livestock. Data collected were analysed using descriptive statistic. The mean flock sizes were 9.2, 6.3, 5.7, 4.7, 4.0, 3.3 and 1.0 for chicken, goat, turkey, sheep, duck, cattle and pig, respectively. *Peste des petits ruminante* was reported by 52.4% of the respondents while 21.4% reported Newcastle Disease. Highest mortality of 5.4 was found in goats while cattle and pig had zero mortality. About 81.1% of the livestock keepers sought veterinary intervention when animals were sick and 3.8% salvage the animals. The study showed high mortality of goats and local chickens as a result of *Peste des petits ruminante* and Newcastle diseases outbreaks in the study area.
Keywords: Newcastle, *Peste des petits ruminante,*Mortality, Ailment

Introduction
Food production in Nigeria is basically in the hands of small scale farmers who are spread all over the country. These farmers are faced with diverse challenges such as predominance of primitive techniques, limited use of biological and chemical technology (Adesoji, 2002). Above all, inconsistency in rainfall pattern, prolonged dry season posed by climate change led to crop failure and consequently affect yield.
Although, some of the crop farmers are engaged in other secondary occupations (Ajayi *et al*., 2019) which can help to cushion the effect of low crop yield for better livelihood. Animal husbandry has been found to be a complimentary occupation due to the symbiotic relationship between the two enterprises. The waste from one enterprise is a resource in the other enterprise.

However, livestock production in Nigeria is faced with challenges such as housing, health and feeding (Doma *et al*., 1999) and good health management practice is pivotal to sustainable animal production. Studies have shown high incidence of diseases as a major constraint associated with animal production resulting in economic losses due to stunted growth, weakness, poor reproductive performance or death in livestock (Jawara, 1990). The study assessed the health condition of animals raised by crop farmers domiciled in Fashola farming community, Oyo.

Materials and methods
The Study was carried out in Fashola farming community, Oyo, located in Oyo West Local Government Area of Oyo State, Nigeria. The area shares boundaries with Orire Local Government in the North, Akinyele Local Government in the South, Iseyin Local Government in the West. The area was purposefully chosen because of the ecological conditions that are suitable for crop-livestock production systems. Individual interview was carried out for data collection using a well structured questionnaire to 58 respondents who were basically crops farmers that raised livestock using a snow ball sampling technique. The questions were translated from English to Yoruba language for the respondents and recorded in English Language. Descriptive statistics such as frequencies and mean were used to analyse the data.

RESULTS AND DISCUSSION

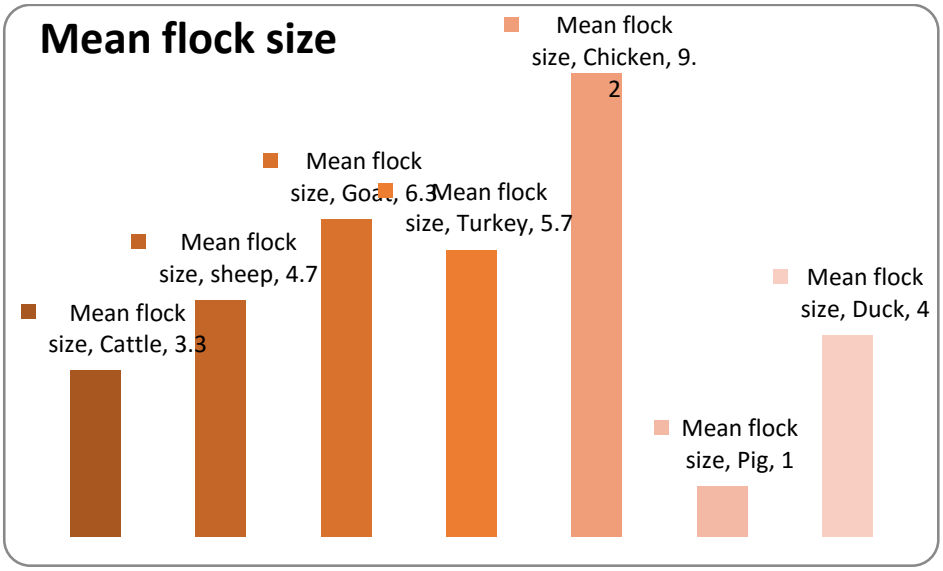


Figure 1: Mean flock size of livestock raised in Fashola farming community, Oyo

(Source: Field survey, 2018)

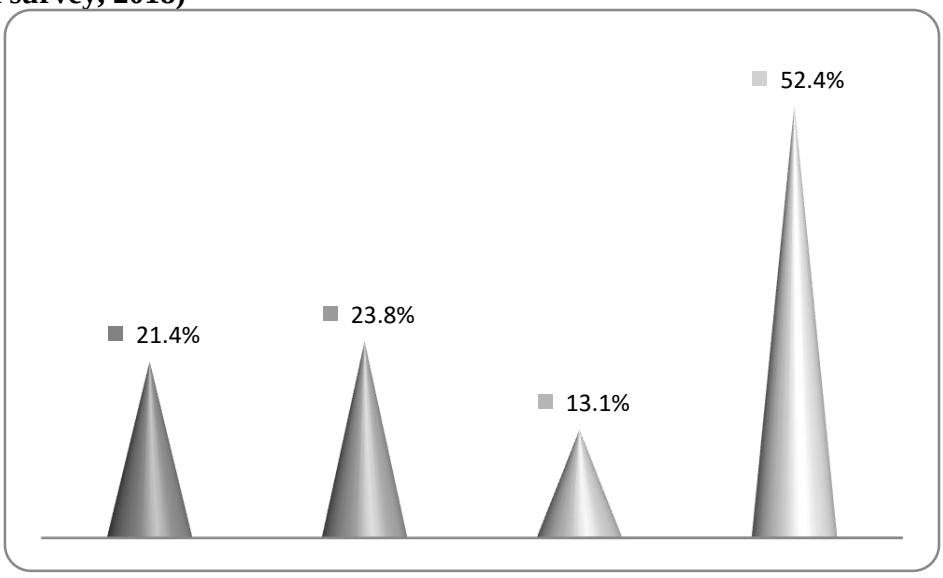


Figure 2: Common ailment affecting livestock in Fashola farming community, Oyo.
Source: Field survey, 2018
***Multiple responses**

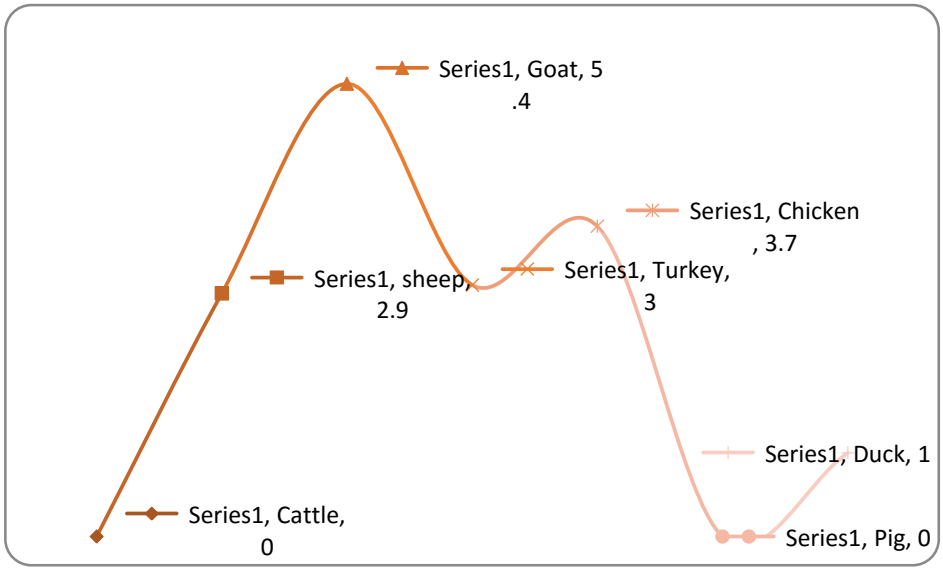
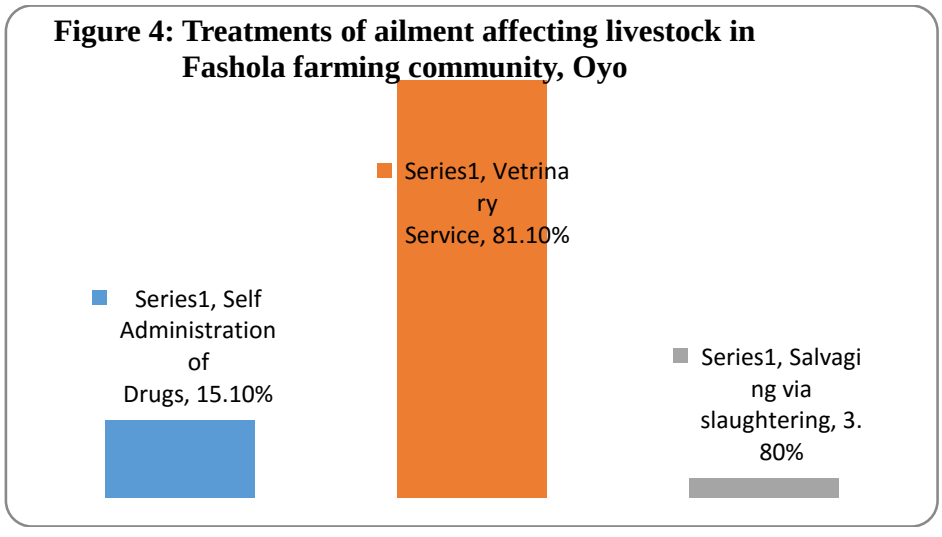


Figure 3: Yearly average mortality rate of livestock raised in Fashola farming community, Oyo. Source: Field survey, 2018



Source: Field survey, 2018

Figure 1 shows the mean flock size of livestock raised in the study area. Local chickens had the average flock size of 9.2 followed by goats which was 6.3 and pig (1) was the lowest. The high population of chickens and goats could be due to the production system adopted by the farmers as majority of the animals were raised on free range. This system of production requires low capital and less managerial involvement. Common ailment affecting livestock in Fashola farming community, Oyo is shown in figure 2. The study revealed that *Peste des petits ruminante* (PPR) was the commonest reported by 52.4% of the respondents while 21.4% reported Newcastle

Disease (ND). PPR and ND are viral diseases that affect goats and local chickens, respectively. The widespread of these viral diseases could also be attributed to the production system as little attention is given to the vaccination of the animals to prevent the occurrence. The yearly average mortality is represented in figure 3. Goats had the highest mortality of 5.4 followed by chickens (3.7). This high mortality can be due to the production system adopted in the study area as less attention is given to vaccination of animals until they come down with ailment. Moreover, Newcastle Disease is reported to be the most prevalent and fatal disease of poultry (Kingori *et al*., 2010). Figure 4 represents the treatments of ailments affecting livestock raised by farmers in Fashola farming community. The study revealed that 81.1% of the livestock keepers relied on veterinary intervention when the animals are sick. About 15.1% were involved in self-administration of drugs to animals while 3.8% salvage the animals for consumption when the animals are sick as reported by Aklili, 2007.

CONCLUSION

The study revealed that *Peste des petits ruminante* (PPR) and New castle diseases were the predominant diseases common to livestock in the study area. The attitude of "not vaccinating animals" was observed among farmers and led to the high percentage of mortality of goats and poultry.

References

Adesoji, S.A., 2002. Socio-economic factors associated with arable crop production in Osun State, Nigeria. M.Sc. Thesis, Obafemi Awolowo University, Ile-Ife.

Ajayi, M. O., Akintola, A. J and Babayemi O. J. 2019. Coping Strategy among crop and livestock farmers in agrarian community of Fashola, Oyo state, Nigeria. *Nigerian Journal of Animal Science.* 21 (3): 160-171.

Aklili, H. A. 2007. Village Poultry in Ethiopia; Socio- Technical analysis and learning with Farmers. PhD thesis, Wagenigen University, Wagenigen, The Nertherlands.

Doma, U D, Mohammed L K and Umeh A P 1999 Observation of small holder sheep and goat management practices in old Bauchi State. Tropical Journal of Animal Science 2(2)123-130

Jawara, D. K. 1990 Animal disease as a factor limiting economic development in Africa. George C Poppensiek Lecture. Cornell Veterinary 80: 17 -25

Kingori, A.M., Wachira, A.M. and Tuitoek, J.K., 2010. Indigenous chicken production in Kenya: A review, International Journal of Poultry Science 9, 309–316

INCIDENCE OF COMMON POULTRY DISEASES IN SELECTED POULTRY FARMS IN OWERRI, IMO -STATE, NIGERIA FROM 2013 – 2017

P.C. Okere, E.U. Ahiwe, F.C. Egenuka, T .C. Iwuji, M. C. Uchegbu, B .O. Esonu.
Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria.
Corresponding author; P.C. OKERE E.mail; okerepeacefuto@gmail. com. +2348060657957

ABSTRACT
A survey on the incidence of common poultry diseases was carried out in five selected poultry farms in Owerri North and Owerri West Local Government Areas of Imo State for the period of January 2013 to December 2017. The diseases investigated include: Newcastle disease, Infectious Bursal disease, Coccidiosis, Fowl typhoid and Chronic Respiratory disease. The farms were Lambert Farm and Engrobic farms in Owerri West Local Government Area; Odimara farms, Ben and Baba Khojo farms and Chiawuotu farms in Owerri North. Data were collected in the selected farms on percentage mortarlity rates of each disease. The prevalence of Coccidiosis was slightly higher than other diseases investigated. Newcastle Disease recorded 1.22% of total percentage mortatily, Infectious Bursal Disease recorded 0.6%, Coccidiosis recorded 1.24%, Fowl typhoid recorded 0.58% and Chronic Respiratory Disease recorded 0.38%. Most of the diseases occurred during the rainy season [April to October] of the years. Most of the poultry farmers were male and within the age range of 32-50 years. Poor management, inadequate diagnostic facilities, improper vaccine handling, self medication coupled with harsh weather conditions were responsible for the distribution pattern. It therefore becomes imperative for poultry farmers to instituite and intensify biosecurity measures inorder to minimize emergence and transmission of these diseases.

Keywords; Poultry diseases, percentage mortality, prevalence, biosecurity measures.

INTRODUCTION
Poultry industry in Nigeria occupies a prominent position as a major source of animal protein and economic empowerment of the resource poor segments of the society. [Udedibie and Opara 1998]. USDA [2013] currently rated Nigeria as the leading country in Africa with respect to egg production, but the fourth in broiler chicken production. According to F.A.O. [2010], Nigeria presently is far from meeting her domestic demand when compared with that of the developed countries. Nigeria 'per capita daily protein consumption/intake' for instance is estimated to be 45.4g as against F.A.O recommended minimum of 53.8g.

Poultry disease has however, been identified as one of the major barriers to expansion of poultry industry in Nigeria [Okere *et al*., 2014; Okoli *et al.*, 2001, 2003; Okoli and Ebere, 2002]. The cost of disease treatment and control tends to increase the cost of production of poultry, hence reducing the profit earned by the poultry farmers. This thereby leads to a hike in purchase of poultry and their products, out of the reach of the common man [Okere *et al.*, 2018]. These poultry diseases are barriers to sustainable poultry production all over the world.

This study will therefore, identify the incidences of the aforementioned diseases, analyse the level of losses reached by these diseases and make appropriate recommendations on how to ameliorate the problem.

MATERIALS AND METHODS
Five selected poultry farms were investigated; Lambert Farms and Engrobic Farms in Owerri West Local Government Area; Odimara Farms, Ben and Baba Khojo Farms and Chiawuotu Farms in Owerri North. Information on the locations of existing poultry farms were obtained from Owerri north and Owerri west local government secretariats. The five poultry diseases investigated were Newcastle disease, Infectious Bursal disease, Coccidiosis, Fowl typhoid and Chronic Respiratory disease. The farms were selected based on existence of farm records, production consistency and efficiency and large population. Mortality rate percentages were determined.

METHOD OF DATA COLLECTION AND ANALYSES

Magazines, journals and internet were the secondary sources of data while the primary sources of data were the farm disease survey records [health records], detailed questionnaires and interviews. Simple descriptive statistical model was employed in the analysis of work using tables, bar charts and graphs.

RESULTS AND DISCUSSION

Table 1 shows the average yearly incidence of the various poultry diseases in all the farms in the two local government areas of Imo State for the period of five years; January 2013 – December 2019.. Figure 1 shows the average percentage mortality of selected poultry diseases from farms in Owerri north and Owerri west local government areas of Imo State for the period January 2013 –December 2017. Newcastle disease recorded the highest percentage mortality of 0.21%.in Lambart farms for the five years. Fowl typhoid recorded the highest percentage mortality of 1.91% in Ben and Baba Khojo farms. Newcastle diease also had the highest percentage mortality of 0.77% in Odumara farms for the five years. In Chiawuotu farms, Coccidiosis recorded the highest percentage mortality rate of 2.58%. Newcastle disease recorded the highest percentage mortality of 2.12% for the five years in Engrobic farms. The average yearly incidence of the various diseases in all the five farms from January 2013 to December 2017 showed that Coccidiosis was the most prevalent in the farms with an average percentage mortality rate of 1.24% while chronic respiratory disease recoded the lowest average percentage mortality of 0.38%. This result agrees with Okere [1999], who reported the incidence of Coccidiosis as the highest [3.4% mortality] amongs five poultry diseases investigated in Imo State. Generally, incidences of these diseases were low in the five farms for the five years investigated, but the effects were devastating. The result of the study showed that Coccidiosis, Newcastle disease and Gumboro disease were the most prevalent in the study area. This is in agreement with Adene [2000] and FAO [2008] who suggested that throughout the world, Newcastle disease, Gumboro [IBD] and Coccidiosis are considered as the most important. It was also observed from the results of the questionnaire that disease outbreaks were mostly during the rainy season [May – October] in accordance with the report of Unamba -Opara [2018]

Table 1: Average yearly incidence of the various poultry diseases in all the farms in Owerri north and Owerri west local government areas of Imo State from January 2013 – December 2017

		2013	**2014**	**2015**	**2016**	**2016**	**TOTAL**
Newcastle Disease	Number of birds stocked Number of dead birds % Mortality	6000 105 1.75	6450 83 1.3	6350 72 1,13	7050 66 1.03	6400 66 1.03	32250 392 1.22
Infectious Bursal Disease	Number of birds stocked Number of dead birds % Mortality	6000 39 0.65	6450 36 0.56	6350 48 0.76	7050 35 0.5	6400 37 0.57	32250 195 0.6
Coccidiosis	Number of birds stocked Number of dead birds % Mortality	6000 90 1.5	6450 78 1.21	6350 75 1.18	7050 78 1.11	6400 79 1.2	32250 400 1.24
Chronic Respiratory Disease	Number of birds stocked Number of dead birds % Mortality	6000 24 0.24	6450 20 0.31	6350 27 0.43	7050 25 0.35	6400 26 0.41	32250 122 0.38
Fowl Typhoid	Number of birds stocked Number of dead birds % Mortality	6000 52 0.87	6450 35 0.56	6350 21 0.33	7050 42 0.6	6400 36 0.56	32250 186 0.58

CONCLUSION AND RECOMMENDATION

In conclusion, Newcastle disease, Infectious bursal disease, Coccidiosis, Chronic Respiratory disease and Fowl Typhoid have been majorly responsible for a number of economic losses to poultry farmers in Owerri north and Owerri west local government areas of Imo State with Coccidiosis recording the highest percentage mortality. It was therefore recommended that strict vaccination and medication schedule be adhered by the farmers, coupled with adequate keeping of health records.

REFERENCES

Adene, D.F [2000]. Poultry Animal Health –Pilot scale study and Report : FAO FGN/TCP/NIR 7822. FAO

FAO , [2008] Animal Production and Health Division 2008 . poultry sector country Renew. FAO, Rome,Pp:26

FAO. [2010]. Agribusiness handwork : poultry meats and eggs , investments centre division . FAO , Rome .Italy

Inyangbe , C.O and Orewa, S.I. [2019]. Determination of daily protein intake **anyway** Rural and Low –income urban Household in Nigeria . American-Eurasian Journal of Scientific Research 4[4]; 290-301

Okere , P.C, Etuk, E.B. , Obikaonu , H.O , Okoro, V.M.O. and udedidie , A.B.I [2014].Evaluation of sun-dried cassava fufu Meal as source of dietary Energy for finisher Broilers . *Intl Journal of Agric and rural development* volume 17[1]] : 1635-1640.

Okere P.C , Egenuka , F.C , Kadurumba , O.E , Etuk , E.B , I. C and Udedibie , A.B.I [2018]. Heamatological and Biochemical characteristics of finisher Broilers fed Gradid level of *Moringa Oleifera* leaf meat 43rd Annual conference of the Nigerian Soc. for Animal Production March 18th -22nd 2018 FUT Owerri.

Okere P.C [1999] .The incidence of common poultry dieases in selected poultry farms in Ohaji/Egbema and Owerri Local Government Areas of Imo –State for the period January 1995-December 1997

Udedibie, A. B. I. [2010]. Diversifying Nigerias Economy: Animal Production option . Department of Animal Science , Faculty of Agriculture, University of Uyo , Uyo Nigeria

Unamba - Opara, I.C [2018]. Retrospective study on the occurrence of infectious Bursal Disease and Newcastle Disease in orlu, Imo-State

United States Department of Agriculture [USDA] [2013] . Internal eggs and poultry report

COMPARISM OF CELLULAR AND HUMORAL IMMUNE RESPONSES OF CHICKS TO *INFECTIOUS BURSAL DISEASE* VACCINATION.

Animoke, P. C.*, Ezeibe, M. C. O., Ngene, A. A***
**Department of Veterinary Medicine, University of Nigeria, Nsukka, Enugu State*
***Michael Okpara University, Umudike, Abia State*
paul.animoke@unn.edu.ng

ABSTRACT
To study the relationship between cellular immune response and humoral immune response of chicks to Infectious Bursal Disease (IBD) vaccination, four groups of chicks vaccinated with IBD vaccine were bled 3 weeks post vaccination (PV).Their whole blood samples were used for total and differential White Blood Cells (WBC) count to determine number of lymphocytes per ml of their blood, while their sera were used for Qauntitative Agar Gel Precipitation Test (QAGPT) to assess antibody titre. Least AGPT titre that gave zero mortality to IBDV challenge was also determined.
Correlation existed between humoral immune response with mean antibody (AGPT) titre, 9 ± 2.06 and cellular immune response with mean lymphocytes count (Per ml) ,216,500 ± 20,900 ($p < 0.05$). From AGPT titre 8 (about 200,000 lymphocytes per ml of blood) and above, there was zero mortality to IBDV challenge.

Key words: Humoral immunity, Cellular immunity, AGPT Antibody titre, IBD.

INTRODUCTION

Infectious Bursal Disease (IBD) is a very important economic problem in Nigeria (Akoma and Baba, 1975, Abdu et al, 2001)(I.W. Musa, L. Sai`du and E.S. Abalaka, 2012. Economic Impact of Recurrent Outbreaks of Gumboro Disease in a Commercial Poultry Farm in Kano, Nigeria. *Asian Journal of Poultry Science, 6: 152-159.*) and in most poultry producing countries of the world (Okoye, 1984). The disease is very contagious (Benton et al, 1967) and causes high mortality (Annon, 1977)(Islam, M.T and M. a. Samad, 2004. Mortaity in chicks associated with economic impact and prospect of layer chicks rearer package programme of the participatory livestock development project in Bangladesh. Int. J. Pout Sci, 3: 119 - 123). Infected chickens that do not die of IBD are often immunosupressed and so, die of secondary infections (Okoye and Aba – Adulugba, 1988)(Rev. sci. tech. Off. int. Epiz., 2000,19(2), 527-543 Infectious bursal disease (Gumboro disease) T.P.van den Berg, N. Eterradossi, D. Toquin & G. Meulemans). Control of IBD is very difficult because of antigenic variations of the causative virus (Mcferan et al, 1980, Aghakehan et al, 1996, Roji and Cerne, 1997). Most countries are now adopting different measures to improve control of IBD. In China, a mixture of yolk IgG and hyperimmune serum is used in prevention and treatment of IBD (Lin – Yusher et al,1997). Haddad et al (1997) reported that USA has used a combination of IBDV strain 2512 and bursal disease antibodies to produce IBDV – BDA complex vaccine which has proved protective even when chicks with maternal antibodies are vaccinated.
In Nigeria. main method of control for IBD is mass vaccination of chicks with live atenuated IBD virus vaccine. IBD often occurs in the country, at times, even among vaccinated flocks (Ezeokonkwo, 1997). A recent serosurvey of day old chicks hatched in Nigeria also showed they lacked maternal antibodies against IBD.There is therefore need for regular evaluation of immune response of vaccinated flocks, especially, parent stock hens.

Viral vaccines provoke immune responses to protect vaccinated animals (White,1984).Immune response is either humoral (mediated by antibodies) or cellular, through lymphocytes (Paul, 1989). Both cellular and humoral immune responses are specific to the invading antigen (Roitt,1994, Stites et al, 1994) and develope cuncurrently

(Janeway and Travers,1994). So, assessment of any of the two, may give indication of ability of vaccinated animals to resist infection by the antigen.

Serologic tests used to assay IBD antibody titres of avian species include Radioimmunoassay (RIA), Enzymeimmunoassay (EIA), PolyAcrylamide Gel Eletrophoresis (PAGE) and Agar Gel Precipitation Test (Roitt,1994, Stite, et al, 1994, Abbas et al, 1994, Herbert, 1994).

Some of these tests are sophisticated and expensive. Most farms and laboratories in developing countries can not afford them for routine assessmet of immune responses of vaccinated animals. Heamatology to determine lymphocyte count is simpler and cheaper. Agar Gel Precipitation Test (AGPT) is also a simple qauntitative serologic test (Herbert,1974).

It was therefore thought useful to compare AGPT titres of IBD vaccinated chicks with their cellular immune response (lymphocytes count) to see if differential lymphocyte count can give a good assessment of immunity against IBDV in vaccinated flocks.

MATERIALS AND METHODS

Four groups, each of 10 chicks vaccinated at 10 days of life were bled 3 days post vaccination. Part of each blood sample was used for differential lymphocytes count while the remaining portion was allowed to clott for serum used for Qauntitative Agar Gel Precipitation Test as described by Herbert (1974). The mean lyphocytes count and mean AGPT titre were compared by correlation co – efficient.

In a second experiment, 6 groups, each of 10 chicks, were vaccinated with IBD vaccine on their tenth day of life.Conditions, such as, medication with multivitamins before and after the vaccination, day of bleeding post vaccination and administration of booster vaccination were varried for the groups in order to get different immune levels in the different groups of chicks.A sevent group was not vaccinated and served as control. Blood was collected from each group for serum before they were challenged with one drop (I/O) of a virulent IBD virus (NVRI, Vom, Nigeria) per chick.

The sera were used for QAGPT to determine antibody titre for each group while the chicks were observed for clinical signs and for mortality.

RESULTS

There was correlation between mean AGPT tire (9 ± 2.06) and 216,500 ± 20,900 per ml got as mean lymphocytes count ($P < 0.05$).

The AGPT titres and lymphocyte counts are as on table 1.

Mortality was 100% for a group with AGPT titre zero, 80% for a group with titre 1 and 70% when titre was 2. Groups with AGPT titres of 8, 16, ≥ 32 and another ≥ 32 had zero mortality each.

Table 1: AGPT titres and Lymphocyte counts of chicks vaccinated with IBD vaccine.

AGPT Titre	Lymphocyte Count(Per ml).
8	212,000
4	168,000
16	270,000
8	216,000

AGPT Titre of chicks vaccinated with IBD vaccine was directly related to their lymphocyte count ($P < 0.05$).

DISCUSSION

The association of humoral immune response (AGPT antibody titre) and cellular immune response (lymphocyte count) seen in this experiment is in agreement with reports of Roilf (1991) and Stites et al (1994) that when an antigen enters a host, the host`s Antigen Presenting Cells (APC) diggest the antigen and present its peptides to the host`s T – cell receptors so that the body produces both cellular and humoral immune responses specific to the antigen. Humoral and cell mediated immunity develope cuncurrently (Janeway and Travers, 1994).

Most laboratories in Nigeria and in other countries in the tropics where IBD causes more mortality (Annon, 1977) run differential WBC count routinely. So, it may be easy to educate poultry farmers especially those who keep parent stocks to check immune responses of their flocks after IBD vaccination by assessing number of lymphocytes per ml of blood of vaccinated chickens.

Since least protective antibody titre was AGPT 8 and from result of the first experiment, two groups with AGPT 8 gave lymphocytes of 212,000 and 216,000 per ml of blood, lymphocyte counts of 200,000 and above may protect chicks against IBDV challenge.

REFERENCES

Abbas, A. K., Lichtman, A. H. And Pober, J. S.(1994). Cellular and molecular Immunology. 2nd Ed. Saunders, Philadelphia. 823 – 837.

Abdu, P. A.,Umoh, J. U., Abdulahi, S. U.and Saidu, I (2001). Infectious Bursal Disease (Gumboro) in Nigeria. Trop. Vet, 19 (4):216 – 236).

Aghakhan, S. M., Fereidouni, S. R., Ashar, N. and Sami, Z. (1996). Characterization of a highly virulent infectious bursal disease virus. Archives-de- 1 Institute Razi. 46 (4) : 55 – 63

Akoma, M. B. and Baba, S. S. (1995). Survey for infectious bursal disease virus antibody for free-range and commercial birds in Borno State, Nigeria. Journal of the Pastur Institute 3: 46 – 48.

Arnon, R. (1987). Synthetic Vaccines. C.R.C. Press, USA.

Benton, W. J., Cover, M. S. and Lake, R. S. (1967). Physiochemical properties of the infectious bursal agent (IBA). Avian Dis. 11: 438 – 445.

Ezeokonkwo, R. C.(1997).Infectious Bursal Disease outbreak in a flock of four weeks old pullets despite repeat vaccination with Infectious Bursal Disease Vaccine. Nig. Vet. J. 18 :253 – 256.

Haddad, E. E.,Whitfill, C. E., Avakian, A. P., Richs, C. A.,Anrews, P. D., Thomas, J. A, and Wakeniel, P.S.(1997).Efficacy of a novel Infectious Bursal Disease Virus immune complex vaccine in broiler chickens. Avian Dis. 41(4):882 – 889.

Herbert, W. J (1974). Veterinary immunology. Blackwell Sc. Pub. Ltd, London pp 150 – 163.

Janeway, C. A. and Travers, P. (1994). Immunology: Current Biology. Garland Press, New York.pp 56 – 73.

Lin – Yusher, Guo-Yuqiang, Zhan-Legun, Yang Liankai and Zhu-Gf (1997). Experiments on the control of infectious bursal disease in chickens, using antibody extracts. Chinese J. Vet. Med. 23 (3): 11 – 12.

Mcfferan,J. B., Mcnulty, M. S.,Mckillop, M. S Corner, T. J. R.,McCraken,R.M.,Collins, D.S and Allan, G. M.(1980).Isolation and serologic studies with IBD fowls, turkeys and ducks:Demonstration of a second serotype. Avian Pathol. 9: 395 – 404.

Okoye, J. O. A.(1984). Infectious Bursal Disease of chickens. Vet. Bull. 54 :425 – 436.

Okoye, J. O. A and Aba – Adulugba,E, P.(1988).Comparative study of the resistance or susceptibility of local Nigerian and exotic chickens to Infectious Bursal Disease. Avian pathol. 27(2) : 168 – 173.

Paul,W. E. (1989). Fundamental Immunology. 2nd Ed. Raven Press, New York.pp 612 – 617.

Roilf,I.(1991). Essential Immunology. Blackwell Sc. Pub. Oxford.

Rojs, O. Z. and Cerne, M. (1997). Pathological changes in specific pathogen free chickens experimentally inoculated with highly virulent field isolate of Infectious Bursal Disease Virus (IBDV) in comparism with vaccinal strain of IBDV. Zhoraik Veterinaske – Fakultete Univerza – Ljubljana. 34 (2) : 177 – 186.

Stites, D. P (1994). Basic and clinical Immunology. 8th Ed. Appleton and Lange pp 377 – 379.

White, D. O.(1984). Antiviral chemotherapy, interferons and vaccines. Monographs . virol. 16 :23 – 26.

CLINICAL MANAGEMENT OF A LUMPY SKIN DISEASE IN A BUNAJI BULL IN TOHU VILLAGE OF ZARIA LGA, KADUNA STATE

[1]Danbirni[*], S., [2]Kaltungo, B.Y., [3]Ememe, M.U., [3]Adeneike, E.A. and [4]Sinkalu, V.O.
[1]Department of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria
[2]Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria
[3]Department of Veterinary Medicine, Michael Okpara University of Agriculture, Umudike, Nigeria
[4]Department of Veterinary Physiology, Ahmadu Bello University, Zaria, Nigeria
Corresponding Author: *[*]Danbirni, Samaila: E-mail: drdanbirni07@yahoo.com*

ABSRACT
A case of lumpy skin disease in a 7-year old Bunaji bull was presented to the Postgraduate students of the College of Veterinary Surgeon of Nigeria (CVSN), Ahmadu Bello University, Zaria, who were on an Ambulatory visit to some sedentary cattle herds in Tohu village in Zaria LGA. The chief complaints were swellings on different parts of the skin and reduced feed intake. Physical examination revealed pyrexia with rectal temperature of 39.9□C, rapid respiratory rate and pulsation of 36 cycles per minute and 90 beats per minute. Other signs included generalized circumscribed firm nodules on the skin especially the neck region, oedema of the limbs, reluctant to move, pale ocular membrane, mucopurulent nasal discharges, and superficial lymphadenopathy. Lumpy skin disease (LSD) was tentatively diagnosed based on the history and clinical signs observed. A non-specific treatment management protocol targeted at preventing secondary bacterial complications using a combination therapy of antibiotic and anti-inflammatory agent was carried out. Incidentally, the bull apparently recovered and was sold for slaughter. Therefore, a combination therapy as a management protocol aimed at preventing LSD complications and saving the life of the affected bull has been relatively successful using antibiotic and anti-inflammatory agent.
Keywords: Clinical management, Lumpy skin disease, Bunaji bull

INTRODUCTION
Lumpy skin disease (LSD) is a transboundary viral disease of cattle caused by a lumpy skin disease virus (LSDV) in the genus *Capripoxvirus* of the family Poxviridae (Woods, 1988). Lumpy skin disease virus is closely related antigenically to sheep and goat poxviruses (Tulman *et al.,* 2002). The LSD is a notifiable disease and it affects calves and adult cattle (Brown and Torres, 2008) resulting to great economic losses due to damage to the hide, reduced milk yield, mastitis, infertility, abortion and sometimes death arising from secondary bacterial complications (Ahmed and Dessouki, 2013). Biting flies and ticks play the most important role in spreading the virus (Sevik and Dogan, 2017). Calves can be infected by drinking milk from an infected cow. The disease can also spread through the saliva of infected animals when they use the same drinking trough (Carn and Kitching, 1995). The disease causes emaciation, temporary or permanent loss of milk production, lowered or complete loss of fertility in bulls and cows, abortion as well as permanent damage to hides (Ali *et al*., 1990)**.** There is a significant decrease in red blood cell count, haemoglobin concentration and packed cell volume interpreted as a macrocytic hypochromic anaemia (Neamat-Allah, 2015). The disease can be confused with demodecosis, besnoitiosis, oncocercariasis, insect bite allergies, dermatophilosis, bovine virus diarrhoea/mucosal disease, bovine malignant catarrhal fever and rinderpest (Radostits *et al* 2007).
There is no specific treatment for LSD. However, non-specific treatment management protocol can be achieved using antibiotics, anti-inflammatory agents and vitamin injections. This type of management protocol is usually directed at treating the secondary bacterial infections, inflammation and fever, as well as improving the appetite of the animal (Salib and Osman, 2011, CFIA, 2011). Prevention through vaccination and biting fly repellants are the cheapest and best method of control of the disease. However, animals that recovered from a natural infection of LSD, are immuned and therefore need not to be vaccinated. (OIE, 2004). Consequently, calves, less than 6 months old born to LSD vaccinated cows or to cows that have recovered from natural infections, need not to be vaccinated (Prozeesky and Barnard, 1981; OIE, 2004). In cases of outbreaks, isolation and prohibition of animal movements, slaughtering of all sick and infected animals, proper disposal of dead animals, cleaning and disinfection of premises and farm implements along with vector control in premises should be carried out (World Organisation for Animal Health, 2012).

CASE REPORT

On 26 September 2018, the Postgraduate student fellows in large animal section of Medicine Speciality of the CVSN, A.B.U Zaria study centre were on an Ambulatory visit to Tohu Village in Zaria L.G.A where a 7-year-old Bunaji bull weighing 400kg from a herd of 27 cattle was presented with complaints of swellings on the skin and not feeding well. The herd was on extensive management system and the onset of the problem was 4 days prior to presentation. The bull and afew other members of the herd were physically examined. Vital parameters of the bull showed rectal temperature to be 39.9° C, respiratory rate 36 cycles per minute and pulse rate 90 beats per minute. Clinical Signs observed on the bull included generalized firm cutaneous nodules especially around the neck region, oedema of the limbs, reluctant to move, superficial lymphadenopathy, mucopurulent nasal discharges, rapid respiration and pneumonia (Plate I). Based on the above signs, LSD, demodecosis, dermatophilosis and urticaria were considered as differential diagnoses. However, a tentative diagnosis of LSD was made based on the history and the severity of the clinical signs. Blood sample was collected for haemogram and faecal samples for routine oocyst and helminths screening to the Clinical Pathology and Helminthology/Protozoology Laboratories of the Ahmadu Bello University Veterinary Teaching Hospital, Zaria respectively.

Laboratory Investigation Results

Blood sample of the bull taken to Clinical Pathology Laboratory for haemogram indicated macroytic hypochromic anaemia with eosinophilia while the faecal samples to Helminthology and Protozoology Laboratories revealed Strongyle eggs ++ and Coccidia oocyst + respectively. The skin nodule tissue and serum samples for viral isolation and serology to be send to the Virology Research Laboratory of the National Veterinary Research Institute, Vom were not taken as the client could not afford the cost.

Case Management and Clinical Outcome

The bull was administered 20% tetracycline at 20mg/kg deep i.m (8000mg) and dexamethasone 0.2mg/kg (80mg) x 3/7 i.m as symptomatic treatment and the bull was dewormed with albendazole suspension 7.5mg/kg p.os (3000mg). Since the cutaneous lesions on the bull hasn't ruptured, a 5% cypermethrin at 10ml/100kg body weight as pour-on was applied on the dorsum from the base of the tail to the cranium of the bull in order to repel biting flies from transmitting the infection to other members of the herd whom the pour-on was also applied on. On the 2nd and 3rd day of the treatment, the owner reported that feed intake by the bull had improved. The vital parameters especially the rectal temperature were near normal. Consequently, 3 days after the treatment there was a remarkable improvement such that fever, anorexia, oedema of the limbs, respiratory signs and other deviations subsided, but the skin still had some lumps.

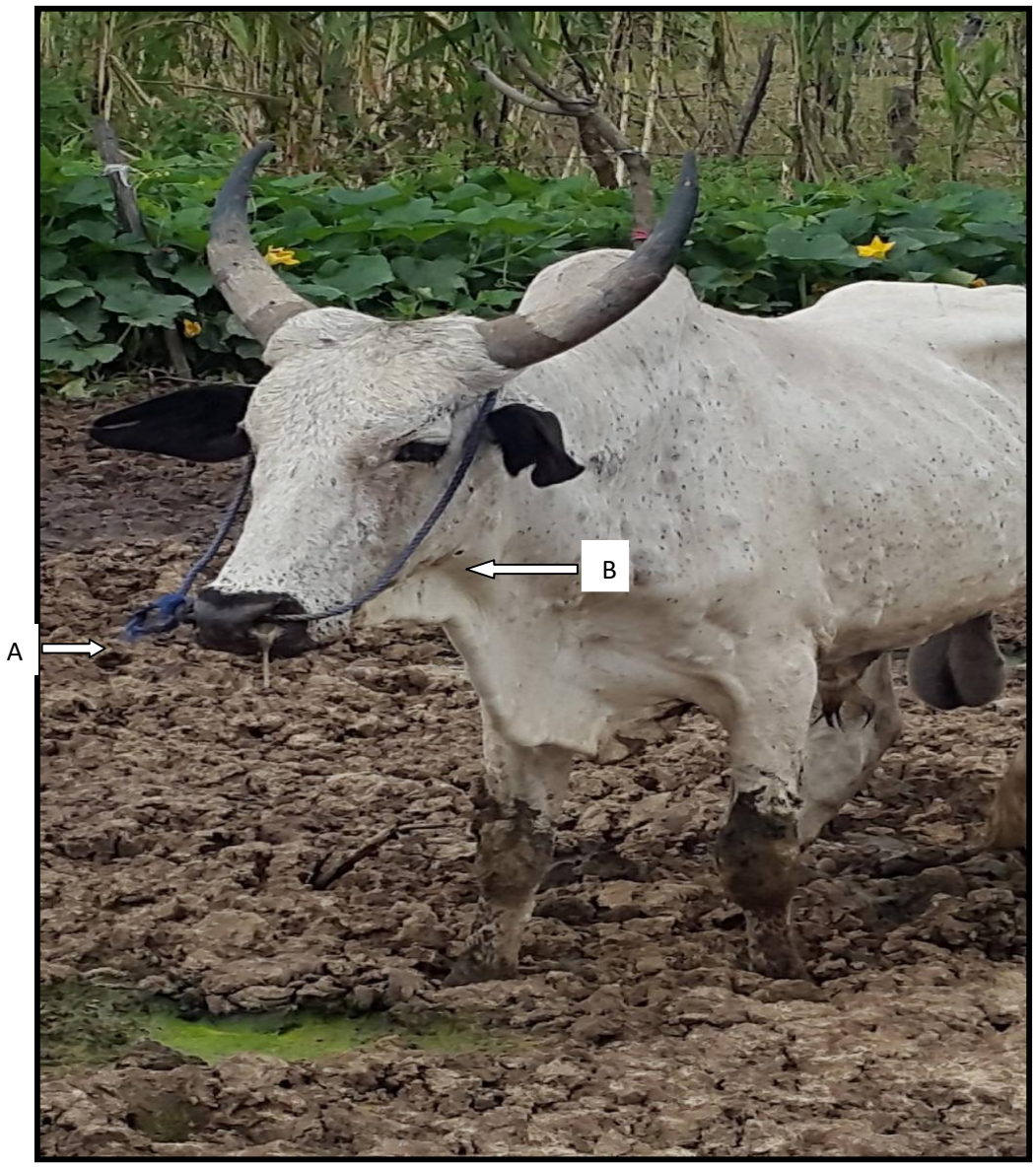


Plate I: Bunaji bull with Lumpy skin disease, A= mucopurulent nasal discharge,
B= skin noodle

DISCUSSION

Lumpy skin disease (LSD) is an economically important disease of cattle and can produce a chronic debility in infected cattle. The symptoms observed in the present case were in agreement with those reported by Radostits *et al*. (2007). Lumpy skin disease causes multiple circumscribed firm nodules on the body, including the muzzle, nostrils, head, neck, back, limbs, scrotum, perineum, udder, eyelids, nasal and oral mucosa (Ali *et al.*, 1990). Nodules can also develop in gastrointestinal tract, especially the abomasum as well as the trachea and lungs, resulting in primary and secondary pneumonia. Lameness may occur from inflammation of the tendons, and severe swelling of the brisket and legs. This lameness can be permanent with severe damage to tendons and joints from secondary bacterial infections (Kahn and Line, 2008). Permanent damage may occur to teats and mammary glands due to secondary bacterial infections and mastitis. Abortion and intrauterine infection are possible; temporary or permanent sterility in both bulls and cows may occur (CFIA, 2011). Therefore, systemic antibiotic and anti-

inflammatory drugs are obligatory for the skin lesions, pneumonia and inflammatory reactions in order to avoid further complications and economic losses (Abutarbush *et al*., 2015).

In the current case, 20% oxytetracycline was administered against bacterial and the coccidial oocyst infections (Danbirni *et al*., 2017) while dexamethasone was administered to suppress inflammatory reactions such as pain, fever and oedema as well as 10% albendazole suspension as a routine deworming against strongyles. The administration of 5% cypermethrin as a pour-on was to repel or kill biting flies and ticks from further spreading the disease from the infected bull to the other apparently healthy members of the herd. Consequently, 3 days after the treatment, there was a remarkable improvement of the bull's health such that fever, anorexia, oedema of the limbs, respiratory signs and other deviations apparently subsided. However, the skin still had some lumps. On the 5th day of the clinicians' visit to the herd, the client reported that all the clinical signs were no longer visible except for the cutaneous nodules and scars and he decided to sell the bull to a butcher for fear of spreading the disease to other members of the herd. As such, the clinicians could not take the picture of the recovery stage of the bull on the 5th day. The client was then, advised to be using pour-on on apparently healthy animals anytime he noticed biting flies or ticks in order to prevent arthropod vectors of LSD within the herd and to routinely deworm the herd as well as to report promptly any sick animal to the nearest Veterinary facility.

CONCLUSION

Lumpy skin disease is a transboundary, notifiable cattle viral disease of great economic importance characterized by distinct circumscribed firm nodular lesions affecting primarily the hide, hence reducing the quality.

A combination therapy as a management protocol aimed at preventing LSD complications and saving the life of the affected bull has been relatively successful using antibiotic and anti-inflammatory agent.

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REFERENCES

Abutarbush, SM, Ababneh, MM, Al-Zoubi, IG, Al-Sheyab, OM, Al-Zoubi, MG, Alekish, MO, *et. al.* (2015). Lumpy skin disease in Jordan: Disease Emergence, Clinical Signs, Complications and Preliminary-associated Economic Losses. *Transbound. Emerg. Dis.*, 62(5): 549 – 554.

Ahmed, A. and Dessouki, A. (2013). Abattoir-based survey and histopathological findings of lumpy skin disease in cattle at Ismailia Abattoir. *International Journal of Biochem. and Bioinform.*, 3: 372-375.

Ali, AA., Esmat, M., Attia, H., Selim, A, Abdel-Hamid, YM. (1990). Clinical and pathological studies on lumpy skin disease in Egypt. *Vet. Record*, 127(22): 549-550.

Brown, C. and Torres A., Eds. (2008). - USAHA Foreign Animal Diseases, Seventh Edition. Committee of Foreign and Emerging Diseases of the US Animal Health Association. Boca Publications Group, Inc.

Carn, VM. and Kitching RP. (1995). An investigation of possible routes of transmission of lumpy skin disease virus (Neethling). *Epidemiol Infect*. 114: 219-26.

CFIA (Canadian Food Inspection Agency) (2011). Lumpy Skin Disease - Fact Sheet. www.inspection.gc.ca/animal/terrestrial-animals/diseases/reportable/lumpy-skin diseases/factsheet/eng.

Danbirni, S., Kaltungo, B.Y., Sulaiman, M.M., Ememe, M.U., Mikail, H.G. and Saidu, SNA. (2017). The use of tetracycline in the treatment of coccidiosis in bunaji bull-calves in Zaria local Government Area of Kaduna State. *Vom J. of Vet. Sci.*, 12, 75-79. (ISSN 03 31 - 8753).

Kahn, CM. and Line S. (2008). Publications Group, Inc.editors. The Merck veterinary manual (online). Whitehouse Station, NJ: Merck and Co; 2006. Lumpy skin disease. Available at:
http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/71104.htm. Accessed 16 Jun 2008

Neamat-Allah, ANF. (2015). Immunological, haematological, biological and histopathological studies on cows naturally infected with lumpy skin disease. *Vet. World*, 8: 1131-1136.

OIE. (2004). Manual of diagnostic tests and vaccines for terrestrial animals. Paris: OIE. Lumpy skin disease. Available at: http://www.oie.int/eng/normes/mmanual/A_00030.htm.

Prozeesky, L. and Barnard, BJH. (1981). A study of the pathology of lumpy skin disease in cattle. *Onderstepoort J. Vet. Res.*, 49: 167-175.

Radostits, OM, Gay, CC, Hinchcliff, KW. and Constable, PD. (2007). Veterinary Medicine: A textbook of diseases of cattle, horses, sheep, pigs and goat. 10th ed. WB Saunders Co., Philadelphia, USA.

Salib, FA. and Osman, AH. (2011). Incidence of lumpy skin disease among Egyptian cattle in Giza Governorate, Egypt. *Vet. World*, 4: 162 – 167.

Tulman ER, Afonso CL, Lu Z, Zsak L, Sur JH, Sandybaev NT, Kerembekova UZ, Zaitsev VL, Kutish GF, Rock, DL. (2002). The Genomes of sheeppox and goatpox viruses. *J Virol.*, 76: 6054-61.

Sevik, M. and Dogan, M. (2017). Epidemiological and molecular studies on lumpy skin disease outbreak in Turkey during 2014 – 2015. *Transbound. Emerg. Dis.*, 64(4): 1268 – 279.

World Organisation for Animal Health. (2012). - Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. OIE, Paris.

Woods, JA. (1988). Lumpy skin disease – A review. *Trop. Anim. Health and Prod.*, 20(1): 11 – 17.

DETECTION OF ANTIMICROBIAL DRUG RESIDUES IN MEAT FROM BUNAJI CATTLE SLAUGHTERED IN MINNA MODERN ABATTOIR

***L.L Mande, J.Y. Adama, A. Usman**

Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology P.M.B 65, Minna, Niger State Nigeria

Corresponding authors E-mail; mandelawal46@gmail.com

ABSTRACT

Antimicrobial drug residues are of global health concern in many countries of the world, with Nigeria reporting occurrence of residue contamination of edible animal products beyond FAO and WHO permissible levels. The occurrence of antimicrobial drugs residues in meat in Minna modern abattoir was investigated during this study, 56 meat samples were collected from 56 Bunaji cattle slaughtered in the abattoir at 2weeks intervals for period of 4months (April – August 2019) . Antimicrobial inhibition test was adopted with zone of inhibition measured in millimetres (mm), samples below 1mm were considered negative. 29(51.78%) samples were tested positive with zone of inhibition at various levels of residue (12mm, 13mm, 15mm, 17mm, 19mm and 20mm), which signified high levels of residue. Samples from female's cows had the highest number 20(68.90%) and values at 20mm. Ages between 6-10 years had 17(58.62%) while the lowest residue was recorded at older animals above 10 years 5(17.24%). This result indicated that consumers in Minna metropolitan are predisposed to health hazards due to the presence of antimicrobial residue, this emphasis the need for effective prevention of infectious diseases, general enlightenment on the withdrawal periods, and establishment of antimicrobial residues monitoring unit in Minna.

Keywords – Antimicrobial residue, Meat, Microbial inhibition test, Abattoir, Minna

INTRODUCTION

Drug administration to domestic animals requires not only consideration of its effect on the animals but also the effect on humans who consume the product from such animals. Antibiotics are natural product of microorganisms or identical synthetic products or similar semi-synthetic products that inhibit the growth of or destroy microorganisms (Karbis, 2007). In animal health practice, antibiotics are widely used as therapeutic prophylactic or as growth promoting agents (Donoghue, 2003). Antibiotics are of different types, with various pharmacokinetic activities which often neglected during slaughter, and hence become potential hazard to human. The presence of antibiotics in meat and other food of animal origin is one of the most important indices for their safety to human consumers (Kozanova *et al.*,2001). Many livestock farmers administer antibiotics indiscriminately for purposes of treating or preventing an ailment or as growth promoters without cognisance of the need to consult an expert for necessary advice, such animals are often slaughtered without recourse to the withdrawal period, even if they used the same drugs as animal health personnel's. The Indiscriminate use of antibiotics in livestock has raised serious public health concern globally, especially in sub-Sahara Africa and particularly Nigeria (Shehu, 2018).

Drug residue arises when treated animals are slaughtered without recourse to pharmacokinetics of the specific drug administered, this situation usually occur with prolonged administration and over dosage of antimicrobial agent, especially if these animals are slaughtered immediately,(vinedresser, 1989)as cited by (Gabriel *et al.* 2012). Toxic level of antimicrobial residues in food animals are known to cause divers health hazards to susceptible unsuspecting human consumers. (Gabriel *et at.*,2012).

Cattle command a prominent position in our meat supply which constitute of about 45% of meat industry. Presently cattle population in Nigeria has been estimated as 15.3million (Umar, 2007).

Bumaji cattle are the most predominant and wide spread of all Nigeria cattle breed, they represents 37% of the national herd (Alphosus,Akpa, Barje and Adamu, 2012). About 800-1000 cattle, sheep and goat are slaughtered daily across Niger state (Dukku, 2018), the abattoir where these animals are largely slaughtered and processed for public consumption, contributed immensely to the economic development of states. In Nigeria as in many other countries, the veterinary structure are not strong (Fau, 2004) and are characterised by indiscriminate usage of veterinary drugs such as antibiotics, which are readily avaailable and obtainable over the counter as well as every rural cattle market, which make it easily accessible to different categories of livestock handlers including the nomadic pastoralist and the middle men. With this development it implies that correct dosage and withdrawal period are not usually adhered to, and hence meat safety quality assurance cannot be granted, Olatoye and Ogundipe, (2009).

MATERIALS AND METHOD

EXPERIMENTAL SITE

The samples were collected from Minna abattoir located along Tayi village in Minna Niger state of Nigeria. Minna the capital city of Niger state is situated on a latitude 9 3105 and longitude 7 421 north, with annual rainfall of 1,200-1,300mm and mean temperature of 38-40c the area has an altitude of 1,46m above sea level in the northern guinea savannah vegetation zone of Nigeria it is characterised by two season, the wet season (April - October and dry season November -march). NSFCO/ ADP.,(2015).

SAMPLES COLLECTION

Fifty six (56) Beef samples weighing 50g were collected from 56 slaughtered white Fulani cattle in Minna modern abattoir for a period of 4 months, (April - August 2019) at 2 weeks intervals, with emphasis to breed, age sex and time intervals, Samples were properly packed and labelled in a polyethylene and refrigerated at -20^0C

SAMPLE ANALYSIS;

MICROBIAL INHIBITION TEST

An adapted microbial inhibition test was employed to screened samples for evidence of antimicrobial drug residues as described by Huber et al, (1969). Mueller Hinton Agar (MHA) was prepared in plates according to manufacturer`s instruction. *Bacillus subtilis* ATCC 6633 was used as test organism. Plates were inoculated with the test organism by dipping sterile cotton swab sticks into the suspension of test organism until saturated. The MHA plates were then gently but thoroughly swabbed uniform to achieve a lawn of confluent growth and allowed to dry for 5 minutes. The extract from the sample were tested by dipping sterile 1.2 mm diameter *whatmann* filter paper disc into the juice extract, until saturated, excess sample were allowed to drained, then, *whatman* filter paper disc containing 30ug of oxytetracycline Hcl was used as control discs, placed at the centre of the plates with test discs at the periphery of the plate and incubated at 37 degree for 18 – 20 hrs, after which presence or absence of zone of inhibition and that of the disc was calculated. Any disc with a difference of >1mm was considered positive.

DATA ANALYSIS;

The data obtained was subjected to descriptive statistical analysis, for the variations between occurrence of drug residues between sex and Age groups, using SPSS version 16.0, (2010)

RESULTS AND DISSCUSSION

Out of the 56 meat samples from 56 cows of different sex and age that were screened for antimicrobial drug residues during this study, 29(51.78%) tested positive under zone inhibition test ranging from 13mm to 20mm, indicating presence of antimicrobial drug residue in the samples; 27(48.21%) were tested negative less than 1mm. All samples were collected from Bunaji cattle in Minna abattoir. The overall results from this study indicated a high incidence (51.78%) of antimicrobial residues in the meat consumed by the public in Minna metropolitan The

results is higher than the reported incidence of 46% residue in beef in Oyo state, (Akinwumi, 2012); 16.11% reported by (Dipeolu and Alonge 2002); 33.1% obtained in broilers (Kabir *et al*,.2004); 25% reported in milk (Yusuf *et.al*., 2017). However the result is lower than 89.3% reported from kidney and urine (Gabriel *et. at.*, 2012) and 79.74% in edible beef (Olatoye and Ogundipe, 2009). **Table 1** Shows distribution of residue on Sex of the cows that were tested positive, 9(31.02%) were males, 3 samples had highest value of 19mm while 1 sample had lowest value of 12mm, females recorded highest antimicrobial residue of 20(68.96%), 2 samples had highest zone inhibition value of 20mm while 1 had lowest of 12mm, the study recorded high incidence of residues on females (68.9%) than males (39.01%), 2 females had high zone inhibition value of 20mn. **Table 2** shows variation on Age, 7(26.3%) were between 1-5 years, 17(53.62%) were between 6-10 years and 5((17.24%) where above 10 years. At 1-5 years 2 samples had highest value of 19mm and the lowest value of 13mm, highest value of 20mm was found at 6-10years and above 10 years respectively, From the result 6-10 years shows 58% residual values than other age groups the result agreed with that reported by (Zeenatudeen, 2015) on milk.

Table 1 Distribution of antimicrobial drugs residue based on Sex of cow under zone inhibition above 1mm detectable limit

Sex	**Meat sample**	**12mm**	**13mm**	**15mm**	**17mm**	**19mm**	**20mm**	**Total**
Male	9	1	1	4	1	3	0	9(31.02%)
Female	20	1	4	4	6	3	2	20(68.96%)
Total	29	2	5	8	7	6	2	29(100%)

Table 2; Distribution of antimicrobial drugs residue based on Age of cows under zone inhibition above 1mm detectable limit

Age years	Meat sample	12mm	13mm	15mm	17mm	19mm	20mm	Total
1-5	7	Nil	Nil	3	2	2	0	7(24.13%)
6-10	17	1	4			3	1	17(58.52%)
Above 10	5	Nil	1	3	5	1	1	5(17.24%)
				2	Nil			
Total	29	1	5	8	7	6	2	29

CONCLUSION

The high percentage of meat with antimibrial residues obtained from this study indicated that, consumers in Minna metropolitan are predisposed to health hazards due to the presence of antimicrobial residue in meat in slaughtered animals from the abattoir, this emphasis the need for the enforcement of antimortem inspection, effective prevention of infectious diseases, general enlightenment on the withdrawal periods, and establishment of antimicrobial residues monitoring unit in Minna.

REFERENCES

Akinwumi, A. O., Adunsi, A. A., Ojola, A. B., Rafiu, T. A., (2012). Effect of Antibiotic Residue on the physical qualities of Beef in Oyo State Nigeria. *4th International Com. on Agriculture and Ani. Sci. DOI: 10.7763/IPCBEE. V47-15*

Alphonsus, C., Akpa, G. N., Barje, P. P., Finangwai, H. I., & Adamu, B. D. (2012). Comparative evaluation of linear udder and body conformation traits of bunaji and friesian x bunaji cows. *World Jour. of Life Sci. and Med. Res.*, 2 (4), 134 - 140. .

Dipeolu, M.A. and Alonge D.O. (2002). Residues of streptomycin antibiotic in meat sold for human consumption in some states of south-western Nigeria. *Arch. Zootec.* **51**, 477-480.

Donoghue, D.J. (2003). Antibiotic residues in poultry tissuesvand eggs: Human health concerns. *Yozrlt. Sci., 82: 618-621.*

Dukku, U., (2018). How antibiotics in livestock farming places all at risk, Daily trust Newspaper, published *December 27, 3:26 am.*

Gabreil, k. O., Ajayi, I. E & Ode, O. J.,, (2012). Assessment of antimicrobial drugs residue in beef in Abuja Federal Capital Territory, Nigeria, *Veterinaria italiana ,48(3) 283-289.*

Huber, W. G., Caslon M. B. And Lepper M. H. (1969). Pennicillin and antibiotic residues in domestic animals at slaughter. *Food microbiology, 154; 1590-1595*

Kabir, J., Umoh,V. I. Audu-Okooh, E., Umoh, I. U., and Kwaga.J.K.P, (2004). Veterinary Drug use in poultry farms and determination of antimicrobial drug residues in commercial eggs and slaughtered chicken in Kaduna State, Nigeria. *Food Control. 15:3-10*

Kirbis, A. (2007). Microbiological screening method for Detection of aminoglycosides, B- lactomas, macidider, tetracyclines and quinolones in meat samples. *Slow vet.res. 44(2): 11-48.*

Kozarova, L., Mate, D. and Cabadaj, R. (2001). Methods for the determination of sulphonamides residues in milk and animal n products In: *Proceeding of Lectures and Posters of the Imtern. Conf. Hygiena Alimentorium XXIII.*

Niger state Fadama Coordition Office (NSFCO)/Agricultural Development Project (ADP) Minna (2015). Annual report.

Olatoye, O. I & Ogundipe, G.A.T., (2009). Preliminary screening of beef consumed in Ibadan, Nigeria for antimicrobial residue. *Afr. J. bsiomed res. vol. 12, no.3*

Shehu, (2018). How antibiotics in livestock farming places all at risk, Daily trust Newspaper, published *December 27, 2018, 3:26 am.*

SPSS.(2010). Statistical Package for the Social sciences, *Version 16.0 IBM USA.*

Umar, A. S. S. (2007). Financial analysis of small scale beef fattening enterprise in bama local government area of Borno state. M.Sc. Thesis, Ahmadu Bello University, Zaria, Nigeria.

Yusuf, M. S., Kabir, J. And Babashani, M. (2017). Occurrence of Tetracycline Residue in Milk from Diary Farms in Kano state Nigeria. *Proceedings of 54th Annual Congress of the Nigerian Vet. Med. Ass. (Kano, 2017)*

Zeenatudeen M. (2015) Dissertation submitted to the postgraduate school Department of Veterinary public Health and preventive medicine, Ahmadu Bello University Zaria.

ORGAN AND CARCASS WEIGHT VARIATION IN *EIMERIA TENELLA* INFECTED BROILER CHICKENS TREATED WITH METHANOL EXTRACT OF *PARKIA BIGLOBOSA* ROOT BARK

Garba M. Ugwuoke[1*]

[1*] *Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Nigeria Nsukka, Enugu, Nigeria; matthias.ugwuoke@unn.edu.ng (*Corresponding Author)*

ABSTRACT

The experiment was designed to evaluate the effect of methanol extract of *Parkia biglobosa* root in *Emeria tenella* infected broilers. One hundred and fifty broilers grouped into 6 groups (n = 25) were used for the study as follows: infected treated with extract (A), infected treated with amprolium (B), infected untreated (C), uninfected untreated; (control) (D), uninfected treated with extract (E), and uninfected treated with amprolium (F). Each broiler was infected at 28 days of age with 20,000 infective *Eimeria tenella oocysts* and treated at day 7 post infection with either extract or Amprolium at a dose rate of 200 mg/ml in drinking water for 7 days. Carcass and Organ weights were measured at 35 days of age. The results showed significant difference in the carcass and organ weights (P>0.05) between the groups. This study proved that the root bark of *Parkia biglobosa* has no adverse effects on organs of treated broilers, instead improved carcass weight and ameliorated clinical signs of bloody diarrhea associated with *Eimeria tenella* infection in broilers.

Keywords: Broilers, Coccidiosis, Organs, *Parkia biglobosa*, Weight.

INTRODUCTION

Coccidiosis is one of the most economically important prevalent parasitic diseases which has adversely affected the growth and fortune of poultry farmers worldwide (Gharekhani et al., 2014). Coccidiosis affects virtually all domestic and wild species, causing signs such as paleness, diarrhea with or without blood, poor feed conversion, weight loss, and in severe cases even death. *Eimeria*, protozoan parasites of the Phylum Apicomplexa are considered the main risk to avian production since they are the causative agent of avian coccidiosis (Blake *et al*., 2015). Avian coccidiosis is caused by seven species of *Eimeria*, which parasitize chickens intestine. According to a recent estimate, the global cost of the protozoan to the poultry industry is estimated to be over USS 2.4 billion per annum (Ola-Fadunsin *et al*., 2017). In Nigeria, the disease is caused by *Eimeria tenella, E. necatrix, E. bruneti, E. acervulina, E. mitis* and *E. praecox* (Jatau *et al*., 2012). These species have predilection sites in the different parts of gastrointestinal tract.The management comprises of ionophorous compounds (ionophores) and synthetic drugs (chemicals). However, the increased occurrence of resistance against routine anticoccidial drugs, the toxic effects of these chemicals on poultry and the development of drug residues in poultry meat and egg (Goetting et al., 2011) have left the poultry industry with a renewed challenge for coccidiosis prevention and control. These have propelled the search for alternative strategies among which plant products provide a good alternative. Some of these plants are indigenous to Nigeria and may serve as a source of foreign revenue when exported to developed economies where people are becoming more aware of the toxic effects of using chemotherapeutic agents in producing animal protein. *Parkia biglobosa* is one of such plant alternatives. The stem bark of *P. biglobosa* has been reported to have some coccidiostatic activities (Maikai *et al*., 2007) and antimalarial effects (Traore *et al*., 2013). The stem bark is used for treating hypertension (Karou *et al*,, 2011) and listed as having wound healing properties in South-Western Nigeria (Adetutu *et al.*, 2013). A decoction of the root is used in the treatment of coccidiosis by natives in western Nigeria (Olanipekun, 2014). There is no data on the anticoccidial activity of the root bark extract of *P. biglobosa* in broiler chickens. In this study, the anticoccidial activity and the effect of methanol extract of *P. biglobosa* root bark was evaluated in broiler chickens experimentally infected with *Eimeria tenella* oocysts.

RESULT

Carcass yield and organ weight

Data on body weight, carcass weight/dressed and parts of the broilers are shown in Table1. It is observed that among the infected groups, the body weight was higher in the *P. biglobosa* treated group A (3.2 kg/broiler) and the amprolium treated group B (3.2 kg/broiler). The infected but untreated group C had the least body weight (2.7 kg/broiler). In the uninfected broilers, group E (*P. biglobosa* treated) recorded a higher body weight (3.4 kg/broiler), followed by the amprolium treated group F (3.3 kg/broiler) and lowest the untreated group D (3.1 kg/broiler). In the results, it was also observed that among the infected groups the carcass yield was higher in group A (2.8 kg/broiler), followed by B (2.6 kg/broiler) and lowest C (2.4 kg/broiler) (Table1). Among the uninfected groups, D (untreated) recorded 2.5 kg/broiler, E (P. biglobosa treated) and F (amprolium treated) recorded 2.6 and 2.8 kg/broiler, respectively.

DISCUSSION

The slight difference observed by the decrease in weight of the carcass parts (thigh, back and neck, wings) in group C and D (Table 1) may be due to the lack of treatment of the broilers with either the *P. biglobosa* or amprolium. Also significant weight difference ($P < 0.05$) existed in group B among the weight of the organs, where the liver (1.8%), heart (0.6%) and the spleen (0.2%) weighed more than those in the other groups as shown in Table 1. The variation in weight of the organs in group B may be due to a compensatory mechanism in relation to treatment with amprolium and the coccidian infection. *Eimeria tenella* is a very pathogenic chicken coccidia that parasitize caecum of young chickens and is characterized by acute onset manifested by clinical signs of bloody diarrhea due to invasion of the mucosal lining of the caecae by the second generation merozoites and the associated microscopic changes due to coccidiosis which include congestion of the mucosa of the intestine, diffuse or patchy haemorrhagic enteritis, lymphocytic and mononuclear cells infiltration of the intestinal mucosa and sloughing of epithelial lining (McDougald and Reid,1997). Also, it is a known fact that the weight of organs in broilers is indicative of the response of birds to the feed intake in relation to their age or growth of broilers. The weight of organs in broilers also reflects the anatomical response of broilers to the type of diets consumed, such as the use of whole grains in feed or large high fibre particles (Atteh, 2004).

CONCLUSION

In conclusion, this study has shown that the methanol extract of *Parkia biglobosa* root bark may have improved the carcass yield of broilers and also ameliorates clinical signs of bloody diarrhea consistent with *Eimeria tenella* infections in broiler chickens. The root bark of *P. biglobosa* has no harmful or adverse effect on the organs of treated broilers with or without *Eimeria tenella* infection. It is recommended that further research on the potential use of the root bark of *P. biglobosa* for the control of coccidiosis in broiler chickens be carried out. *P. biglobosa* root bark may be recommended to poultry farmers in the absence of conventional anticoccidial drugs.

References

Adetutu A, Morgan W, Corcoran O (2013). Ethnopharmacological survey and in vitro evaluation of wound-healing plants used in South-western Nigeria. *Journal of Ethnopharmacol* 137 (1): 50 - 56.

Atteh J.O (2004). Critical review of the activities of feed enzymes in Nigeria. *Bio-ingredients (Nig.) Ltd Seminar* held on 21st May, 2004 at Airport Hotel, Ikeja, Lagos State.

Blake D.P, Clark E.L, Macdonald S.E, Thenmozhi V, Kundu K, Garg R …Fiona M (2015). Population, genetic, and antigenic diversity of the apicomplexan *Eimeria tenella* and their relevance to vaccine development. *Proceedings of the National Academy of Sciences of the United States of America* 112 (38): 5343 – 5350.

Gharekhani J, Sadeghi-Dehkordi Z, Bahrami M (2014). Prevalence of coccidiosis in broiler chicken farms in western Iran. *Journal of Veterinary Medicine*, 1-4.

Goetting V, Lee K.A.,Tell L.A (2011). Pharmacokinetics of veterinary drugs in laying hens and residues in eggs: a review of the literature. *Journal of vet. Pharmacol. Therapeutics*.34, 521–556..

Jatau I.D, Sulaiman N.H, Musa I.W, Lawal A.I, Okubanjo O.O, Isah I, … Magaji Y (2012). Prevalence of Coccidia Infection and Preponderance *Eimeria* Species in Free Range Indigenous and Intensively Managed Exotic Chickens during Hot-wet Season, in Zaria, Nigeria. *Asian Journal of Poultry Science* 6: 79 - 88.

Karou S.D, Tchacondo T, Tchibozo M.D, Abdoul-Rahaman S, Anani K, Koudouvo Komlam B, …. Comlam D (2011). Ethnobotanical study of medicinal plants used in the management of diabetes mellitus and hypertension in the Central Region of Togo. *Pharmacological Biology* 49 (12): 1286 – 1297

Maikai, Victor, Adeiza, Abubakar, Maikai B.V (2007). Preliminary Studies of Anticoccidial Effect of Mahogany (Khaya senegalensis) and African Locust Beans Tree (Parkia biglobosa) Aqueous Bark Extracts on Chicken Infected with Coccidia. *Savannah Journal of Agriculture* 2: 43 – 51.

McDougald L.R, Reid W.M (1997). Coccidiosis in Chickens. In: Diseases of Poultry, Calnek, BW, HJ Barnes L.R McDougald, Saif Y.M (Eds.). Iowa State University Press, Ames, Iowa, USA. 865 - 878.

Ola-Fadunsin S.D, Ademola I.O (2013). Direct effects of *Moringa oleifera* Lam (*Moringaceae)* acetone leaf extract on broiler chickens naturally infected with Eimeria species. *Tropical Animal Health and Production* 45 (6): 1423–1428.

Olanipekun M.K (2014). Survey And Chemical Composition Of Plants Used As Herbal Remedies In Managing Poultry Animal Diseases In Ekiti State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science* **7** (11): 10 - 16.

Traoré M, Baldé M, Oularé K, Magassouba F, Diakité I, Diallo A,…. Balde A.M (2013). Ethnobotanical survey on medicinal plants used by Guinean traditional healers in the treatment of malaria.. *Journal Ethnopharmacology* 150 (13) 1145 – 1153.

CAMEL (*Camelus dromedarius*) DISEASES PREVALENCE AND ETHNO–VETERINARY MEDICINE (EVM) USE APPROACHES BY CAMEL KEEPERS IN NORTHERN JIGAWA STATE, NIGERIA

[*]Ghude, M. I., [ж]Muhammad, B., [∞]Alkali, H. A. and [β]Maigandi, S. A.
[*]Veterinary Section, Agric Dept. Nassarawa LGA, Kano State – Nigeria
[ж]Veterinary Section, Agric Dept., Kazaure LGA, Jigawa State – Nigeria
[∞]Department of Animal Science, Federal University, Kashere, Gombe State – Nigeria
[β]Department of Animal Science, Usmanu Danfodiyo University, Sokoto State – Nigeria
**Corresponding author: elghudemusa@yahoo.com +234 803 615 9450*

ABSTRACT
This study was designed to investigate the Ethno–Veterinary Medicine (EVM) use approaches of camel keepers at Kazaure Local Government Area of Jigawa State, Northwest Nigeria. Thirty (30) structured questionnaires were administered to purposively selected camel keepers and data generated were subjected to descriptive statistics. Majority (43.00%) of the respondents had over 50 years of experience in keeping camel, while the most common herd size (70.00%) was between 5–10 camels. *Dermatophilosis* (37.00%) was most prevalent disease condition while with common diseases while observable signs of diseases (70.00%) were scratching of the body. The disease was also more prevalence in the rainy season (46.67%). EVM (60.00%) remain the major animal healthcare approach adopted by the camel keepers while route of drugs administration (26.00%) were topical application. Since EVM remains a widely accepted animal healthcare option among the camel keepers at the study location, further studies should be carried out to elucidate the actual practice of the camel keepers.
Key words: Camels, *dermatophilosis*, diseases, ethno–veterinary medicine

INTRODUCTION
Camels are very tough, energetic and healthy animals, but, like other animals, they still required care and maintenance (Scott, 2009). Inspite of this, there are still some infections that affects the camels both externally and internally (Kent, 2001). Animal health, production and management in the tropics are facing a serious set–back as a result of inadequate facilities and inputs to keep the system of production at sustainable level. In most of the tropical countries, camel (*Camelus dromedarius*) owners do not patronize available conventional veterinary services due to the believe that camels are hardy and resist disease conditions to some extent (FAO, 2001). EVM practices are however common among the pastoralists across the world and have been found to be effective despite recent difficulties (Kent, 2001). Camel keepers also exploit EVM approaches sto treat their animals suffering from various degrees of infection across different seasons of the year (Scott, 2009). In this context, there is need to elucidate information on the current EVM approaches and practices at specific location in Nigeria, since such information could add to what is known, and could also be useful in policy formation on the subject matter.
The objective of this study therefore to determine of EVM use approaches by camel keepers in Jigawa State, Northwest, Nigeria.

MATERIALS AND METHOD
The study was conducted at Kazaure Local Government Area of Jigawa State. The State covers an estimated land area of 22,410 square kilometers and shares boundary with the Niger Republic to the North, Katsina, Kano and Yobe States to the west, south and east respectively. The
population of the State was 4,348,649 during the 2006 national head count (NPC, 2006). Jigawa State is located in the Sudan savannah vegetation belt that is characterized by hot and dry climatic conditions. The hottest temperature ranges from 20.6^0C to 32^0C while the annual rainfall is 687mmHg (JARDA, 2006). The livestock types kept in the area include: cattle, camel, sheep, goat and poultry. Camels are particularly are particularly kept in the area as tough and hardyfor burden bearing, meat and milk.

Data collection

The study lasted for three (3) weeks. Thirty (30) structured questionnaires were administered to purposively administered to camel keepers at Kazaure Local Government Area of Jigawa State, Nigeria to capture their biodata, camel production experiences, diseases prevalence and treatment approaches.

Data analysis

The data collected were summarized and analyzed using simple descriptive statistics (Frequencies and Percentages).

RESULT AND DISCUSSION

Biodata of the respondents

Biodata of the respondents were presented in Table 1. Majority (33.33%) of the respondents fell within the age range of 41–60 and >60 years. This is in agreement with Ghude *et al.*, (2012) who reported that camel production in Northern Nigeria not a practiced by younger generations. All the camel keepers were males while most (83.00%) were engaged in both into crop and camel production and only 10.00% engaged into camel keeping only. Also, 83.00% of the camel keepers in the study area attended Islamic schools while only 17.00% obtained primary school leaving certificate.

TABLE 1: Personal data

Parameters	Frequency	Percentage
Age		
0 – 20	3	10.00
21 – 40	7	23.34
41 – 60	10	33.33
> 60	10	33.33
Total	**30**	**100**
Occupation		
Full time camel rearer	3	10.00
Crop farmer/camel rearer	25	83.00
Trading/farmer/camel rearer	2	7.00
Trading/camel rearer	-	-
Civil servant/camel rearer	-	-
Total	**30**	**100**
Level of education		
Qur'anic	25	83.00
Primary	5	17.00
Secondary	-	-
Tertiary	-	-
Total	**30**	**100**

Source: Field survey, 2016

Experience in camel production

Table 2 showed that 43.00% of the respondents had over 50 years experience in camel keeping followed by 41–50 years as identified by 33.00%. Most of them were engaged in pastoral practice from childhood. Although they may not own their herds at younger age but they participate fully in all the activities as earlier reported by Wilson, (1998). Herd size is small in the study area with 70.00% of keepers possessing between 5–10 camels and only

17.00% owned more than 30 camels respectively. Camel herd size in the Tropics and some Asian countries is small due to the practice of subsistence agriculture (Wilson, 1998).

TABLE 2: Experience in camel production

Parameters	Frequency	Percentage
Years of experience		
0 – 10	-	-
11 – 20	2	7.00
21 – 30	5	17.00
31 – 40	-	-
41 – 50	10	33.00
> 50	13	43.00
Total	**30**	**100**
Herd size		
5 – 10	14	70.00
11 – 15	3	10.00
16 – 20	1	3.00
21 – 30	-	-
> 30	6	-
No response	5	17.00
Total	**30**	**100**

Source: Field survey, 2016

Diseases experience and Season of the disease infection

In Table 3, the camel keeping experience in identifying various diseases and infections were presented. A skin infection (*Dermatophilosis*) was more prevalence in camels as identified by 37.00% of the respondents followed by 33.00% that identified ecto–parasites. The observable signs included scratching of the body (70.00%) and loss of appetite (13.00%). According to Kent, (2001), tick infestation is the major camel health problem that causes substantial economic losses, particularly in tropical and subtropical countries where approximately 80% of the world's dromedary camel population is raised. Higher prevalence of infection was observed during early rainy season (46.67%) and late dry season (23.33%). An improved veterinary treatment protocol that includes improved hygiene and general supportive treatment decreases the significance of such skin disease in camels and enhances response of animals to the utility activities (Scott, 2009).

TABLE 3: Diseases experience and season of the disease infection

Parameters	Frequency	Percentage
Types of diseases affecting camels in your area		
Endo – parasites	3	10.00
Ecto – parasites	10	33.00
Dermatitis	11	37.00
Physical injury	4	13.00
Eye problem	2	7.00
Total	**30**	**100**
Observable Signs of diseases		
Emaciation	3	10.00

Loss of appetite	4	13.00
Scratch of the body	21	70.00
Discharge from the nose	-	-
Coughing/sneezing	-	-
Discharge from the eye	2	7.00
Total	**30**	**100**
Season of disease infection in your herd		
Early rainy season	14	46.67
Late rainy season	3	10.00
Early dry season	-	-
Late dry season	7	23.33
No response	6	20.00
Total	**30**	**100**

Source: Field survey, 2016

Treatment applied (method of application) and types of drugs used

Table 4 shows the treatment/methods and types of drugs used by camel keepers in treating *dermatophilosis*. Sprinkling, spray and dusting methods was largely practiced as indicated by 43.00% of the respondents followed by 26% who used application (rubbing) method. This is in agreement with the report of FAO, (2008) that the application method and administration of ethno veterinary drugs (EVDs) is through the use of traditional methods are usually done through the use of traditional methods. EVDs were adopted and in use as indicated by 60.00% of the camel keepers, while 26.67% seemed to avoid any use of medication. This is in agreement with the report of Kent, (2001) that tropical and in some Asian countries extensively exploits EVDs in the treatment of camel diseases.

TABLE 4: Treatment/method applied and types of drugs used

Parameters	Frequency	Percentage
Method of administering the treatment		
Oral	5	17.00
Application (Rubbing)	8	26.00
Injection	2	7.00
Intra ocular	2	7.00
Sprinkling/Spray/dusting	13	43.00
Dipping	-	-
Total	**30**	**100**
Types of drugs in use		
Veterinary drugs	4	13.33
Ethno – veterinary drugs	18	60.00
No response	8	26.67
Total	**30**	**100**

Source: Field survey, 2016

CONCLUSION AND RECOMMENDATION

Most of the camel keepers at Kazaure Local Government Area of Jigawa State employ EVM in the healthcare of their animals. Since EVM remains a widely accepted animal healthcare option among camel keepers at the study locations, further studies should be carried out to elucidate the actual EVM practice of the camel keepers.

REFERENCES

FAO, (2001). Statistical record book. Food and Agriculture Organization. Rome, Italy. Retrieved from http://www.fao.org/ag/againfo/themes/en/dairy/camel.html. on 7 July, 2014.

Ghude, M. I., Bitto, I. I. and Maigandi, S. A. (2012). Prevalence of one humped camel (*Camelus dromedarius*) diseases in Zamfara State, Nigeria. In: Akpa, G. N., Dairo, F.A.S., Bawa, G. S., Solomon, I. P., Amaefuele, K. U., Odunsi, A. A. and Ladokun, A. O. (eds). Proceedings of the 17th Annual Conference of Animal Science Association of Nigeria held in Abuja, 9th–13th Sept. 2012. Pp 160–162.

JARDA (2006). Jigawa State Agricultural and Rural Development Authority, Media and Publicity Department, Dutse, Nigeria.

Kent, M. (2001). Camels diseases and preferred treatment: A traditional approach. *Int. J. Vet. Med. 41: 201–208.*

NPC, (2006). Year 2006 National head count official result. National Population Commission., HQs, Abuja, Nigeria.

Scott, B. (2009). An investigation on camel health kept under pastoral production system. *J. Anim. Sci. Res. 23: 43–49*.

Wilson, R. T. (1998). The Camels (*Camelus dromedarius*). Macmillan Education Ltd., London.

GUT BALANCE BOOSTER™ AS A PROSPECTIVE ALTERNATIVE TO ANTIBIOTICS IN SWINE DIET.

[1]Abonyi F.O*, [1]Ugwu P.C, & [1]Amechi C.D

[1]Department of Animal Health and Production, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria.
**Email: festus.abonyi@unn.edu.ng; Telephone: +2348035078356*

Paper for oral presentation under the monogastric nutrition sub-theme

ABSTRACT

This study accessed the effects of dietary inclusion of Gut Balance Booster™ (GBB) on performance of weanling pigs. Twenty four six week old weaned pigs of mixed sexes were randomly assigned into two groups of 12 piglets each. They were fed diet A (normal starter diet without GBB) and diet B (starter diet with GBB at 200g/kg). Feed intake, weight gain, feed conversion ratio (FCR), haematology, serum lipid profile, faecal egg count, shedding of selected bacteria and cost-benefit of the additive were determined. Results showed that there was no significant difference ($p \leq 0.05$) in daily feed intake, FCR and weight gain. However, the values favoured the supplemented group (1.16±0.10 vs.1.06±0.13kg; 2.61±0.34 vs. 3.04±0.23; 485.29±59.12 vs. 355.00±40.30g). Haemoglobin, PCV, RBC and WBC and Lymphocyte counts were higher in group B. Lipid profile showed no significant difference ($p \leq 0.05$) in the two groups. The GBB reduced faecal strongyle eggs output, *salmonella species* and increased *Bacillus subtilis* and *Escherichia coli*. Net gain due to GBB supplementation within the experimental period was ₦221,508 ($613.60). It was concluded that in pigs, dietary inclusion of GBB at starter phase improves gut health, growth performance and is cost beneficial.

Keywords: Swine, antibiotics, feed additives, growth performance, cost benefits.

INTRODUCTION

Antibiotics are used in animal feed to maintain and improve animal performance and prevent /control enteric pathogens (FAO, 2016). However, consumption of the animal products can result in bacterial resistance in human pathogens and this led to its ban in 2006 by the European Union. Following this ban, researches focused of developing alternative to antibiotic feed additives to enhance livestock performance (Thacker, 2013). Organic acids, enzymes, probiotics, prebiotics, antimicrobial peptide and phytogenic compounds have widely been recognized as potential alternatives (Yang *et al.*, 2015). Strong odour, poorly understood mode of action, complex chemical composition, unpredictable effects of individual compounds, low availability and stability in gastro-intestinal tract limit the use of feed additives singly, particularly the phytogenics (Stevanović, 2018). Gut Balance Booster™ (GBB) contains Zinc, Benzoic acid, Calcium, Sodium butyrate and essential Oils. According to the manufacturer, in broilers, where it is recommended to be used within the first 35 days of life, it supports gut health by stimulating the growth of gut microvilli, and excretion of enzymes that improves nutrient absorption. The objective of this study was to assess if dietary inclusion of GBB™ could serve as an alternative to antibiotics growth promoter in swine diet.

MATERIALS AND METHODS

Experimental animals, husbandry and diet

Experimental animals comprised 24 weanling pigs of mixed sexes, progeny of three sows and one boar and aged six weeks. They weight ranged between 8.50 to 10.00kg. They were acclimatized for two weeks during which they were identified and given some prophylactic treatment. The experimental diet was formulated using following NRC (1998) nutritional requirements for swine.

Animal care:

Animal studies were carried out following the guideline of the ethical procedure of the Animal Use and Care Committee of the Faculty of Veterinary Medicine, University of Nigeria (FVM-UNN-IACUC-2019-056).

Experimental design:

Following the acclimatization period, the 24 animals were randomly divided into two groups A and B with 12 piglets in each. They were fed diet A (normal starter diet without GBB) and diet B (starter diet with GBB at 200g/kg).

Daily feed was determined as the difference between amount of feed fed and the amount left over in 24 hours while the feed conversion ratio (FCR) was determined by dividing feed intake by weight gained within the same period.

Packed cell volume pigs was determined by microhaematocrit method (Coles, 1986), Haemoglobin concentration was determined by the cyanomethemoglobin method (Jain, 1986) using SP6-500UV spectrophotometer (PYE UNICAM, England). Red blood cell and total WBC counts were enumerated using the Leishman stained blood smear and the different cells of the leucocytes series counted by the longitudinal counting method. The total and differential leukocyte counts, and red blood cell counts were carried out using an improved Neubaeur haemocytometer method (Coles, 1986). The lipid profile which include LDL, H DL, VLDL, Triglycerides and Cholesterol were determined using Biosystemtest kits (Biosystem, S.A Costa Brava 30 Barcelona, Spain).

The feacal egg count was done using faecal floatation technique. Where large egg numbers were involved, McMaster technique was employed for quantitative analysis. Microbial populations were determined by serial dilution (10^{-1} to 10^{-10}) in anaerobic diluent before inoculation onto petri dishes of sterile agar and enumerated as previously described (Singleton, 2004). Cost-benefit analysis (CBA) was carried out using cost benefit ratio (BCR); a basic financial tool.

Statistical

Statistical analyses were done using the SPSS program (SPSS Inc., Chicago, IL). Data from the study was analyzed with Independent t-test between the groups. Level of significance was taken as $p \leq 0.05$.

Results

There was no significant difference ($p \leq 0.05$) in the performance output of the weanling pigs fed with Gut Balance Booster™ supplemented diet when compared to the control group. However, the values from feed intake, weight gain, FCR, and final body weight were higher in the test group. There was no significant difference ($p \geq 0.05$) in the haematological profile of the pigs. However, the values obtained in HB, PCV, RBC and WBC count, and Lymphocyte counts were also higher in group B. Triglycerides, LDL and VLDL were higher in the test group than group A. The GBB reduced faecal strongyle eggs output (106.00 - 0.00epg), *salmonella species* (4.9×10^4 - 2.9×10^4cfu/ml) and increased *Bacillus subtilis* (1.4×10^4 - 2.8×10^4 cfu/ml) and *Escherichia coli* (2.7×10^4 - 3.1×10^4cfu/ml). Net revenue due to GBB supplementation within the experimental period was ₦221,508 ($613.60).

DISCUSSION

This study revealed that growth performance of the supplemented group was better compared to the control group. This is in line with the observation of Bühler (2009) that showed that dietary benzoic acid had an influence on fattening duration, though comparative analysis did not result in statistical significance. Optimal performance is only possible when enough nutrients are absorbed. The antimicrobial effect of organic acids can reduce the microbial population in the gut and thus competition for nutrients (Richards *et al*., 2005). The growth performance in this experiment is also in line with Han and Thacker (2010) who demonstrated more rapid growth for pigs fed with Zinc oxide supplemented diet. This data supports previous studies which demonstrated that pharmacological doses of zinc oxide stimulate performance in weanling pigs (Hill *et al.*, 2000). Similarly, the study revealed that growth performance of the supplemented group was better compared to control group This is in line with the observations of other researchers that have shown the beneficial health effects of combining probiotic and Sodium

butyrate to have positive effects on livestock production parameters such as weight gain, feed intake, and FCR (Abonyi 2018). Dietary content can affect the blood profile of healthy animals. The determination of haematological indices in this study was to determine any possible negative effects of the additive including leucograme abnormalities. This was in line with the report of Isaac *et al*. (2013) that hematological components which consist of RBCs, WBCs or leucocytes, platelets, haemoglobin and are valuable in monitoring food toxicity as well as the health status of farm animals. Values for haematological profile studied were within normal range for pigs. In like manner, probiotics were reported to have no adverse significant effect on the erythrocytes, PCV, haemoglobin concentration, MCV, MCH and leucocytes of rabbit (Ezema and Eze, 2010).
The lipid profile showed a reduction in values of cholesterol and triglycerides in the treatment group compared to the control. The work is in line with Favier *et al.* (1995), who reported reduced cholesterol levels in experimental guinea pigs.

According to Ooi and Liong (2010), feed additives such as probiotic and/or prebiotics have been widely assessed for their effects on lipid profiles of livestock such as total cholesterol, LDL, HDL and triglycerides. However, not all trials have yielded conclusive results as was observed in this trial.

In this study, GBB recorded some anthelmintic effect. To the best of our knowledge no other study has shown that this additive or its components reduce helminth burden in pigs.

This is a pioneer work done with GBB on weanling pigs and hence, is the first time the use of the additive has been put under cost benefit analysis. The result obtained however showed a significant increase in the profit margin, giving a net gain due to its dietary inclusion in pig starter diet to be ₦221,508 ($613.60).

CONCLUSION.
Diet B stimulated more positive influence on the production parameters we investigated by improving their gut health through reducing harmful and increasing beneficial bacterial load and anthelmintic effect. This suggests that GBB could be an alternative to antibiotic growth promoter in weanling pigs. More studies are recommended to elucidate GBB's appropriate inclusion level and potentials in reducing worm burden in pigs.

REFERENCES

Abonyi, F. O. (2018). Comparative Evaluation of Growth Performance, Gut Morphology, Microflora, Haematology and Immune Response of Broilers Fed Sodium Butyrate and Saccharomyces Cerevisiae Supplemented Diets. Project Dissertation, College of Veterinary Surgeons Nigeria.

Bühler, K. (2009). Benzoic acid as feed additive in pig nutrition: Effects of diet composition on performance, digestion and ecological aspects. A dissertation submitted to ETH ZURICH.

Coles, E.H. (1986). Veterinary Clinical Pathology. Saunders W. B. Co. Philadelphia 4th Edition Pp 145-151.

Ezema, C. and Eze, D.C. (2010).Determination of the effect of the probiotics (*Saccharomyces cerevisiae*) on growth performance and haematological parameters of rabbits. Comparative clinical pathology. 21 (1): 73-76.

FAO (2016).Probiotics in animal nutrition - Production, impact and regulation. FAO Animal Production and Health Paper No. 179.

Favier, M-L., Moundras, C., Demigné, C., and Rémésy, C. (1995). Fermentable carbohydrates exert a more potent cholesterol-lowering effect than cholestyramine. *Biochim.Biophys.Acta*1995,1258, 115-121.

Jain, N. C. (1986). Schalm's Veterinary Haematology, 4th edn. Lea and Febigir Company, Philadelphia.

Han, Y.K., and Thacker P.A. (2010).Effect of antibiotics, zinc oxide and rare earth mineral yeast on performance, nutrient digestibility and blood parameters in weaned pigs. Asian-Aust J Anim Sci. 2010,23: 1057-1065.

Hill, G.M., Cromwell, G.L., Crenshaw, T.D., Dove, C.R., Ewan, R.C., Knabe, D.A., Lewis, A.J., Libal, G.W., Mahan, D.C., Shurson, D.C., Southern, L.L., and Veum, T.L. (2000). Growth promotion effects and plasma changes from feeding high dietary concentrations of zinc and copper to weanling pigs (regional study). J. Anim. Sci. 78:1010-1016.

Isaac, L.J., Abah, G., Alepan, B. and Ekaette, I.U. (2013). Haematological proportions of different basis and sexes of rabbits, Proc. of the 18th Annual conf. of Anim. Sci. Assoc. of Nig., Pp: 24-27

NRC (1998).Nutrient requirements of swine 10th edition, National Academy of Sciences, National Academy Press, Washington D.C.

Ooi, L.G., and Liong, M.T. (2010). Cholesterol-lowering effects of probiotics and prebiotics: a review of in vivo and in vitro findings. International Journal or Molecular Sciences 2010, 11, 2499-2522.

Richards, J.D., Gong, J., and de Lange C.F.M. (2005). The gastrointestinal microbiota and its role in monogastric nutrition and health with an emphasis on pigs: Current understanding, possible modulations, and new technologies for ecological studies. Canadian Journal of Animal Science. 85:421-435.

Singleton P. (2004).Bacteria in biology, biotechnology and medicine. Biotechnology and Medicine. Singleton P. Southgate (Ed), 6th edition. Wiley and Sons Limited, Chichester, West Sussex, England. 42-43.

Thacker, P.A. (2013). Alternatives to antibiotics as grpwth promoters for use in swine production:a review. Journal of Animal Science and Biotechnology 4:35.

Yang, C., Chowdhury, M.A.K., Hou, Y., and Gong, J. (2015). Phytogenic compounds as alternatives to in-feed antibiotics: Potentials and challenges in application. Pathogens 2015, 4, 137-156.

OCCURRENCE OF GASTROINTESTINAL PARASITES OF DONKEYS IN THREE LOCAL GOVERNMENT AREAS OF BAUCHI STATE, NIGERIA

Shu'aibu I., Sanusi M., Mancha Y. P., Mai H.M., Adamu S.
Department of Animal Production, Faculty of Agriculture and Agricultural Technology,
Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, 740005 Nigeria
Corresponding author e-mail: drmsanusi@gmail.com

ABSTRACT
A total of 1331 faecal samples were collected to determine the prevalence of gastrointestinal parasites of donkeys in Darazo, Ganjuwa and Ningi Local Government Areas of Bauchi State, Nigeria. Season, Body Condition Score (BCS), and other parameters were considered. Samples were analyzed using standard coprological methods. The overall prevalence of 52.7% and five species of parasites were identified including: Strongyles (34.3%), *Gastrodiscus spp* (2.4%), *Strongyloides* (19.6%). *Trichonema spp (42.3%), Tricodontophorus* (1.3%). Body Condition Score, age and season have significant influence on the parasitic burden ($p<0.05$). Donkeys in the localities should be strategically treated against parasitic infection to enhance their condition and welfare.

INTRODUCTION
In remote rural areas of Northeastern (NE) Nigeria where modern transportation is infrequently available, the contribution of donkeys in agriculture is imperative. Donkeys suffer a number of health and other welfare difficulties especially in the rural areas. Gastrointestinal helminths are among the most serious health problems of donkeys in Africa. High prevalence of internal parasites of donkeys has been reported from African countries (Pandey *et al.*, 1994, Abdullahi *et al.*, 2010, Umar, 2013,). Despite these comprehensive reports, little information is available from this part of the country and hence one of the aims of this study.

MATERIALS and METHODS
The study was conducted in Darazo, Ningi, and Ganjuwa Local Government Areas (LGAs) of Bauchi Sate northeastern Nigeria. The state occupies an area of 49,119 Km^2 representing about 5.3% of the Nigeria's total land mass. There are two climatic seasons: rainy (May – September) and dry (October – April) in the state (Maleka, 2006). Three major livestock markets; one in each of the LGA were visited twice each season. The study animals comprised of 1331 (605 – males, 726 – females) donkeys of five different ages. Animals were randomly selected at the markets and grouped according to some measurable parameters (age, BCS) estimated using standard methods (Coombs, 2002, Pearson and Quassat, 1996). Faecal samples were collected from the rectum and transferred into labeled polythene bags and transported to the laboratory in a cooler containing ice blocks. The collected samples were analyzed using direct faecal smear, and floatation techniques at the National Veterinary Research Institute (NVRI) Parasitology Laboratory, Bauchi. Eggs were further examined microscopically. The modified McMaster and Bearman techniques were used to count the helminth eggs (epg) (Urquhart *et al.* 1996). Data was analyzed using descriptive statistics, Chi-square test and one-way ANOVA. Microsoft Excel (XP 2007) and SPSS 17.0 (2007) were used for the analysis.

RESULTS
The study showed an overall prevalence of 52.7%. Prevalence among the LGAs was similar in Darazo (54.4%) and Ganjuwa (59.5%) but significantly ($P<0.05$) different in Ningi (44.2%). The prevalence was also significantly ($P< 0.001$) higher in rainy (84.4%) than dry (23.2%) season and between young (55.3%) and old donkeys (44.8%). These findings were however; lower than the previous studies of other researchers in the neighboring states. In 2010 Abdullahi *et al.* reported a prevalence of 86.32% and in 2013, 67.88% was recorded by Ibrahim. The variation could be due to differences in year, mode and locations of studies. The study conducted by Ibrahim (2013) in Yemaltu Deba L.G.A of Gombe State was in rainy season and involved working donkeys only, while the present study considered the two seasons but did not classify the donkeys into working or trade. Prevalence rates were similar between males (51.7%) and female donkeys (53.6%). This might be due to the absence of gestation and lactation in the female donkeys. In general, it was speculated that sex is a factor that influences the prevalence

of gastrointestinal and other parasites of mammals (Pal and Qayyum, 1992). However, there was significant (P<0.001) differences across different categories of BCS with only 3.9% recorded in category V (obese) and as high as 95.7% in the BCS – I (thin) donkeys. The reason might be associated with the fact that animals with poor BCS have weak immunity and as a result they could not resist the parasitic burden when compared with animals of good BCS (Sapkota, 2009). Five different types of parasites were identified in the study which were almost present in all the three LGAs: *Trichonema spp (42.3%),* were highest followed by Strongyles (34.3%), *Strongyloides* (19.6%) *Gastrodiscus spp* (2.4%), *Tricodontophorus* (1.3%) (Tab. 1). Mixed infestation was observed in 47.9% of the donkeys. This was in line with the previous reports in the Nigeria and other countries (Jajere *et al*., 2016).

Table 1: Occurrence and species distribution of gastrointestinal parasites of donkeys in 3 Local Governments Areas (LGAs) of Bauchi Sate, NE Nigeria

LGA	**N**	**No. positive**	**(%)**
Ganjuwa	445	265	59.5
Darazo	445	242	54.4
Ningi	441	195	44.2
Total	**1331**	**702**	**52.7**
Species			
Strongyles		241	34.3
Strongyloides		138	19.6
Trichonema spp		297	42.3
Gastrodiscus spp		17	2.4
Tricodontophorus spp		9	1.3
Total		**702**	**100**

CONCLUSION

Donkeys will continue to play crucial roles in the livelihood of Nigerian farmers particularly in the rural areas. Parasitism, and other ill-health identified in this study, will remain a persistent treat to the health and welfare of these animals. Donkeys in the localities should be strategically treated against parasitic infections. Owners need to be educated on the basic principles of health management of donkeys. Research on donkeys should be included in priority lists of sustainable animal production in the country.

REFERENCES

Abdullahi, U.S., Ahmed, A.I. and BiAllah, M.B. (2010). Prevalence of Gastrointestinal Parasites among the trade donkeys in Bauchi State, Nigeria. *Sahel Journal of Vterinary Science*, 9(**2)**: 51-53.

Coombs S. (2002). Useful techniques. In: *The SPANA Guide to Animal Care*. SPANA London WC1N2EB 31 – 43p.

Ibrahim, U. (2013). Prevalence of Gastrointestinal Parasites among Working Donkeys in Yemaltu-Deba Local Government Area of Gombe State, Nigeria. A HND Thesis Bauchi state college of Agriculture.

Jajere, S.M., J.R. Lawal, A.M. Bello, Y. Wakil, U.A. Turaki and I. Waziri. (2016). Risk factors associated with the occurrence of gastrointestinal helminths among indigenous donkeys (*Equus asinus*) in Northeastern Nigeria. *Scientifica*, Vol.2016–7p https://doi.org/10.1155/2016/3735210.

Maleka, I. C. (2006). Bauchi state in brief. In: Adaba AT, Adaba M, Hamid MA, Eds.: *Bauchi State a Historical Perspective*. Trim Communication Limited, Abuja, Nigeria. 100p.

Microsoft Excel (2007). Microsoft Office Excel 2007. Microsoft Corporation

Pal, R. A. and Qayyum, M. (1992). Breed, age and sex wise distribution of helminthes of sheep and goats in and around Rawalpindi region. *Pak, Vet. J*: 12, 60-63.

Pandey, V. S. and Eysker, M. (1990). Internal Parasites of Donkeys from the Highveld of Zimbabwe. *Zimbabwe veterinary Journal*, 21:27-32.

Pandey, V.S. Khallaayoune, K. Ouhelli, H. and Dakkah, A. (1994). Parasites of Donkey in Africa pp. 35-44 in: Bakkoury M. and Prentiss R.A. (Eds), Working Equines. Proceedings of Second International Colloquium Held 20-22 April 1994, Rabat, Morocco. Actes Editions, Institute Agronomies and Veterinary Hassan II Abat, Morocco. 412p. ISBN 998-01-119 Development of Livestock and Pest Control Services (FDL & PCS) Abuja, Nigeria.

Pearson, R. A. and Ouassat, M. (1996). Estimation of the live weight and Body Condition of Working Donkeys in Morocco. *The Veterinary Record*, 138: 229-233.

Sapkota, C. R., (2009). A report on prevalence of helminthes parasites in mules of Brick Kiln of Lalitpur District. Himalayan College of Agricultural Sciences and Technology. Purbanhal University Gatthaghar, Bhaktapur.

SPSS Statistics 17.0 (2007). SPSS Inc., 233 South Wacker Drive, Chicago, IL 60606-6412.

Urquhart, G. M. Aremour, J. Dunchan, J.L. Dunn, A. M. and Jeninis, F. W. (1996). *Veterinary parasitology* 2nd edition. The University of Glasgow, Blackwell sciences, Scotland; Pp.3-137.

ASSESSMENT OF TICK'S INFESTATION ON SMALL RUMINANTS PRODUCTION IN PAIKORO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA.

*** Idris, I. A [1] & D.O.Balogu[2]**
[1]*Department of Animal Production,*
Ibrahim BadamasiBabangida University, Lapai, Nigeria.
[2]*Department of Food Science Technology,*
Ibrahim BadamasiBabangida University, Lapai, Nigeria,
[*]*Corresponding author Email:idib2288@gmail.com +2348032562607*

ABSTRACT
The study was conducted from 15th April to 31st July 2019 in Paikoro Local Government Area of Niger State, Nigeria; with the aim of determining the types, prevalence and intensity of ticks infestation in small ruminants production and identifying the major risk factors. Clinical examination and laboratory analysis were made on 160 sheep and 160 goats. The collected raw data were analyzed using software package SAS (Version 2010). Out of 320 sampled animals 67.2% (215/320×100) were found to be infested with one or more of tick species. The prevalence ticks observed were *Rhipicephalusevertsievertsi* 70(21.9%), *Amblyommavariegatum* 59(18.4%), *Boophilusdecoloratus* 40(12.5%), while *Hyalommaanatolicumexcavatum* 36(11.3%) and *Rhipicephaluspulchellus* 26(8.1%) were the minor species of ticks observed on goats and none on sheep were recorded in the study area. The infestation rate of tick in species, age and body condition scored (BCS) were significantly varied (P<0.05), however in sex (P> 0.05). In conclusion, the high prevalence in tick infestation becomes a threat to small ruminants production in the study area, therefore, further studies is recommended on the epidemiology of tick infestation, tick borne diseases as well as tick related risk factors on small ruminants production; as these may provide a benchmark to design appropriate prophylactic and control measures of tick infestation in the study area.
Key words: Small Ruminant, Infestation, Tick, Prevalence, Paikoro.

INTRODUCTION
Sheep and goats farming is one of the most important features of agriculture, which has contributed significantly towards the growth and development of the national economy of Nigeria. They play significant roles in the livelihood of rural households, where they are largely the property of women and their children (5). They provide a vast range of products and services, such as meat, milk, hairs and skin, horns, bones, manure, security gifts, religious ceremonies as well as production of drugs (11, 2).

Ticks infestation on sheep and goats reduce their ability to provide the above mentioned products and services. It could lead to noticeable economic losses to farmers due to loss of efficiency, death, and skin diseases. They are described to cause a wide range of diseases such as painful sore, mechanical tissue damage, bowel, loss of weight, loss of blood, and in strict conditions death of infested animals often followed by socioeconomic implications (7, 9). Apart from the direct effect of tick infestation on small ruminants' production and efficiency, ticks can harbor multiple pathogenic agents; patient can be infected with multiple pathogens at the same time, there by making diagnosing and treatment to be difficult (14). Despite these serious strikes no animal, the significance and incidence of tick infestation on small ruminants has not been assessed in Paikoro Local Government Area of Niger State, Nigeria. Therefore, the aim of this study was to determine the types, prevalence and intensity of ticks' infestation on small ruminants' production in Paikiro Local Government Area of Niger State, Nigeria, with a view to suggesting control measures for increasing efficiency of livestock and other meat producing animals.

MATERIALS AND METHODS
Study Location
Paikoro Local Government Area is one of the Local Government areas in Niger State, Nigeria. It has its administration headquarter situated in Paiko town about 25km south of the state capital Minna. It is located in the eastern region of the state, it lies within longitude 9°26'N and 6°38'E and latitude 9.433°N and 6.633°E. It has an area of 2,066km^2 (798 sq. mi) and a population of 158,086 which comprises of 79,399 males and 78,779 females at the 2006 census (6). Annual rainfall is between 1,100mm to 1,300mm with a mean temperature of 37°C during the dry season.

For the collection of data, a random sampling technique (12) was applied to gather the data on tick prevalence from eight wards out of eleven wards in 160 sheep and 160 goats in Paikoro Local Government Area of Niger State, Nigeria from 15th April to 31st July 2019. All the information required such as species, sex, age and body condition score were recorded on the predesigned proforma.

Prior to collection of ticks, animals were restrained properly and their whole body was thoroughly examined for the present of tick following which they were manually collected using hand with gloves. The collected ticks were preserved in 70% ethanol in labeled plastic vial and were taken to animal biology Laboratory, Federal University of Technology (FUT), Minna, for ticks' identification with the aid of stereomicroscopy using identification key described by (15).

All data were analyzed using Statistical Package for Social Science (SPSS) Software (Version 20).

RESULTS

During the present survey, all the eight wards were visited and a total of 320 small ruminants v*iz.* 160 sheep and 160 goats were randomly inspected for tick collection. Out of 320 animals 215/320×100 (67.2%) were found to be infested with one or more of tick species. From the sampled animals 134/160×100 (83.8%) and 81/160×100 (50.6%) sheep and goats respectively were found positive for tick infestation. The differences in tick infestation in species (χ^2= 7.89, df= 1, P< 0.05), in age (χ^2= 3.83, df= 1, P< 0.05),and in body conditioned scored (BCS) (χ^2= 12.82, df= 1, P< 0.05)were statistically significant. However, the difference in sex (χ^2= 2.35, df= 1, P> 0.05), was not significant (Table 1).

Overall, a total of 933 *ixodidae* ticks were collected from 160 sheep and 160 goats. In general, four *Ixodidae* tick genera (Table 2) and five species (Table 3) were identified from the study area. From the identified tick species male ticks outnumber female ticks (Table 4).

Table 1: Prevalence of Ticks' Infestation Based on Rick Factors.

Variable	Category	No. of animals examined	No. of animals infested (%)	Significance
Species	Sheep	160	134(83.8)	χ^2= 7.89
	Goats	160	81(50.6)	P= 0.005
Sex	Female	160	122(76.3)	χ^2= 2.35
	Male	160	93(58.1)	P= 0.126
Age	Young	160	89(55.6)	χ^2= 3.83
	Adult	160	126(78.8)	P= 0.050
Bcs	Poor	149	134(89.9)	χ^2= 12.82
	Good	171	81(47.4)	P= 0.000

Table 2: Prevalence of Tick Burden at Genera Level in the Study Area.

Tick species	Sheep (Prevalence in %)	Goats (Prevalence in %)
Amblyomma	216 (37.44)	236 (66.29)
Rhipicephalus	319 (55.29)	60 (16.85)
Boophilus	42 (7.28)	28 (7.87)

Tick species	Sheep (Prevalence in %)	Goats (Prevalence in %)
Hyalomma	0 (0.00)	32 (8.99)
Total	**577 (100)**	**356 (100)**

Table 3: Tick Species-Level Prevalence on Small Ruminants in the Study Area.

Tick species	Sheep (n=160) Prevalence (%)	Goat (n=160) Prevalence (%)	General score of all ruminants Prevalence (%)
R. evertsievertsi	63 (39.4)	7 (4.4)	70/320 × 100 (21.9)
A. variegatum	49 (30.6)	10 (6.3)	59/320 × 100(18.4)
B. decoloratus	32 (20.0)	8 (5.0)	40/320 × 100 (12.5)
H. anatolicumexcavatum	0 (0.00)	36 (22.5)	36/320 × 100(11.3)
R. pulchellus	0 (0.00)	26 (16.3)	26/320 × 100 (8.1)

Table 4: Total Adult Tick Species and Sex Ratio in Small Ruminants.

Tick species	Female tick Count	Male tick Count	Female: Male Ratio
Amblyommavariegatum	200	252	0.8: 1
Rhipicephaluspulchellus	0	24	0: 1
Rhipicephalusevertsievertsi	200	155	1.3: 1
Boophilusdecoloratus	24	46	0.5: 1
Hyalommaanatolicumexcavatum	32	0	1: 0

DISCUSSION

The study revealed the overall prevalence of tick infestation 67.2%. The result recorded in this study is higher than 16.7% prevalence of ecto-parasites in sheep and goats reported inNorth Eastern, Nigeria by(1), but this result is slightly lower than 68.1%in South Eastern Nigeria reported by (8). The higher proportion of ticks' infestation in sheep (83.8%) as compared to goats (50.6%) could be due to the marshy habitat and soft skin of sheep as compared to drier habitat and hardy skin of goats. This result is in consistence with the previous work of (10) who reported higher prevalence in sheep (47.0%), in goats (19.0%). The difference in the prevalence might be due to the geographical difference, season of the study period, management conditions as well as ticks control strategies in the study area.

The difference in the prevalence rate was found to be statistically significant between the two species of the small ruminants' production. This result was in agreement to the study undertaken by another author on ecto-parasites in Gombe State, South Eastern Nigeria (1). However, this report is parallel to the findings of (4) who reported that male animals are more susceptible to ticks.

The proportion of tick infestation was higher in adult animals as compared to young animals. However, there was no statistical significant association (P> 0.05) and the greater prevalence rate could be due to the long distance movement of the adult animals in search of food and water in comparison to the young animals; this maximized the chance of exposure to ticks. This finding is in line with the report ofecto-parasites by(17) who statedsimilar observation for a higher proportion of adult animals being studied.

The higher prevalence of tick infestation found in this report was not statistically significant between bodies conditioned scored. This observation could be attributed to the fact that good body conditioned scored animals were well fed and this make them to developed resistance to different types of diseases to which they were exposed whilst grazing in the field or were maintained in their sheds in comparison to poor body conditioned scored

animals who lack body potentials to build resistance as a result of poor nutrition especially during the dry season, thus make them to be more susceptible to ticks. This report of higher prevalence in poor body conditioned scored animals is in accord with that of (13).

The higher prevalence of single infestations to double infestations recorded in this report agreed with that of (3) who reported a single infestation, three double infestations and one triple infestation. The effects of tick infestations are more noticeable when infestation is heavy and combined. Thus, more single infestation recorded in this report means that the effect of tick infestations was not so noticeable on the animals.

In all cases, except *Rhipicephalusevertsievertsi*and *Hyalommaanatolicumexcavatum*, males ticks out number females ticks, this is due to the fact that the females engorged on much blood, its expanded greatly then detached and convert the blood to eggs drop off the body of the host to the ground to lay eggs, and finally dies after this single laying, while the males ticks takes repeated small meal of blood and attempt to mate repeatedly whilst on the same host (16).

CONCLUSION AND RECOMMENDATION

The present study revealed a high prevalence of tick infestation on small ruminants in the study area and difference determinants such as species, sex, age and body conditioned scored are the risk factors for ticks' distribution. Therefore, based on this finding further studies is recommended on the epidemiology of tick infestation, tick borne diseases as well as tick related risk factors on small ruminants production; as these may provide a benchmark to design appropriate prophylactic and control measures of tick infestation in the study area.

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REFERENCES

Adang, K. L.,Ayub, J.&Yoriyo,K.P. (2015). Ectoparasites in Sheep (Ovisaries L.) and Goats (Capra hirus L.) in Gombe, Gombe State, Nigeria. Pakistan Journal of Biological Sciences, 18:224-231.

Anyanwu, W. (1998). Agriculcultural Science for West African Colleges, Ibadan University Press, Nigeria, page: 224.

Brito, D.R., Santos,A.C. &Guerra,R.M. (2005). Ectoparasites in goat and sheep folks from Alto Mearim and GrajauMicroregion, State of Maranhoa. RevistaBrasileiraParasitogiaVeterinaia, 14: 59-63, (In Portuguese).

Hussen, Y. (2009). Preliminary survey of cattle tick species and burden in and around Bako Town. DVM Thesis, School of Veterinary Medicine Jimma University, Jimma, Ethiopia.

Lebbie, SHB. (2004). Goats under household condition. Small Ruminant Research, 51: 131-136.

National Bureau of Statistic (2010). Annual Abstract of Statistic, Federal Republic of Nigeria, p. 37.

Nyangiwe, N. &Horak, I. G. (2007). "Goats as alternative hosts of cattle ticks," Onderstepoort*Journal of Veterinary Research*, vol. 74, no. 1, pp. 1–7, 2007. View at Google Scholar • View at Scopus.

Obi, Z.C.L., Anyaegbunam&Orji,M.K.N. (2014). Ectoparasitosis, a challenge in sheep and goat production in Uli, Anambra State, Nigeria. *Int. J. Fauna Biol. Stud*., 1:27-29.

Ofukwu, R.A., Ogbaje,C.I. &Akwuobu, C.A. (2008). Preliminary study of the epidemiology of ectoparasite infestation of goats and sheep in Makurdi, North Central Nigeria. Sokoto Journal of Veterinary Sciences, Vol.7 (2) 22-26.

Ohaeri, C.C. &Ugwu,A.U. (2013). Survey of ectoparasites of farm animals *J. Agric. Vet. Sci*., 5:163-172.

Sertse, T. &Wossene,A. (2007). Effect of ectoparasites on quality of pickled skins and their impact on the tanning industries in Amhara regional state, Ethiopia. Small Rumin. Res., 69: 55-61.

Thrusfield, M. (2007). Veterinary Epidemiology. USA: Blackwell Science Limited; 180-185.

Tsegaw, D., Abraham,F. &Surafel,K. (2015). Survey of tick Infestation in Domestic Ruminants of Haramaya District, Eastern Hararghe, Ethiopia. *J. Bacteriolparasitol* 6: 246.

Unsworth, N. B.,Stenos, L. &Graves,S.R. (2007). "Flinders Island spotted fever rickettsioses caused by 'marmionii' strain of Rickettsia honei, Eastern Australia". Emerging Infectious Diseases. 13 (4): 566–73. doi:10.3201/eid1304.050087. PMC 2725950 Freely accessible. PMID 17553271.

Walker, A.,Bovattour, J.,Camicas, I.,Horak&Latif, A. (2003). Ticks of domestic animals in Africa: A guide to identification of species. Bio Science. Report. Pp. 1-122. Wallingford, UK. Pp. 440-485.

Walker, MD. (2017). Ticks on dog and cats. The Veterinary Nurse, 8(9), 486-492.

Yishak, I.,Tsegalem, A. &Wakayo,B.U. (2015). Epidemiological study on ectoparasite infestation of small ruminants in SodoZuria District, Southern Ethiopia. *J. Vet. Med. Anim. Health*, 7: 140-144.

PREVALENCE OF BRUCELLOSIS IN SOME SETTLED CATTLE FARMS IN BAUCHI LOCAL GOVERNMENT AREA, BAUCHI STATE, NIGERIA

Ahmad,A. A.,Mai, H. M. and Abdullahi, U. S.
Department of Animal Production,
Faculty of Agriculture and Agricultural Technology,
Abubakar Tafawa Balewa University, Bauchi
***Corresponding Author's Email**:ahmadabare@gmail.com*

ABSTRACT
Serological study was conducted to determine the prevalence of brucellosis in some settled cattle farms in Bauchi Local Government Area, Bauchi State, Nigeria. A total of 500 cattle sera from 6 farms were collected and examined for antibodies against *Brucella* species using Rose Bengal plate test (RBPT). Information about the sex, age, and breeds of cattle were collected using structured questionnaire. Association between prevalence of the disease and age, sex and breeds of cattle were determined using Chi-square test. The results obtained revealed overall prevalence of 35 (7%).The highest prevalence observedin cattle aged between 4-6 years old was 18 (3.6%) while the least prevalence of 1 (0.2%) was recorded in cattle aged above 9 years. Based on sex, the infection was higher in females 22 (4.4%)than males 13 (2.6%). There was a significant association between the prevalence of brucellosis and the sex of cattle at $P \leq 0.05$. However, there is no significant association between prevalence of the disease and the age and breeds of cattle examined.The study confirmed the presence of brucellosis in the study area and infected cattle in the screened farms are likely to transmit the disease to humans and other susceptible animals. It is recommended that allinfected animals should be immediately culled to avoid further spread of the infection, susceptible animals should be vaccinated and public should be enlightened about the zoonotic nature of the disease.
Key words: Brucellosis, Cattle,Prevalence, RBPT

INTRODUCTION

Brucellosis is an infectious and contagious disease primarily of livestock caused by a number of host-adapted species of Gram-negative intracellular bacteria of the genus *Brucella*. The disease is one of the most widespread zoonoses in the world (Munir*et al.*, 2010). It is one of the most devastating trans-boundary animal diseases and also a major trade barrier and economically very important as a major cause of losses in the livestock industry (Gul and Khan, 2007). Brucellosis infection is widespread globally and is endemic in many developing countries including Nigeria and it has been reported in various parts of the country and in various animal species and in humans (Cadmus *et al*., 2006;Mai *et al*., 2012; Kudi*et al*., 2015; Saleh *et al*., 2016;Mai *et al.*, 2018).In a large seroprevalence survey of brucellosis in cattle herds under diverse production systems in northern Nigeria,Mai *et al*. (2012) reported a significantly higher seroprevalence of brucellosis in cattle with overall level of 37% using RBPT and 26.3% after confirmation with c-ELISA. Many cases have been reported in various literatures (Adamu*et al*., 2016; Saleh *etal*., 2016; Agada*et al*., 2017).

The disease is well known for its effects on decreasing productivity of infected livestock by causing abortions, reduced fertility and decreased milk yield, resulting in substantial economic losses (Nicoletti, 1980). Other clinical signs that characterised the disease include; sterility, still birth, retained placenta, orchitis, hygroma and epididymitis (Adams, 2002). However, the rare clinical signs like mastitis, repeat breeding and joint ill were also reported (Chakravarty *et al.*, 2007). There is an occupational risk to veterinarians, abattoir workers and farmers who handle infected animals/carcasses and aborted fetuses or placentas. Brucellosis is also one of the most easily acquired laboratory infections (OIE, 2006).

Yagupsky and Baron (2005) reported that *Brucella* infection is readily transmissible to humans, causing acute febrile illness – undulant fever – which may progress to a more chronic form and can also produce serious complications affecting the musculo–skeletal, cardiovascular, and central nervous systems. Infection is often due to occupational exposure and is essentially acquired by the oral, respiratory, or conjunctival routes, but ingestion of dairy products constitutes the main risk to the general public. The incidence of the disease in human is thus closely tied to the prevalence of the infection in sheep, goat and cattle and to practices that allow exposure to humans, to potentially infected animals or their products (Carrera *et al.*, 2006).

MATERIALS AND METHODS

To have an insight in to the role of cattle in the epidemiology of brucellosis, we conducted a study to determine the prevalence of brucellosis in some settled cattle farms in Bauchi Local Government Area, Bauchi State, Nigeria.A total of 500 serum samples were collected from six settledcattle farms and tested for the presence of *Brucella* antibodies using Rose Bengal Plate Test (RBPT) as described by Alton *et al.* (1975).Information about individual animal and farms were collected using structured questionnaire (Thrusfield, 2005).

RESULTSAND DISCUSSION

The overall prevalence of brucellosis observed in all the six farms combined was 35 (7%). This is in line with the result of the investigation carried out on cattle by Adamu *et al*. (2016) in three senatorial zones of Bauchi State which revealed the prevalence of (5.4%) using RBPT. Similarly, Farouk *et al*. (2011) also reported much lower overall herds' prevalence of (4.04%) using RBPT from Jigawa State.

The prevalence among the age groups showed that cattle aged between 3-6 years had a prevalence of 18 (3.6%) followed by those between the ages of 7-9 years 11 (2.2%), 0-3 years 5 (1%), and those aged above 9 years 1 (0.2%). This supported the result of investigation conducted in Bauchi State by Adamu *et al*. (2016), who reported the seroprevalence of 6.3% in cattle aged 4-5 years, followed by 5.5% in cattle aged<4 years thencattle with the age range of 5-7 years showed the prevalence of 4.6%, whereas cattle aged above 7years showed the least seroprevalence of 4.0%.Our result revealed no statistically significant association at $p \leq 0.05$ among all the age groups tested. This is also in consonance with the report by Adamu *et al*. (2016).

Based on sex, the result revealed the highest prevalence in females than in males with 22 (4.4%) and 13 (2.6%) respectively using RBPT. Statistically, this showed significant association between the sex of the cattle and the prevalence of the disease ($P \leq 0.05$). This is because female cows remain the locale of the infection, which helps to spread the disease from one animal to another, either through lactation or during mating. Pregnancy and lactation were reported to enhance susceptibility to infection. The growth of virulent strains of *Brucella* organism was reported to be stimulated more in females because of the presence of higher volume of D-erythritol normally found in fetal tissue than in testes and seminal vesicles (Bayemi*et al*., 2009). These thoughts provide proofs as to the different extend of prevalence of bovine brucellosis in relation to sex of animals concern.In addition, this finding agreed with earlier reports byJunaidu*et al*. (2011) who stated that the foci of *Brucella* infection remain in females, which spread the infection from one animal to another. Also, Adamu *et al*. (2016) reported similar result of higher prevalence in females (7.6%) than males (5.8%).

Based on the breeds of cattle examined, the highest infection was found in Bunaji with prevalence of 18 (3.6%), followed by Friesian with 8 (1.6%), Cross breeds 5 (1%), Wadara 3 (0.6%), Bokoloji 1 (0.2%) and Red Bororo 0 (0%). There was no statistically significant association between the breeds of cattle examined and prevalence of brucellosis ($p \leq 0.05$). This agrees with the report by Saleh *et al*. (2016) who indicated that brucellosis is more prevalent in Bunaji cattle slaughtered in three municipal abattoirs of Gombe state. Cadmus *et al*. (2006) also reported the highest prevalence of brucellosis in Bunaji cattle over Red Bororo, Bokoloji and Cross breeds.

CONCLUSIONS AND RECOMMENDATIONS

This study showed that brucellosis is found in the study area. Cattle of all ages and both sexes are carrying the disease andinfected cattle in the herds examined are likely to transmit the disease to humans and other susceptible animals. It is recommended thatinfected animals should be isolated and culled immediately to enable the total eradication of the disease. Food products derived from animals should be properly cooked to protect the consumers from *Brucella* infection andintegrating vaccination against brucellosis into the annual vaccination program of livestock are highly recommended.

REFERENCES

Adamu, S. G.,Atsanda, N. N.,Tijjani, A. O.,Usur, A. M.,Sule, A. G. and Gulani, I. A. (2016). Epidemiological study of bovine brucellosis in three senatorial zones of Bauchi State, Nigeria.*Vet. World*. **9**(1): 48–52.

Adams L.G. (2002). The pathology of brucellosis reflects the outcome of the battle between the host genome and the *Brucella* genome. *Vet.Microbiol.*, **90**(1-4): 553-561.

Agada, C. A.,Goden, C. P. and Ogugua, J. O. (2017). Prevalence of Bovine Brucellosis and Analysis of Risk Factors in Resident Cattle Herds of Kanke Local Government Area, Plateau State, Nigeria. *Nig. Vet. J.* **38**(2): 104-116.

Alton G. G., Jones, L. M. and Pietz, D. E. (1975). Laboratory Techniques in Brucellosis, *Monograph Series World Health Organisation***55**:1-163.

Bayemi, P., Webb, E.C., Nsongka, M.V., Unger, H. and Njakoi, H. (2009) Prevalence of *Brucella abortus*antibodies in serum of Holstein cattle in Cameroon. *Trop. Anim. Health and Prod.*, **41**(2): 141-144.

Cadmus S.I.B., Ijagbone I.F., Oputa H.E., Adesokan H. K. and Stack J.A. (2006). Serological Survey of Brucellosis in Livestock Animals and Workers in Ibadan, Nigeria. *Afr. J. Bio. Res.*,**9**: 163-168. ISSN 1119-5096.

Carrera, M. J. A., Rodriguez, A. M.,Sapina, L. A. and Sacristan, A.P. (2006) "Probable transmission of brucellosis by breast milk," *J. Trop. Pediatr.*, **52**:380-381.

Chakravarty, A., Barman, N. N., and Sarma, S. (2007). Seroprevalence of bovinebrucellosis in different age groups of cattle. *Indian Vet. J.*, **84**: 873 –874.

Farouk Mohammed U., Salisu Ibrahim, IkweAjogi, and Bale Olaniyi J. O. (2011). Prevalence of Bovine Brucellosis and Risk Factors Assessment in Cattle Herds in Jigawa State. *Int. Schol. Res. Net.*doi:10.5402/2011/132897.

Gul, S.T. and Khan, A. (2007). Epidemiology and epizootology of brucellosis: A review *Pak. Vet. J.*,**27**:145-151.

Junaidu, A.U., Oboegbulem, S.I. andSalihu, M.D. (2011). Serological survey of *Brucella* antibodies in breeding herds. *J. Microbiol. Biotech. Res.*,**1**(1):60–65.

Kudi A. A., Ahmed R. A. and Baba-Ali F. (2015). Human Brucellosis: Seroprevalence amongst Patients attending the General Out-patient Department (GOPD), Federal Teaching Hospital Gombe, Nigeria. *J. Nig. Biomedic. Sci.*on: 3rd Quarter, 2015 Editions.

Mai H. M., Irons P. C., Kabir J. and Thompson P. N. (2012). A large seroprevalence survey of brucellosis in cattle herds under diverse production systems in northern Nigeria. *BMC Vet. Res.***8**: 1-144.

Mai, H. M., Ahmad, A. A. and Bobbo, A. G. (2018). Impact of Brucellosis in Sheep and Goats in Funakaye Local Government Area, Gombe State, Nigeria. *Nig. J. Trop. Agric*., **18**: 96-106.

Munir, R., Afzal, M., Hussain, M., Naqvi, S. M. S, and Khanum A, (2010). Outer membrane proteins of *Brucella abortus*vaccinal and field strains and their immune response in buffaloes," *Pak. Vet. J.*,**30**:110-114.

Nicoletti P. (1980) "The Epidimiology of Bovine Brucellosis," *Adv. Vet. Sci. Comp. Med.*,**24:** 69-98.

Saleh Mohammed Jajere, Naphtali NayamandaAtsanda, AsinamaiAthliamaiBitrus, TasiuMallamHamisu and AjurojoOluwaseun Ayo (2016). Prevalence of brucellosis among cattle slaughtered in three municipal abattoirs of Gombe state, Northeastern Nigeria. *Vet.World*, **9**: 2231-0916.

Thrusfield M. V. (2005). Criteria for success of questionnaire. In: *Vet.Epid.*, 3rdedn, Oxford, UK: Blackwell Science. Pp189-213.

World Organisation for Animal Health (OIE) (2016). Brucellosis: *Brucella abortus, B.melitensis and B. suis*(Infection with *B. abortus, B. melitensis and B. suis*).

Yagupsky P. and Baron E. J. (2005). Laboratory exporsure to *brucellae* and implications for bioterrorism. *J. Emerg. Infect. Dis.*; **11**:1180–1185.

CLINICAL MANIFESTATIONS OF BRUCELLOSIS IN CATTLE IN NORTHERN NIGERIA

[1]Mai, H. M.,[2]Thompson, P. N., [2]Irons, P. C.,[1]Ahmad, A. A.,[3]Qadeer, M. A. and [1]Kalla, D. J. U.
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
[2]Department of Production Animal Studies, Faculty of Veterinary Science, University of Pretoria, South Africa
[3]Department of Zoology,ModibboAdama University, Yola

ABSTRACT
This study was conducted to determine the clinical manifestations of brucellosis in cattle under differentmanagement systems in northern Nigeria. Using multi-stage sampling, serum samples of 4,745 cattle from 271 herds were tested using the Rose-Bengal plate-agglutination test (RBPT) and positives were confirmed using a competitive enzyme-linked immunosorbent assay (c-ELISA). The results indicated the seroprevalence of 37% with RBPT and 26.3% following confirmation with c-ELISA. The infection level was greater amongst pastoral herds than agro-pastoral herds and in herds with hygromas.

INTRODUCTION
Brucellosis is an infectious and contagiouszoonotic disease primarily of livestockthat has significant animal health and devastating national and international trade consequences.It is an endemic, emerging and neglected diseasein Nigeria.

The disease is caused bya number of host-adaptedbacteria species of the genus *Brucella*.The genus consists of small non-motile, non-spore forming, non-encapsulated, intracellular,Gram-negativeaerobic cocci, coccobacilli or bacillary organisms of 0.5-0.7 x 0.6-1.5 µm dimension, usually arranged singly, but they may be in pairs or small groups.

*Brucella*species are poorly staining and are seen mostly as single cells and appearing like “fine sand”**.** Colonies are smooth, round, small, translucent and pale honey colour. Later they became, larger and browner but remain clear.

Objectives
The study was aimed at determining the clinical manifestations of brucellosis in cattle from different management systems over a wide geographic area of northern Nigeria using accurate tests.

MATERIAL AND METHODS
This study was carried in cattle under various management systems in Adamawa, Kaduna and Kano states, northern Nigeria. Using multi-stage sampling, serum samples of 4,745 cattle from 271 herds were tested using the Rose-Bengal plate-agglutination test (RBPT) and positives were confirmed using a competitive enzyme-linked immunosorbent assay (c-ELISA).

Clinical signs of brucellosis observed in cattle during the study period and laboratory pictures of the two tests results

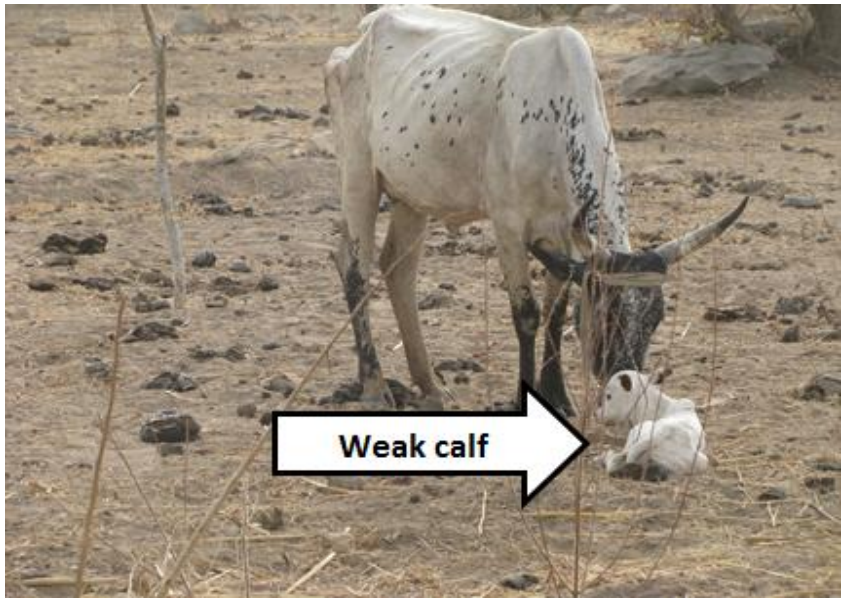
The signs of brucellosis in cattleincluded: abortion, still birth, retained placenta, birth of weak calves, hygroma, orchitis and epididymitis. However, other symptoms like mastitis, repeat breeding and joint ill were seen.

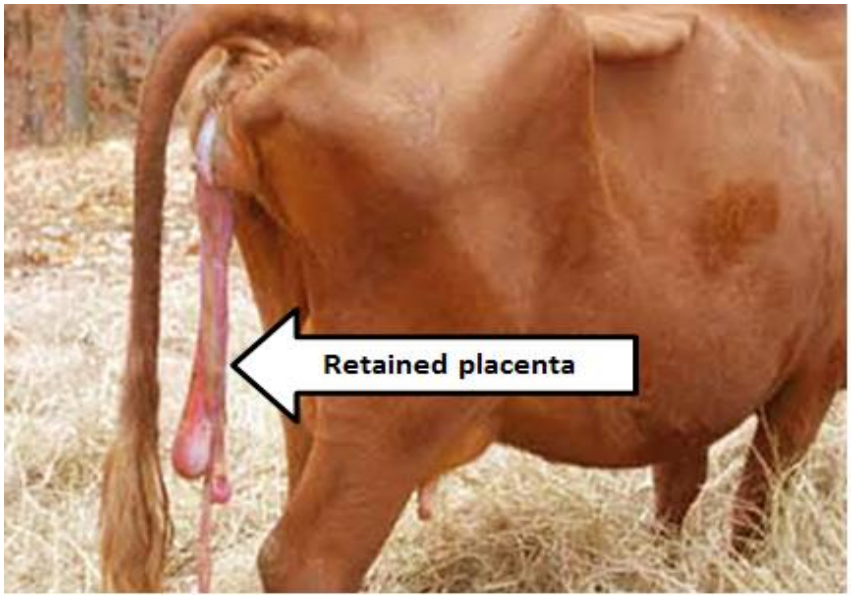
I. Effects of brucellosis onreproductive system





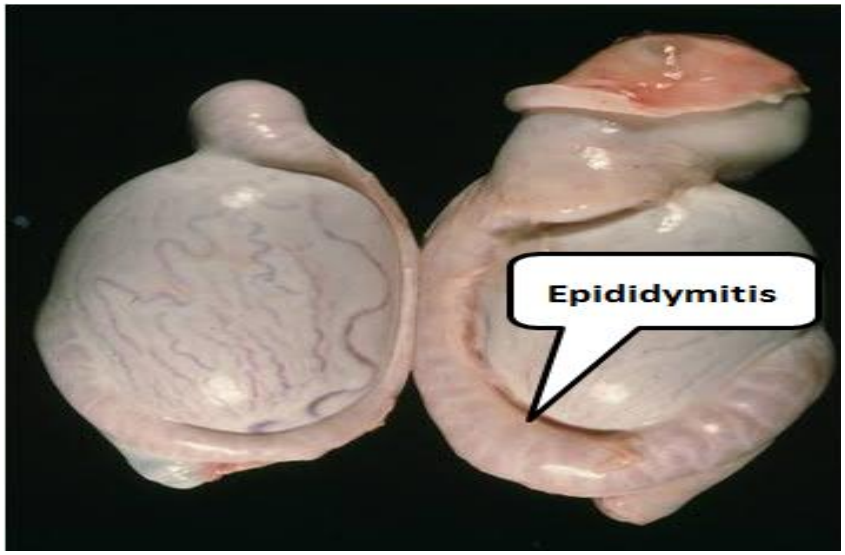

Stillbirth calf


Weak calf


Retained placenta

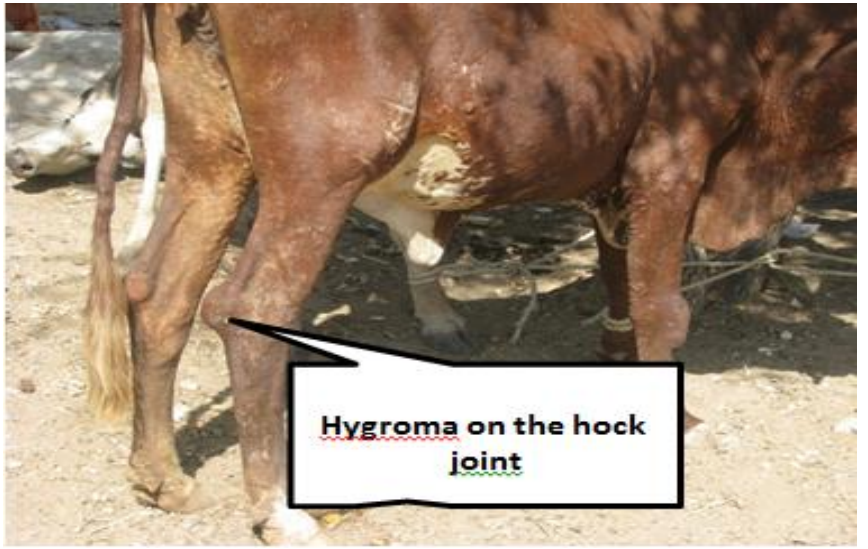

Mastitis

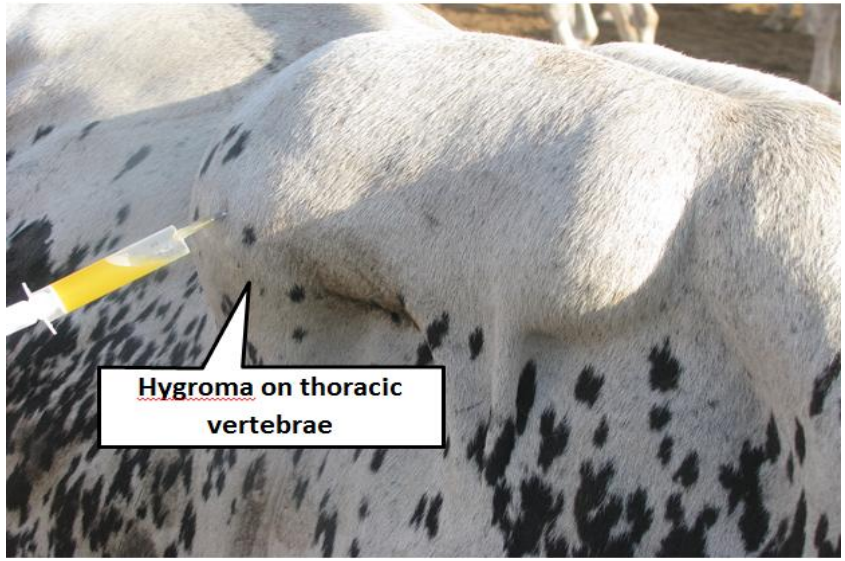


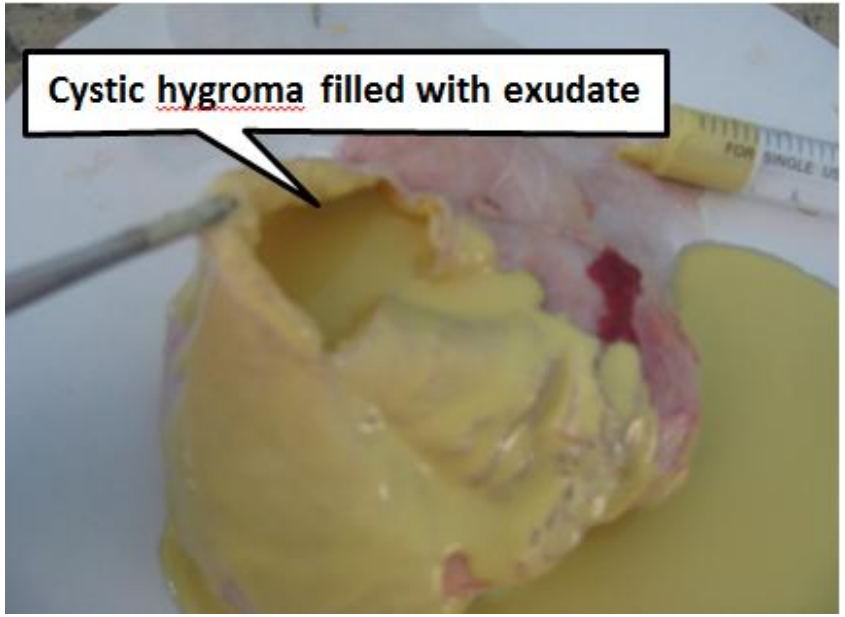


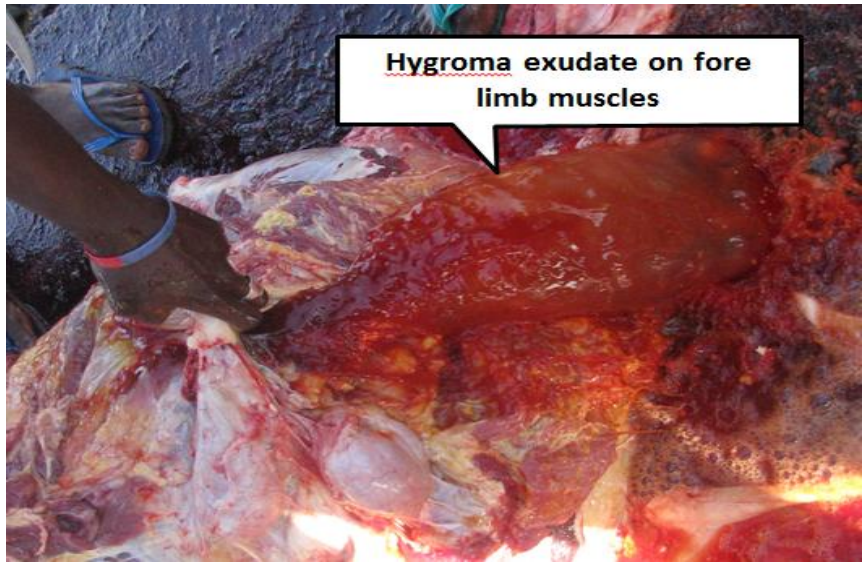
II. Effects of brucellosis on joints/muscles& nature of the fluid

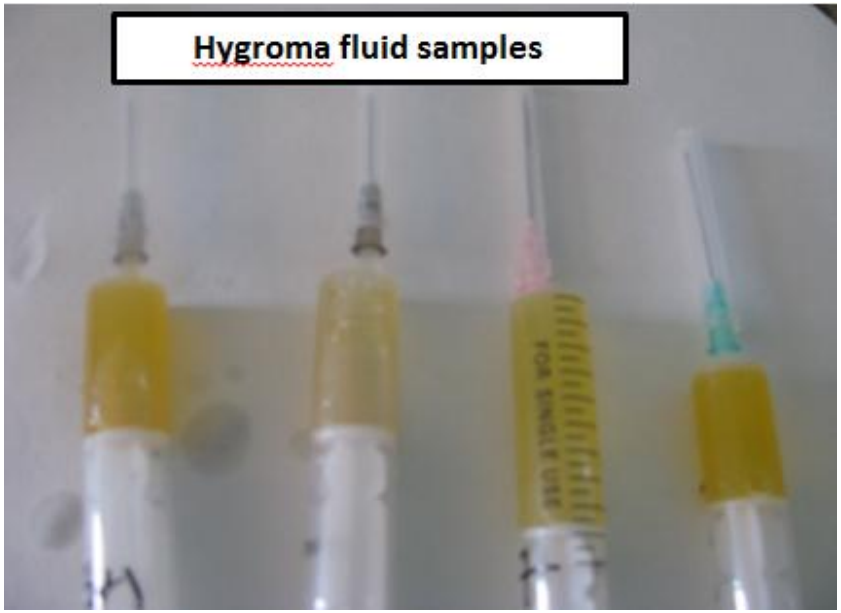


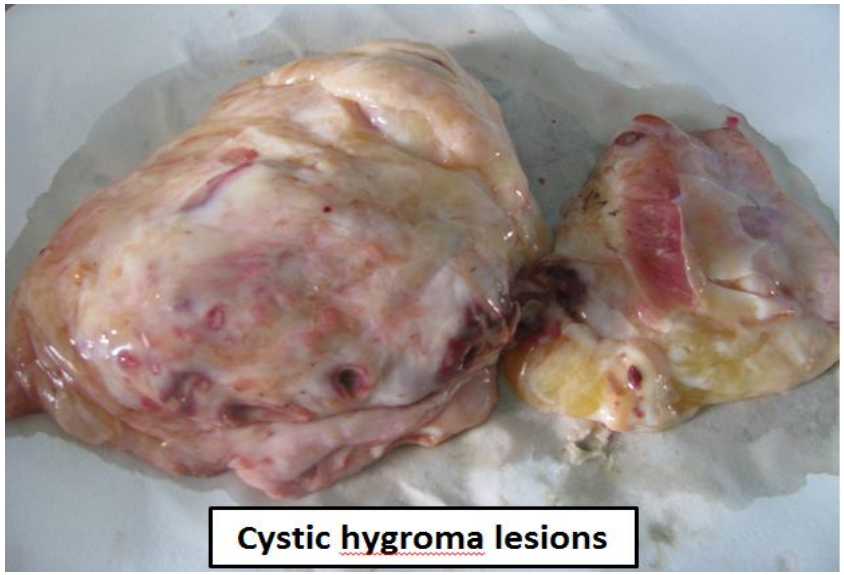



Hygroma on thoracic vertebrae

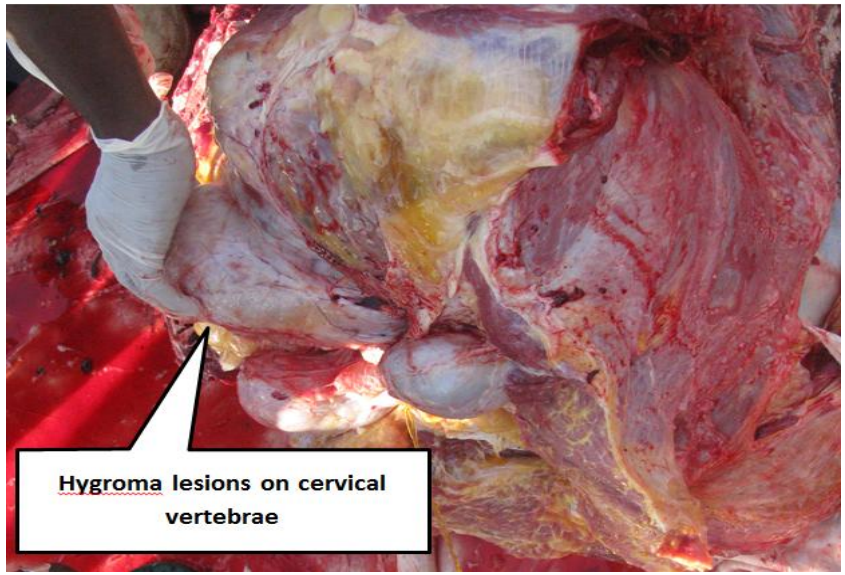

Cystic hygroma filled with exudate

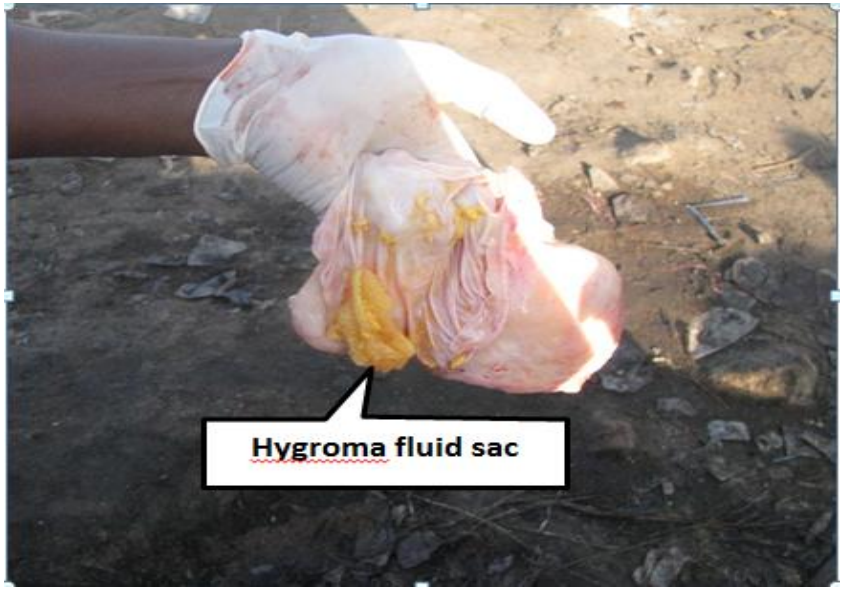

Hygroma exudate on fore limb muscles


Hygroma fluid samples


Cystic hygroma lesions

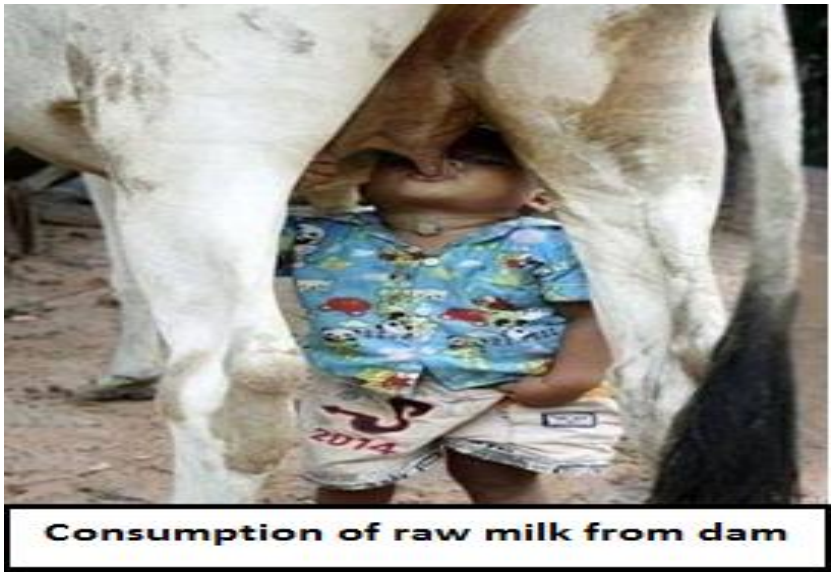

Hygroma lesion on hind limb





III. Transmission of brucellosis incattle and humansand the traditional practice for treatment of hygroma

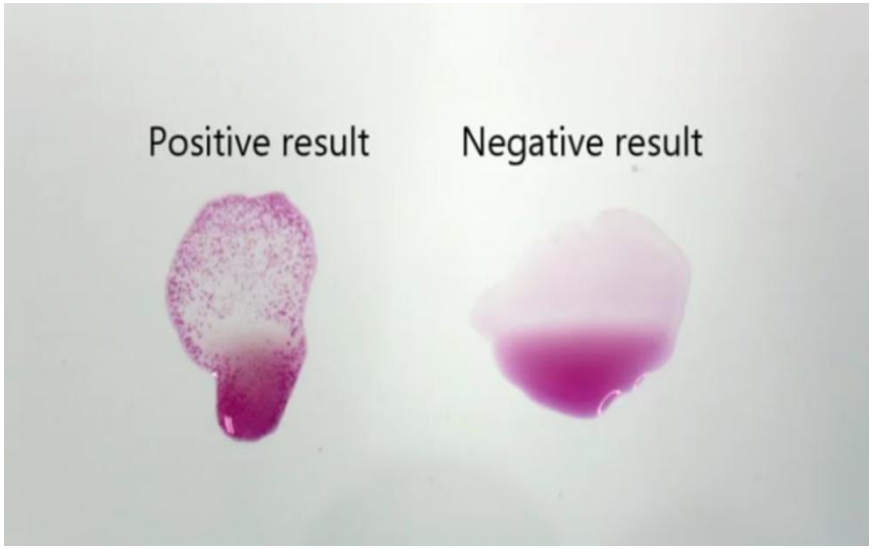




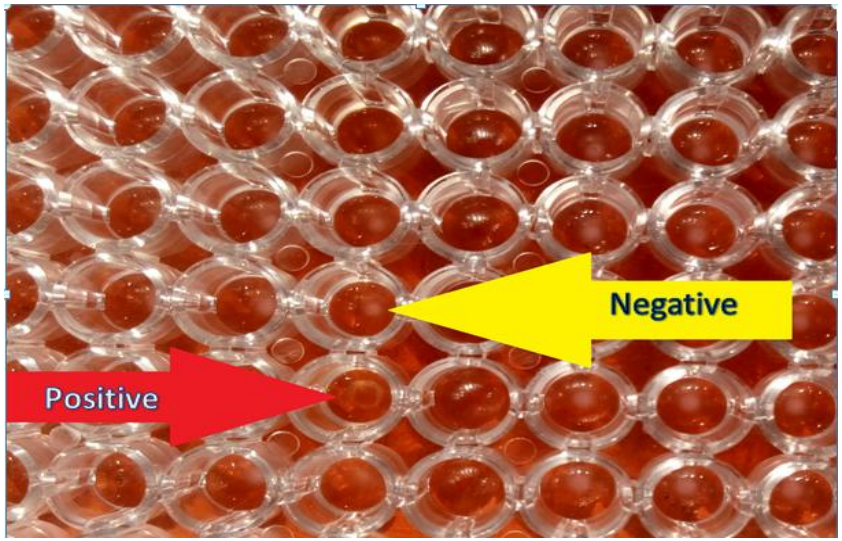




IV. Laboratory pictures of the two tests results



Brucellosis positive and negative samples using (RBPT)



Brucellosis positive and negative results on micro plate using c-ELIS

RESULTS AND DISCUSSION

Data from the 4,745 samples from 271 herds used in the study showed 37% of all animals were RBPT positive, and after confirmation with c-ELISA the overall animal-level seroprevalence was 26.3%. Based on herds examined, there were 225 herds (84.9%) with at least one animal testing positive based on RBPT and 210 herds (77.5%) based on c-ELISA. The herd-level seroprevalence of brucellosis in the three states combined, adjusted for the sampling weights, was estimated to be 77.5%.Interstate movement and trade in cattle across the country, as well as the nomadic nature of the pastoral Fulanis may have contributed to the high infection of brucellosis.

Twenty three per cent of all herds sampled and 30% of the infected herds had animals with hygromas. Of the 63 herds in which hygromas were present, 54 (64.3%) were from Adamawa, 7 (13.7%) from Kano and 2 (2.7%) from Kaduna states. Only one herd with cattle with hygromas (1.6%) was negative for brucellosis. Other clinical manifestations of brucellosis on the reproductive system, joints, muscles etc. were also observedwith varying nature of fluids and cysts. Furthermore, transmission in cattle and humans were noted.

The odds of brucellosis seropositivity were 3.5 times greater amongst pastoral herds than agro-pastoral herds in this study. The high seroprevalence of brucellosis in a pastoral management system may partly be attributed to long distance movement of cattle in search of pasture and water and co-mingling in communal grazing areas and at watering points, particularly during the dry season having adverse weather conditions and famine. During such times animals become concentrated on scarce pastures and around watering points, which may become contaminated with aborted foetal materials or fluids from infected normal calvings.

CONCLUSIONS

It is evident from this study that brucellosis is endemic in northern Nigeria with high seroprevalence. Various clinical manifestations were observed in cattle in the study areas, affecting differentbody systems. Increased education and farmer extension, particularly amongst the nomadic Fulani, regarding the zoonotic risk associated with milk consumption and contact with aborted materials, and implementation of appropriate control measures are recommended.

REFERENCES

Mai H. M., Irons P. C., Kabir J., Thompson P. N. (2012). A large seroprevalence survey of brucellosis in cattle herds under diverse production systems in northern Nigeria. *BMC Veterinary Research***8**: 1-144, retrieved 2013-10-10. Available: http://www.biomedcentral.com/1746-6148/8/144.

Mai H. M., Irons P. C. and Thompson P. N. (2015).Brucellosis, genital campylobacteriosis and other factors affecting calving rate of cattle in three states of Northern Nigeria.*BMC Veterinary Research,***11**:7.

PREVALENCE OF FASCIOLOSIS IN NOMADIC PASTORALIST'S CATTLE HERDS IN OYO STATE, NIGERIA

[1]Abdullahi, M.H.,[1]Mai,H. M.,[1]Abdulkarim, M.,[1]Ahmad,A. A.,[2]Qadeer, M. A., Sanusi, M. & [3]Umar, M. B.

[1]Department of Animal Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University Bauchi.

[2]Department of Zoology, School of Life Sciences, ModibboAdama University of Technology, Yola[3]Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria

Corresponding Author's Email: hassanmai@hotmail.com

ABSTRACT

The study was conducted to determine the prevalence of fasciolosis in nomadic pastoralist's cattle herds in Oyo state, Nigeria.Faecal samples were collected from 750 apparently healthy cattle. An overall infestation of 399 (53.2%)were recorded. The prevalence from three selected geographical zones in the state were82.0%, 34.8% and 42.8% for Ibarapa, Ogbomoso and Oke-ogun zones respectively. Thebreeds based prevalencerecorded were Bunaji168 (50.9%), Bukoloji 125(50.8%) and Rahaji 106(60.9%).Based on sex,the result revealed higher prevalence in females 266(56.7%) than males 133(50.4%). In relation toage,higher prevalence was recorded in adultswith 249 (56.1%) and the least inyoung with 150(49.0%).Seasonal distribution of the diseaserecorded were 36.9%,57.4%,73.4% and 44.9% for early dry, late dry, early wet and late wet seasons respectively.There was significant association between the prevalence of fasciolosis and location and season at $P<0.01$. However, no significantassociation was observed between the prevalence of the disease and the sex, age and breeds of cattle ($P<0.05$). The result of the study showed the presence of fasciolosis in the study area. It is recommended that periodic medication of affected animals and public enlightenment of the nomads on the mode of transmission of fasciolosis should be employed. Control of snails intermediate host is also essential for the control of the disease.

Key Words: Cattle,Fasciolosis, Nomadic, Pastoralists, Prevalence

INTRODUCTION

Fasciolosisalso known as fascioliasis is an important disease caused by trematodes of the genus *Fasciola*. *Fasciolagigantica*and *Fasciola hepatica* species are responsible for the disease in tropical and temperate regions respectively (Damwesh and Ardo, 2012). Fasciolosis caused by *Fasciolagigantica*is responsible for heavy economic losses to farmers due to reduced weight gain, poor carcass quality, reduced milk yield, cost of treatment and control, mortality and condemnation of affected livers at abattoirs and slaughtered slabs in Nigeria (OdigeandOdigie, 2013; Yahaya and Tyav, 2014).

Walker *et al.* (2008) indicated that the life cycle of *Fasciola* worms involved snail as an intermediate host. The species of snails involved in their life–cycles vary according to geographical distribution and climatic differences. The *Lymnaenatalensis* is the snail for *Fasciolagigantica* and *Lymnaetrucatula*is the intermediate host for *Fasciola hepatica* (Bhatia *et al.*, 2014). The life cycles of *Fasciola*involves five larval stages commencing with eggs which hatches into Meracidium, Sporocyst, Radia, Cercaria and Metacercariae (Anawat*et al.*,2015).

Fasciolosis is transmitted by ingestion of metacercaria-infested forage or drinking water containing floating metacercariae (Arjona*et al.*, 1995).Among many parasitic problems of farm animals,fasciolosisis a major disease which imposes direct and indirect economic impact on livestock production particularly of cattle and sheep (Keyyu *et al*., 2006). Fasciolosis is enzootic in Nigeria and is of great economic importance especially in the northern part where stagnant water and fadamas are used as watering and grazing sites during the dry season (Biu*et al.*, 2006).

The pathological manifestations depend mainly on the number of metacercariae of *Fasciola*ingested;these may results in acute, sub-acute or chronic fasciolosis(Bhatia *et al.*, 2014;Walker *et al*., 2008).

According to Suhardono*et al*. (2006) the form of the *Fasiolosis*thatoccurs will depend on the numbers of infective metacercariae ingested and the period of time over which they are ingested. Acute fasciolosisin ruminant is often a syndrome of death without apparent clinical abnormalities (Kelly, 1999). In Sub-acute fasciolosis the infected liver is seen covered with migratory tracts, infiltration of white cells is more in evidence and early fibrosis maybe seen. While in chronic fasciolosisthere will be loss of weight, sub-mandibular edema and pale mucous membrane.Over a period of weeks shedding of wool or hair may occur in sheep and cattle, also in cattle there will be reduction in milk and chronic diarrhea (Bhatia *et al.*, 2014).

MATERIALS AND METHODS

Faecal samples were collected from 750 nomadic pastoralist cattle from thethree selectedgeographical zones of Oyo State and examined for the presence of fasciolosis using standard sedimentation technique as described by Hanson and Perry (1994). Structured questionnaires were administered in collection of data on the location, sex, age and breeds of cattle.

RESULTS AND DISCUSSION

The study revealed the overall prevalence of392(52.3%). This corresponds with 52.1% reported by Olusegun-Joseph*et al*. (2000)from Zaria and 54.0% prevalence observedin Gwagwalada abattoir Abuja by Idris *et al*. (2004).In addition, a higher prevalence of 94.8% was reported by Yohanna*et al*. (2012) in Jos.However, lower prevalence of 46.6% and 2.37% were reported by Hassan and Anwo (2010) and Oladele-Bukala and Odetokun (2014) respectively.

Based on locations,the result showedthe highestinfectionof 82.0% in Ibarapafollowed by 42.8% in Oke-Ogunand 34.8% inOgbomoso zones. The high prevalence in Ibarapa zone mightbe due to more favourable environmental conditions of the area such as presence of flooded natural pastures, water shed areas, ponds and rivers which favour the development ofsnail intermediate hosts.It may also be associated with the fact that the zone is neighbouring Ogun State which is characterized by lots of swampy areas and lagoons that may favour the growth of greener pastures that may attract nomadsmigration during the dry season resulting in congregation of the cattle which will enhance the spread of fasciolosis than in other zones. There was significant association between the prevalence of fasciolosis and location at $P<0.01$ in this study.

Breed based prevalence indicated 60.9% in Rahaji, 50.9% in Bunaji and 50.8% in Bokoloji. In relation to sex, the result revealed the highest prevalence in female (56.1%) than male (50.4%).The lower margingrecorded between the prevalence in males and females may be associated with close cohabitation of the animalsas nomadic pastoralist keep both females and malestogether and grazed them onsame pasture and move in search of food and water together which could expose them to similar risks of infection.

The prevalence among the age groups showed that older cattle aged>3 years had higher prevalence of (56.1%) than younger once aged <3 years with (49.0%). This agrees with the report of Iboyi*et al*. (2017) who indicated that fasciolosis prevalence is higher in adult than young cattle.However, the resultsof this study showed no significant association between prevalence of fasciolosis and breed, sex and age of cattle at $p<0.05$. This is in line with the finding of Magaji*et al*. (2014) and Adang*et al*. (2015).

Regarding seasons, the distribution of the disease indicated highest infestation in early wet season with 138 (73.4%) followed by late dry season 108 (57.4%), late wet season 84 (44.9%) and early dry season 69 (36.9%). This corresponds with the report ofDamwesh and Ardo (2012) who also observed that the prevalence of fasciolosis was high before and during the onset of rainy season in Adamawa State, Nigeria. Similar resultswere reported by various researchers (Qureshi *et al*., 2012; Shahzad*et al*., 2014).There was significant association betweenprevalence fasciolosis and seasons at$p<0.01$.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study showed that fasciolosis is enzootic in the study area which may affect the performance of the cattle resulting in hugeeconomic losses. It is recommended that all animals in the study area should be dewormedwith broad spectrum anthelminthic in the beginning and end of each rainy season, indiscriminate used of flukicide should be avoided as it could lead to the development of drug resistance and nomads should be educated on methods of prevention and control of the disease.

REFERENCES

Adang, L. K.,Kela, S. L. and Kashere, M. B. (2015) *Fasciolosis* in cattle slauthered at Gombe abattoir, Nigeria. *Int. Bio. Chem. Sci.*,**9** (2): 7783-792.

Anawat, P., chalobol, W., Anmat, R. and Jong-Yil, C. (2015). Experimental life historyandbiological characteristics of *Fasciolagigantica*(digenea: Fasciolidae) *Korean J.Parasitol.*,**53** (1): 59 – 64.

Arjona, A., Riancho, J.A., Aguado, J.M., Salesa, R. and Gonzalez-Macias, J. (1995) Fasciolosis in developed countries: A review of classic and aberent farms of the disease. *Medine Baltimore*,**74** (1): 13-23.

Bhatia, B.B., Pathak, K.M. L. and Juyal P. D. (2014).Text book of Veterinary ParasitologyReprinted by KalyaniPublishers, New Delhi 110002 India.41-46 and 55 – 65pP.

Biu, A.A., Ahmed, M. I. and Mshelias, S. (2006) Economic Assessment of loses due to parasitic diseases common at the Maiduguri abattoirs Nigeria. *Afr. Sci.*,7(3): 143 – 145.

Damwesh, S. D. and Ardo, M.B. (2012). Epidemiological studies of Bovine Fasciolosis in Yola modern abattoir, Adamawa, state Nigeria. *Vom J. Vet. Sci.*, **9** (1): 54- 60.

Hanson, J. and Perry, B. (1994). The Epidemiology, diagnosis and control of helminth parasites of ruminants:A hand book of food and agricultural organization of the united nations, Rome, Italy. 72-89.

Hassan, A. A. and Anwo, O. O. (2010). Trematode egg infection of gall blader in cattle slaughtered at isheriOlofin, Ogun State, Nigeria. Book of obtracts 6th annual conference of the zoological Social of Nigeria, held at conference centre University of Ibadan from 1st – 5th March pp 20.

Iboyi, M.O., Adaga, P.A. and Imandeh, N.G. (2017). Study on the Prevalence of Fasciolosis on cattle slaughtered at Minna modern abattoir Niger State, Nigeria. *J. Appl.Life Sci. Int.*, **15** (3): 1-6.

Idris, H. S., Amota, K. S., Azare, B. A. and Madara, A. A. (2004). Prevalence *Faciolosisgigantica* in cattle slaughtered in Gwagwalada Abattoir, Abuja, Nigeria. Abstract of papers 2nd*National Conference of the Zoological Society of Nigeria* held at Institude of development research, Ahmadu Bello University, Zaria, Nigeria from 8th – 11th November, Pp23.

Kelly, W. R. (1999). Veterinary clinical Diagnostic second edition, Pp.199-201.

Keyyu, J. D., Kassuku, A. A., Msalilwa, L. P., Monrad, J. and Kyvsgaard, N. C. (2006). Cross sectional prevalence of helminth infection in cattle on traditional, small scale and large scale dairy farms in Iringadisctrict, Tanzania. *Vet. Res.Commun.*, **30** (2): 45-50.

Magaji, A. A., Kabir, I., Salihu, M. D. and Saulawa, A. (2014). Prevalence of Fasciolosisin cattle slaughtered in Sokoto Metropolitan Abattoir, Sokoto, Nigeria, *Adv. Epid.*,**4**:10-15.DOI: 10.1155/2014/247258. http://dx.doi.org/10.1155/2014/247258.

Odige, B. E. and Odigie, J. O. (2013).*Fascioliasis* incattle: a survey of abattoirs in Egor, Ikpoba – okha and Oredo Local government areas of Edo State, using histochemical techniques. *Int. J. Basic Appl. Innovative Res.*,**2**(1):1-9.

Oladele-Bukola, M. O. and Odetoku, I. A. (2014). FasciolosisPrevalence of Bovine Fasciolosisat the Ibadan minucipal abattoir, Nigeria. *Afr. J. Food Agric. Nutr. Dev.*,**14** (4): 9056-9070.

Olusegun-Joseph, T. S., Doherty, V. F. and Edeghagha, B. O. (2000). Prevalence of Fasciolosisin cattle slaughtered at Zaria abattoir Accessible from www.jenvscs.com.

Qureshi, A. W., Tanveer, A., Magbool, A. and Niaz, S. (2012). Seasonal and monthly prevalence pattern of Fasciolosisin baffaloes and its relation to some climatic factors in North-Eastern areas of [Punjab, Pakistan.*Iranian J. Vet. Res.*,**13** (2): 134-137.

Shahzad, A., Iqbal, Z., Ali, M., Chaudhry, H. R., Sial, N., Ahsan, U., Ali, A. and Afif, M. Z. (2014). Seasonal Prevalence of *Fsciola hepatica* infection in buffaloes Bahawalpur district of Punjab, Pakistan. *J. Infect. Mol. Biol.,* **2** (2):30-32.

Suhardono, R. J. A. and CApeman, D. B. (2006).Distribution of Metacercariae of *Fasciolagigantica*on rice straw *Trop. Anim. Health Prod.,* **38**: 117-119.

Walker, S. M., Makurdi A. E. and Namuba, F.V. (2008).The distribution of *Fasciola hepatica* and *Fasciolagigantica*within Southern Tanzania Constraints Associated with the Intermediate Host.*Parasitol.*,**135** (4): 495-503.

Yahaya, A. and Tyav, B. (2014).A survey of gastro intestinal parasitic helminthes of bovine slaughtered in abattoir, Wudil local government area, Kano state, Nigeria.*Greener J. Biol. Sci.*, **4**(4): 128-134.

Yohanna, J. A., Maisaje, R. D., Nwibari, B. M. W. and Njoku, C. I. (2012).Gastrointestinal helminths among slaughtered cattle at Jos abattoir, Plateau State.*Nig. J. Parasitol.*, **33** (2):141-144.

A RETROSPECTIVE STUDY ON PREVALENCE OF PPR AND HELMINTHOSIS OF SHEEP AND GOATS IN KANO AND ENVIRONS

[1]Yahaya, A.,[2]Mai, H. M., [2]Ahmad, A. A.,[3]Okoh, J. J.,[3]Maigado, A, I.,[4]Qadeer, M. A. and [1]Kalla, D. J. U.
[1]Nigerian Institute for Trypanosomiasis Research, Katsina
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
[3]Department of Animal Science, Federal University, Kashere
[4]Department of Zoology, School of Life Sciences,ModibboAdama University, Yola
Corresponding Author's Email:asmaiwanki@gmail.com

ABSTRACT
A retrospective study was conducted on prevalence of *Pests-des-PetitsRuminantum* (PPR)and helminthosisfromKundila veterinary hospital and Gwale veterinary clinic, Kano state, Nigeriabetween2012 and 2016. The investigation revealed the presence of the diseases in the study area. The results recorded showed the highest prevalence of PPR during early rainy season(34.98%), whereashelminthosis was observed to be higherduring the late rainy season (40.00%).Based on species, PPR tended to be higher in goats than sheep; 76.88% and 23.12% respectively. On the other hand, sheep were more susceptible to helminthosis(65.49%) than goats (44.71%). Regarding sex of the small ruminants, both the diseases were more prevalent in females than males:PPR;females (60.31%),males (39.68%) and helminthosis;females (54.26%)males (45.74%). ThePPR and helminthosis are important diseases of small ruminants which may affect their productivity. The results indicated that the diseases occurred throughout the study period and all year round with varying intensities. The occurrenceofthe diseases in both species were statistically significant ($P<0.05$) in relation to sex, season, species and annual distribution. It is recommended that farmers should be enlightened on the effects of the diseases, routine management and seeking prompt veterinary attention in cases of outbreaks.Annual vaccination against PPR isemphasized.
Keywords: Goats**,**Helminthosis,PPR**,**Sheep

INTRODUCTION
Nigeria has an estimated populationof 490 million Sheep and 483 millionGoats. The contribution of livestock to the overall food output in developing countries is increasing faster than that of cereals. In 1990, meat production increased from 69million tones to about 105million tones by the year 2000 (FAO, 2003).Small ruminants constitute an important source of animal protein to Nigerians. A lot of socio-economic importance is therefore attached to ownership of these animals. In some cases, it may be the only reliable wealth of a rural household. This economic importance is primarily associated with their small size, as it favours low investment, small risk of loss and their high reproductive efficiency (Omoike, 2006). Sheep and goats are major sources of food and fiber and play very significant social and economic roles in developing countries. Sheep and goats' secondary functions include the production of milk, wool, skin and manure (Tefera *et al*., 2009).

Pests-des-PetitsRuminantum (PPR)is endemic in various parts of the world including Nigeria(Peacock, 1998;ILCA, 1991). The PPR was first described in sheep and goats in 1956 in Ivory Coast (Cote D'voire) and the Republic of Benin. Small ruminants in all climatic zones of Nigeria are affected by the disease (Peacock, 1998). It has been among the most devastating diseases of small ruminant production in Nigeria. PPR is Rinderpest-like in manifestation and still has a great influence on animal protein supply in many countries (ILCA, 1996).

Helminthosis is a disease or group of diseases which affects animal hosts caused by parasitic worms known as *helminiths*. The infestation is prevalent and constitutes a serious economic problem in livestock. Helminthosis is also a serious risk to humans and companion animals such as dogs, cats and other pets (WIPO, 1994). The rate of development of the parasites tends to increase with rise in temperature and moisture which are factors known to be common in Nigeria, particularly in the northern part. The parasites develop rapidly to the infective stage (Williamson, 1989), and are controlled using various forms of anthelminthic (Peacock, 1998).

RESULTS AND DISCUSSION
The results obtained revealed the variation in the clinical prevalence of both PPR and helminthosis in sheep and goats in the study area. Goats appeared to be more susceptible to PPR than sheep with 3,927 (76.88%) and 1,181 (23.12%) respectively. This is in line with the report of Tail (1984) which

stated thatGoats are often affected by the acute form of the disease while sheep usually suffer from the sub-acute or chronic form. Also, according to Obi (1992) sheep are found to be less affected with PPR than goats.

On the contrary to the findings on PPR above,helminthosisis found to be higher in sheep than goats with 3,422 (65.49%) and 1,803 (34.51%) respectively. This is in line with the results of Downie (1990) who recorded higher prevalence of helminthosis in sheep than in goats.

Based on sex, female sheep and goats showed higher frequency for all the diseases than their male counterparts.This trend is similar with the report of Egwurube and Ofukwo (2002) who indicated higher cases of helminthosis and PPR in females than males small ruminants.

The seasonal distribution of PPR and helminthosis in sheep and goats seem to occur all year round with varying prevalence. In the case of PPR, the highest infestation of 1,784 (34.98%) occurred during the early rainy season followed by the early dry season1,736 (33.99%), then late dry1,073 (21.01%) with least prevalence during the late rainy season 512 (10.02%).The rise in the prevalenceduring the early rainy season and the fact that the disease is mostly encountered all year round is in agreement with the findings of Obi (1990) and Tamburawa (1997) from southern Nigeria.

In case of helminthosis, the highest number of cases was encountered during the late rainy season 2,090 (40.00%). This is in consonance with the findings of Smyth (1996) who stated that these parasites require a period of development outside the host before becoming infective and that the rate of their development and survival are influenced by climatic and environmental factors such as a rise in temperature and moisture. Also, eggs of some trematodes such as *Fasciolahepatica* and *Fasciolamagna* are found to be wide spread in wet, swampy or sub-irrigatedareas which support the emergence of substantial population of their intermediate hosts(snails).

Annually, thedistribution of the disease revealedthe total of 5,108 cases of PPR in both sheep and goats within the study period (2012 – 2016). The highest prevalence of 1,403 (27.47%) were recorded in the year 2016 while the lowest prevalence of 612 (11.98%) was observed in 2014. Thisresultcorresponds with that of Taylor *et al*. (1990), who reported that the disease follows a cyclic pattern with significant increase in prevalence every 3 – 4 years.

For helminths, 5,225 cases were recorded with the highest of 1,501 (28.73%) in 2016. The lowest number of cases of 682 (12.02%) was obtained in 2013. The trend of the disease showed an increasing pattern. Thisis in agreement with the suggestionof Peacock (1996) that the probable increase in animal population and inadequateknowledge of the disease by farmers and poormanagement practices such as lack of regular deworming lead toincrease of the disease.Theresult of the study indicated that occurrence ofthe diseases in both species were statistically significant ($P<0.05$) in relation to sex, season, species and annual distribution.

CONCLUSIONS AND RECOMMENDATIONS

The investigation revealed that thediseasesareendemic in the study area with an increased in prevalence in both species.Theoccurrence of the diseases was affected byspecies, sex, season and annual distribution.Farmers should be enlightened on the effects of these diseases, need to seek for prompt veterinary attention and improved management practices such as good hygiene and annual vaccination against infectious diseases especially PPR.

REFERENCES

Dorny, P., Symoens, C., Jalila, A., Vercruysse, J. and Sani, R. (1995). *Strongyle* infections in sheep and goats under the traditional husbandry system in Peninsular Malaysia.*Vet Parasitol*, **56**: 121-136.

Egwurube and Ofukwu (2002) Clinical cases of helminthosis in Sheep and Goats in Makurdi Area of Benue State Nigeria. *Anim.Prod. J.*,**26**(1): 47-49.

FAO(1992).Distribution and impact of helminth diseases of livestock in developing countries.

ILCA (1999): Livestock Production in Sub-Humid Zone of West Africa, A Regional Review.

Obi, T. V., Ojo, M. O. and Durujaiye, O. A. (1992).*Impact of Livestock disease in Africa*.*Vet. J.*, Pp. 209

Omoike, A. (2006). Prevalence of disease among sheep and goats in Edo State, Nigeria.*J. Agric.Soc. Res*., **6**(2): 23-31.

Peacock, C. (1996). Improving Goats Production in the Tropics.A manual for development worker.*OX Farm/Farm Africa Publication*.

Smyth, J. D. (1996).Animal Parasitology *Cambridge University Press. Cambridge*.

Taylor, W. P. Obi, T. V. and Rome, L.W. (1990). Serological Studies with PPR and Rinderpest virus in Nigeria. *Trop.Anim.Health Prod.*, **16**:115.

Tamburawa, M.S. (1997). The Epidemiology of pest des petitit ruminant (PPR) in Bauchi state.*B.Sc Agric. Tech. Thesis.* ATBU, Bauchi Nigeria.

Tefera, M.Batu, G.Bitew, M.(2009).Prevalence of gastrointestinal parasites of sheep and goats in and around Bedelle, South Western Ethiopia.*Internet J. Vet.Med*.,**8**(2):1-6.

Williamson, I. I. (1978). New Biology for West Africa School longman. England.

Wipo (1994).World Intellectual property organization lonene polymers as anthelmintic in animals.Pp. 2.

A SEVEN YEAR RETROSPECTIVE STUDY OF BOVINE TUBERCULOSIS IN JOS ABATTOIR, PLATEAU STATE, NIGERIA

[1]Mai, H. M., [1]Ahmad, A. A.,[1]Bello, M. A.,[2]Qadeer,M. A., [3]Bobbo, A. G.,[4]Umar,M. B.and [1]Umar, M. B.
[1]Department of Animal Production,
Faculty of Agriculture and Agricultural Technology,
Abubakar Tafawa Balewa University, Bauchi
[2]Department of Zoology, ModibboAdama University of Technology, Yola
[3]Department of Animal Science, ModibboAdama University, Yola
[4]Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria
Corresponding Author's Email:hassanmai@hotmail.com

ABSTRACT
This retrospective study was aimed at determining the prevalence of tuberculosis in cattle slaughtered in Jos abattoir from 2010 to 2016. A total of 41,607 cattle were slaughtered during the periodwith an overall prevalence of 3.3%. The result showed highest number 876 (8.6%) of tuberculosis lesions in 2010 and the lowest 7 (0.1%) was observed in 2014. There was seasonal trend of tuberculosis lesions with peak prevalence in early rainy season. In terms of months, May showed the highest and December the lowest prevalence. The study showed that bovine tuberculosis is prevalent in Plateau state. Government at all levels should organize public enlightenment campaigns aimed at highlighting the zoonotic importance of bovine tuberculosis among butchers, livestock owners, veterinarians and meat handlers who are at high risk of acquiring the disease. Proper meat inspection at the abattoirs should also be employed.
Key words: Bovine, prevalence, retrospective, tuberculosis,

INTRODUCTION
Tuberculosis (TB) is an infectious, chronic and debilitating disease caused by acidfast, rod-shaped bacillus *Mycobacterium tuberculosis* which typically affects the lungs but can affect other organs (WHO, 2001).Bovine tuberculosis results from infection with *Mycobacterium bovis* that occasionally affects other species of mammals butcattle are the primary host (Abubakar *et al*., 2005). It is a zoonotic disease that can spread to humans typically by the inhalation of aerosols, ingestion of unpasteurised milk or through breaks in the skin. Raw or undercooked beef can be a source of infection (Ameen *et al*.,2008).In most cases, *M. bovis* is transmitted between cattle in aerosols during close contact. Drinking raw milk is the primary route of *M. bovis* infection in humans; hence human tuberculosis caused by *M. bovis* is mostly extra pulmonary, particularly in cervical lymphadenitis (Ameni and Erkihun, 2007).
Although bovine tuberculosis was once found worldwide, control programs have eliminated or nearly eliminated the disease from domesticated animals in countries like Denmark and Sweden(Ashford *et al.*, 2001; Ameni and Erkihun, 2007). Bovine tuberculosis is still widespread in Africa, parts of Asia and some Middle Eastern countries (Assaged*et al*., 2000).According to WHO Report (2011), tuberculosis continues to be a global priority. In 2010, an estimated 8.5–9.2 million tuberculosis cases were reported globally along with 1.2–1.5 million deaths (including deaths from TBamong people living with HIV). Asia and Africa are disproportionately affected with 57% and 26% of the disease burden, respectively (WHO, 2011).

MATERIALS AND METHODS
Surveillance records of slaughtered cattle and suggestive tuberculosis lesions examined at postmortemfrom 2010-2016 in Jos abattoirPlateau State was used.Characteristics TB lesions on organs were diagnosed by veterinary officers andsimple percentages were used in analyzing the result.

RESULTS AND *DISCUSSION*
Records on annual slaughtered cattle and suggestive TB lesion cases at Jos abattoir, Plateau State, Nigeria showed that a total of 41,607 cattle were slaughtered from 2010-2016, out of which 1,373

(3.3%) were found with lesions of tuberculosis at post mortem. The record reviewed revealed that, the highest number 876 (8.6%) of tuberculosis lesions in cattle were recorded in 2010 followed by *275 (5.6%) in 2011.* However, the lowest prevalence of (0.1%) was recorded in 2014, then (0.2%) prevalence in 2015 and 2016 consecutively. The low prevalence observed in this study may be due to under reporting and reduced activities at the abattoir as a result of extensive religious and ethnic crisis experienced in the study area.

Information on bovine tuberculosis in Plateau State is limited, though TB was the most common pathology encountered at abattoir*(*Lilian *et al*., 2016).*Below arethe annual results (Figure 1) and monthly distribution of suggestive tuberculosis lesions (Figure 2).*

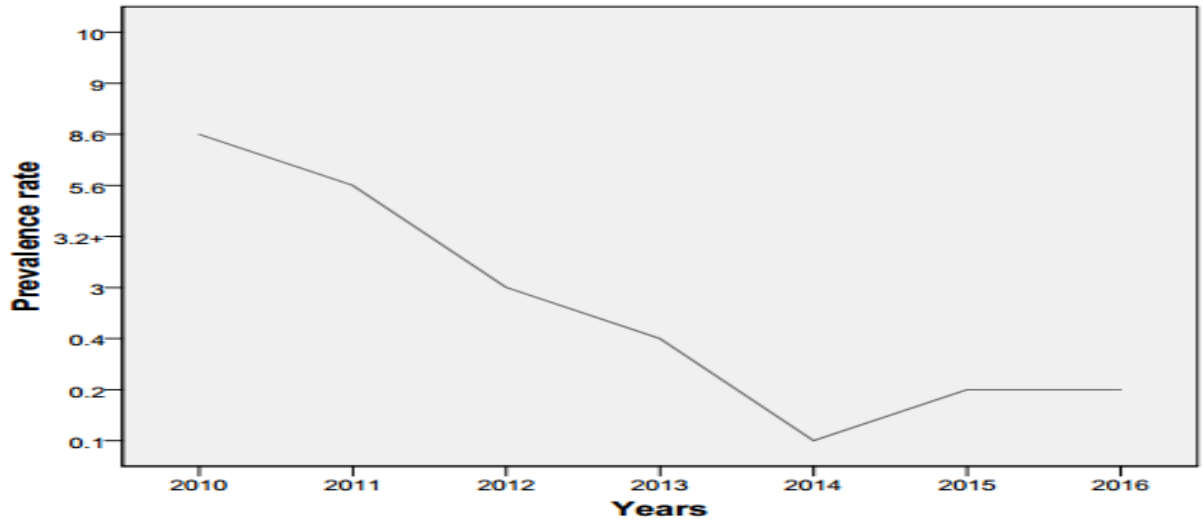


Figure 1:*Overall prevalence of TB lesions in cattle from 2010-2016.*

The finding of this study showed that TB is more prevalent during the months of May(most critical) and least in December (Figure 2). This supports the report of Perry *et al*. (2002) who stated that the detection of tuberculosis lesions was influenced by season and it was higher during stressful periods such as inter-season and peak-season periods and also when slaughtering was elevated. In addition, similar observation was reported by Bikom (2005) in Cross River State abattoir indicating strong association between the occurrence of tuberculosis lesions and seasonal distribution.

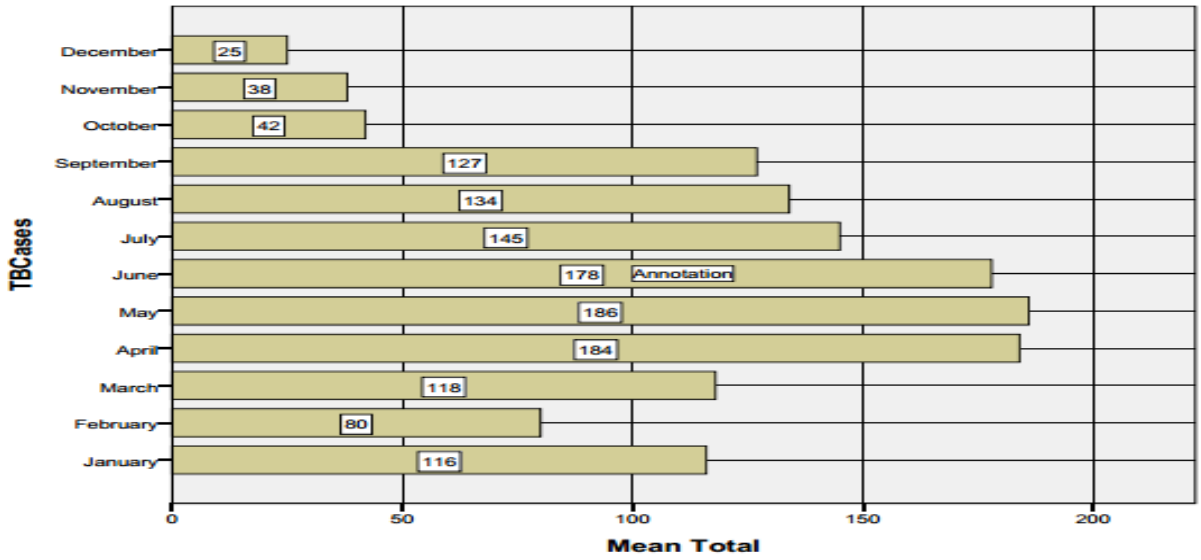


Figure 2: *The number per month of suggestive tuberculosis lesions from slaughtered cattle at Jos South abattoir, Plateau State*
Nigeria 2010-2016.

The reasons responsible for the wide fluctuation in annual distribution of the TBduring the entire period of the study were not clear. However, inadequacies in capacity building and lack of thoroughness of the veterinary staff carrying out meat inspection could have played major roles. These agree with Perry *et al*. (2002) who reported that postmortem surveillances for detection of bovine TB lesions in particular depend on the work load, time and diligence of the inspectors conducting the examinations.It was also common that when veterinary staff inspect carcasses, condemn and seize infected meat and meat products for disposal, some pathological cases may be missed completely due to lack of adequate personnel in the abattoirs couple with rough behaviors of butchers and meat traders. In addition, with repeated meat inspections, butchers acquire ample knowledge about the nature of pathologies that can lead to condemnation of carcassesand therefore avoid condemnation of their products by the veterinary staff. Furthermore, unruly butchers could obstruct inspection of their carcasses or hide lesions from meat inspectors.

CONCLUSIONSAND RECOMMENDATIONS

The study showed that tuberculosis is present in the study area and adds to the existing evidence depicting lack of adequate knowledge on the effect of tuberculosis.Public awareness is essential to avoid theconsumption of improperly cooked meat especially lungs and the zoonotic nature of TB. Condemnedmeat should bediscarded, burnt or buried and owners of such should beadequatelycompensated. Proper surveillance/ambulatory servicesshould be carried out within the state and its environs, for diagnosis and treatment of infected animals.This information can serve as critical input for health programmesaiming at tackling the cases of tuberculosis in bothanimals and humans.

REFERENCES

Abubakar, A. A., Brooks, P. H., Abdullahi, S. U., Kudi, A. C andOkaiyeto, O. (2005).Epidemiology of bovine and human tuberculosis in the Federal Capital Territory of Nigeria, Abuja.*Proceedings of the British Society of Animal Science Annual Conference*; 4th-6th April, York, UK.

Ameen, S. A., Adedeji, O. S., Raheem, A. K., Leigh, O. O., Rafiu, T. A andIge, A. O. (2008).Current status of bovine tuberculosis in organisms area of Oyo state. *Middle East J. Sci. Res.*,**3**(4):207-210.

Ameni, G. andErkihun, A. (2007).Bovine tuberculosis on small-scale dairy farms in Adama Town, central Ethiopia, and farmer awareness of the disease.*Sci. Tech. Rev.*,**26**(3):711-9.

Ashford D. A., Whitney, E., Raghuntan, P. andCosivi, O. (2001). Epidemiology of selected Mycobacteria that infect humans and other animals - In: Mycobacterial infections in domestic and wild animals. *Sci. Tech. Rev.*,**20**(1): 265-290.

Assaged, B., Lubke-Becker, A., Lemma, E., Tadele, K. and Britton, S. (2000). Bovine tuberculosis: a cross-sectional and epidemiological study in and around Addis Ababa. *Bull. Anim. Health Prod. Afr.*,**48**:71-80.

Bikom, P. M. (2005).Incidence of Bovine Tuberculosis in Cross River State Abattoirs, Nigeria. An*MSc Thesis, Faculty of Veterinary Medicine, University of Nigeria, Nsukka*.

Cadmus, S. I. B., Adesokan, H. K., Adejuwon, T. A. andAdeyemi, M. O. (2008). Retrospective Study of Bovine Tuberculosis and other diseases of Public Health Importance in Oko-Oba Abattoir, Lagos State - Book of Abstracts. *J. Nig. Vet. Med. Ass.*,**089**:72-73.

LilianAkudoOkeke, OlufunmilayoFawole, Maryam Muhammad, IkennaOsemekaOkeke, Patrick Nguku, Peter Wasswa, David Dairo, Simeon Cadmus (2016). Bovine tuberculosis: a retrospective study at Jos abattoir, Plateau State, Nigeria. *Pan. Afr. Med. J.*,**25**:202.

Perry, B. D., Randolph, T. F., Mcdermott, J. J., Sones, K. R. and Thornton, P. K. (2002).In Investing in Animal Health Research to Alleviate Poverty. *Int. Livestock Res. Inst., Nairobi (Kenya)*:ILRI.,Pp.148.

World Health Organisation"WHO" (2001).Infections and infectious diseases.*A manual for nurses and midwives in the WHO European Region*.World Health Organization Regional Office for Europe and International Federation of Red Cross and Red Crescent Societies.

World Health Organisation "WHO" (2011) Global Tuberculosis Control: *WHO Report. Geneva*.

RETROSPECTIVE STUDY ON THE PREVALENCE OF TURKEY POX IN BAUCHI METROPOLIS FROM 2010 TO 2017

[1]Mai, H. M.,[1]Ahmad, A.A., [1]Abdullahi, S., [2]Umar, M. B.,[3]Bobbo, A. G.,[1]Sanusi, M. and [1]Kalla, D. J. U.
[1]Department of Animal Production,Abubakar Tafawa Balewa University, Bauchi
[2]Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria
[3]Department of Animal Science, ModibboAdamaUniversity, Yola
Corresponding Author's Email:hassanmai@hotmail.com

ABSTRACT
The study was conducted at Area Veterinary Clinic Ran Road Bauchito investigate the prevalence of turkey pox in turkeys from 2010 to 2017. A total of14,596 turkeys were presented, out of which 1,822cases of turkey pox were recorded within the study period. The highest prevalence of 28.3% was observedin 2010and the least (6.4%) in 2013. turkey pox overall monthly prevalence was higher in the month of September and August with 15.4% and 13.4% respectively and the lowestprevalence was recorded in November with 4.8%. In addition,turkey pox overall prevalence was higher in poults/hens than chicks/tomswith 58.9% and 41.1% respectively. Similarly, the overall prevalence was higher in poults/chicksthan hens/tomswith 72% and 28% respectively. Out of the total number of cases recorded during the study period, late rainy season accounted for the highest prevalence of 39.2%, followed by late dry season 26.7%, early dry season 17.3% and early rainy season 16.9%. However, season and sexhave nostatistically significant difference on disease occurrence whereas ageis significant ($p<0.01$). The findings of this study indicate that, turkey pox is an important avian disease affecting turkeys which may decrease their productivity. Therefore, it is recommended thatturkey farmers should be enlightened on methods of prevention and control whichshould include vaccination and use of netted cages/houses to control vectors of the disease.
Key words: Poults, Prevalence,Retrospective,Toms,Turkeypox.

INTRODUCTION
The production and consumption of eggs and poultry meat is increasing worldwide. Over the last quarter of a century, the consumption of eggs has doubled and chicken meat tripled (Jordan and Pattisons, 2001). Poultry production forms an important component of Nigeria's livestock sector as a provider of employment and income. Over 70% of those who keep livestock are reported to keep poultry birds for the production of day old chicks, meat, eggs, and poultry manure for rural, urban and semi-urban populations (Amar-Klemesu and Maxwell, 2000; Eduvie, 2002). Poultry sector is next to ruminants as a source of animal protein supply in Nigeria and accounts for about 25% of local meat production (Ajala and Alli-Balogun, 2004).
There are many underrated, but highly promising poultry species such as turkeys, quails and guinea fowls. Turkey (*Meleagrisgallopavo*) is a type of poultry species with numerous attributes; turkey thrives better under arid conditions, tolerates heat better and has higher quality meat (Yakubu*et al.,* 2013). Currently, turkey production is an aspect of poultry industry whose potentials have not been fully utilized and is one of the most suitable alternative sources of animal protein supply in Nigeria considering the cost of production (Ibe, 1990; Peters *et al.*, 1997).Smith (1990) reported that carcasses of turkeys contained a higher percentage of protein than the carcasses of chickens.
Diseases have been the major constraint in rearing domestic poultry especially in developing countries (Van-Riper and Forrester, 2001). Turkeypoxis one of the most commondiseases in the wild turkey population(Wright *et al.*, 2005). It is caused by turkeypox virus of the genus *Avipoxvirus* under the family *Poxviridae*(Timoney, 1988). Like all avipoxviruses, is transmitted either through skin contact or by arthropods (typically mosquitos) acting as mechanical vectors(Wobeser, 1997).*Avipoxvirus* infections have been reported in over 232 bird species in 23 orders of birds, but most of our knowledge comes from the study of *fowlpox* virus and *canarypox* virus as they are the only species with full genome sequences available (Weli and Tryland, 2011).

Turkey Pox is a worldwide, slow-spreading disease characterized by formation of progressively increasing nodular lesions in part of the unfeathered skin such as head, upper neck and eyelids (cutaneous form) that progresses to thick scab or fibrin necrotic and proliferative lesions in the mucous membrane of the upper respiratory tract, mouth, and oesophagus (diphtheritic form) (Jordan and Gordon, 1982; Docherty *et al*., 1991). A concurrent systemic infection may also occur (Abdu and Musa, 2014).

MATERIALS AND METHODS

Recorded data on cases of turkey pox for eight years (2010-2017) presented to the veterinary clinic Ran Road Bauchi, Bauchi State were considered. The disease was diagnosed based on flock history, clinical signs and post mortem findings. The distribution of the disease based on sex, age, seasons and months of the year were obtained during the study.

RESULTS AND DISCUSSIONS

A total of14,596 turkeys were presented to the veterinary clinic, out of which 1,822cases of turkey pox were recorded within the study period. This gives an average of about 228 cases annually. The year 2010 recorded the highest number of cases 515(28.3%), while the lowest prevalence of 117(6.4%) were recorded in 2013 (Table 1). The results confirmed the high prevalence of turkey pox in the study area. The disease may be exacerbated by other pathogens such as viruses of Newcastle disease, infectious bronchitis and fowlpox, and also *Haemophilusparagallinarum* and *Mycoplasma gallisepticum*. Deficiency of Vitamin A and excess ammonia in the atmosphere may also predispose to severe turkey pox infection (Jordan and Patherson, 1999).

Table 1: Yearly distribution of positive cases of turkey pox in Bauchi metropolis during the eight year period (2010 – 2017)

Year	Number positive	Percentage +ive
2010	515	28.3
2011	222	12.2
2012	181	9.9
2013	117	6.4
2014	153	8.4
2015	194	10.6
2016	214	11.7
2017	226	12.4
Total	**1,822**	**100**

In relation to sex, poults/hens are found to be more infected than chicks/toms with 1074(58.9%) and 748(41.1%) prevalence respectively. This may not be unconnected to the fact that, farmers usually keep high number of poults/hens than chicks/toms in the study area.

Based on age, a total of 1,310 cases were recordedin poults/chickswhich account for (72%) prevalence whereas512(28%)prevalence were recorded in hens/toms.This corresponds to the report of Odoya*et al.* (2006) which reported higher outbreak in young turkeys in VomPlateau State, Nigeria. The high prevalence in young ones could also be associated with the under developed immune system of the young ones which make them more susceptible to the infection than adults.

In relation to the season, the overall prevalence revealed the highest infection in late rainy season with 713 (39.2%), followed by late dry season 487 (26.7%) and early dry season 314(17.3%). The least prevalence was recorded in the early rainy season 308 (16.9%).The monthly distribution of the disease indicates a steady rise from July through Augustand the peak in September. This represents the rainy season when there is high presence of the disease vectors (mosquitoes) responsible for transmitting the disease causing organism to the susceptible hosts (turkeys).This agrees with the findings of Anon (1991) whostated that when mosquitoes are plentiful, transmission within the flock may be rapid. Furthermore, in another study,Odoya*et al*. (2006) reported the outbreak of the turkey

pox inVom, Plateau State, Nigeria in the month of June which also indicated the highoccurrence of the disease in the rainy season.In this study,there was no significant difference observed between the prevalenceof turkey poxwith sex but with ageat $p<0.01$.

CONCLUSIONS AND RECOMMENDATIONS

The study showed that turkey pox is a major constraint affecting turkey production in Bauchi metropolis causing economic losses by reducing productivity, predisposing affected birds to secondary infections; attract treatment cost thereby increasing cost of production.Birds of all sexes and ages are susceptible to the infection. It is recommended that control measuresagainst mosquitoes should be adapted as the potential preventivemeasure.Fowl pox vaccine is the most common vaccine used against the infection in Nigeria. However, development of turkey pox vaccine from turkey pox virusis strongly recommended for effective prevention of the disease.

REFERENCES

Abdu, P. A. and Musa, U. (2014).Textbook of Avian Medicine.*P.A. Ndahi Press Zaria, Nigeria*, 94-96.

Ajala, M.K. and AlliBalogun, J.K. (2004) Economics of rabbit production in Zaria, Kaduna state,Nigeria. *Trop. J. Anim. Sci.*,**7:**1-10.

Amar-Klemesu, M. and Maxwell, D. (2000). Accra: Urban Agriculture as an Asset Strategy. In: Supplementary Income and Diets, Bakker, N., M. Dubbeling, S. Gundel, U.S. Koschella and H. de Zeeuw (Eds.). *Growing Cities, Growing Food, Havana, Cuba,*Pp234-236.

Anon (1991).Merk Veterinary Manual.*Merck and Con Inc.* USA,p. 1625-1626.

Docherty, D. E., Long, R. I., Flickinger, E. L. and Locke, L. N. (1991) Isolation of poxvirus from debilitating cutaneous lesions on four immature grackles (Quiscalus sp.). *Avia. Dis.*,**1**:244-7.

Eduvie, L.O. (2002). Poultry production as an important componenent of Nigeria's livestock subsector.*A training manual on national training Workshop on Poultry production in Nigeria in NAPRI, ABU, Shika, Zaria, Nigeria*.

Ibe, S.N. (1990) Utilizing local poultry genetic resources in Nigeria proc. *4th World Congress on Genetics Applied to Livestock, Edinburgh Scotland*.Pp 51-53.

Jordan, F.T.W. and Gordon, R.F. (1982).Poultry Disease 2nd edition *BaillitereTindedCasset Ltd*,p.119.

Jordan, F.T.W. and Patherson M. (1999).Poulrty Disease. 4th edition.*W.B Sanders Company Ltd*, p.171– 172.

Jordan, F.T.W., Pattison, M., Saunders, W.B. (2001).*Poultry.Diseases*.,1996 4th and 5th edition.

Odoya. E.M., Abegunde, A., Agyogbo, B.G., Omotainse, S.O., Gwankat, E. and Okpara, U.G. (2006). Outbreak of turkey Pox Disease in Fowl Pox vaccinated Poults in Vom Plateau State of Nigeria. *Afr.J. Clin. Exp. Microbiol*.,**7**(2): 136-138.

Peters, S.O., Ikeobi, C.O.N. and Bamkole, D.D. (1997) Smaller holder local turkey Production in Ogun State, Nigeria. In: Sonaiya, E.B. (Ed). Issues in Family Poultry Development Research. Proceedings of an international workshop held in at M'Bour Senegal. Published by the *International Network for Family Poultry Development Department of Animal Science*.ObafemiAwolowo University Ile-Ife Nigeria, Pp. 308.

Smith, A.J. (1990). Poultry.The Tropical Agriculturist series.*The Macmillian Press Ltd, London*.

Timoney, John Francis (1988), Hagan and Bruner's Microbiology and Infectious Diseases of Domestic Animals, *Cornell University Press*, ISBN 978-0-8014-1896-9.

Van-Riper, C.,and Scott, J.M. (2001).Limiting factors affecting Hawaiian native birds. In Studies in Avian Biology,Vol. 22, J. M. Scott, S. Conant, and C. van Riper III (eds.). Allen Press, Lawrence, Kansas, U.S.A., Pp. 221–233.

Weli, Simon C. andTryland, Morten (2011). "Avipoxviruses: Infection biology and their use as vaccine vectors". *Virol.J.*,**8**: 49.

Wobeser, Gary, A. (1997), Diseases of Wild Waterfowl, *Springer*, p. 50, ISBN 978-0-306-45590-2.

Wright, E. J.,Nayar, J. K. and Forrester, D. J. (2005). "Interactive effects of turkeypox virus and *Plasmodium hermani* on turkeypoults". *J. Wildl. Dis*., **41** (1): 141–8.

Yakubu, A, Abimuku, H.K., Musa-Azara, I.S., Idahor, K.O., Akinsola, O.M. (2013).Assessment of flock structure, preference in selection and traits of economic importance for domestic turkey (*Meleagrisgallopavo*) genetic resources in Nasarawa State,Nigeria.*J. Agric. Ext. Rural Dev.*, **25** (18).www.Irrd.org/Irrd25/1/yaku25018.htm.

GROWTH PERFORMANCE AND SKIN LESION SCORE OF WEANED PIGS REARED ON GUINEA GRASS BEDDED PIGSTIES

Adebiyi O. A, Idahosa P. O, Tolno Haly, Kadiri Ibukun, Famakinwa A. A., Bankole T. O., Adebiyi F. G. and Muibi M. A.

Department of Animal Science, University of Ibadan, Ibadan, Nigeria

Corresponding Author: Famakinwa A.A. E-mail:famakinwaayoola@yahoo.com, Tel:08067509274

ABSTRACT

In order to ensure sustainable pig production in most tropical countries, alternative flooring systems need to be investigated and adopted. A five-week experiment was carried out to investigate the growth performance and skin lesion score of 36 weaned pigs, separated into four treatments with three replicates each, in a completely randomized design. The treatments include three different heights of Guinea Grass Straw (GGS): T1 (without GGS): concrete floor, T2: 0.1m high GGS, T3: 0.2m high GGS and T4:0.3m high GGS. Data were collected on growth performance: final weight, weight gain, feed intake and feed conversion ratio (FCR) and skin lesion (front, middle and rear). All data obtained were subjected to analysis of variance (ANOVA). Weight gain 4.75kg (T3) was higher ($P<0.05$) when compared with 4.28kg (T2), 3.94kg (T4) and 3.34kg (T1). Final weight followed similar trend with pigs in T3 (9.94kg) having the highest weight compared with T2 (9.40kg), T4 (9.22kg) and T1 (8.55kg). Higher ($P<0.05$) FCR was recorded for T1 (4.72) while the least was in T3 (3.39). The result for skin lesion for the different parts observed, revealed the least lesion in pigs on T3 and higher occurrence in pigs on T1 (without beddings). Generally, skin lesions occur most at the front legs and heads. It can be concluded that the use of guinea grass straw at the depth of 0.1m and 0.2m can improve the performance of weaned piglets, while guinea grass straw of 0.3m high reduced skin lesions score.

Keywords: Beddings, depths, environmental enrichment, guinea grass, weaned pigs

INTRODUCTION

The value of enrichment materials for pigs could be higher if the materials are complex and compound (Jensen and Pedersen, 2007) and include one or more attractive food components (Olsen *et al.,* 2000). Studnitz *et al*. (2007) concluded that exploratory behaviour of pigs is best stimulated by materials that are complex, changeable, destructible, manipulable and contain sparsely distributed edible parts. Experts on pig welfare assign considerable importance to the availability of a substrate such as straw in their welfare assessments of housing systems (Spoolder *et al*., 2003). Enrichment and flooring are important factors affecting the incidence of injuries and stomach ulcers in pigs. Ariane *et al.* (2005) evaluated the impact of housing systems on the health and welfare of grower and finisher pigs. Evaluation of pig behaviours associated with health and welfare were assessed through indicators including presence of lesions on the snout, ears, shoulders, legs and tail. Ramis *et al.* (2005) found that the prevalence of limb lesions was much greater in barren-housed pigs (24% of observations) compared to pigs housed in sawdust-bedded barns (1% of observations). Guinea Grass (*Panicum maximum*) which is indigenous to Africa and widely distributed in West Africa, grows naturally in many parts of Nigeria, this could therefore help in boosting welfare-friendly pig production systems in Nigeria. Hence, this study was conducted to investigate the growth performance and skin lesion score of weaned pigs reared on guinea grass bedded pigsties.

MATERIALS AND METHOD

The experiment was carried out at the Piggery Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State.Thirty-Six (36) (Land race X Large white) weanling pigs were used for the study. The animals were kept and monitored for one week for acclimatization and proper adaptability before the commencement of the experiment. Animals were fed with commercial feed and water was provided *ad libitum*. The treatments were the control (without straw) and three different heights of Guinea Grass Straw (GGS): T1: concrete floor (without GGS), T2: Guinea Grass Straw (0.1m high), T3: Guinea Grass Straw (0.2m high), T4: Guinea Grass Straw (0.3m high). Growth performance data were collected on initial weight, feed intake, weight gain, final weight and feed conversion ratio (FCR).For the purpose of skin lesion assessment, the body of the pigs was divided into three parts. Each part received a score based on the number of lesions on it. The parts of the body assessed were: (1) front (head, neck, shoulders and front legs), (2) middle (flanks and back) and (3) rear (rump, hind legs and tail). To keep the scores consistent throughout the experiment, direct observation of the skin

following the checklist of Björklund (2005) was used. All data obtained were subjected to analysis of variance (ANOVA) using SAS 9.2 (2012) Software. Means were separated using Duncan's Multiple Range Test (DMRT) of the same statistical software.

RESULTS

PERFORMANCE CHARACTERISTICS

The effect of different height of guinea grass straw beddings on performance characteristics of weaned pigs was as shown in Table 1. The average initial weights ranged from 5.12kg to 5.28kg. There was no significant effect (P>0.05) of the different straw height on the feed intake, however, pigs in T1 consumed the highest feed (15.73kg) while the least was 15.56 in pigs on T3 and T4. There was significant (P<0.05) difference in weight gain, final weight and FCR. Weight gain in T3 (4.75kg) was higher compared to 4.28kg (T2), 3.94kg (T4) and 3.34kg (T1). Final weight followed the same trend with pigs in T3 (9.94kg) having the highest weight compared to T2 (9.40kg), T4 (9.22kg) and T1 (8.55kg). Highest FCR was recorded in T1 (4.72) while the least was in T3 (3.39).

Table 1: Effect of different height of guinea grass straw beddings on performance characteristics of weaned pigs

Depth(m)	Initial weight(kg)	Feed intake(kg)	Weight gain(kg)	Final weight(kg)	FCR
T1	5.21	15.73	3.34^{b}	8.55^{c}	4.72^{a}
T2	5.12	15.60	4.28^{ab}	9.40^{ab}	3.68^{b}
T3	5.19	15.56	4.75^{a}	9.94^{a}	3.39^{b}
T4	5.28	15.56	3.94^{ab}	9.22^{bc}	3.98^{ab}
SEM	0.22	0.05	0.17	0.11	0.13

^{a,b,c} means on the same column with different superscripts are statistically significant (P<0.05)

SEM: Standard error of means; T1: Concrete, T2: Guinea grass staw at 0.1m high, T3: Guinea grass straw at 0.2m high, T4: Guinea grass straw at 0.3m high, FCR: Feed conversion ratio

SKIN LESION OBSERVATIONS

The mean skin lesion score on the front body part among the treatments is reported in Figure 1. It was observed that the control treatment (T1) had lesions at the various parts (front legs (1), shoulder (1), neck (1)) and recorded the highest score (2) for head among the treatments. The least lesion was recorded in GG 0.3 where lesion was observed only in the front leg (1). Figure 2 illustrates the mean skin lesion score on the middle body part of the pigs among the treatments. T2 and T4 had no record of lesions. However, the control (T1) and T3 recorded a lesion score of 1 each on the flank. Figure 3 shows the mean skin lesion score on the rear body part of the pigs among the treatments. There was no record of lesion on pigs in T3 and T4. However, the control (T1) had lesion records for hind leg (1) and tail (1) while T2 had a lesion record for hind leg (1).

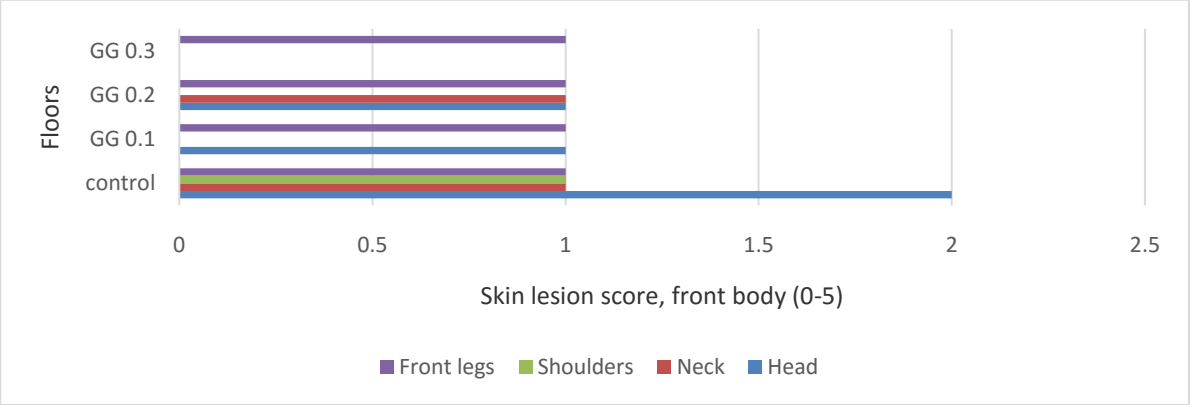


Figure 1: Mean skin lesion score on the front body part of the pigs among the treatments
Control: Concrete at 0metres high; GG 0.1: Guinea grass bedding at 0.1metres high; GG 0.2: Guinea grass bedding at 0.2metres high; GG 0.3: Guinea grass bedding at 0.3metres high.

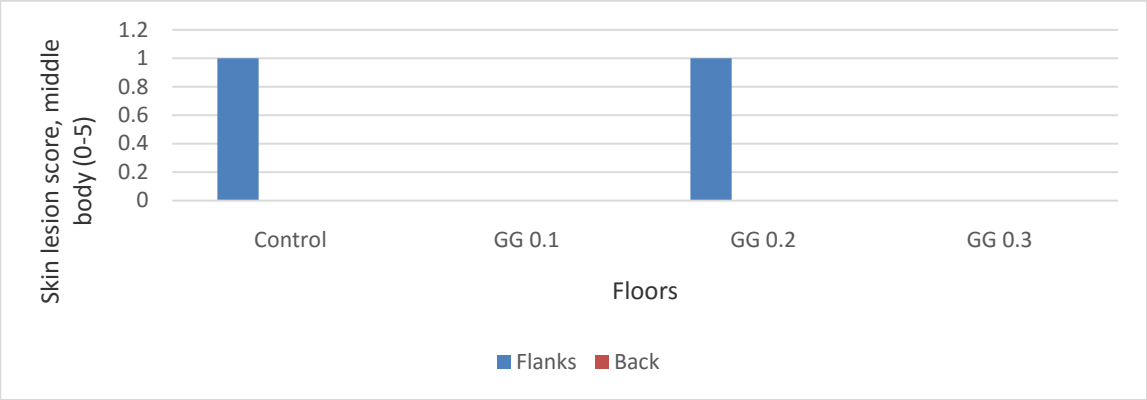


Figure 2: Mean skin lesion score on the middle body part of the pigs among the treatments
Control: Concrete at 0metres high; GG 0.1: Guinea grass bedding at 0.1metres high; GG 0.2: Guinea grass bedding at 0.2metres high; GG 0.3: Guinea grass bedding at 0.3metres high

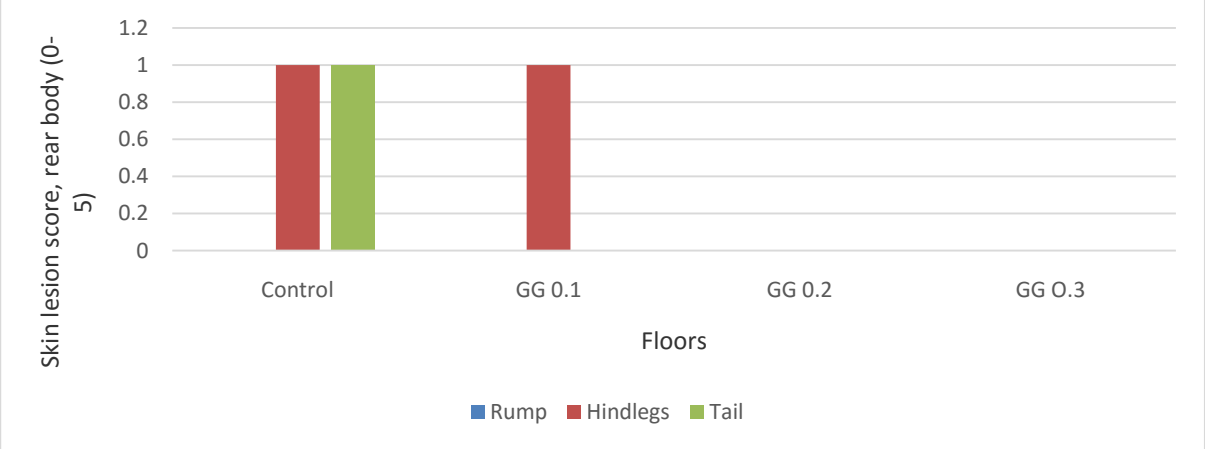


Figure 3: Mean skin lesion score on the rear body part of the pigs among the treatments
Control: Concrete at 0metres high; GG 0.1: Guinea grass bedding at 0.1metres high; GG 0.2: Guinea grass bedding at 0.2metres high; GG 0.3: Guinea grass bedding at 0.3metres high.

DISCUSSION

Environmental enrichment is crucial for pig production as it reflects in their performance and welfare. In this study it was observed that treatments with beddings had higher values for final weight and weight gain. This corroborate the findings of Vanheukelom *et al*. (2011) that reported an increase in post weaning weight gain for pigs housed in an enriched environment. In the study of Van de Weerd *et al.*, (2006) using different enrichment substrates, it was reported that pigs housed in straw-bedded pens had higher daily weight gain than their counterparts. Conversely, Jordan (2013) reported that straw and hay did not influence growth rates of pigs. It was also observed in this study that the FCR across the treatments were lower in treatments with beddings when compared to the concrete floor. This was in agreement with the report of Beattie *et al.* (2000) that observed a similar trend in pigs reared on wood shavings as against concrete floor.

The provision of guinea grass bedding in this study was beneficial to the pigs as most of the lesions recorded were from pigs housed in concrete floor. This agreed with the findings of Ramis *et al*. (2005) on prevalence of limb lesions in barren-housed pigs (24% of observation) compared with pigs housed in sawdust-bedded barns (1% of observations).Specifically, Peterson *et al*. (1995) reported that pigs housed in pens enriched with straw, logs, and branches spent more time rooting, biting, and chewing the provided materials, whereas pigs housed in barren environments spent more time rooting, biting, and chewing the floors and walls of their pen. These findings suggest that any environmental enrichment that promotes exploration and is an outlet for oral activities may be the most effective means of redirecting oral vices away from pen fittings and penmates in order to improve animal well-being. This might explain the reason why in this study, tail lesion was only recorded in the control (without guinea grass straw) since there was absence of explorative materials that could help divert the attention of the weaner pigs. On the contrary, Scott *et al.* (2006) reported that adding enrichment objects to straw-bedded pens had no influence on skin injuries.

CONCLUSION

It is therefore, concluded that guinea grass height of 0.1m and 0.2m are preferred for the enhancement of the conventional concrete floor in consideration for growth performance, while height of0.3m is excellent enhancement of concrete floor in terms of skin lesion occurrence.

REFERENCES

Ariane, C., Regula, G. and Danuser, J. (2005). The impact of different housing systems on health and welfare of grower and finisher pigs in Switzerland. Swiss Federal Veterinary Office, Switzerland

Beattie, V.E., O'Connell, N.E., Moss, B.W. (2000): Influence of environmental enrichment on the behaviour, performance and meat quality of domestic pigs. *Livestock Production Science* 65, 71–79

Björklund, L. (2005). Effects of rearing boars and gilts in mixed-or single-sex groups and split-marketing on behaviour, welfare and performance. Linköping: Linköpings universitet—Institute of Technology

Jensen, M. B. and Pedersen, L. J. (2007). The value assigned to six different rooting materials by growing pigs. *Applied Animal Behaviour Science*, 108: 31-44

Jordan D. (2013): Environmental enrichment in intensive production systems for farm animals [PhD Thesis]. Baden-Württemberg, Germany: University of Hohenheim; 2013

Olsen, A. W., Vestergaard, E. M. and Dybkjaer, L. (2000). Roughage as additional rooting substrates for pigs. *Animal Sciences* 70: 451-456

Peterson, V., Simonsen, H.B., Lawson, L.G. (1995): The effect of environmental stimulation on the development of behaviour in pigs. *Applied Animal Behaviour Science* 45, 215–224. pp.73-74

Ramis, G., Gomez, S., Pallares, F. J. and Munoz, A. (2005). Comparison of the severity of esophagogastric, lung and limb lesions at slaughter in pigs reared under standard and enriched conditions. *Animal Welfare*, 14: 27-34

SAS, (2012). Statistical Analytical Software User's Guide. Static version 9.2 Ed. SAS institute Inc. Cary

Scott, K., Taylor, L., Gill, B.P., Edwards, S.A. (2006): Influence of different types of environmental enrichment on the behaviour of finishing pigs in two different housing systems. 1. Hanging toy versus rootable substrate. *Applied Animal Behaviour Science* 99, 222–229.

Spoolder, H. A. M., De Bree, J., Van der Mheen, H. W. and Bracke, M. B. M. (2003). Not animal related but housing parameters determine an experts intuitive welfare assessment of pig farms. In: Ferrante, F., Canali, E., Carenzi, C., Mattiello, S., Minero, M., Palestrini, C., Tosi, M.V., Verga, M. (Eds.), Proceedings of the 37th International Congress of the ISAE, Abano Terme, Italy, 24–28 June

Studnitz, M., Jensen, M. B. and Pedersen, L. J. (2007). Why do pigs root and in what will they root? A review on the exploratory behaviour of pigs in relation to environmental enrichment. *Applied Animal Behaviour Science*, 107: 183-197

Vanheukelom, V., Driessen, B., Maenhout, D. and Geers, R. (2011). Peat as environmental enrichment for piglets: the effect on behaviours, skin lesions and production results. *Applied Animal Behaviour Science*, 134, 42-47

Van de Weerd H.A, Docking C.M, Day J.E.L, Breuer K, Edwards SA.(2006): Effects of species – relevant environmental enrichment on the behaviour and productivity of finishing pigs. *Applied Animal Behaviour Science* 2006;99:230-47.

INFLUENCE OF STOCKING DENSITY ON THE TEMPERATURE AND HUMIDITY OF BROILER CHICKEN PENS

[1]Asaniyan*, E. K. and [2]Akinduro, V.O.

[1]Department of Animal Production and Health, Ondo State University of Science and Technology, P.M.B.353, Okitipupa. Ondo State, Nigeria.

[2]Department of Animal Science, College of Agriculture, Osun State University, P. M. B 4494, Osogbo. Osun State, Nigeria

Corresponding Author : E-mail: ekasaniyan@gmail.com Phone: +2348035726703

ABSTRACT

This study was conducted to investigate the effect of stocking densities on the temperature and humidity of broiler pens during the wet season. Ninety day-old chicks of Arbor acre breed were used for the experiment which lasted 8 weeks. The birds were randomly assigned to three treatments of stocking densities 5, 10 and 15 birds/m^2 with three replicates per treatment in a deep litter house. Data on daily ambient Temperature and Relative Humidity within the pen were obtained using the Maxims thermocron i-button Temperature and Humidity sensors, which were programmed to measure at 10 minutes sampling interval. Virtually no significance observed between the stocking densities in weekly mean temperature and relative humidity in the broiler chicken pens throughout the period of the study. Therefore, it is concluded that stocking density does not influence broiler chicken's ambient temperature and humidity.

Key words: Broilers pens, stocking density, temperature, humidity

INTRODUCTION

The commercial production of broiler chickens under intensive management is commonly at stocking densities higher than optimum stocking density of 5 birds per m^2 (Asaniyan and Agbede, 2012). This may influence the ambient condition of the birds. The impact of the ambient condition may be beneficial or detrimental, depending on the extent of weather elements variations. The impact of weather elements may be expressed singly or in combinations; for instance, Bianca (1976) reported that low ambient temperature plus high air movement (cold) or high ambient temperature and high relative humidity plus solar radiation (heat) exert various effects on animal well-being, demonstrated in neuroendocrine, cardiorespiratory and behavioural responses. The concern for weather elements in recent years is due to the fact that they are not constant, but change continuously. Such changes affect the internal environment of birds, including the blood through the nervous and endocrine systems (Oladele *et al*., 2003). In the tropical environment, weather elements exert significant influence on domestic birds. Direct weather elements affecting birds include, especially, high ambient temperature and high relative humidity, resulting in severe heat stress (Ayo *et al*., 2011). The report of Egbunike (1979) suggests that the effect of a hot environment on the body of birds depends not only on the nature of the microclimatic factors involved, but also on their intensity. Heat stress is very common and on the increase in the tropical and subtropical production of poultry chickens. It inflicts heavy economic losses on poultry production as a result of stunted growth (Sahin *et al.,* 2001). In Nigeria, the combination of high ambient temperature and high relative humidity, reaching climax at the onset of the rainy season, constitutes extreme heat stress, which depresses the production of broiler and layer birds. Conversely, the low ambient temperature and low relative humidity, prevailing from November to February during the Harmattan season, especially in the morning and evening hours of the day, enhance egg and broiler production (Bannor and Ogunsan, 1987). Heat stress depresses growth rate and production as a result of a down-turn in voluntary feed intake in broilers (Sahin *et al.,* 2001). Heat stress is a deterrent to successful and profitable poultry production (McNabb and King, 1993). The optimum ambient temperature range for poultry is 12–26◦C (Plyaschenko and Sidorov, 1987). However, the ideal temperature for broilers is 10-22˚C to get optimum body weight and 15-27˚C for feed efficiency (Rama Rao *et al*., 2011). A temperature above 30˚C represents a heat-stressed condition for birds and is one of the most common stressors that affect the production criteria in poultry (Rama Rao *et al*., 2011). Broiler heat loss is comprised of two components; latent heat loss and sensible heat. Latent heat loss is usually expressed as the amount of water evaporated from the

broiler, referred to as "moisture production". Evaporation uses broiler heat to change water state from liquid to vapor. The evaporation takes place inside the broiler as water passes over the wet surfaces of its respiratory system. Sensible heat loss refers to heat dissipated through heat transfer from the broiler to the surrounding air. If the air is cooler than the broiler's surface temperature, heat flows from the broiler to the surroundings. If the air is warmer than the broiler's surface temperature, broilers will not be able to dissipate heat and heat stress will occur. Stress is of major concern for poultry industry because it exerts deleterious effects on different parameters like feed intake, feed conversion ratio, weight gain and so on (Pawan *et al*., 2012). Therefore, this study tends to investigate whether stocking densities influence ambient temperature and relative humidity within the broiler chicken pens.

MATERIALS AND METHOD

This study was carried out on the Poultry Unit of the Teaching and Research Farm, Joseph Ayo Babalola University, Ikeji Arakeji, Osun State, Nigeria; located at latitude 07° 51' N and longitude 4° 88' E.Prior to the start of the experiment all chicks were individually weighed and randomly assigned to three groups of different stocking densities. Each pen was 1m^2. In each treatment, the chicks were kept in tagged pens under deep litter management system in a ventilated house. Ninety (90) day-old chicks of Arbor acre breed were used as experimental unit in the experimental trial that lasted eight (8) weeks. The birds were randomly assigned to three treatments of stocking densities S5, S10 and S15 of 5, 10 and 15 birds/m^2 respectively with three replicates per treatments. The birds were raised in deep litter system bedded with wood-shaving litter.

The meteorological data (Temperature and Relative humidity) within the pen were obtained using the Maxims thermocron i-button Temperature and Humidity sensors, which were programmed to measure at 10 minutes sampling interval. Each of the sensors were shielded and well positioned in each pen. Data on the daily ambient temperature and relative humidity were collected throughout the eight weeks duration of the study. The data obtained from the experiment were subjected to Analysis of Variance and the means were separated by Duncan Multiple Range Test (SAS Institute, 1987).

RESULTS AND DISCUSSION

The weekly mean values of weather parameters observed in the broiler chicken pens under the three stocking densities (5, 10 and 15 birds/m^2 tagged S5, S10 and S15 respectively) are presented in Table 1.

Table 1: Weather parameters of poultry pens at three different stocking densities from week 1 to 8

Week	Temperature			Relative Humidity		
	S5	S10	S15	S5	S10	S15
1	27.15±0.193	27.15±0.198	27.22±0.196	79.5±0.801	79.4±0.826	79.3±0.814
2	30.61±0.318	29.73±0.278	29.76±0.279	74.4±0.699	77.8±0.564	78.2±0.595
3	29.84±0.266	31.79±0.360	76.9±0.932	83.0±0.642	75.9±0.998	31.43±0.353
4	30.18±0.213	26.94±0.178	27.59±0.180	69.8±0.733	82.6±0.670	79.7±0.655
5	27.05±0.138	25.62±0.125	25.94±0.125	80.9±0.512	88.3±0.515	86.7±0.475
6	26.71±0.163	25.88±0.132	26.19±0.135	84.5±0.618	90.2±0.561	88.5±0.518
7	26.75±0.144	26.02±0.138	26.25±0.137	82.9±0.663	88.3±0.715	86.4±0.644
8	25.47±0.136	25.88±0.136	26.09±0.138	87.8±0.639[a]	88.5±0.665[b]	86.8±0.598[ab]

Mean± SEM S5 = 5 birds/m^2; S10 = 10 birds/m^2; S15 = 15 birds/m^2Means with different superscripts in the same row are significantly different (P<0.05).

The overview of the responses revealed no significant (P>0.05) influence of the stocking densities on weekly mean temperature and relative humidity of the poultry pens throughout the period of study except in week 8 for the relative humidity.The mean temperatures of the broiler chicken pens showed similar increasing trends from the first week to the third week with the peaks at 31.43±0.353^{o}C for treatments S5 (5birds/m^2), 29.84±0.266^{o}C for S10 (10birds/m^2) and 31.79±0.360^{o}C for S15 (15birds/m^2), and decreased thereafter. The increasing temperatures that got to their peak at week three for the different treatments was probably as a result of increasing body sizes of the broiler chicks that enhance increasing metabolic activities with the corresponding heat loss through the skin and breathing. However, the temperature that peaked on week three and decreased thereafter confirmed the fact that broiler chickens had limited physiological capacity to control body temperature at the early age (1-4 weeks) as reported by Maarten *et al*. (2015). Also, the differently peaked temperatures for the treatments could be attributed to the different stocking densities; showing that stocking densities is directly proportional to the temperature within the broiler pens. Therefore, increasing stocking densities could bring about increased ambient temperature according to the findings of Dawkins *et al*. (2004). However, recorded mean temperatures were not too far from the 30°C crucial temperature for poultry, beyond which feed and energy intake declines to such an extent that birds are no longer able to compensate for it, thereby suffer rapid production decline and increase rate of mortality (Daghir, 2009).This tends to show that the birds experienced similar ambient atmospheric condition throughout the period irrespective of the different stocking densities. The significant (P<0.05) influence of the stocking density on the relative humidity among the treatments at the eighth week could be jointly associated with the relative differences in temperature at week 8 and the age related increase in metabolic activities that yielded more respiratory and faecal moistures that contributed into atmospheric moisture within the pens. Fortunately, mortality was not recorded throughout the duration of this study. This could be an indication that the weather conditions within and outside the broiler house during rainy season (between late May and early July) when the study

was conducted had contributed favourably (good ventilation) to the inability of the stocking densities to influence the weather situation within the broiler pens significantly to the detriment of the broilers' welfare. This corroborated the report of Dawkins *et al*. (2004) that high environmental quality is far more important than density per se in maintaining good health, performance and welfare of broiler chickens. Therefore, irrespective of stocking density levels, adequate ventilation has the mediating potential against the fatality of weather modification in the broiler pens.

CONCLUSION

There was virtually no significant influence of the stocking densities on weekly mean temperature and relative humidity in the broiler chicken pens during the rainy season.

Recommendation

Irrespective of stocking density levels, rearing environment of broiler chickens should not compromise adequate ventilation.

REFERENCES

Asaniyan, E.K.and Agbede, J.O. (2012). Potentials of Sand as Litter Material instead of Wood Shavings in Broiler Enterprise. In: Building a Non-Oil Export Based Economy for Nigeria: The Potential of Value-Added Products from Agricultural Residues. (Ed. Simeon O. Jekayinfa) Göttingen: Cuvillier, 2012, p. 229 - 240.

Ayo, J. O., Obidi, J. A. and Rekwot, P. I. (2011). Effects of Heat Stress on the Well-Being, Fertility, and Hatchability of Chickens in the Northern Guinea Savannah Zone of Nigeria: A Review. ISRN Veterinary Science (2011), 10.5402/2011/838606

Bannor, T.T. and Ogunsan, E.A. (1987). The effect of environmental temperature on intensive poultry in Sokoto State of Nigeria. *Bulletin of Animal Health and Production in Africa*. 1987;35:39–45.

Bianca, W. (1976). The significance of meteorology in animal production. *International Journal of Biometeorology*. 1976;20(2):139–156.

Daghir, N.J. (2009). Nutritional Strategies to Reduce Heat Stress in Broilers and Broiler Breeders, *Lohmann Information*, Vol. 44, No.1 (April 2009) pp. 6-15. ISSN: 1617-2906

Dawkins, M.S., Donnelly, C.A. and Jones, T.A. (2004). "Chicken welfare is influenced more by housing conditions than by stocking density." Nature 427:342-344.

Egbunike, G.N. (1979). The relative importance of dry- and wet-bulb temperatures in the thermorespiratory function in the chicken. *Zentralblatt fur Veterinarmedizin. Reihe A*. 1979; 26(7):573–579.

Maarten de, G., Koos van, M., Kristof van M., and Ellen van't, V. (2015). Broiler signals, A practical Guide to Broiler Focused Management. 120 pp. Roodbont Agricultural Publishers B.V. The Netherlands.

McNadabb, F. M. A. and King, D. B. (1993). "Thyroid hormone effect on growth, development and metabolism in vertebrates," *Zoological Science*, vol. 10, pp. 873–885, 1993.

Oladele, S.B., Ogundipe, S., Ayo, J.O. and Esievo, K.A.N. (2003). Seasonal and species variations in erythrocyte osmotic fragility of indigeneous poultry species in Zaria, Northern Guinea Savannah zone of Nigeria. *Bulletin of Animal Health and Production in Africa*. 2003; 51:204–214.

Pawan, K. V., Yashwant, S., Rajinder, R. and Jitender, K. (2012). Stress Biomarkers in Vanaraja Chicken Maintained Under Various Rearing Systems. *Journal of Advanced Veterinary Research* Volume 2 (2012) 5-8.

Plyaschenko, S.I. and Sidorov, V.T. (1987). Stresses in farm animals. *Agropromizdat, Moscow*. 1987:192 pages. (Rus).

Rama Rao, S.V., Raju, M.V.L.N., Panda, A.K., Poonam, N.S., Moorthy, O.K., Srilatha, T. and Shvam (2011). Performance, carcass variables and immune responses in commercial broiler chicks fed graded concentrations of threonine in diet containing sub-optimal levels of protein. *Animal Feed Science and Technology* 169 (3-4), 218-223, 2011.

Sahin, N., Sahin, K. and Küçük, O. (2001). Effects of vitamin E and vitamin A supplementation on performance, thyroid status and serum concentrations of some metabolites and minerals in broilers reared under heat stress (32°C) *Veterinarni Medicina*. 2001;46(11-12):286–292.

SAS Institute Inc. (1987). SAS/STATTM Guide for Personal Computers. Version 6, SAS Institute Inc. Cary.

INCUBATION WEIGHT LOSS, FERTILITY AND HATCHABILITY OF JAPANESE QUAIL (*Coturnixcoturnixjaponica*) EGGS AT DIFFERENT AGES IN LAY

Ayoola,A.A.,Egbeyale, L. T. Ayodeji, E. T. and Olatunbosun, O. B.
DepartofAnimalProductionandHealth,FederalUniversityofAgriculture,P.M.B.2240, Abeokuta, Nigeria
Corresponding author- ayoolaaa@funaab.edu.ng, 08062299054

ABSTRACT
This study was conducted to determine the effect of age on the Incubation weight loss, fertility and hatching characteristics of Japanese quail eggs. One hundred and fifty (150) Japanese quails comprising of one hundred (100) females and fifty (50) males were selected from 5 weeks old quail flock on the farm. Eggs were collected from the birds in triplicate for incubation at different ages i.e. the 9th, 13th and 17th weeks of age of the birds. Data were collected on incubation weight loss, fertility, hatching traits and subjected to One-way Analysis of variance. Age of Japanese quail did not significantly (P>0.05) affect fertility. Hatchability was better at 13(74.64%) and 17(70.09%) weeks of age. The highest (P<0.05) embryonic mortality was recorded at the 9th week of age and chick weight varied consistently with egg weight. Based on the result obtained in this study, it could be concluded that age did not influence incubation weight loss, fertility and hatch weight. Hence, eggs for hatching should be selected after four weeks in lay.
Keywords: Fertility, Hatchability, Incubation and Embryonic mortality, Age

INTRODUCTION
One of the important factors such sex ratio, period and condition of egg storage, breeding system and the parental life weight that will have effect on fertility and hatchability of eggs is the age of the laying quails (Narahari *et al.*, 1988). Researchers reported that the fertility (Kling and Soares 1982 and Narahari *et al*., 1988) and hatchability of incubated eggs reduced depending on the older the age of the laying quail (Narahari *et al*., 1988 and Elibol *et al*., 2002) and also embryonic mortality increased in eggs of older laying birds compared to younger ones (Novo *et al.*, 1997). Sahan and Ipek (2000) considered eggs obtained from very young and very old laying quails inappropriate for incubation. Hence, this study sought to investigate the effect of age of laying quail on the laying performance, fertility, hatchability, incubation weight loss and the embryonic mortality in early and late periods.

MATERIALS AND METHODS
Experimental Site: The rearing of the birds was carried out at the poultry unit of the University Farms, Federal University of Agriculture, Abeokuta while egg incubation took place at Obasanjo Hatchery, Owiwi, Abeokuta.
Source and Management of Experimental Birds: One hundred and fifty (150) Japanese quails comprising of one hundred (100) females and fifty (50) males were selected from 5 weeks old quail flock on the University farm and raised in cages. The male to female ratio was 1:2 i.e. 50 females to 25 males. Birds were fed diet containing 20.2% crude protein and 2976.48Kcal/kg Metabolisable Energy. Eggs were picked twice daily (morning and evening).
Experimental Design: Eggs were collected from the birds for incubation at different ages i.e. the 9th, 13th and 17th week of age of the birds. Eggs for incubation were collected within 3days of stipulated weeks and stored in refrigerator (7°C) in order to get sufficient number of eggs. The eggs (180) collected per each week in lay was in triplicate i.e was randomly grouped into three (3) replicates (60 eggs each).
Egg Management: Potassium tetraoxomanganate VII ($KMnO_4$) and formaldehyde (HCHO) at ratio 1:2 was used as fumigant for the eggs. The treatment lasted for 20 minute in a closed chamber. The eggs were set in egg trays with broad end upward to prevent rupture of air cell. Each egg tray was labelled according to the replicate and individual eggs were numbered prior to setting to facilitate data collection. Eggs were set in Petersime incubator (B-9870 model). Temperature (37.5°C) and humidity were automatically regulated. Egg turning was automatic on hourly basis.

Data Collection
Determination of Incubation Weight Loss: The eggs were weighed before setting and on the 15th day. Incubation weight loss was determined using the formula below;
Weight loss (g) = Initial weight – Final weight Weight loss (%) = $\frac{Weight\ Loss\ (g)}{Initial\ \ Weight\ (g)}\ X\ 100$

Percent Fertility: This was determined using the formula stated below;

$$\text{Fertility (\%)} = \frac{Number\ \ of\ fertile\ \ eggs}{Total\ \ number\ \ of\ eggs\ set\ in\ the\ incubator}\ X\ 100$$

Percent Hatchability: This was determined using the formula stated below;

$$\text{Hatchability (\%)} = \frac{Number\ \ of\ chicks\ \ hatched}{Total\ \ number\ \ of\ \ fertile\ \ eggs}\ X\ 100$$

Percent Embryonic Mortality: This was determined using the formula stated below;

$$\text{Embryonic mortality (\%)} = \frac{Number\ \ of\ unhatched\ fertile\ \ eggs}{Total\ \ number\ \ of\ \ fertile\ \ eggs}\ X\ 100$$

Hatch Weight: This was determined using the formula below;

$$\text{Hatch weight} = \frac{Total\ \ Weight\ of\ chicks\ \ hatched}{Total\ \ number\ \ of\ chicks\ \ hatched}$$

Statistical Analysis: Data collected were subjected to One-way Analysis of variance using SAS (1999) while significant means was compared using Duncan's Multiple Range Test (Duncan, 1995) in the package.

RESULTS

Effect of Age on Incubation Weight Loss an hatching Characteristics of Japanese Quail eggs

The incubation egg weight loss and hatching traits of Japanese quails at different ages is shown in Table 1. Percent egg weight loss were similar (P>0.05) at the 9th and 17th week of age, but higher at the 13th week (14.98%) of age. The fertility percentage of the eggs was similar (P>0.05) at all stages of lay considered. Percentage hatchability of eggs collected at the 9th week (58.23%) of age was significantly (P<0.05) lower while the hatchability was similar (P>0.05) at the 13th week (74.64%) and 17th week (70.09%) of age. The total embryonic mortality was highest (p<0.05) in eggs collected at the 9th week (41.77%) of age but was similar (P>0.05) at the 13th (25.36%) and 17th (29.91%) week of age.

DISCUSSION

The observed significance in incubation weight loss across the ages in this study did not give a clear picture of effect of age as there was no definite trend. According to Romanoff (1967), most of the water of the egg is initially in the albumen which declines continuously during incubation as a result of water loss to the ambient air and movement to the compartments.

The result of fertility is in consonance with Islam *et al.* (2002) who reported that age did not influence percent fertility and hatchability but rather by factors such as genetic, physiology, social and environmental factors. However, the result is at variance with Elibol (2002) who reported that fertility decreases as parental age increases. Similarity in fertility among the eggs selected for incubation at various week of age could be as a result of short interval between weeks of collection.

The percent hatchability obtained in this study is in agreement with Insco *et al.* (1971), who stated that a gradual increase was noted regarding the hatchability of incubated eggs of the Japanese quails up to the age of 12-14 weeks then a gradual decrease occurred in the age period of 15-19 weeks. The percent hatchability obtained in this study is also in correlation with the report of Sahan and Ipek (2000) who reported that eggs obtained from very young and very old laying quails are not considered as appropriate for the hatching activities. However, similarity observed between 13th and 17th week of age might be due to short interval (4 weeks interval) between the ages.

Table 1: Effect of Age on Incubation Weight Loss and Hatching Traits of Japanese Quails

	Age of quail hens (Weeks)		
Parameters	9	13	17
Egg weight loss			
Initial egg weight (g)	$9.48^{c} \pm 0.03$	$10.02^{a} \pm 0.60$	$9.67^{b} \pm 0.04$
Final egg weight (g)	$8.22^{c} \pm 0.10$	$8.57^{a} \pm 0.05$	$8.41^{b} \pm 0.05$
Weight loss (g)	$1.26^{b} \pm 0.07$	$1.45^{a} \pm 0.06$	$1.26^{b} \pm 0.10$
Weightloss (%)	$13.29^{b} \pm 0.40$	$14.98^{a} \pm 0.20$	$13.03^{b} \pm 0.38$
Hatching traits	$9.48^{c} \pm 0.03$	$10.02^{a} \pm 0.60$	$9.67^{b} \pm 0.04$
Fertility (%)	96.34 ± 0.42	96.34 ± 2.04	94.34 ± 1.36
Hatchability (%)	$58.23^{b} \pm 3.18$	$74.64^{a} \pm 1.15$	$70.09^{a} \pm 1.78$
Embryonic mortality (%)	$41.77^{a} \pm 3.18$	$25.36^{b} \pm 1.15$	$29.91^{b} \pm 1.78$
Hatch weight (g)	$5.69^{c} \pm 0.06$	$6.54^{a} \pm 0.19$	$5.99^{b} \pm 0.02$

^{abc} means with different superscript differs significantly ($p<0.05$)

Highest total embryo mortality observed at 9th week of age support the result of Ritsareva (1991), who noted that hatching of first laid quail eggs was not satisfactorily successful. Similarity observed between the 13th and 17th week of age is in agreement with Othman *et al*. (2014), who concluded that there was no significant difference between the effects of age of hens on embryo mortality rate of eggs. Variation in chick weight observed in this study could not be attributed to differences in age but due to differences in the weight of eggs incubated as variation were consistent between both. A positive correlation was observed between the egg weight and the chick weight in a related study by Farooq *et al.* (2001).

CONCLUSION

This study concludes that fertility was not influenced by age of quail, however hatchability of eggs collected at the 9th week of age was poorest. Variation in hatch weight of chicks was a result of concomitant variation in egg weight and not the age of quail hens.

RECOMMENDATION

It is recommended that quail eggs for hatching should be selected after 4 weeks in lay for better hatchabillty.

REFERENCES

Elibol, O. and Brake, J. 2004. Identification of critical periods for turning broiler hatching eggs during incubation. *British Poultry Science*, 45(5): 631-637.

Farooq,M., K. Aneela, F.R. Durrani, A.K. Muqarrab, N.Chandand A. Khurshid, 2001. Egg and shell weight, hatching and production performance of Japanese broiler quails. *Sarhad J. Agri.*, 17: 289-293.

Insco, W. M., D. W. Mac Laura, J. J. Jr. Begin and T. H. Johnson, 1971. The relationship on egg weight to hatchability of coturnix eggs. *Poultry Science*, 50: 297- 298.

Islam,M. S.,Howlinder,M. A. R.Kabir, F.andAlam, J.2002. Comparative assessment of fertility and hatchabilityBarredPlymouthRock,WhiteLeghorn, RhodeIslandRedandWhiteRockHen.*International Journal of Poultry Science*., 1: 85-90

Kling, K. and J. H. Soares, 1982 Vitamin E deficiency in Japanese quail. *Poultry Science* 8: 2:55.

Narahari, D., K. A. Mujeer, A. Thangavel, N. Ramamurthy, S. Viswanathan, B. Mohan, B. Burunganandan and V. Sundararasu, 1988. V. traits influencing the hatching performance of japanese quail eggs. *British Poultry Science*, 29: 1:101-112.

Novo, R. P., L. T. Gama and M. C. Soares, 1997. Effects of oviposition time, hen age and extra dietary calcium on egg characteristics and hatchability. *J. Appl.Poult. Res.,* 6: 335-343.

Othman, R. A, Amin, M. R. and Rahman, S. 2014. Effect of egg size, age of hen and storage period on fertility, hatchability, embryo mortality and chick malformations in eggs of Japanese quail (*Coturnixcoturnixjaponica*). *Journal of Agriculture and Veterinary Science*. 7 (1): 101- 106

Ritsareva, A. 1991. Incubation of quail eggs. *Poultry Breeding*, 3: 15-17.

Romanoff, A.J. 1967. Biochemistry of the Avian Embryo. John Wiley and Sons: New York, NY

Sahan, U. and A. Ipek, 2000. Effects of breeder age and incubation humidity on hatching characteristics of broiler breeder eggs. *Journal Poultry Researh*, 2(2):11-14.

CHEMICAL COMPOSITION AND ORGANOLEPTIC EVALUATION OF MINCED MEAT *(DAMBUN NAMA)* OF SOME POULTRY SPECIES

***Ambore C.B., Mancha Y.P., D.J.U Kalla., U.D. Doma**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author: brucecharles95@gmail.com mobile No: 07064328014*

ABSTRACT

The study examined chemical composition, sensory evaluation and microbial loads of minced meat product of poultry species within Bauchi metropolis. Five different minced meat products from guinea fowl, Noiler, Indigenous chicken, Broiler and duck were subjected into sensory evaluation. These products were given to a taste panel which comprises of staffs and student using a 9 – point hedonic scale. The different meat products were subjected to chemical and microbial load analysis. The result showed that in proximate composition of protein ranges from 59.13 – 56.93%, dry matter 83.61 – 81.61%, ether extract 11.29 – 10.19% and Ash 2.03 – 1.83% respectively. The minerals of different minced meat product varied in terms of calcium, from 0.21 – 0.17%, phosphorus 0.20 – 0.15%, sodium 0.06 – 0.04% and likewise potassium 0.003 – 0.001% differ from each other. The microbial counts revealed the total bacteria load of the products varied significantly ($P<0.001$) with indigenous chicken 272.67 x 10^6cfu/g tends to have highest bacteria load while 109.33 x 10^6cfu/g the least load of bacteria was in broiler minced meat. Total fungal count was also significant statistically ($P<0.001$) in various product however, indigenous chicken, 121.10 x 10^6cfu/g differ among the products, statistically and broiler 68.67 x 10^6cfu/g was the lowest. However sensory evaluation of different minced meat product were significant ($P<0.001$) in terms, of flavour, aroma, acceptability while juiciness, palatability were also significant at ($P<0.001$) and colour tends to be significant ($P<0.05$), tenderness not significant among all products. Guinea fowl and Noiler tends to have higher flavour as compared with the rest of the products though all are similar, aroma is high in Noiler (8.33 x 10^6cfu/g) followed by guinea fowl (8.30 x 10^6cfu/g) and low in duck (6.63 x 10^6cfu/g). Juiciness is high in Noiler (8.17x 10^6cfu/g) low in duck (6.67x 10^6cfu/g) respectively. In conclusion Noiler and broiler, meat were most preferred by the taste penalists as well as having the least microbial load. It is safer for short time storage particular for travellers.

Keywords: poultry, Minced meat

INTRODUCTION

Today the world faces the problem of shortage of food supply, which makes malnutrition and its consequences in developing countries a major problem (Sadler *et al.,* 2004). Food of livestock origin such as meat and meat products contain important nutrients like amino acids, vitamins, minerals and fatty acids which are essential for growth and development (World Population Data Sheet, 2010). Further processing of meat offers the opportunity to add value, improve food safety and extend shelf life, resulting in increased household income and improve nutrition. Moreover, a significant number of the world population are deficient in key vitamins and minerals, particularly vitamin A, iodine, iron and zinc. Highly nutritious foods such as meat are required by women, children and HIV AIDS infected people. Bala (2014) showed that meat preservation is more difficult than other forms of food preservation as it may lead to oxidative rancidity, mouldiness, sliminess, discolouration and off flavour. It has been shown that processing of meat produced enhanced handling, packing, distribution and marketing of the products (Omojola *et al.*, 2004). An average Nigerian for instance, consumes only about 10g *per* day of the minimum daily intake of 35g recommended by food and agricultural organization (FAO, 1992). The processing of meat in different forms to avoid spoilage can close the gap of protein shortage (Ani and Okorie 2004). However, in Nigeria there are different types of meat products, specifically dambun nama, as a major contributor of quality nutrients for normal growth and reproduction, less importance is attached to possible effects on health due to product contaminants. Over the last years, there has been a growing interest in meat from different animal species such as duck, guinea fowl, broiler chicken, Noiler chicken, indigenous chicken, rabbit etc (Horbanczuk, 2003). Therefore the objectives of this research was to evaluate the proximate and mineral composition, microbial load and sensory properties of minced meat from duck, guinea fowl, Noiler chicken, broiler chicken and indigenous chicken meat.

MATERIALS AND METHODS

The study was conducted within Bauchi metropolis. Live broiler chicken, duck fowl, guinea fowl, Noiler chicken, indigenous chicken were bought from various locations within Bauchi metropolis. They were taken to Bauchi abattoir for dressing into carcass and immediately transported for processing into minced meat (Dambun nama) and analyzed so as to determine dry matter, crude protein, ether extract, crude fibre and ash following the procedures of AOAC (1995).

Processing of Dambun Nama

(Minced meat) duck, guinea fowl, Noiler, broiler meat (chicken), and indigenous chicken meat were processed to produce various dambun nama. Dambun nama (minced meat was prepared from meat of these livestock using the procedures of Farouk (1995) and Kalla *et al*. (2005). Fresh meat of good grade was cut into pieces of about 4cm by 2.5cm dimension and washed thoroughly with clean water, mixed with spices and ingredients (seasoning, salt, curry, ginger and thyme) boiled for about 90 minutes and pounded into shreds using a mortar and pestle. This was then shallow fried using groundnut oil in stainless steel frying pan to obtain dambun nama, which is usually brownish in colour.

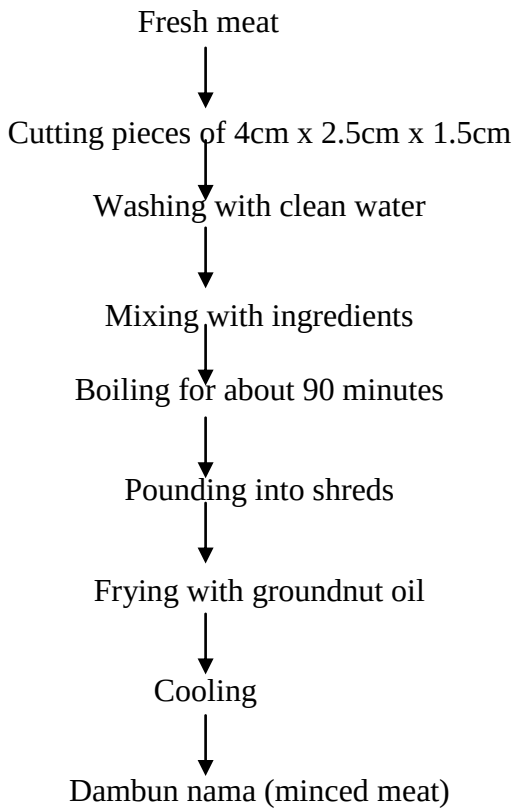


Fig 1: Preparations of Dambun nama: (Bube, 2003)

Data collection

The data for the study were collected through the sixty (60) questionnaires using Hedonic scale. The questionnaires were distributed among university staff and students. Five different samples were given to each individual. All the questionnaires distributed were later collected from different respondents.

Data analysis

Data from the study were subjected to analyses of variance (SAS, 2002). The means with significant differences were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Table 1: Proximate Composition (%) of Minced Meat (Dambun Nama) of Some Poultry Species

	Meat types					
Parameters (%)	**Guinea fowl**	**Noiler**	**Local chicken**	**Broiler**	**Duck**	**Overall mean**
Dry matter	83.61	82.31	82.94	81.61	82.50	82.59
Protein	58.13	59.13	56.93	57.64	57.59	57.88
Ether extract	10.74	10.19	10.23	11.29	10.45	10.58
Ash	1.83	2.03	2.10	1.92	1.86	1.95

The proximate composition of minced meat (Dambun nama) in relation to dry matter, crude protein, ether extract, ash content are shown in Table 1. The values reported were in line with Bube (2003) who reported dry matter contents of 93.8 to 95.9% using monogastric and ruminants dambun nama. This research finding on chemical composition of dambun nama processed from guinea fowl, Noiler, local chicken, broiler chicken meat and duck meat varies among these poultry species. The dry matter was high in guinea fowl followed by local chicken. The trend is in conjunction with the investigation of Bube (2003). Similarly, the protein content of dambun nama was high in Noiler followed by guinea fowl and differ among the others and was in accordance with reports of Bube (2003) and Kalla *et al.* (2005), though parameters such as ether extract and ash tends to followed same trends according to the work of Muhammad *et al.* (2010) who uses local meat products. Ether extract was high in broiler chicken and low in Noiler, ash was high in local chicken and lower on guinea fowl. These could be based on genetic makeup and mode of management in relation to the differences in parameter observed.

The result for mineral composition of minced meat is shown in Table 2. The calcium and phosphorus content is in agreement with the finding of Bube (2003), Kalla *et al.* (2005). Calcium content was high in Noiler, low in local chicken whereas phosphorus was high in Noiler with the least in duck followed by sodium which was high in guinea fowl minced meat and low in broiler minced meat and then potassium was more in local chicken.

Table 2: Mineral composition (%) of minced meat (Dambun nama) of some poultry species

	Meat types					
Parameters (%)	**Guinea fowl**	**Noiler**	**Local chicken**	**Broiler**	**Duck**	**Overall mean**
Calcium	0.19	0.21	0.17	0.18	0.19	0.19
Phosphorus	0.17	0.20	0.15	0.17	0.16	0.17
Sodium	0.06	0.04	0.04	0.03	0.05	0.04
Potassium	0.001	0.002	0.003	0.001	0.001	0.002

Table 3: Sensory evaluation of minced meat *(Dambun Nama)* of some poultry species

	Meat types					
Parameters	**Guinea Fowl**	**Noiler**	**Local Chicken**	**Broiler**	**Duck**	**LOS**
Flavour	8.43^{a}	8.43^{a}	7.90^{ab}	7.60^{b}	6.90^{c}	***
Aroma	8.30^{ab}	8.33^{a}	7.43^{bc}	7.67^{ab}	6.63^{c}	***
Juiciness	7.70^{a}	8.17^{a}	7.87^{a}	7.40^{ab}	6.67^{c}	***
Palatability	8.20^{ab}	8.53^{a}	7.53^{b}	7.90^{ab}	7.50^{b}	**
Tenderness	7.50	8.10	7.20	7.67	7.10	NS
Colour	8.10^{ab}	8.10^{a}	7.57^{ab}	7.67^{ab}	7.17^{b}	*
Acceptability	7.83^{a}	8.53^{a}	7.90^{a}	7.80^{a}	6.97^{b}	***

abc means within row having different superscripts differ significantly at (* =p<0.05, **p<0.01, ***p<0.001, NS = not significant)

Table 3 shows the results for sensory evaluation of minced meat of some poultry species. The most superior flavour was obtained from guinea fowl and Noiler chicken which were closely followed by broiler chicken. Noiler chicken was observed to give the best aroma, guinea fowl Noiler chicken and local chiken were the juiciest while Noiler chicken was the most palatable. All the meat was observed to be tender as there was no significant difference among them. Noiler chicken was observed to posses the best colour. Acceptability is an important quality of meat and from the result it was

deduced that duck meat was the least acceptable while guinea fowl, Noiler chicken, local chicken and broiler chicken were the most acceptable.

Table 4 shows the microbial load of minced meat of some poultry species stored for seven days. The bacterial load of various meat products were significant (P<0.001). Local chicken has the highest bacteria count (272.67 x 10^6cfu/g) followed by the least bacterial count in broiler chicken (109.33 x 10^6cfu/g) which is the most preferred to consumers as reported by Rouger *et al.* (2017) Therefore, ensuring the microbial safety of poultry meat products is an important factor in the context of increasing consumption and production.

Among the products, it was observed that broiler chicken has the lowest fungal load (68.67 x 10^6cfu/g) while local chicken possessed the highest fungal load (121.00 x 10^6cfu/g) which deter its consumption as compared to the broiler which seems to be the most preferred in terms of quality to consumers.

Table 4: Microbial loads of minced meat *(Dambun Nama)* of some poultry species stored for seven days

	Meat types					
Parameters	**Guinea Fowl**	**Noiler Chicken**	**Local Chicken**	**Broiler**	**Duck**	**LOS**
Bacterial Load(2.2 X10^6 cfu/g)	212.00^b	175.67^d	272.67^a	109.33^e	181.33^c	***
Fungal Load(1.08X10^6 cfu/g)	108.33^b	87.00^d	121.00^a	68.67^e	91.67^c***	

abcde mean different superscripts with the row differ significantly (*=p<0.001)**

CONCLUSION

It was concluded that Noiler and broiler birds were most preferred by consumers. Processing poultry meat into minced meat (*Dambun Nama*) significantly increased shelf life and acceptability of the product by the consumers. It is therefore recommended that standard method of processing and production of minced meat be enforced so as to reduce the level of microbial load and increase shelf life.

REFERENCES

Ani, A.O and Okorie, A.U. (2004). Response of broiler finishers to graded levels of dietary castor oil bean (*Ricinus communis L*) meal supplemented with L-lysine proceeding of 9th Annual Conference of Animal Science Association of Nigeria. September 13th -16th 2004. Ebonyi State University, Abakaliki, Pp. 81-85.

AOAC (1995). Official Methods of Analysis. Association of Official Analytical Chemist, Wahington DC, **1510**, P931-946.

Bala, G.R. (2014). Quality characteristics and microbial studies of beef smoked with different plant material and suya produced from round muscles. Unpublsihed M.Sc thesis, Department of Animal Sciences, Ahmadu Bello University Zaria.

Bube, M.M. (2003). Nutritional evaluation of meat from various animal species processed by different methods. Unpublished Ph.D thesis, Animal Production Programme, Abubakar Tafawa Balewa University, Bauchi

FAO (1992) Legumes trees and other fodder trees as protein sources for livestock. Food and Agriculture Organisation of the United Nation, FAO, Rome. **Animal Production Health Paper** 102:14-18.

Farouk, M.M., (1995). Traditional processing of some Nigerian meat products. A paper presented at 19th**Annual Meeting of the Nigeria Institute of Food Science and Technology** (NIFST), Kano, Nigeria, 27-30th August, 1985, p12-23.

Horbanczuk, J.O. I. Malecki, R.G. Cooper A Joz=wik, d. Klewiec, J. Krzyzewski, H. Kalifa, W. Chylinski, A. Wajeik, and M. Kawka (2003). Cholesteral content snd fatty acid composition of two fat depots from slaugheter ostriches (*struthin camelun)* aged 14 months *Animal Science paper presentation***22**: 247-251.

Kalla, D.J.U., Zaharddeen, D., Abubakar, M. Oladotum, F.B. and Jibia, S.D.(2005). Influence of species and processing method on red meat acceptance among panelists of various cultured background in Bauchi. *Journal of Agriculture, Business and Technology*, **3**(2):51-57.

Muhammad, B.F., Muhamood, A..B. and Mustapha, A. (2010). Effects of processing method on composition and consumer acceptability of camel (*camdus dromedaries*) meat and beef. *Nigeria Journal of Animal Production*, 135-143.

Omojola, A.B., Kassim, O.R., Adewumi, M.K., Ogunshola, O.O., Adeyemo, G.O and Deshiyan, A.B. (2004). Evaluation of the effects of variation in ingredients composition on the eating qualities of suya. *African Journal of Livetock Extension*, **3**:28-32

Rouger, A., Remenant, B., Prevost, H., Zagoree, M.A. (2017). Method to isolate bacterial communities and characterized ecosystems from food products; validation and utilization as a reproducible chicken meat model, *International journal food microbiology*, 247:38-47.

Sadler, M., J., (2004): Meat alternatives market developments and health benefits. *Food Science and Technology*. **15**:250-260.

SAS (2002). Statistical Analysis Systems Institute. User Guide version 9.2. Windows cary North, Carolina, USA.

World Population data sheet (2010). Population Reference Bureaus, Washington D.C., 2010.

COST AND RETURN OF BEEF CATTLE BUTCHERY ACTIVITIES IN KANO KADUNA AND KATSINA STATES, NIGERIA

Rekwot, G. Z.,Anosike, F.U., Achi, P.N., Atiku, J.A Owoshagba, O. B and Ibrahim, O.A.
National Animal Production Research Institute, Ahmadu Bello University, Shika, Zaria Nigeria
Corresponding Author's Email and Phone No.: zrekwot@gmail.com+2348038013957

ABSTRACT
The objectives of this study were to determine the profitability of beef cattle production, A multi-stage sampling procedure was employed in the selection of a sample size of 72 beef cattle butchers used in the study. The study made use of primary data which were obtained through the use of computer-aided personal interview software. Descriptive statistics and Net income analysis was used for the data analyses. The results of the profitability of beef cattle butchery activities shows that the total cost incurred in beef cattle butchery was ₦4,093.77 per 10 slaughtered cattle, the total revenue was ₦33,185.15, resulting in a net revenue or profitability of ₦29,091.38 per 10 slaughtered cattle. The results of the constraints confronting the beef cattle butchering activities showed that most (95.5%) of the abattoirs lack facilities. It can be concluded that beef cattle butchery activities was a profitable agribusiness activity. Lack of facilities in the abattoirs was one of the major constraints encountered by majority of the butchers in the study area as such it was recommended that private sector should participate in the provision of better slaughtering facilities such as modern abattoirs.
Key Words: Profitability, butchers, net income, Abattoirs.

INTRODUCTION
Beef cattle production is a crop-livestock economic production activity in the core cattle producing states of Nigeria because they are used for farm operations and subsequently fattened and sold off (Okaiyeto *et al.,* 2006). However, beef cattle production has been shown to be inefficient across nomads, agro-pastoralists and ranchers indicating that there is still much opportunity for increased efficiency given the present state of technology (Nwigwe *et al.,* 2016). Butchery in the beef production includes stunning, exsanguinations, skinning, and evisceration, splitting and selling of the beef and its products to the consumers. Economically butchery activities provide an important source of empowerment and income generation in Nigeria and it has an important socio-cultural position in the rural areas (Oyediran *et al.,* 2018). Empirical evidence on cost and returns of butchery activities in the study area is limited in the study area.
Therefore, the main objectives of this study were to**:**

i. determine the costs and returns of beef cattle butchers in the study area
ii. identify the constraints limiting beef cattle butchers in the study area

METHODOLOGY
Study area
The study was conducted in Kano, Kaduna and Katsina States of north-west zone, Nigeria. The north-west comprises of Jigawa, Kano, Katsina, and Kaduna, Zamfara, Sokoto and Kebbi States. According to the 2006 population census, the total population of the zone was estimated at 35.7 million with an average density of 103 persons per square kilometer (NPC, 2006). The projected population of the zone in 2016 was about 47.5 million, based on an annual growth rate of 3.2%. The north-west zone is known for livestock production activities such as cattle, goat, sheep, and poultry etc.
Sampling and data collection
Multi-stage sampling technique was employed in the selection of the respondents. First, six Local Government Areas (LGAs) Rimin Gado, Gwarzo, Kubau, Soba, Faskari and Kafur were purposively selected (two from each State) based on their prominence in beef cattle production (agro-pastoralist). One abattoir in each of the 6 LGAs was randomly selected to give a sample of 6 abattoirs and 10 butchers per abattoir to give a sample of 66 butchers derived from a registered list of cattle butchers association.

The study made use of primary data. The data were obtained through the use of computer-aided personal interview (CAPI) version of survey instrument rather than paper-based questionnaire. The survey was administered using trained enumerators under the supervision of the first author.

Analytical Technique

Descriptive statistics

Descriptive statistics such as percentages was used to identify the constraints limiting beef cattle butchery activities in the study area.

Net income analysis

Net income analysis was used to determine the cost and returns of beef cattle butchery. It is expressed as:

π = Net income or Profit (₦)

TR = Total revenue (unit price x quantity) (₦)

TC = Total cost (Total variable cost + Total fixed cost) (₦)

The unit of profit for beef cattle butchery was Naira per 10 slaughtered cattle. Variable costs for butchers includeD cost of beef cattle/beef purchase, feeds, water, labour, marketing costs such as costs of transportation, packaging, beef refrigeration, market charges, brokers charges, costs of processing items etc. Fixed costs included depreciation on equipment and tools as well as land/shop rent. The depreciation was estimated by the straight line method:

$$D = \frac{P-S}{N} \quad \ldots\ldots 3.3$$

Where,

D = Depreciation (₦)

P= Purchase value of each asset (₦)

S= Salvage value, which is the price of the asset after its expected years of usage (₦)

N = Life span of the asset measured in years.

Following Bennett *el al.* (2019) a value added model was used to gain further insights on the value created by the actors in the beef cattle value chain and it is expressed as follows:

$$VA = TR - IC \quad \ldots\ldots 3.4$$

Where,

VA = Value added (₦)

TR = Total revenue (unit price x quantity) (₦)

IC = Intermediate consumption (cost of raw materials used up in the value addition activity) (₦)

Profitability of beef cattle butchery

The costs and returns in beef cattle butchery enterprise was estimated per 10 slaughtered cattle**.** The results presented in Table 4.1 showed that a total cost of ₦4,093.77 was incurred while total revenue of ₦33, 185.15 was generated by the beef cattle butchers resulting in a profitability of ₦29,091.38 per 10 slaughtered cattle. This showed that beef cattle butchery was profitable in the study area. The profit per naira invested in beef cattle butchery was 7.11 which indicated that a naira invested in beef cattle butchery gave a profit of ₦ 7.11. This high returns supported the income generation and youth empowerment opportunities in butchery activities as reported by Oyediran *et al.* (2018). Also, the results revealed that value addition by beef cattle butchery in the study area was ₦30,460.31. The average number of cattle slaughtered by the butchers in a month was 38. Based on the average number of cattle slaughtered in a month, an annual income of ₦1,326,566.92 was generated which was far above the minimum wage of ₦216,000 per year (₦18,000 per month). Therefore the income generated from beef cattle value chain by the butchers corresponded to 614.2% of the annual national minimum wage which was in agreement with the findings of Oyediran *et al.* (2018) on the potentials of butchery activity for income generation. In terms of the cost components of butchery activity, the costs of processing items (₦2,167.41 per 10 slaughtered cattle) constituted the highest variable cost incurred in beef cattle butchery activities in the study area and the least was the cost of water (₦557.43) as shown in table 1.

Table 1: Costs, returns, profitability and value addition of beef cattle value chain actors

Items	Butchers
Average costs	
Water	557.43
Marketing charges/tax/levy	1,152.60
Processing items (ingredients, firewood, kerosene etc.)	2,167.41
Total variable cost (TVC)	3,877.44
Depreciation	216.33
Total fixed cost (TFC)	216.33
Total cost (TC)	4,093.77
Average revenue	
Revenue per 10 cattle slaughtered	33,185.15
Total revenue (TR)	33,185.15
Net income (NI) = TR-TC	29,091.38
Profit per naira invested (NI/TC)	7.11
Intermediary consumption (IC)	2,724.84
Value added = TR-IC	30,460.31

Note: Average number of cattle slaughtered by butchers per month is 38

Constraints faced by butchers in beef cattle value chain

Lack of facilities in abattoirs indicated by 95.5% of the butchers ranked as the first constraint faced by the butchers as shown in Table 2. The poor and unhygienic conditions of abattoirs was not only common to the study area but appears to be a common challenge in most abattoirs across the country as reported by Iyiola, and Oni-Ojo (2013). This adversely affects the effective operation of butchery activities in the abattoirs. Lack of access to credit as indicated by 75.0% of the butchers ranked as the second constraint faced by butchers in the study area. This is in line with the findings of Oyediran *et al.* (2018) who reported that poor infrastructure in the abattoir and limited access to credit as well as poor financial support from formal financial institutions were some of the constraints faced by youths involved in butchery activities in the Abattoirs of Ogun State, Nigeria. Other constraints faced by butchers in the study area were high cost of butchery inputs, inadequate organization of butchers, lack of training opportunities, high charges, low bargaining power/difficulty in setting price and lack of health inspection of animals before slaughter.

Table 2: Constraints faced by butchers (n=66)

Constraints	*Frequency	Percentage	Ranking
Lack of facilities in abattoir	63	95.5	1st
Lack of access to credit facilities	58	87.8	2nd
High cost of butchery inputs	46	69.6	3rd
Butchers are not well organized	46	69.6	3rd
High charges	35	53.0	4th
Lack of training opportunities	24	36.3	5th
Low bargaining power/difficulty in setting price	22	33.3	6th
Lack of health inspection of animals before slaughter	8	12.1	7th

*NB: Multiple responses allowed

CONCLUSION AND RECOMMENDATION

It can be concluded that beef cattle butchery activities was a profitable agribusiness activity. Lack of facilities in the abattoirs was one of the major constraints encountered by majority of the butchers in the study area. Therefore, it was recommended that private sector participation in the provision of better slaughtering facilities such as modern abattoirs and proper drainage systems, amongst others were necessary to create good enabling environment to improve beef butchery activities.

REFERENCE

Bennett, B., Chakoma, C., Figué, M., Vigne, M. and Katic, P. (2019). Beef Value Chain Analysis in Zimbabwe. Report for the European Union, DG-DEVCO. Value chain Analysis for Development Project (VCA4D CTR 2016/375-804), pp.193 + Annexes.

Iyiola, O. and Oni-Ojo, E.E. (2013). Attitudes Toward Service Innovations in Red Meat Industry and its Consumption Effects on Nigerian Consumers. *Dev. Country Studies*, 3(9): 39-49.

National Population Commission (NPC), (2006). Official Census Figures. NPC, Abuja, Nigeria.

Nwigwe, C., Okoruwa, V., Adenegan, K. and Olajide, A. (2016b). Technical Efficiency of Beef Cattle Production Technologies in Nigeria: A Stochastic Frontier Analysis. *African Jour. Agric. Res*, 11(51): 5152-5161.

Okaiyeto, P.O., Muhammad, I.R., Lamidi, O.S. and Abubakar-Adee, A.A. (2006). The Structure and Marketing of Beef in Katsina State of Nigeria. *Jour. Engr and Applied Sciences*, 1(2): 125-129.

Oyediran, W.O., Omoare .A.M., Osinowo, O.A and Onabayo, A.O. (2018). Assessment of Income Generating and Youths Empowerment Opportunities in Butchery Activities in the Abattoirs of Ogun State, Nigeria. *Jour. Dairy and Vet. Sciences*,6(1): 1-9.

PESTE DES PETITS RUMINANTS VACCINATION AWARENESS AND CONSULTATION OF VETERINARY SERVICES AMONGST SMALL RUMINANT FARMERS IN SOUTH EAST NIGERIA

***Chukwudi, I.C. [1], Ogbu, K.I.[2], Olaolu, O.S.[3], Ugochukwu, E.I.[1], Chah, K.F.[4]**

[1]Department of Veterinary Medicine, University of Nigeria Nsukka, [2]Department of Animal Health, Federal College of Animal Health and Production Technology National Veterinary Research Institute Vom, Plateau state Nigeria, [3]National Institute for Trypanosomosis Research Vom Plateau state Nigeria, [4]Department of Veterinary Pathology and Microbiology, University of Nigeria Nsukka

**Corresponding author- email- ijeoma.adieme@unn.edu.ng; Tel No-+2348033572147*

Extended Abstract

INTRODUCTION

Peste des petits ruminants (PPR) has been identified as one of the major diseases that pose a serious challenge to successful small ruminant farming. It is acute, highly contagious, trans-boundary viral disease of sheep and goats that poses a threat to livestock production in many developing countries and produces variable rates of morbidity and mortality that can reach 100% and 90%, respectively (El-Yuguda *et al.,* 2009). The economic loss due to PPR outbreaks in Nigeria was estimated to be 6.8 billions of Naira (NGN) (Fadiga *et al.*, 2013). Close contact between susceptible animals is important for the transmission of PPR virus (the aetiologic agent) to occur as discharges from the eyes, nose, mouth, as well as the loose faeces contain large amounts of this virus. Fine infective droplets are released into the air from these secretions and excretions, particularly when affected animals cough and sneeze (Ezeibe *et al*., 2008). There is no specific treatment for PPR. The most effective control measures among others is mass vaccination of small ruminants with the homologous PPR vaccine (OIE, 2012). The homologous PPR vaccine has been widely used to protect small ruminants against PPR virus, but outbreak of the disease is still being reported and thus the continuous spread of PPR infection (Albina, *et al.,* 2013). This study was conducted to find out the level of PPR vaccination awareness and consultation of veterinary service amongst small ruminant farmers in South East Nigeria.

MATERIALS AND METHODS

Three states: Anambra, Ebonyi and Enugu(latitudes 7°07′N and 3°90′N and longitudes 6°51′E and 8°30′E) in South East Nigeria were randomly selected for the study.Scheduled structured interviews were conducted on sheep and goat farmers/traders and veterinary doctors. Information elicited includes: the most encountered disease symptoms among their flock, farmer's awareness of PPR vaccination and consultation of veterinary services and also the availability of PPR vaccine in Veterinary establishments. The pretested structured interview used for the study was validated by an epidemiologist in the Department of Veterinary Public health and Preventive Medicine, Faculty of Veterinary Medicine, University of Nigeria, Nsukka. Data obtained were subjected to descriptive statistics.

RESULTS

Seventy-eight (52%) of the 150 farmer respondents indicated they used herbal medicine in the treatment of their ruminants while 57 (38%) and fifteen (10%) employed orthodox and both herbal and orthodox medicine in small ruminants, respectively. Forty (55.5%) of those that practise orthodox medicine usually consult the services of a veterinarian while 32 (44.4%) purchase their drugs from local drug stores on the drug seller's prescription. None of the respondents has ever vaccinated his/her flock against PPR. Among the symptoms listed, diarrhoea caused the biggest problem (92%) in their flock. This is followed by catarrh (85%), cough (64%) and the least abortion (10%). Out of the 100 practising Veterinary doctors that were interviewed, none had homologous PPR vaccine available at their establishments at the time of the study. Nearly all (90%) of the practicing Veterinary doctors never had the vaccine in their establishments, while 10% had the vaccine at a time.Also 97% of the

practicing Veterinarians said there was no demand of the homologous PPR vaccine by their clients (farmers/small ruminant keepers).

DISCUSSIONS

The small ruminant rearers/raisers were engaged in indiscriminate use of antimicrobial without prescription. The rearers resort to selling their sick animals when they are seriously sick and weren't responding to their medications. This correlated with the low demand for veterinary services for small ruminants recorded in the study area compared to veterinary services for dogs and poultry. This corresponds with the report of Obua (1992) in his study in Southern Nigeria. Sheep and goat rearers tend to consult butchers or sell off their ill animals instead of veterinary doctors. The self-medication practiced by small ruminant farmer/traders offers room for the development of antimicrobial resistance due to misuse and overuse of antibiotics. Sales of animals on medication and before the withdrawal period for human consumption leads to the development of antibiotics resistance in human. Inappropriate prescription practices and the use of antimicrobials in animal production has been reported to lead or cause the development of antibiotics resistance (Ayukekbong *et al*., 2017). Taking ill animals to the market for sales equally serves as a source of spread of the disease to other animals from different households and communities. Animals not sold or those bought are taken home to other flock. This practice encourages outbreaks of the disease. The non-availability of homologous PPR vaccine at the time of visit in the veterinary establishments/outlets in the studied States was another major finding. Lack of demand and inadequate power to preserve the vaccine (maintenance of cold chain), expiration of stored vaccines were the chief complaint recorded from veterinary doctors. Thus, lack of awareness of PPR vaccination amongst small ruminant farmers, lack or limited use of veterinary services by sheep and goat rearers, non-availability of vaccine at veterinary establishments in the sampled States are potential risk factors of PPR prevalence in South East Nigeria. Poor consultation of veterinarians by farmers will lead to poor management of the disease and delayed or lack of treatment, will in-turn create room for further contamination of the environment and spread of the disease. Based on our findings, there is need for extension program on the importance and benefits of PPR vaccination and the use of veterinary services with stakeholders and farmers. This will serve as a tool for effective planning of nationwide vaccination campaign for improved control of PPR in South East Nigeria and the country at large.

REFERENCE

Albina, E., Kwiatek, O., Minet, C., Lancelot, R., de Servan Almeida, R. and, Libeau, G. (2013). *Peste des Petits Ruminants*, the next eradicated animal disease? *Vet. Microbiol.*, **165** (1–2): 38–44.

Ayukekbong, J.A., Ntemgwa, M. and Atabe, A.N. (2017). The threat of antimicrobial resistance in developing countries: causes and control strategies. *Antimicrob. Resist. Infect. control*, **6** (47).

El-Yuguda, A.D., Abubakar, M.B., Nabi, A.B., Andrew, A. and Baba, S.S. (2009). Outbreak of PPR in an unvaccinated Sahel goat farm in Maiduguri, Nigeria. *J.Biomed. Res*, **12:** 83 – 87.

Ezeibe, M.C.O., Okoroafor, O.N., Ngene, A.A., Eze, J.I., Eze, I.C. and Ugonabo, J.A. (2008). Persistent detection of *Peste des Petits Ruminants* antigen in the faeces of recovered goats. *Trop. Anim. Health Prod.,* **40** (7): 517-519.

Fadiga, M., Jost, C. and Ihedioha, J. (2013). Financial costs of disease burden, morbidity and mortality from priority livestock diseases in Nigeria. Disease burden and cost–benefit analysis of targeted interventions. ILRI Research Report 33. Nairobi, Kenya: ILRI.

Obua, B.E. (1992). Survey of Small-holder Sheep and Goat Production Systems in Selected Local Government Areas in Imo and Enugu States of Southern Nigeria. M.Sc thesis (PG/M.Sc/90/9094), Department of Animal science. University of Nigeria.

Office International des Epizootics (OIE), (2012). *Peste des Petits Ruminants*. Chapter 2.7.11. In Terrestrial Manual. Office International des Epizootics. http://www.oie.int/fileadmin/Home/eng/ Health_standards/tahm/2.07.11_PPR. pdf retrieved 2012-08-15.

EFFECT OF COLD WATER NEEM (*Azadirachta indica)* LEAVES EXTRACT ON MEAT QUALITY OF BROILER CHICKENS

Egbeyale, L. T*., Ojetunji, O. C., Adeleye, O.O., Ayo-Ajasa, O. Y. & Adewole, F. A.
Department of Animal Production and Health, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.
*Corresponding author: *egbeyalelt@funaab.edu.ng. Phone No: 08060743664*

ABSTRACT
This study was conducted to determine the effect of cold water neem leaf extract on meat quality of broiler chicken. One hundred and sixty broiler chicks (Cobb) were randomly divided into four groups of 40 birds per treatment. Each group was sub-divided into four replicates of 10 birds. The birds in group 1 served as control and antibiotics were administered to them while 0.1, 0.2 and 0.3% concentration of neem leaf extract were administered to bird on groups 2, 3 and 4, respectively. The period of experiment was six weeks. The birds were fed ad libitum. One bird close to average final weight was selected randomly in each replicate and was slaughter at 42nd day of the experiment. Meat samples from breast muscle of the bird were subjected to cooking weight loss, refrigeration weight loss and sensory evaluation. The data obtained were subjected to one-way Analysis of Variance in a completely randomized design (RCD). The cooking loss increased ($P<0.05$) with higher concentration of the extract while refrigeration weight loss percentages were similar ($P>0.05$) across the treatments. The result on Sensory evaluation showed that only colour, tenderness and overall flavour were significantly ($P<0.05$) influenced. The study concluded that aqueous Neem (Azadirachta indica) leaf extract (ANLE) administration in drinking water of broiler chicken as alternative to antibiotics did not pose any adverse threat on the meat quality.
Keywords: neem extract, refrigeration and cooking losses, sensory evaluation, broiler chicken

INTRODUCTION
Medicinal plants extracts were developed and proposed for use in food as natural antimicrobials (Hsieh and Mau, 2001). Beneficial effects of herbal extracts or active substances in animal nutrition includes the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, anti-viral, antioxidant and anthelminthic actions. Generally, plant extracts have no problem of antimicrobial resistance (Tipu *et al*., 2006) and broilers fed on herbal feed additives were accepted well by consumers (Hernandez *et al.*, 2004).
Aqueous extract of Neem leaves has a good therapeutic potential as anti-hyperglycemic agent, antibacterial agent and could be used for controlling airborne bacterial contamination in the residential premise (Mishra *et al.,* 2013). It was shown that Neem leaves extract acts as a growth promoter (Landy *et al.,* 2011), improves performance and hematological parameters (Nayaka *et al.*, 2013) and immune response (Jawad *et al*., 2013) in broilers. Due to paucity of information on the effect of neem leaf extract on meat quality, this study was designed to investigated the effect of cold water extraction of neem leaves on eat quality of broiler chickens.

MATERIALS AND METHODS
Experimental site: The rearing of birds took place at the Poultry Units of the Teaching and Research Farm, while the meat quality section was carried out at the Meat Processing Laboratory, Department of Animal Production and Health, College of Animal Science and livestock Production, of Federal University of Agriculture Abeokuta (FUNAAB).
Source and preparation of the extract: Fresh neem (*Azadirachta indica*) leaves were harvested, rinsed thoroughly with water to remove all the dirt from it then pounded in a mortar with pestle to increase the surface area for better extraction. The pounded leaves were weighed on the sensitive scale at 1, 2 and 3g, which were needed for the experiment. The weighed freshly pounded neem leaves were added to clean cold water (at room temperature) at 1g of neem leaves to 1 litre of water, 2g of neem leaves to 1 litre of water, and 3g of neem leaves to 1 litre of water and thereafter was left for 12 hours at room temperature and was sieve before it was offered to the birds.
Experimental Design: A Completely Randomized Design (CRD) was adopted for this experiment. The one hundred and sixty 7 days old broiler chicks of Cobb strain were allocated into four treatments

with each treatment contains 40 birds. Each treatment was further sub-divided into four replicates of ten birds each. The period of the experiment lasted for six weeks. The treatment groups are; Treatment 1 (Control) was administered antibiotics (Enrofloxacin at the manufacture's recommendation), Treatment 2 (0.1%) of neem extract in drinking water, Treatment 3 (0.2%) of neem extract in drinking water and Treatment 4 (0.3%) of neem extract in drinking water. Starter broiler diet of 23% CP and 11.47 MJ/Kg was supplied *ad libitum* for the first three weeks while finisher broiler diet of 20.10%CP and 11.62 MJ/Kg was supplied during the last three weeks of the experiment.

Data Collection: At the 42nd day of the experiment, one broiler chicken close to average final weight was selected randomly from each replicate and was slaughtered. After dressing, breast meat sample of 54.13-54.80g from each broiler chicken was cooked separately at 70°C for 15 minutes in a water bath (Egbeyale *et al*., 2012). The difference between the weights before and after cooking gave the cooking weight loss of the meat samples. Meat samples of another set of 51.20-54.50g were cut from the breast muscles of the slaughtered broiler chicken. Each sample was weighed and labeled according to the treatment before being stored in a refrigerator at about 10°C for 24 hours (Egbeyale *et al*., 2012).

Sensory evaluation: For sensory evaluation, a uniform size of cooked chicken breast meat was sliced into cubes and the cooked chicken breast meat was labeled according to each treatment and samples were allowed to cool before serving the panel. Eight educated panelists were isolated from each other, so as to prevent communication and each panelist was asked to rinse his/her mouth with ordinary water after each sample testing to avoid any carry over effects. The panelist evaluated the meat colour, flavour, juiciness, aroma, texture, saltiness and overall acceptability. The evaluators were asked to score the sample on nine points scale according to Egbeyale *et al*. (2012)

Statistical analysis: Data collected were subjected to one-way Analysis of Variance (ANOVA) and differences in means were separated using Duncan Multiple Range Test (SAS 2012) at 5% significance level.

RESULTS

The effect of aqueous neem leaf extract (ANLE) on cooking and refrigeration weight losses of broiler chicken is present in Table 1. Cooking weight loss (CWL) was significantly ($p<0.05$) influenced. The CWL of meat from birds on 0.3%ANLE were significantly higher than the control. However, the meat from birds that drank water containing 0.1 and 0.2% ANLE recorded values similar to both control and 0.3%ANLE group. The refrigeration weight loss and percentage refrigeration loss did not show any significant ($p>0.05$) different among the treatments.

Table 1: Effect of cold water neem (A*zadirachta indica*) leave extract on cooking and refrigeration loss of broiler chicken

	Inclusion level of NLE (%)			
Parameters	0	0.1	0.2	0.3
Cooking				
Weight before cooking (g)	54.80±0.47	54.13±0.78	55.33±1.36	54.30±1.11
Weight after cooking (g)	49. 15±0.37	47. 13±0.95	48. 90±1.26	46.98±1.36
Cooking weight loss (g)	5.65±0.37^{b}	7.00±0.61^{ab}	6.43±0.18^{ab}	7.33±0.55^{a}
Percentage weight loss (%)	10.30±0.61^{b}	12.94±1.12^{ab}	11.62±0.27^{ab}	13.52±1.11^{a}
Refrigeration				
Weight before refrigeration (g)	53.80±1.35	51.20±0.58	54.08±0.91	54.50±0.55
Weight after refrigeration (g)	52.75±1.18^{a}	48.75±1.03^{b}	51.50±1.19^{a}	52.50±0.87^{a}
Refrigeration weight loss (g)	1.05±0.35	2.45±0.73	2.58±1.52	2.00±0.34
Percentage weight loss (%)	1.93±0.62	4.80±1.45	4.68±2.79	3.69±0.68

$^{a,b;}$ Means on the same row with different superscripts are significantly ($p<0.05$) different

*the initial weight of the refrigeration was used as co-variate

The effect of aqueous neem leaf extract (ANLE) on sensory characteristics of broiler chicken meat is present in Table 2. The juiciness, meaty flavour, saltiness and overall acceptability were not significantly ($p>0.05$) influenced across parameters measured, while colour, tenderness and overall flavour were significantly ($p<0.05$) influenced.

Table 2: Effect of cold water neem (A*zadirachta indica*) leaves extract on sensory quality of broiler chicken

	Inclusion level of NLE (%)			
Parameters	0	0.1	0.2	0.3
Colour	5. 14±0.22^{ab}	4.79±0.31^{ab}	5.50±0.23^{a}	4.32±0.35^{b}
Juiciness	5. 39±0.30	6. 04±0.34	6. 11±0.24	5.93±0.38
Tenderness	5.14±0.38^{b}	5.71±0.35^{ab}	6.39±0.34^{a}	5.18±0.35^{b}
Overall Flavour	5.18±0.26^{ab}	4.86±0.30^{b}	5.75±0.28^{a}	5.07±0.33^{ab}
Meaty Flavour	6.14±0.29	6.36±0.31	6.50±0.20	6.17±0.30
Saltiness	5.04±0.28	5.04±0.26	4.54±0.20	4.75±0.40
Overall acceptability	5.18±0.33	4.96±0.36	5.68±0.32	4.79±0.34

$^{a,b;}$ Means on the same row with different superscripts are significantly ($p<0.05$) different

DISCUSSION

The cooking loss values reported in this study are lower than the values reported by Gohar *et al*. (2012) who compared cooking loss in broiler and layer meat and reported that cooking loss in broiler meat was in the range of 15.55 to 36.00%. The increase in the cooking weight losses with increasing levels of ANLE obtained in this study is in accordance with the results of the work of Ncube *et al*. (2018) who studied the effect of *Acacia angustissima* leaf meal on yield of carcass components and meat quality of broilers and reported that increasing levels of the leaf meal resulted in drier meat. High cooking loss also implies the less ability of the meat to hold water during processing and storage (Abu *et al*., 2015). According to Michalczuk *et al*. (2014), high meat cooking loss has an adverse effect on sensory perception as it reduces juiciness. The influence of ANLE on tenderness and overall flavour is consistent with results published by Jang *et al.* (2008) on the enhancement of flavour after feeding a mixture of herbal tree extracts to broilers. Similarly, the result agrees with Aderinola *et al.* (2013) who reported enhanced flavour of meat from *Moringa oleifera*-fed broilers. These similarities in juiciness and meaty flavour are in agreement with findings of Bonsu *et al*. (2012) who studied the medicinal response of broiler chickens to diets containing neem (*Azadirachta indica*) leaf meal. Egbeyale *et al*. (2012) in their study of meat qualities characteristics of broiler chicken fed varying levels of *Ocimum gratissimum* reported that parameters such as juiciness, saltiness and overall acceptability were not significantly influenced. However, the authors reported that overall flavour were significantly influenced which is in accordance with the results of this study.

CONCLUSION AND RECOMMENDATION

Aqueous extracts of neem (*Azadirachta indica*) leaf at 0.3% could be administered in the drinking water of broiler since it does not compromise the quality of meat.

REFERENCES

Abu, O.A., Olaleru, I.F. and Omojola, A.B. 2015. Carcass characteristics and meat quality of broilers fed cassava peel and leaf meal as replacements for maize and soybean meal. *Journal of Agricultural Veterinary Science*, 8(3): 41-46.

Aderinola, O.A., Rafiu, T.A., Akinwumi, A.O., Alabi, T.A. and Adeagbo, O.A. 2013. Utilization of *Moringa oleifera* leaf as supplement in broiler diet. *International Journal Food, Agriculture Veterinary Science*, 3(3):94-102.

Bonsu, F.R.K., Kagya-Agyemang, J.K., Kwenin, W.K.J. and Zanu, H.K. 2012. Medicinal response of broiler chickens to diets containing Neem *(Azadirachta indica*) leaf meal, haematology and meat sensory analysis *World Applied Science Journal*, 19(6):800-805.

Egbeyale, L.T., Sogunle, O.M., Adeleye, O.O., Oseni, M.A., Fajohunbo, G.O., Oyeleye, A.M. and Oduwaye S.A. 2012. Meat qualities characteristics of broiler chicken fed varying levels of *Ocimum gratissimum. International Journal of Applied Animal Science,* 1(2): 63-67.

Gohar, R., Abdul, B., Inayat, U.R., Mudassir, K. and Sayed, A.K. 2012. Comparative study on cooking loss in broiler and layer meat. A project report submitted through the department of veterinary science, faculty of animal husbandry and veterinary science, to Sindh agriculture university Tandojam in connection with partial, fulfilment of the requirements for the Id subject of final Prof. D.V.M 2012

Hernandez, F., Madrid. J., Garcia, V., Orengo, J. and Megias, M. D. 2004. Influence of two plant extracts on broiler performance, digestibility and digestive organ size. *Poultry Science,* 83: 169-174.

Hsieh, P.C. and Mau, J.L. 2001. Antimicrobial effect of various combinations of plant extracts. *Food microbiology,* 18: 35-43.

Jang, A., Liu, X. D., Shin, M. H., Lee, S. K., Lee, J. H. and Jo, C. 2008. Anti-oxidative potential of raw breast meat from broiler chicks fed a dietary medicinal herb extract mixture. *Poultry Science,* 87, 2380-2389.

Jawad. Z., Younus, M., Rehman, M.U., Maqbool, A., Munir, R., Muhammad, K., Korejo, R.A. and Qazi, I.H. 2013. Effect of Neem leaves (*Azadirachta indica*) on immunity of commercial broilers against newcastle disease and infectious bursal disease. *African Journal of Agricultural Research,* 8: 4596-4603.

Landy, N., Ghalamkari, G., Toghiani, M. and Yazdi, F.F. 2011. Humoral immune responses of broiler chickens fed with antibiotic and neem fruit powder (*Azadirachta indica*) as feed additive supplemented diet. IPCBEE 3:153-155.

Michalczuk, M., Lukasiewicz, M., Zdanowska-Sasiadek, Z. and Niemiec, J. 2014. Comparison of selected quality attributes of chicken meat as affected by rearing systems. *Poultry Journal Food Nutrition Science,* 64 (2), 121-126.

Mishra, A., Mamta, Neema, Niketa, Poonam, Pranjul, Priyanka. 2013. Antibacterial effects of crude extract of *Azadirachta indica* against *Escherichia coli* and *Staphylococcus aureus*. *International Journal of Science, Environment and Technology*, 2: 989–993.

Nayaka, H.B.S. Umakantha, B., Ruban, S.W., Murthy, H.N.N. and Narayanaswamy, H.D. 2013. Performance and hematological parameters of broilers fed Neem, turmeric, vitamin E and their combinations. *Emirates Journal of Food and Agriculture*, 25: 483-488.

Ncube, S., Halimat, T.E., Chikosi, E.V.I. and Saidi, P.T. 2018. Effect of *Acacia angustissima* leaf meal on performance yield of carcass components and meat quality of broilers. *South African Journal of Animal Science,* Vol.48 (No.2).

SAS, 2012. Statistical Analysis System, User's Guide. Statistical version 9.1th *Statistical Analysis System Institute Inc. Cary, North Cariolina, United State of America*.

Tipu, M. A., Akhtar, M. S., Anjum, M. I. and Raja, M. L. 2006. New dimension of medicinal plants as animal feed. *Pakistan Veterinary Journal*, 26 (3): 144-148.

CURRENT RESEARCH PRIORITIES AND DISTRIBUTION OF ANIMAL AGRICULTURE RESEARCH (AAR) SCIENTISTS IN NIGERIA

I.C. Okoli, I.P. Ogbuweu, C.C. Achonwa, O.O. Emenalom & B.O. Esonu
Department of Animal Science and Technology, Federal University of Technology, Nigeria
Presenting author: *C.C. Achonwa; E-mail: chukwumachristian1@gmail.com*

ABSTRACT
In March 2018, the Nigerian Society for Animal Production (NSAP) held its 43rd Annual Conference at Owerri, southeast Nigeria, with the theme "Exploring Science and Technology Innovations for Sustainable Livestock Development" and produced a book of proceedings as its major conference output. This paper analyzed the 440 papers contributed to the book of proceedings, in order to highlight the current research priorities and sources of animal agriculture research (AAR) in Nigeria. Overall, 387(87.95%) oral and 53(12.05%) poster papers were contributed. AAR in Nigeria focused more on monogastric animal nutrition (MON) (18.68%, n=82) and animal physiology, reproduction and welfare (APRW) (17.27%, n=76) than other disciplines such as agricultural economics and extension (2.27%, n=10) and aquaculture (2.50%, n=11). The most popular animal model used in these studies was the domestic chicken, which accounted for 36.00%, (n=158) of overall papers and 34.81% (n=55) and 25.95% (n=41) of papers contributed under MON and APRW respectively. Papers were contributed from all the six geographical zones of the country, with the southeast (34.00%, n=149) and southwest (27.00%, n=116), recording the highest contributions and northeast the lowest (3,6%, n=17). The participants came from 83 institutions; however, more institutions were based in northcentral (24.12%, n=20) and southwest (21.62%, n=18) Nigeria. Most of the principal authors were affiliated to universities (59.00%, n=49), while only 4.00% (n=3) were affiliated to research institutions. AAR activities need to be resuscitated in these research institutes, while agricultural social scientist, aqua-culturist and pasture management experts should be encouraged to participate more in future conferences.
Keywords: Animal production, chicken, livestock, Nigeria

INTRODUCTION
The livestock industry in Nigeria represents a very important national resource that contributes substantially to the national wealth and also supplies the populace with the important animal proteins which are required for healthy living (Achonwa, 2017). For the past 43 years, the Nigerian Society for Animal Production (NSAP) has organized an annual conference, with the overall objective of linking the science of animal agriculture with the broader stakeholders in a knowledge sharing environment in order to engender innovative products development and practices. During these events, experts working across the different disciplines in animal agriculture research (AAR) gather to learn, share, innovate and foster new collaborations. Papers that highlight the current research focus and priorities of the national AAR community are routinely presented and produced as an annual conference book of proceedings.

In March 2018, the Society held its 43rd Annual Conference at the Federal University of Technology Owerri (FUTO) in southeast Nigeria, with the theme "Exploring Science and Technology Innovations for Sustainable Livestock Development". A conference book of proceedings containing 440 paper contributions was produced as the major output from the event. In this paper, we present our analysis of this book of proceedings, with the main objective of determining the current research priorities and affiliations of animal agriculture research scientists in Nigeria.

MATERIALS AND METHODS

The 2018 Annual Conference of the Nigerian Society for Animal Production (NSAP) was held from 18 – 22 March 2018 at the Federal University of Technology Owerri (FUTO), Imo State, Nigeria. The FUTO campus is located at Ihiagwa in Owerri West Local Government Area (LGA) of Imo state, South East Nigeria. The state lies between latitudes 05° 30" and 05° 56" north of the equator and between longitudes 05° 37" and 07° 26" east of the Greenwich meridian and occupies a land area of 13, 032 square kilometers. The climate falls under type AW in the Kopper-Geiger classification of wet and dry climate and zone B of the Nigerian eco-climatologically zones (Ofomata, 1975). Given the close relationship between climate and vegetation, the location of the conference coincides with the rain-forest belt. It receives an annual rainfall range of 2000 to 2484 mm, with an average daily temperature of 26°C.

The event generated a conference book of proceedings containing 440 presentations made-up of 387oral and 53 poster papers. With the aid of frequency counts and percentages, we analyzed the information on the paper contributed by authors to the book of proceedings, in order to determine their disciplinary, inter-disciplinary, regional and researcher affiliation diversity. In all cases, researcher affiliation was based on the given address of the principal author. Data generated were presented in graph formats.

RESULTS AND DISCUSSION

Figure I shows that out of the 440 papers presented at the conference, 18.64% (n = 82) and 17.27% (n = 76) were on monogastric animal nutrition (MON) and animal physiology, reproduction and welfare (APRW) respectively, constituting the major subject areas of focus by the researchers. Papers dealing with Animal production, economics and extension (APE), aquaculture and fishery management (AFM) and pasture and range management (PRM) were particularly few.

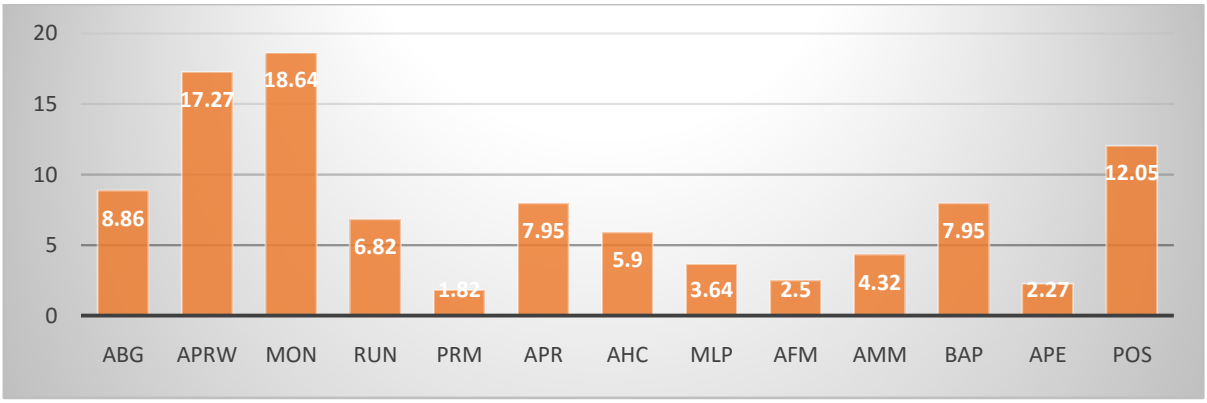


Fig. I: Percentage distribution of papers contributed across different subject areas during the conference (n = 440). Legend:ABG = Animal breeding and genetics; APRW = Animal physiology, reproduction and welfare; MON = Monogastric nutrition; RUN = Ruminant nutrition; PRM = Pasture and range management; APR = Animal products and processing; AHC = Animal health and disease control; MLP = Microlivestock production; AFM = Aquaculture and Fishery Management; AMM = Animal Management and Modelling; BAP = Biochemistry and Biotechnology Applications; APE = Animal production economics and extension; POS = Poster presentations

Figure II shows the percentage distribution of paper contributions across different animal species highlighted the fact that the domestic chicken was the major species (35.91%, n = 158) used as animal model by the researchers. Of these papers dealing with domestic chicken research, 34.81% (n = 55) and 25.95% (n = 41) were presented under MON and APRW subject areas respectively (Figure III). The results in figure IV also show that across the two popular research areas, MON and APRW, chicken research again constituted 67.07% (n = 55) and 55.26% (n = 42) of the papers presented. The use of chicken as animal model for researching alternative feedstuffs is popular in Nigeria and is driven by the urgent need to sustain the recent growth in the industry through identification of cheaper and locally available feed ingredients (Esonu, 2009; Ifeduba, 2018).

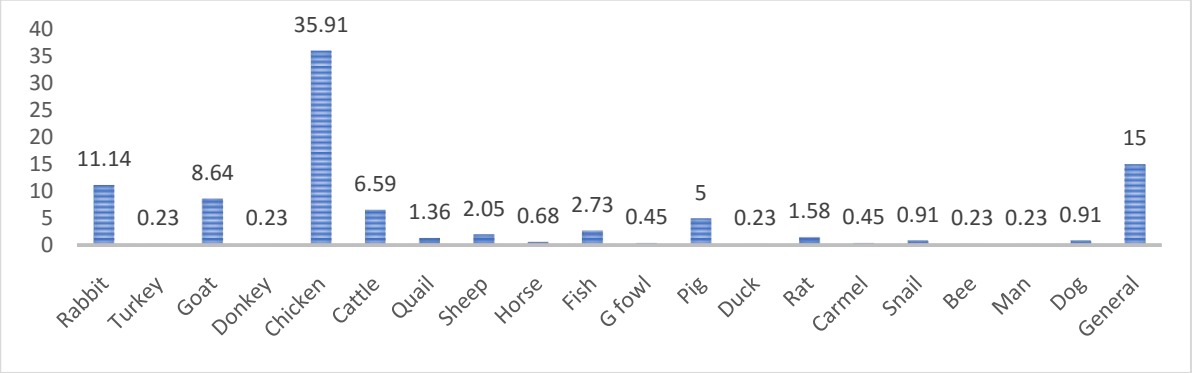


Fig. II: Percentage distribution of paper contributed across different animal species (n = 440)

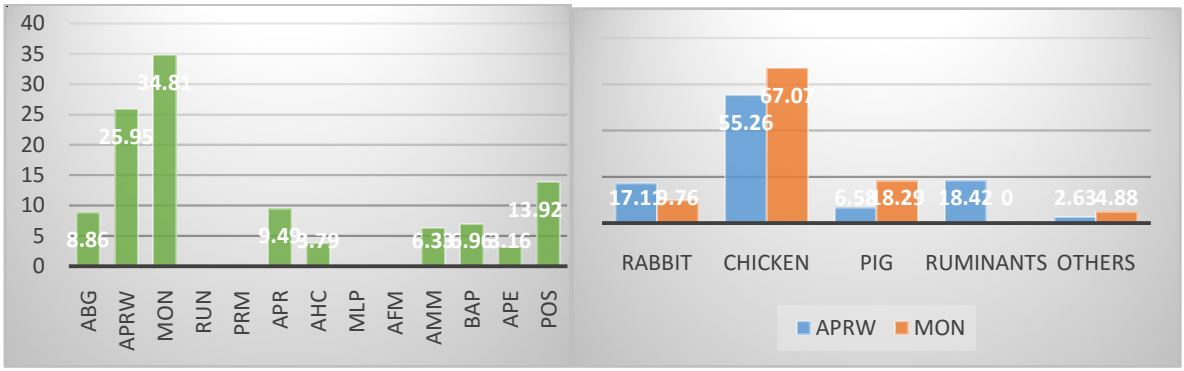


Fig. III: Percentage distribution of papers dealing with chicken research across different subject areas (n = 440). Legend: As in Figure I

Fig IV: Percentage distribution of animal species used in animal physiology and monogastric nutrition research (n = 76 for APRW and 82 for MON). Legend: As in Figure I

Figure V shows the percentage distribution of papers across the six geographical zones of Nigeria, namely South west (SW), South east (SE), South-south (SS), North central (NC), North west (NW) and North east (NE) zones. It is interesting to note that all the six zones were represented, however, about 34.00% (n = 149) of the papers were understandably contributed by researchers affiliated to institutions based in the SE zone, which was the location of the conference venue.



Fig. V: Percentage distribution of papers across the different geographical zones during the conference (n = 440). Legend: SW = South west; SE = South east; SS = South-south; NC = North central; NW = North west; NE = North east.

Fig. VI: Percentage distribution of institutional affiliations of first authors of papers (n = 83)

Figure VI showed that the papers were actually contributed by researchers working in 83 institutions spread across the different zones of the country, with NC (24.12, n = 20) and SW (21.69, n = 18) hosting the highest number of institutions. It is therefore interesting to note that even though 15.00% of the conference papers were contributed by researchers based in NC Nigeria, its institutional

representation was higher than those of other zone. Figure VII showed the percentage distribution of papers according to types of authorship. Generally, most of the papers were written by more than one author, with the trend being multiple authorship.

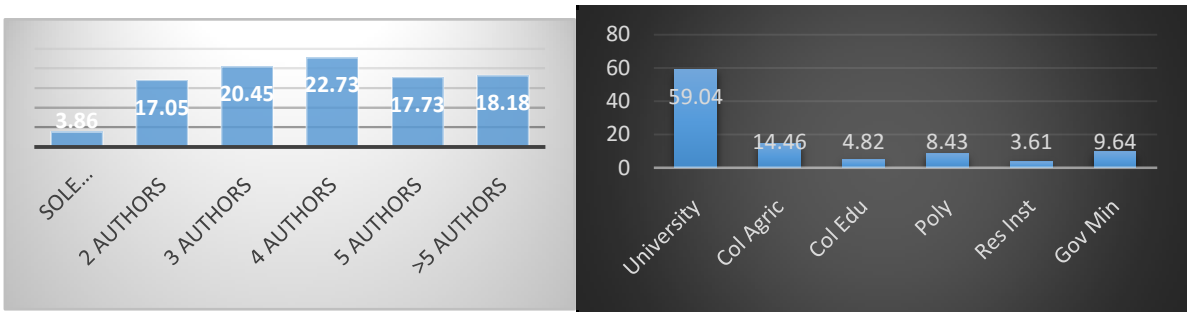


Fig. VII: Percentage distribution of papers according to type of authorship (n = 440)

Fig: VIII: Percentage distribution of papers according to type of institutions affiliated to the first authors (n = 440). Legend: Col Agric = College of Agriculture; Col Edu = College of education; Poly = Polytechnic; Res Inst = Research Institute; Gov Min = Government Ministry

Figure VIII presented the percentage distribution of papers according to institutional affiliation of the principal authors of the papers. The results show that 59.00% (n = 49) of the institutions affiliated to the principal authors were university, while 14.00% (n = 12) were affiliated to colleges of agriculture. The lowly 4.00% (n=3) recorded for research institutes was strange and may reflect serious challenges to research in these institutions, probably due to poor funding by government.

CONCLUSION

This study has shown that animal agriculture research in Nigeria is currently focused majorly on monogastric animal nutrition and animal physiology, reproduction and welfare and that the most popular animal model for these studies is the domestic chicken. These papers were contributed by researchers from all the six zones of the country, but especially from the SE and SW, mostly affiliated to the university system. The very low research output from the country's research institutes might be reflecting serious challenges to research in these institutions. There is the need to attract more papers from economics and extension, aquaculture and pasture management researchers to future conferences, since they were poorly represented.

REFERENCES

Achonwa, C.C. (2017). Socio-cultural and physicochemical studies of *Ficus microcarpa* as a small ruminant feedstuff at Nnobi, southeastern Nigeria. MSc Thesis, Federal University of Technology Owerri, Nigeria.

Esonu, B.O. (2009). Unconventional feed resources for livestock development and food security. Paradigms for Nigerian Livestock industry. 14th Inaugural Lecture, Federal University of Technology Owerri, Nigeria.

Ifeduba, A.V. (2018). Computer models on the performance of broilers and layers fed alternative feedstuff. MSc Thesis. Federal University of Technology Owerri, Nigeria.

Ofomata, G.E.K. (1975). *Nigeria in maps: Eastern states.* Ethiop Publishing House Benin City, Nigeria.

EFFECT OF SOLE AND COMBINED HERBAL LEAF MEAL AS FEED ADDITIVES ANTIBIOTICS ON CARCASS CHARACTERISTICS AND MEAT QUALITY OF GROWING PIGS

D.J. Ibigbami, C.P. Njoku, O.A. Adeyemi, S.A. Ayankola & C.A. Ayodele
Department of Animal Production and Health, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Ogun State, Nigeria:
***Correspondence author**: D.J. Ibigbami; Email: damilolaibigbami60@gmail.com; Tel: +2348139559768*

ABSTRACT
A total of thirty (30) grower pigs were used to determine the effect of sole and combined herbal leaf meal as feed additives in-feed antibiotics on carcass characteristics and meat quality of growing pigs. The pigs were grouped on weight equalization into 5 treatments (T1: pigs fed diet without antibiotics, T2: pigs fed diet containing synthetic antibiotics, T3: pigs fed diet containing moringa leaf meals, T4: pigs fed diet containing Neem leaf meals, T5: pigs fed diet containing mixture of Moringa and Neem leaf meals). Each treatment consisting of 6 pigs was further subdivided into 3 replicates. Each replicate consisted of 2 pigs. On the last day of the study, 2 pigs from each treatment were slaughtered for carcass analysis and meat quality. Data generated were subjected to Analysis of Variance in a Completely Randomized Design. Results revealed head was significantly ($p<0.05$) highest (11.40%) in T4 and lowest (9.27%) in T1. Tail was significantly ($p<0.05$) highest (0.38%) T4 while lowest values (0.21 and 0.22%) were recorded in T1 and T2, respectively. Values (0.43, 0.42, 0.45 and 0.37%) recorded for heart were statistically similar in T1, T2, T3, and T5, respectively which were significantly ($p<0.05$) lower than 0.56% recorded in T4. Cooking loss and thermal shortening were significantly ($p<0.05$) highest (22.73 and 38.40%) in T4 and lowest (15.06 and 26.46%) in T5. Chilling loss was significantly ($p<0.05$) highest (2.30%) in T2 and lowest (1.05%) in T5. Therefore, feeding pigs diet containing Neem leaf meal improved cut parts (head and tail), organs (heart) and meat quality.
Keywords: herbal leaf meal, carcass, meat quality, pigs

INTRODUCTION
The use of antibiotics in feed of livestock has not only been linked to the emergence of antibiotic resistant zoonotic bacterial pathogens but the presence of antibiotic residue contamination of animal products (Gong *et al*., 2014). Thus, a great number of consumers are concerned about the type and quality of their food. These consumers are rejecting the use of synthetic chemicals, such as antibiotics because their use is associated with animal and human health risks (Hao *et al*., 2014). This has led to the prohibition of the use of antibiotic for livestock production in many countries and the thorough search for alternatives to antibiotics (Valenzuela-Grijalva *et al*., 2017). One of such alternative sources is moringa and Neem (*Azadirachta indica*). Moringa (*Moringa oleifera*) is known as a miracle tree because of its numerious nutritional properties. Neem is an indigenous plant known for its useful medicinal properties like antibacterial, antifungal, antiprotozoal, hepato-protective and various others without showing any adverse effects (Esonu 2006). This study therefore aimed to determine the effect of sole and combined herbal leaf meal as alternatives antibiotics on carcass characteristics and meat quality of growing pigs.

MATERIALS AND METHODS
Experimental Site
The study was carried out at the Piggery Unit of the Directorate of Universities farm, Federal University of Agriculture, Abeokuta while analysis of meat was carried out at the Animal Product and Processing Laboratory of the Department of Animal Production and Health, Federal University of Agriculture, Abeokuta.
Preparation of Herbal leaf meals
Neem (*Azadiracta indica*) and Moringa (*Moringa oleifera*) leaves were procured within Odeda Local Government Area, Ogun State. The leaves were air dried for 3-5 days until they became crispy while retaining their greenish coloration. The leaves were afterwards milled and incorporated into experimental diets.

Experimental pigs and management

A total of thirty (30) grower pigs were purchased from a reputable farm in Abeokuta, Ogun State. The pigs were grouped on weight equalization into 5 treatments (T1: pigs fed diet without antibiotics, T2: pigs fed diet containing synthetic antibiotics, T3: pigs fed diet containing moringa leaf meals, T4: pigs fed diet containing Neem leaf meals, T5: pigs fed diet containing mixture of Moringa and Neem leaf meals). Each treatment consisting of 6 pigs was further subdivided into 3 replicates. Each replicate consisted of 2 pigs. Feed and water were provided *ad libitum* throughout the experimental period that lasted for 12 weeks.

Data Collection

Carcass Characteristics

On the last day of the study, 2 pigs from each treatment were selected, weighed, fasted overnight, stunned using percussion method and slaughtered by severing the jugular vein. The carcass weights as well as weights of cut-parts and offals were recorded and expressed as percentages of the live weights.

Meat Quality

The following meat quality parameters were determine;

- Cooking loss (%) = $\frac{(\text{Weight of meat before cooking} - \text{weight of meat after cooking})}{\text{Weight of meat before cooking}} \times 100$
- Chilling Loss (%) = $\frac{\text{Weight before refrigeration} - \text{Weight after refrigeration}}{\text{Weight before refrigeration}} \times 100$
- Thermal Shortening = $\frac{\text{Length before cooking} - \text{length after cooking}}{\text{Length before cooking}} \times 100$
- Cold Shortening = $\frac{\text{Length before refrigeration} - \text{length after refrigeration}}{\text{Length before refrigeration}} \times 100$

Statistical Analysis

Data generated were subjected to Analysis of Variance in a Completely Randomized Design using SAS (2003). Significantly ($p<0.05$) different means were separated using Duncan Multiple Range Test as contained in the same statistical Package.

RESULT AND DISCUSSION

The effect of sole and combined herbal leaf meal as alternative feed additives antibiotics on carcass characteristics of growing pigs is presented in Table 1.Values recorded for head was significantly ($p<0.05$) highest (11.40%) in T4 and lowest (9.27%) in T1. Tail was significantly ($p<0.05$) highest (0.38%) on T4 while lowest values (0.21 and 0.22%) were recorded in T1 and T2, respectively. Similar means (14.30, 14.65 and 14.39%) were recorded for GIT in T1, T3 and T4, respectively which were significantly ($p<0.05$) lower than 17.75% recorded in T5. Values (0.43, 0.42, 0.45 and 0.37%) recorded for heart were statistically similar in T1, T2, T3, and T5, respectively were significantly ($p<0.05$) lower than 0.56% recorded in T4. Full stomach was significantly ($p<0.05$) highest (2.45%) in T5 and lowest (1.38%) in T3. In terms of these characteristics, literature is limited on the use of herbal leaf meal in pig production. However, few studies with phytochemicals that assessed carcass characteristics in poultry revealed improvement in parameters, including carcass weight, breast weight, and carcass dressing percentage and reduced abdominal fat and relative abdominal fat (Hong *et al*., 2012; Kanduri *et al*., 2013).

Table 1: Effect of sole and combined herbal leaf meal as alternative feed antibiotics on carcass characteristics of growing pigs

Parameters	T1	T2	T3	T4	T5
Live weight (kg)	57.25±10.18	52.50±4.84	50.75±0.85	53.75±3.57	51.50±2.63
Hot carcass weight(Kg)	35.35±6.55	33.00±3.70	34.00±0.82	33.00±3.51	33.75±3.68
Eviscerated weight (kg)	41.58±7.38	39.33±4.02	40.80±1.38	40.32±3.79	40.55±3.83
Dressing Percentage (%)	61.40±2.83	62.52±1.35	66.97±0.63	61.03±3.20	65.11±4.60
Cut part[1]					
Head	9.27±0.52^{b}	9.76±0.56^{ab}	11.06±0.83^{ab}	11.40±0.26^{a}	10.64±0.44^{ab}
Fore trother	0.88±0.06	1.02±0.09	0.94±0.14	1.04±0.12	1.10±0.04
Hind trother	1.22±0.09	1.40±0.14	1.33±0.08	1.48±0.20	1.50±0.07
Ham	10.14±0.37	10.24±0.46	9.90±0.33	10.90±0.68	10.35±0.33
Shoulder	10.06±0.82	11.36±0.63	10.92±0.49	10.69±0.41	9.80±0.47
Tail	0.21±0.02^{b}	0.22±0.02^{b}	0.26±0.03^{ab}	0.38±0.09^{a}	0.25±0.01^{ab}
Offal [2]					
GIT	14.30±0.67^{b}	16.72±1.22^{ab}	14.65±1.02^{b}	14.39±1.15^{b}	17.75±0.94^{a}
Spleen	0.23±0.05	0.25±0.06	0.64±0.39	0.28±0.04	0.31±0.11
Heart	0.43±0.03^{b}	0.42±0.03^{b}	0.45±0.05^{b}	0.56±0.01^{a}	0.37±0.02^{b}
Liver	1.83±0.11	1.87±0.12	1.75±0.04	1.91±0.06	1.85±0.15
Kidney	0.37±0.04	0.40±0.06	0.35±0.03	0.36±0.02	0.32±0.02
Lung	1.19±0.13	1.24±0.25	1.10±0.08	1.04±0.09	1.19±0.06
Full stomach	1.59±0.15^{bc}	1.83±0.24^{bc}	1.38±0.15^{c}	2.01±0.07^{ab}	2.45±0.24^{a}

[a, b, c,] means values with different superscripts within row are significantly different ($p<0.05$)
[1, 2,] values are expressed as percentages of the live weight

In Table 2, the effect of sole and combined herbal leaf meal as alternative feed antibiotics on meat quality of growing pigs is shown. Values for cooking loss was significantly ($p<0.05$) highest (22.73%) in T4 and lowest (15.06%) in T5. Chilling loss was significantly ($p<0.05$) highest (2.30%) in T2 and lowest (1.05%) in T5. Cold shortening values were significantly ($p<0.05$) higher (11.38 and 11.30%) in T1 and T3 and lowest (7.24, 5.52 and 7.52%) in T2, T3 and T5, respectively. Thermal shortening was significantly ($p<0.05$) highest (38.40%) in T4 and lowest (26.46%) in T5. Although, there are few studies on the effect of herbal leaf meal on meat quality of pigs, the present study contradicted the findings of Liu *et al.* (2016) who reported no effect of *S. baicalensis* and *Lonicera japonica* extract mixture supplementation on cooking loss and drip loss of meat from finisher pigs. Lei *et al.* (2018) also reported negligible results for drip loss and cooking in pigs fed natural and fermented herbs. This contradiction may be due to the kinds of herbs used and the age of the animal.

Table 2: Effect of sole and combined herbal leaf meal as alternative feed additives antibiotics on meat quality of growing pigs

Parameters (%)	T1	T2	T3	T4	T5
Cooking loss	20.55±0.73^{b}	21.24±0.20^{ab}	19.77±0.44^{b}	22.73±0.74^{a}	15.06±0.86^{c}
Chilling loss	1.60±0.18^{bc}	2.30±0.22^{a}	1.57±0.18^{bc}	1.85±0.38^{ab}	1.05±0.08^{c}
Cold Shortening	11.38±1.89^{a}	7.24±0.67^{b}	5.52±0.80^{b}	11.30±1.56^{a}	7.57±0.95^{b}
Thermal shortening	34.69±1.80^{ab}	32.38±1.63^{b}	36.12±1.42^{ab}	38.40±1.45^{a}	26.46±1.16^{c}

[a,b,c,] means values with different superscripts within row are significantly different ($p<0.05$)

CONCLUSION AND RECOMMENDATION

From this study, it was concluded that feeding pigs diet containing Neem leaf meal improved cut parts (head and tail), organs (heart) and meat quality while feeding pigs diet containing moringa and moringa and neem leaf meal improved dressing percentage and reduced cooking loss.

REFERENCES

Esonu, B.O. (2006). Animal nutrition and feeding: A functional approach, 2nd edition. Memory press, Owerri, Imo state, Nigeria p212

Gong, J., Yin, F., Hou, Y., and Yin Y. (2014). Review: Chinese herbs as alternatives to antibiotics in feed for swine and poultry production: Potential and challenges in application. *Canadian Journal of Animal Science* 94(2): 223-241

Hao, H., Cheng, G., Iqbal, Z., Ai, X., Hussain, H.I., Huang, L., Dai, M., Wang, Y., Liu, Z. and Yuan, Z.H. (2014). Benefits and risks of antimicrobial use in food-producing animals. *Frontiers in Microbiology* 5(288):1–11.

Hong, J.C., Steiner, T., Aufy, A. and Lien, T.F. (2012). Effects of supplemental essential oil on growth performance, lipid metabolites and immunity, intestinal characteristics, microbiota and carcass traits in broilers. *Livestock Science* 144:253–262

Kanduri, A.B., Munde, V.K., Khan, M.A., Thakur, P.N., Saxena, M.J., Ravikanth, K., Thakur, A. and Maini, S. (2013). Study on the comparative efficacy of natural growth promoter (AV/AGP/10) with antibiotic supplements on overall growth performance and intestinal micrometry of broiler birds. *British Microbiology Research Journal* 3:623-636

Lei, X. J, Lee, I. S. and Kim, I. H. (2018). Effects of expanded diets and phase feeding programme on growth performance, carcass traits and meat quality in growing-finishing pigs, *Journal of Applied Animal Research,* 46(1): 984-989, DOI: 10.1080/09712119.2018.1448822

Liu, W.C., Pi, S.H. and Kim, I.H. (2016). Effects of *Scutellaria baicalensis* and *Lonicera japonica* extract mixture supplementation on growth performance, nutrient digestibility, blood profiles and meat quality in finishing pigs. *ItalianJournal of Animal Science* 15:446–452.

SAS, (2003). Statistical Analysis System. SAS Release 9.1 for windows, SAS Institute Inc.Cary, NC, USA.

Valenzuela-Grijalva, N. V., Pinelli-Saavedra, A., Muhlia-Almazan, A., Domínguez-Díaz, D., and González-Ríos, H. (2017). Dietary inclusion effects of phytochemicals as growth promoters in animal production. *Journal of Animal Science and Technology*, 59: 8. doi:10.1186/s40781-017-0133-9.

AGRO-INDUSTRIAL BY-PRODUCTS UTILISATION FOR SHEEP AND GOATS PRODUCTION IN OSUN STATE

***[1]Odu O., [2]Olajide B.R, [3]Idahor K.O. & [1]Babatope T.C.**
[1]Departmentof Animal Science, Faculty of Agriculture, University of Ibadan
[2]Departmentof Agricultural Extension and Rural Development, Faculty of Agriculture, University of Ibadan
[3]Department of Animal Science, Nasarawa State University, Keffi, Shabu-Lafia Campus
**Email address: olatunbosunodu@gmail.com*

ABSTRACT
Sheep and goats enterprise has been found to sustain economic growth and alleviate poverty among the farmers but inadequate feedstuff has posed a threat to their production beyond subsistence level. Therefore, this study investigated the agro-industrial by-products used by households and farmers in Osun State. Information on socio-economic background and utilisation of agro-industrial by-products for sheep and goats production was collected from 160 respondents using interview schedule. It was observed that more of the respondents were married (57.5%), had secondary education (46.9%) and majority (85.6%) earned about ₦49,000:00 monthly. Maize stover (57.5%) and cut grass (45.6%) were often used in feeding sheep and goats in the study area. Among the agro-industrial by-products used in sheep and goats feeding were from maize, sorghum, cowpea, rice, groundnut and millet production.
Keywords: Alternative feed resources, ruminant production, rural households

INTRODUCTION
Essentially, sheep and goats contribute immensely to rural development in many parts of Nigeria yet; the output is not enough to meet the animal protein requirements of the populace. For instance, in Nigeria it has been estimated that there are about 22.1 million sheep and 34.5 million goats (FDLPCS, 1992) and about 70% of these were reared by smallholder farmers under semi-intensive and extensive systems. This has been attributed to farmers lack of interest in rearing sheep and goats as well as inadequate feedstuff with poor nutritional quality and low forage productivity (Amole and Ayantunde 2015; FAO, 2012; Olorunnisomo, 2011). To ameliorate these constraints, a coping mechanism whereby alternative feed resources are utilised in sheep and goats feeding has been suggested (Haile *et al*., 2017; Garg *et al*. 2013; Ugwu, 2007). Hence, this study was aimed at investigating the utilisation of available and unconventional feedstuff in sheep and goats production in Osun State.

MATERIALS AND METHODS
Study location
Osun State has 30 local government areas with three senatorial zones: Osun East, Osun West and Osun Central and it is situated in the tropical rain forest zone of Nigeria with abundant mineral resources and presence of rivers. It covers an area of approximately 1,487,500 hectares and lies between latitude 7° 30′ 0″ North and longitude 4° 30′ 0″ East with 3,423,535 people (NPC 2006). It has cultivatable land area of 1,190,000 hectares, with only 761,600 hectares cultivated with arable crops and 178,500 hectares cultivated with tree crops (Osun MTSS, 2019-2021). The state is estimated to have about 256,000 farm families. As an agrarian state, there is availability of both food and cash crops as well as animals like cattle, sheep, goats, poultry, rabbits and swine, hence the high economic activities in the state.
Sampling technique, data collection and analysis
Simple random sampling approach was used to obtain information from sheep and goat rearers in the three Agricultural Development Program (ADP) zones: Ife/Ijesa, Iwo and Oshogbo in Osun State. This was further subdivided into 16 sub-zones proportionate to the sizes of the ADPs (4 sub-zones each in Iwo and Osogbo and 8 in Ife/Ijesa) for reliable data collection. Ten sheep and goat rearers were randomly selected in each area to respond to interview schedule that had 30 close-ended questions. Information were gathered on personal and socio-economic characteristics and utilisation of agro-industrial by-products for sheep and goats feeding and were analysed using simple descriptive statistics according to Adesoye (2004).

RESULTS AND DISCUSSION

The personal socio-economic characrteristics of the respondents presented in Table 1 showed that more married people (57.5%) were involved in sheep and goats production, while 18.8% widow/widower were also involved. Among the respondents, 16.3% had primary education, 46.9% and 10.0% had secondary and tertiary education, respectively. A total of 26.9% did not have formal education. Respondents were mostly Christians (57.5%), followed by Muslims (39.4%) while 3.1% practiced traditional religion. These observations corroborated the report of Fakoya and Oloruntoba (2009) that more married people with a level of education across the main religious groups in Osun State, are involved in small ruminant production. Though the respondents were basically farmers (40.6%) and traders (35.0%), majority of them (85.6%) earned about ₦49,000:00 only. One of the respondents (0.6%) earned about ₦200,000 monthly. Though an insignificant proportion, it suggests that sheep and goats rearing could be a veritable source of livelihood especially among the rural dwellers. This seemingly lent more credence to the assertions by many people, that sheep and goat rearing contributes immensely to household's income particularly, as source of cash to meet instant household financial obligations (Amole and Ayantunde, 2015; Legesse *et al*., 2008; MoFA, 2006; Dibissa, 2000). Therefore, sheep and goats rearing should be encouraged to enhance the well-being of households in particular and the gross domestic product at large.

Table 1: Distribution of respondents by their personal and socio-economic characteristics

Variables	Categories	Frequency	Percentage
Marital status	Single	13	8.1
	Married	92	57.5
	Co habiting	2	1.3
	Divorced	23	14.4
	Widow/widower	30	18.7
	Total	**160**	**100**
Education	Primary	26	16.3
	Secondary	75	46.9
	Tertiary	16	10.0
	No formal education	43	26.8
	Total	**160**	**100**
Religion	Muslim	63	39.4
	Christianity	92	57.5
	Traditional	5	3.1
	Total	**160**	**100**
Primary occupation	Civil servant	14	8.8
	Trader	56	35.0
	Farmer	65	40.6
	Others	25	15.6
	Total	**160**	**100**
Age (years)	20-39	36	22.5
	40-59	83	51.9
	60-79	37	23.1
	80 and above	4	2.5
	Total	**159**	**100**
Income (₦)	0-49,000	143	89.3
	50,000-99,000	14	8.8
	100000-149000	2	1.3
	200000 and above	1	0.6
	Total	**154**	**96.3**

Source: Field survey (2018)

Table 2 shows the agro-industrial by-products used by sheep and goats rearers in Osun State. Maize stover (57.5%) and cut grass (45.6%) were often used in feeding sheep and goats, compared to sorghum stover, sorghum grain residue, maize grain residue and cowpea haulm that were reported to be rarely used by 63.1%, 55.0%, 53.1% and 47.5% of respondents, respectively. Interestingly, it was observed that millet grain (81.3%), rice straw (74.4%) and rice grain (68.8%) were never used in feeding sheep and goats among the respondents. This could be possibly due to lack of awareness of the potentials of the feed resources and may also be due to unavailability of those resources. Also, it could be largely due to feedstuff selective behaviour of sheep and goats even in confinement that made *in situ* grazing still a better feeding option for sheep and goats (Oppong-Anane, 2013; Ugwu, 2007). Meanwhile, Haile *et al*. (2017) stated that pastures and stubbles are inadequate to meet the nutritional requirements of sheep and goats due to overgrazing and climate change adversities. Hence, the need for utilisation of agro-industrial by-products as a coping measure to boost animal protein availability in Osun State in particular and Nigeria at large.

Table 2: Agro-industrial by-products utilisation in sheep and goats production in Osun State

Agro-industrial by-products	Never	Rarely	Often	Very often
Maize stover	2 (1.3)	17 (10.6)	92 (57.5)	49 (30.6)
Sorghum stover	13 (8.1)	101 (63.1)	41 (25.6)	5 (3.2)
Cowpea haulm	54 (33.8)	76 (47.5)	29 (18.1)	1 (0.6)
Rice straw	119 (74.4)	37 (23.1)	4 (2.5)	0 (0.0)
Groundnut haulm	128 (80.0)	31 (19.4)	0 (0.0)	1 (0.6)
Cut grass	37 (23.1)	43 (26.9)	73 (45.6)	7 (4.4)
Maize grain/residue	25 (15.6)	85 (53.1)	45 (28.1)	5 (3.1)
Sorghum grain/residue	58 (36.2)	88 (55.0)	12 (7.5)	2 (1.3)
Rice grain/residue	110 (68.7)	44 (27.5)	4 (2.5)	2 (1.3)
Millet grain/residue	130 (81.3)	24 (15)	6 (3.8)	0 (0.0)

Source: Field survey (2018). Values in parentheses are the corresponding percentages (%)

CONCLUSION AND RECOMMENDATION

Myriads of agro-industrial by-products like those from maize, sorghum, cowpea, rice, groundnut and millet appeared to be available in Osun State but maize stover and cut grass were more utilised. However, all the identified agro-industrial by-products could be utilised in sheep and goats production to enhance the well-being of households. Consequently, awareness on the possible utilisation of these by-products in sheep and goats feeding becomes imperative.

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REFERENCES

Adesoye P. O 2004. Practical guides to statistical analysis for scientists. A Primer edition. *Debo Prints*, Ibadan, Pp 189.

Amole, T. A. and Ayantude, A. A. 2016. Improving livestock productivity: Assessment of feed resources and livestock management practices in Sudan-Savanna zones of West Africa. *African Journal of Agricultural Research*, 1: 422 – 440.

Dibissa, N. (2000). Sheep production on smallholder farms in the Ethiopian highlands – a farming system approach. *Doctoral Dissertation*, Humboldt Universit¨at Berlin, Institutf¨ur Nutztierwissenschaften.

Fakoya, E. O. and Oloruntoba, O. 2009. Socio-economic determinants of small ruminant production among farmers in Osun State, Nigeria. *Journal of Humanities, Social Sciences and Creative Art*, 4(1): 90-100.

FAO, 2012. Balanced Feeding for Improving Livestock Productivity: Increase in Milk Production and Nutrient, Use Efficiency and Decrease in Methane Emission. 1st Edn. *FAO, Rome, Italy*, Pp 42.

FDLPCS (1992). Federal Department of Livestock and Pest Control Services (FDLPCS).

Garg, M. R., Sherasia, P. L., Bhanderi, B. M., Phondba, B. T., Shelke, S. K. and Makkar, H. P. S., 2013. Effects of feeding nutritionally balanced rations on animal productivity feed conversion efficiency, feed nitrogen use efficiency, microbial protein supply, parasitic load, immunity and enteric methane emissions of milking animals under field conditions. *Animal Feed Science and Technology*, 179, 24–35

Haile, E., Gicheha, M., Njonge, F. K. and Asgedom, G. 2017. Determining Nutritive Value of Cereal Crop Residues and Lentil (*Lens esculanta*) Straw for Ruminants. *Open Journal of Animal Sciences*, 7: 19-29.

Legesse, G., Abebe, G., Siegmund-Schultze, and Valle Zarate, A. 2008. Small Ruminant Production in two mixed-farming systems of Southern Ethiopia: Status and Prospects for Improvement. Experimental Agriculture, 44: 399-412.

MoFA, 2006. Ministry of Food and Agriculture Development Plan (3 year plan 2007-2009). District Agricultural Development Unit. Talensi-Nabdam district. Pp 5-23.

NPC, 2006. National Population Census, Abuja, Nigeria. National Population Commission Reports. NPC.

Olorunnisomo, O. A. 2011. Intake and digestibility of elephant grass ensiled with cassava peels by Red Sokoto goats. Conference on International Research on Food Security, Natural Resource Management and Rural Development. University of Bonn, October 5-7.

Oppong-Anane, K., 2013. Cassava as animal feed in Ghana: Past, present and future. B. Berhanu, L. Cheikh and P.S. Harinde (eds.), FAO Country report Accra, Ghana, pp, 42-56.

Osun MTSS, 2018. State of Osun 2019-2021 Medium-Term Sector Strategy.

Ugwu, D. S. 2007. The role of small ruminant in the household economy of southeastern zone of Nigeria. Research Journal of Applied Sciences 2(6): 726-732.

EFFECTS OF DIET FORTIFICATION WITH *MORINGA OLEIFERA* AND *AZADIRACHTA INDICA* LEAF MEALS ON SERUM TOTAL PROTEIN OF RABBITS INOCULATED WITH *TRYPANOSOMA BRUCEI BRUCEI*.

Salifu, A. O [*]., Carew, S. N[°]. & Adamu, M[ᵛ].

**Nigerian Institute for Trypanosomiasis Research (NITR) Vom, Plateau State, Department of Animal African Trypanosomiasis (AAT) Kaduna.*

°University of Agriculture Makurdi, Benue State, Department of Animal Production.

ᵛUniversity of Agriculture Makurdi, Benue State, Departmentof Veterinaryparasitology.

ABSTRACT

The anti-trypanosomal effects of dry leaf meals of *Moringa oleifera*and *Azadirachta indica* for serum total protein were investigated using grower rabbits. Forty rabbits were randomized into eight groups (1, 2, 3, 4, 5, 6, 7 and 8) of five animals each with mean live weights of 1.2 Kg. Groups 5, 6, 7 and 8 were Inoculated subcutaneously with normal saline diluted blood containing $3.98\times10^{6}ml^{-1}$ of *Trypanosoma brucei brucei* , while groups 1, 2, 3 and 4 were not inoculated . The rabbits were fed on four diets. Diet (D) 1 had no leaf meal (basal) and was fed to groups 1and 5 (controls). D 2 was fortified with 1% Moringa Leaf Meal (MLM) and was fed to groups 2 and 6. D 3 had 1% Neem Leaf Meal (NLM) and was fed to groups 3 and 7. D 4 had both MLM and NLM at 1% each and was fed to groups 4 and 8. Data were subjected to statistical analysis using SPSS ANOVA and Duncans new multiple range test at 95% confidence limit. The results of total blood proteins gl^{-1} was significantly ($P<0.05$) higher for rabbits inoculated with *T. brucei brucei* than for non inoculated rabbits except group 6 ($P>0.05$). The findings in this study reveals that the serum total protein of rabbits in group 6 inoculated with *T. brucei brucei* which was not significant ($P>0.05$) from group 2 (non inoculated rabbits) supports the hepato protective capability of MLM over NLM.

Keywords: Anti-trypanosomal, serum total protein

INTRODUCTION

The disease Animal African Trypanosomosis (AAT) affects most domestic animals. It is caused by extracellular haemoprotozoan parasites belonging to the genus *Trypanosoma* (Zawua *et al*., 2015). The most important species of trypanosomes affecting livestock in Nigeria are *T. vivax, T. brucei brucei, T. congolense, T. evansi* and *T. simiae*. Trypanosomes are mainly transmittedcyclically by tsetse fly, a vector belonging to the genus *Glossina*. Trypanosomosis is considered to be among the most important constraint to livestockproductivity in sub Saharan Africa (Wellburn *et al*., 2001). Losses include a decrease in productive potential such as diseased growth rate, poor milk yield, weight loss in young growing animals and death(Kaewthamasorn and Wongsamee, 2006). Several ethno medicinal plants have been researched on to find alternative treatments for trypanosomosis as against the three major salts of Diminazene, Homidium and Isomethamidium chloride produced in 1950s and still used as trypanocides to treat AAT (Nok *et al*., 1993; Geerts *et al*., 2001 and Atawodi, 2005).

The shrub *Moringa oleifera* is a pan-tropical species that is reputed to possessing nutritional and medicinal properties (Gafar and Itodo, 2011). It belongs to the family moringaceae. It is widely cultivated in Asia, Africa and other tropical parts of the world (Makker and Becker, 1997). Anti-trypanosomal trial of moringa leaves prolonged the lifespan of rats and was reported to be non toxic (Olugbemi *et al*., 2010).

The neem tree scientifically called *Azadirachta indica* has been highly valued in India for over 4,000 years and is referred to as miraculous healing plant (Gunguli, 2002). It belongs to the mahogany family meliceae and can reach a height of 15-20 meters. Reports had been made on the trypanocidal potentials of *Azadirachta indica* leaves extract (Nok *et al*., 1993). Domestic rabbits (*Oryctolagus cuniculus*) were used as model laboratory animals to represent animals naturally infected by trypanosomosis.The aim of this study was to investigate the antitrypanosomal effect of serum total protein in prophylactic treatment of moringa and neem leaf meals against *T. brucei brucei*experimentally infected rabbits.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the Nigerian Institute for Trypanosomiasis Research (NITR) -Vom in Plateau State, Nigeria.

Preparation of Moringa and Neem Leaf Meals

Fresh moringa and neem leaves were harvested from residential houses in hudco quarters north bank, makurdi, Benue state. The leaves were air dried on clean surfaces in the laboratory indoors until crisp. The dried leaves were then pulverized and stored in sealed polythene bags until they were used in feed preparation.

Experimental Animals and their Management

Forty weaner rabbits were purchased from Dagwom farm in Vom. They were vaccinated against Coccidiosis using Coccinor, treated with long acting Oxytetracycline and Ivermectin following manufacturer's directives against mange and gastro-intestinal parasites. The animal house, hutches and all handling equipments were washed with detergent and disinfected with 3.5% Sodium Hypochlorite before arrival of the rabbits. Each rabbit were housed individually in wire mesh cages. An acclimatization period of three weeks was observed. The animals were maintained according to the CIOMS guidelines (1985).

Proximate Composition and Energy Content of Leaf Meals

The proximate composition and energy value of *Moringa oleifera* Leaf Meal (MLM) and Neem Leaf Meal were determined according to AOAC (2002) at the Biochemistry Department of the National Veterinary Research Institute (NVRI) Vom.

Experimental Diets, Animal Groups and Inoculation with Trypanosomes

Four types of diet and eight groups ofrabbits fed with diet 1 which contained no leaf meal (basal diet) served as control. The second diet (D 2) contained 1% Moringa Leaf Meal (MLM). The third diet (D 3) had 1% Neem Leaf Meal (NLM). The fourth diet (Diet 4) had approximately 1% each of MLM and NLM.Diet 1 was fed to groups 1 and 5, diet 2 was fed to groups 2 and 6, diet 3 was fed to groups 3 and 7 and diet 4 was fed to groups 4 and 8 respectively.

The *T. brucei brucei* (Federe Strain)used was obtained from the parasitology division of Nigerian Institute for Trypanosomiasis Research (NITR) Vom, Plateau State, Nigeria. The parasites were maintained by serial passage in albino rats bred in NITR-Vom. Blood was obtained from the serial passage rats by tail bleeding into normal saline and the parasitaemia adjusted to 3.98×10^6 trypanosomes per milliliter (ml) by the method of Herbert and Lumsden (1974). Each infected rabbit received 0.5ml of saline containing *T. brucei brucei.* The infection was by intraperitoneal injection. The duration of the experiment was 12 weeks (3 weeks pre-infection and 9 weeks post-infection periods).

Collection of blood samples

Trypanosomes were monitored daily and detected using a rapid approximation method (Herbert and Lumsden, 1974). At the end of the experiment, 5ml of blood was collected from the heart of three rabbits each per group and euthanized, for serum total protein test into blood sample tubes.

Biochemical technique

The total plasma protein was estimated using the Golgberg refractometer method as described by Kohn and Allen (1995).

Statistical analysis

The data collected were subjected to statistical analyses by Analysis Of Variance (ANOVA) and Duncans New Multiple Range Test (DMRT) at 95 % confidence limit using SPSS 24 (2016). Data are presented as Mean ± standard error ba

RESULTS AND DISCUSSION

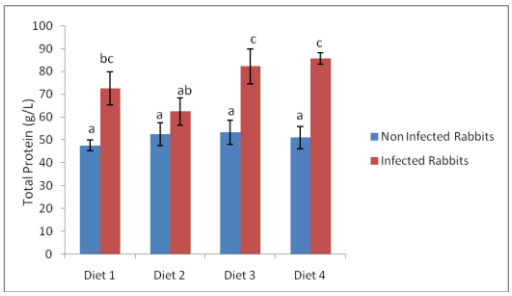
The results of proximate composition of neem and moringa leaf meals are presented in Table 1. The moringa leaf meal had higher moisture, crude protein, ether extract, ash, Nitrogen Free Extract (NFE) and metabolizable energy than the neem leaf meal.

Table 1: Proximate composition of Neem and Moringa leaf meals.
Weight per 100grams of sample.

Neem Leaves		Moringa Leaves
Proximate analysis	**Result (g/100g)**	
Moisture	10.4	15.0
Crude Protein	16.2	25.4
Ether Extract	4.1	6.3
Crude Fibre	14.5	8.6
Ash	7.4	8.8
NFE	47.3	35.9
Metabolizable Energy Kcal/Kg	2596.1	2694.5

M.E was calculated using the method of Pauzenga, 1985. M.E (Kcal/Kg) = 37 x % CP + 81.8 x % EE + 35 x % NFE.

The results on serum total protein effects of moringa leaf and neem leaf meals are presented in figure 1. It revealed significantly ($p<0.05$) higher total protein for the rabbits inoculated with *Trypanosoma brucei* than the non inoculated rabbits for groups fed on diets 1, 3 and 4 except for diet 2 which had no significant difference ($p>0.05$) between the non inoculated and the *T. brucei* inoculated rabbits that fed on the diet containing the 1% moringa leaf meal. The significantly higher ($P<0.05$) serum total protein of the infected rabbits in this study agrees with the report of Takeet and Fagbemi (2009) who also had increase in serum total protein of rabbits infected with trypanosomes. This strongly suggests an increase in some forms of the serum protein reacting to the presence and activities of the trypanosomes in the body system of animals.



Different a, b and c means are considered significant at $p<0.05$, I error bar.
Figure 1. Effects of diets 1(basal), 2 (basal and 1% Moringa Leaf Meal MLM), 3 (basal and 1% Neem Leaf Meal NLM) and 4 (basal, 1% MLM and 1% NLM) on serum total protein of rabbits after 9 weeks post inoculation (pi) with *Trypanosoma brucei brucei*.

CONCLUSION AND RECOMMENDATION

The findings in this study reveal the superior hepato protective capabilities of MLM over NLM in *T. brucei brucei* infection constraint. In conclusion, the serum total protein revealed greater potentials of moringa over neem in trypanosmosis infection of rabbits. It is recommended that MLM should be selected to ameliorate trypanosomosis disease over NLM.

REFERENCES

AOAC. (2002). Association of Official Analytical Chemist. Official method of Analysis. 16 edition, William Tryd. Press Washington D.C U.S.A. Chapter 4 PP. 17-34.

Atawodi, S. E. (2005). Comparative In vitro trypanocidal activities of petroleum ether, chloroform, methanol and aqueous extracts of some Nigerian Savannah plants. *African Journal of Biotechnology*. 4(2): 177-182.

CIOMS (1985). Council for International Organizations of Medical Sciences International guiding principles for biomedical research involving animals.

Gafar, M. K. and Itodo, A. U. (2011). Proximate and Mineral Composition of Hairy Indigo Leaves. *In Electronic journal of Environmental, Agricultural and Food Chemistry (EJEAChe*). 10(3): 2007-2018.

Geerts, S., Holmes, P.H., Eisler, M. C. and Diall, O.(2001). African bovine trypanosomiasis: The problem of drug resistance.*Parasitology. Today.*, 17(1): 25-28.

Gunguli, S. (2002). Neem. A therapeutic for all seasons. *Journal of current science*. 82 (11): 1304-1306.

Herbert, N.J. and Lumsden, W.H. (1976). *Trypanosoma brucei*: A rapid "Matching" Method for Estimating the Host's parasitemia. *Experimental Parasitology* 40: 429-431.

Kaewthamasorn, M. and Wongsamee, S. (2006). A preliminary survey of gastrointestinal and haemoparasites of beef cattle in the tropical livestock farming system in Nan province, Northern Thailand. *A journal of parasitological Research.*

Kohn, R. A. and Allen, M. S. (1995). Enrichment of proteolytic activity relative to nitrogen in Preparations from the rumen for in vitro studies. *Animal feed science technology*, 52(1/2): 1-14.

Makkar, H. P. and Becker, K. (1996, 1997). Nutritional value and anti-nutritional components of whole and ethanol extraction of *M. oleifera* leaves. *Journal of Animal Feed Science and Technology* 63: 311-322.

Nok , A.J., Esievo, K.A., Hondjet, I., Arowosafe, S., Onyenekwe, P. C., Gimba C. E., and Kagbu, J.A. (1993). Trypanocidal potential of *Azadirachta indica:* Invivo activity of leaf extract against *T. brucei brucei. Journal of Clinical Biochemistry and Nutrition*., 15: 113-118.

Ogbuewu, I. P., Okoli, I. C. and Iloeje, M. U. (2008). Serum Biochemical Evaluation and organ weight characteristics of Buck Rabbits fed Graded levels of Neem (*Azadirachta indica*) leaf meals Diets. www.priory.com/neem_rabbits.

Olugbemi, T.S., George, P. and Dauda, O.M. (2010). Anti-trypanocidal potentials of aquaeous and ethanolic leaf extracts of *Moringaoleifera* in wistar stock albino rats. www.ajol.info.journalhome 8: (2).

Pauzenga, U. (1985). Feeding parent-stock. Zootenicia International, December 1985. Pp. 22-24.

Takeet, M. I. and Fagbemi, B. O. (2009). Haematological, Pathological and Plasma Biochemical changes in Rabbits experimentally infected with Trypanosoma congolense. *Science World Journal*, 4(2):1597-6343.

Wellburn, S. C., Coleman, P. G., Fevre, E. and Maudlin I. (2001). Sleeping Sickness- a tale of two diseases. *Trends Parasitology*. 17:19-24.

Zawua, T. P., Amali, O., Amuta, E. U. and Sar, T. T. (2015). Haemoparasites of cattle Slaughtered for sale within Gboko Metropolis of Benue State, Nigeria. *Nigerian journal of parasitology*. 36 (1): 72-76.

NUTRIENT DIGESTIBILITY AND PRODUCTIVE PERFORMANCE OF WISTAR ALBINO RATS FED PROCESSED SICKLE POD (*Senna obtusifolia*) LEAF MEAL-BASED DIETS

Augustine, C*., Khobe, D*., Babakiri, Y*., Igwebuike, J.U., Kwari, I.D**., Ardo, M.U***., Medugu, C.I** Maspalma, A.J*** & Shall, M.P*****

**Department of Animal Production, Adamawa State University, Mubi*
***Department of Animal Science, University of Maiduguri,*
****Department of Home Economics Adamawa State College of Education, Hong*
Corresponding author: audaggai@gmail.com

ABSTRACT

A feeding trial was conducted for 28 days to evaluate the nutrient digestibility and productive performance of wistar albino rats fed processed sickle pod (*Senna obtusifolia*) leaf meal (SOLM) –based diets. Five experimental diets were compounded to contain 0 and 20% each of the sun-dried, boiled, fermented fresh and boiled and fermented SOLM designated as T_1, T_2, T_3, T_4 and T_5, respectively. A total of 90 growing albino rats with an initial average weight of 13.52 – 14.48 g were randomly allocated to the dietary treatments in a completely randomized design replicated 3 times with 6 rats each. The apparent nutrient digestibility indicated significant ($P<0.05$) variation except the nitrogen-free extract and energy. The apparent nutrient digestibility in the rats fed the processed SOLM based-diets indicated similar trend.The dry matter, crude protein and crude fibre digestibility in rats fed the processed SOLM-based diets range from 66.75 to 68.15%, 64.45 to 66.71% and 30.22 to 34.61%. The productive performance was not significantly ($P>0.05$) different except for the feed intake which indicated significant ($P<0.05$) variation. The highest total feed intake was recorded in albino rats fed the control diet 0% SOLM (365.40 g) and 20% boiled and fermented SOLM (334.32 g). The overall weight gain among the albino rats fed the processed SOLM-based diets were not significantly ($P>0.05$) different. It was concluded that, the different processed SOLM-based diets were better digested and had enhanced the productive performance of the albino rats. However, the boiled and fermented SOLM-based diet indicated better nutrient digestibility and growth performanceand is therefore the most recommended for feeding albino rats.

Key words: Nutrient digestibility, productive performance, *Senna obtusifolia*.

INTRODUCTION

The use of alternative feed ingredients to augment the conventional feed resources has become very paramount in the Nigerian livestock industry. This will go a long way to make available affordable protein to many Nigerians especially the North-eastern part of Nigeria were insecurity challenges had consequently led to protein malnutrition. Ardo *et al.* (2019) and Shaahu *et al.* (2010) advocated the use of alternative feed resources to be integrated into sustainable livestock feeding systems.

It was documented that green vegetables are the most abundant and cheapest source of protein which is due to their ability to synthesize amino acids from wide range of primary sources (Fasuyi, 2016). *Senna obtusiolia* leaves have good protein content (20.40%) but also contain some anti-nutritional factors such as tannins which necessitates some forms of processing before incorporation into livestock feed. It is in view of the above that this study was conducted to evaluate the effects of feeding differently processed *Senna obtusifolia* leaf meal-based diets on nutrient digestibility and productive performance of wistar albino rats.

MATERIALS AND METHODS

Location of the study area

The study was conducted at the Animal House of the Department of Biological Sciences, Adamawa State University, Mubi. The area is located between latitudes 9° 30' and 11° north of the equator and longitudes 13° and 9° 45' east of Greenwich meridian (Adebayo, 2004).

Experimental diets and treatments

Five experimental diets were compounded to contain 0% and 20% each of the sun-dried, boiled, fresh fermented and boiled and fermented *Senna obtusifolia* leaf meal designated as T_1, T_2, T_3, T_4, and T_5, respectively as presented in Table 1.

Table 1: Ingredient Composition and Calculated Analysis of the Experimental Diets

Ingredients	T_1 0% SOLM	T_2 20%SDSOLM	T_3 20%BSOLM	T_4 20%FFSOLM	T_5 20%BFSOLM
Maize	49.00	49.00	49.00	49.00	49.00
Maize offal	15.00	7.15	7.15	7.15	7.18
Roasted soya bean meal	25.65	13.50	13.50	13.50	13.50
Fish meal	7.00	7.00	7.00	7.00	7.00
PSOLM	0.00	20.00	20.00	20.00	20.00
Salt	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.15	0.15	0.15	0.15	0.15
Premix	0.20	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Crude protein (%)	20.61	19.13	19.06	19.39	19.48
Crude fibre (%)	4.70	5.64	4.80	3.75	3.25
Calcium (%)	2.43	3.13	3.08	3.41	3.47
Phosphorus (%)	2.75	3.21	3.03	3.22	3.25
*Energy kcal/kg	2877.61	2877.58	2849.83	2851.75	2861.50

PSOLM = Processed *Senna obtusifolia* leaf meal; SOLM = *Senna obtusifolia* leaf meal; SDSOLM = Sun-dried *Senna obtusifolia* leaf meal; BSOLM = Boiled *Senna obtusifolia* leaf meal; FFSOLM = Fresh fermented *Senna obtusifolia* leaf meal; BFSOLM = Boiled and fermented *Senna obtusifolia* leaf meal; *Energy calculated according to the formula of Pauzenga (1985) ME (kcal/kg) = 37 x %CP + 81 x %EE + 35.5 x %NFE, CP = crude protein; EE = Ether extract; NFE = Nitrogen-free extract

Experimental animals and their management

A total of 90 young albino rats with initial average weight of 13.52 to 14.48 g were managed inside constructed metal cages. The rats were acclimatized to the cages and the experimental diets for one week. Thereafter they were fed with measured quantity of feed which was supplied at *ad libitum*. Clean drinking water was regularly supplied. The rats were managed using standard management practice of handling experimental animals as described by Ochei and Kolhatkar (2007) and also in accordance with the Animal Care and Ethics Committee of the Adamawa State University, Mubi. The experiment lasted for 28 days.

Parameters measured

The feed intake was determined by the difference between daily feed offered and feed leftover. Total fed intake was obtained by cumulative addition of the daily feed intake.

Weight gain: The rats were weighed at the commencement of the experiment and the initial weight was recorded. Final weights of the rats were recorded at the end of the experiment and overall weight gain was obtained by subtracting the initial weight from the final weight.

Feed conversion ratio: This was determined by dividing the weight gain by feed intake.

Mortality: The mortality was recorded as they occur.

Determination of nutrient digestibility

At the end of the experiment, 4 rats were randomly selected from each treatment and placed in small cages with perforations underneath. A metal tray was placed beneath each cage for feacal collection.Faecal samples were collected and feed intake was also measured. The feacal samples were bulk, properly oven-dried and analysed for their proximate composition. Nutrient digestibility (ND) was computed using the formula

$$ND = \frac{\text{(nutrient in diet x feed intake)} - \text{(nutrient in faeces x feacal output)}}{\text{Nutrient in diet x feed intake}}$$

RESULTS AND DISCUSSION

The result of apparent nutrient digestibility of wistar albino rats fed processed SOLM-based diets is presented in Table 1.Theresult revealed significant ($P<0.05$) variation among the treatment groups except digestibility for nitrogen-free extracts and energy. The nutrient digestibility among the rats fed the process SOLM-based diets indicated similar digestibility trend. This is an indication that all the processing methods were effective in reducing the levels of the anti-nutritional factors and fibre content thereby enhancing digestibility and utilization of nutrients. This finding corroborates the report of Ardo *et al.* (2019) who reported similar findings for albino rats fed processed *Senna obtusifolia* seed meal-based diets. Sun-drying was reported to be effective in reducing anti-nutritional factors of leafy vegetables thereby enhancing their utilization (Udofia and Obizoba, 2005; Patricia *et al.* 2015). Tuleum *et al.* (2011) reported that boiling and fermentation are effective in neutralizing anti-nutritional factors in feedstuffs.

The albino rats fed the control diet (0% SOLM) indicated higher feed intake followed by those fed the boiled and fermented SOLM-based diet. This observed effects might be due to the flavour of the processed SOLM in the diet which is in line with the report of Takashi *et al*. (2013) who reported that, flavour have sedative effect, decrease the motivation to eat feed, feed intake and weight gain

Table 1: Nutrient Digestibility and Productive Performance of Wistar Albino Rats Fed Processed *Senna obtusifolia* leaf meal Based-Diets

Parameters	**T_1** **0%SOLM**	**T_2** **20%SDSOLM**	**T_3** **20%BSOLM**	**T_4** **20%FFSOLM**	**T_5** **20%BFSOLM**	**SEM**
Dry matter (%)	74.57[a]	66.75[b]	66.02[b]	67.49[b]	68.15[b]	1.02*
Crude protein (%)	69.09[a]	64.45[b]	66.53[b]	65.24[b]	66.71[b]	0.70*
Crude fibre (%)	37.45[a]	30.22[b]	31.95[b]	33.68[b]	34.61[b]	2.02*
Ether extract (%)	64.18[a]	61.09[b]	66.70[b]	65.48[b]	65.10[a]	1.87*
NFE (%)	63.28	62.36	62.75	62.65	63.07	1.47[NS]
Energy Kcal/kg	64.08	61.33	64.00	66.19	65.31	1.62[NS]
Total feed intake (g)	365.40[a]	295.12[c]	287.56[c]	285.04[c]	334.32[b]	1.35*
Initial weight (g)	14.06	13.52	13.79	14.02	14.48	0.25[NS]
Final weight (g)	137.50	116.61	129.00	127.81	132.82	9.20[NS]
Weight gain (g)	123.74[a]	103.09[b]	115.21[b]	113.79[b]	118.34[b]	5.53*
Feed conversion ratio	123.74[a]	103.09[b]	115.21[b]	113.79[b]	118.34[b]	5.53*
Mortality (number)	0.00	0.00	0.00	0.00	0.00	-

abc = means in the same raw with different superscript are significantly different; SEM = standard error of means; SOLM = *Senna obtusifolia* leaf meal; SDSOLM = Sun-dried *Senna obtusifolia* leaf meal; BSOLM = Boiled *Senna obtusifolia* leaf meal; FFSOLM = Fresh fermented *Senna obtusifolia* leaf meal; BFSOLM = Boiled and fermented *Senna obtusifolia* leaf meal; NFE = Nitrogen-free extract

CONCLUSION

It was concluded from this study that the different processing methods (sun-drying, boiling and fermentation) were effective in detoxifying *Senna obtusifolia* leaves which positively enhances nutrient digestibility and productive performance.

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REFERENCES

Adebayo, A.A. 2004. *MubiRegion: A Geographical Synthesis*, Paraclete Publishers, Yola, Nigeria Pp 17 – 65.

Ardo, M.U., Augustine, C., Khobe, D., Garba, Y.M., Faci, A.D., Ahmed, S., Katsala, J.G. and Yusuf, J. (2019). Nutrient digestibility, carcass characteristics and organ weights of albino rats fed processed sickle pods (*Senna obtusifolia*) seed meal based-diets. *Book of Proceedings of 8th ASAN-NIAS Joint Annual Meeting*, held on the 8 -12th September, at Umuahia, Abia State

Fasuyi, A.O. (2016). Nutritional protein of some tropical vegetable leaf meals. *Journal of Biotechnology*, 5(1):49 – 53.

Ochei, J. and Kolhatkar, A. (2007). *Medical Laboratory Science Theory and Practice* 6th ed. Tata McGraw-Hill Publishing Company Limited 1232 pp

Partricia, D.O., Lessoy, T.Z., Adom, J.N. and Sebastien, L.N. (2015). Impact of sun-drying on nutritive and anti-oxidant properties of five leafy vegetables consumed in Northern Cote D'voire. *Asian Journal of Applied Science*, 3(5): 628 – 637.

Pauzenga, U. (1985). Feeding Parent stock. *Zootecnia International*, Pp22-25.

Shaahu, D.T., Ayoade, J.A. and Babatunde I.B. (2010). Effects of graded level of groundnut testa on the growth performance of growing rabbits. *Proceeding of the 36th Annual conference of the Nigerian society for Animal Production*, A.A., Adeniji, E.A. Olatunji and Gana, E.S. (eds) University of Abuja, March, 13 – 16, 2010, Pp. 315 – 317.

Takashi, Y., Tadashi, T. and Tadakata, T. (2013). The odor of *osmanthus* fragments alternates food intake. *Scientific Reports*, **3**:1518, Doi:10.1038/Srep01518.

Tuleun, C.D., Adenkola, A.Y., and Orayaga, K.T. (2011). Naturally fermented mucuna seed meal based diets: effect on performance and carcass characteristics of broiler chickens. *Research Journal of Poultry Science*,4(4): 50 – 55.

Udofia, U.S. and Obizoba, I.C. (2005). Effects of sun-drying and shade-drying on nutrients and anti-nutrients content of some green leaf vegetables consumed in Uyo Communities Akwa-Ibom State.*Journal of Biomedical Investigation*, 3(1):1-5.

EFFECT OF DURATION OF STORAGE ON EGG QUALITY

[*]Adeoye, A.A., [**]Udoh, J.E., [***]Oladepo, A.D., & [****]Ojajuni, J.B
[*]Animal Production and Health, Ondo State University of Science and Technology, Okitipupa.
[***]Agricultural Science, Adeyemi College of Education, Ondo
[**]Animal Science Department, University of Uyo, Uyo
[****]Zoology programme, Ondo State University of Science and Technology, Okitipupa
e-mail address:adeomoh@yahoo.com; Phone No. 08138273174

ABSTRACT
One hundred and twenty (120) freshly laid eggs by 36 weeks old Isa brown layers kept at the Poultry Unit, Teaching and Research Farm, Ondo State University of Science and Technology, Okitipupa were randomly collected and stored at room temperature for 21 days. At week 0, week1, week 2 and week 3 of storage, 30 eggs were broken for egg quality analysis. Data collected were subjected to statistical analysis. Duration of storage had significant effect ($p<0.05$) on all the internal and external parameters except shell index and shell thickness. The overall egg weight, egg length, egg width, shell index, shell weight, shell ratio and shell thickness were 56.82, 5.69, 4.43, 78.02, 7.45, 13.11 and 0.28 respectively, while yolk height, albumen height, yolk weight, albumen weight, albumen ratio, yolk ratio and Haugh unit were 13.55, 4.97, 16.32, 33.06, 58.11, 28.82 and 67.50 respectively. Most of the traits declined in values as the storage duration increased except yolk weight and ratio which increased as the egg aged. Duration of storage of egg had effect on the egg quality that determines acceptability by consumers.
Keywords: Eggs; Isa brown; storage duration; shell index; yolk ratio

INTRODUCTION
The egg is a complex structure distinguished by having four different parts; the egg shell, shell membrane, albumen and yolk. When eggs are for human consumption, it is important that they are suitable for this purpose (Kabir *et al.,* 2014). This is determined by both the internal and external quality (Smith, 1990). Egg quality is composed of characteristics that affect its acceptability to consumers such as cleanliness, freshness, weight, shell quality, yolk index, albumen index, Haugh unit and chemical composition (Song *et al.*, 2000). Unlike external quality, internal egg quality begins to decline as soon as the egg is laid. Variability in the quality and nutritional values of eggs have significant impact on consumers' health and welfare. Some factors affect egg quality. They include the breed and strain of layers (Kucukyilmaz *et al*., 2012), dietary composition (Goldberg *et al*., 2012), birds' health, environmental conditions and storage, processing and handling and age (Ryu *et al*., 2011 and Kabir *et al.,* 2014). The objective of this study is to determine the effect of duration of storage on the internal and external quality of eggs kept at room temperature.

MATERIALS AND METHODS
One hundred and twenty (120) freshly laid eggs were randomly collected in a batch from 36 weeks old exotic chickens (Isa Brown) kept at the Poultry Unit, Teaching and Research Farm, Ondo State University of Science and Technology, Okitipupa, 30 of the eggs were analysed for internal and external quality within 24 hours of laying. The remaining were stored at room temperature on the laboratory desk and at weekly interval 30 eggs were randomly selected till 21 days and similarly analysed.The external quality parameters included egg weight (EWt), egg length (EL), egg shell weight (ESWt), egg width (EWdt), shell index (SIdx), shell ratio (SRatio) and egg shell thickness (EST). The internal egg quality traits included albumen weight (AlbWt), albumen height (AlbHt), albumen ratio (AlbRatio), yolk weight (YlkWt), yolk height (YlkHt), yolk ratio (YlkRatio), Haugh unit (Hu).Data collected were subjected to one-way analysis of variance procedure of SAS (2003). Significant means were separated using Duncan Multiple Range Test, (Duncan, 1955). The following statistical model was employed:

$Yij = \mu + Di + eij$

Where: Yij= Individual observation, μ= Overall mean, Di= Effect of the ith duration (i= 1, 2, 3, 4) and eij= Random error.

Results

Table 1 shows the summary statistics of egg quality traits. The external quality traits - egg weight, length, width and shell index, weight, ratio and thickness were 56.82 g, 5.69 mm,

4.43mm, 78.02 %, 7.45 g, 13.11 %, 0.28 mm respectively, for external traits. The internal quality - yolk height, albumen height, yolk weight, albumen weight, albumen ratio, yolk ratio and Haugh unit were 13.55 mm, 4.97 mm, 16.32 g, 33.06 g, 58.11 %, 28.82 % and 67.50 respectively.

Table 1. Summary Statistics for egg quality traits

Variables	Means	N	Minimum	Maximum	CV
Egg weight (g)	56.82 ± 0.40	109	47.3	67.96	7.37
Egg length (mm)	5.69 ± 0.03	109	5.06	6.62	6.39
Egg width (mm)	4.43 ± 0.02	109	4.06	5.28	6.12
Shell index	78.02 ± 0.50	109	64.23	92.63	6.70
Shell weight (g)	7.45 ± 0.07	109	5.60	9.14	9.39
Shell ratio	13.11 ± 0.10	109	10.91	15.52	7.58
Shell thickness (mm)	0.28 ± 0.02	109	0.01	0.49	59.40
Yolk height (mm)	13.55 ± 0.23	85	7.09	16.90	15.84
Albumen height (mm)	4.97 ± 0.15	107	2.36	10.23	30.76
Yolk weight (mm)	16.32 ± 0.19	89	12.50	22.90	10.92
Albumen weight (g)	33.06 ± 0.40	89	24.10	41.87	11.41
Albumen ratio	58.11 ± 0.37	89	46.35	65.20	6.02
Yolk ratio	28.82 ± 0.34	89	21.22	40.00	10.98
Haugh unit	67.50 ± 1.21	107	40.15	100.00	18.58

Table 2 shows the effect of duration of storage on the external traits. Significant difference ($P<0.05$) was observed in all the traits considered except shell index. In egg weight, no significant difference was observed from week 0 to 2. Egg weight reduced with age. Egg lengths across weeks were 5.72, 5.87, 5.63 and 5.49 mm. No significant difference was observed from week 0 to 2. Similar trends were observed in egg width and shell ratio. The values for shell weight were 7.72, 7.38, 7.19 and 7.43 for the weeks respectively. Table 3 shows the effect of storage duration on the internal quality traits. Significant difference ($P<0.05$) was observed in all the traits considered. For yolk height, significant difference was observed from week 0 to 3. Hence, yolk height reduced as the egg age. The values for albumen height were 6.80, 4.32, 4.30 and 3.86. Similar trend was observed for albumen ratio and Haugh unit. Albumen ratio reduced as the egg age, but yolk ratio increased with age.

Table 2: Effect of storage duration on external quality of egg

Variable	0-week	1-week	2-week	3-week	SEM
Egg weight (g)	58.48[a]	57.38[a]	56.29[a]	53.94[b]	0.40
Egg length (mm)	5.72[ab]	5.87[a]	5.63[bc]	5.49[c]	0.03
Egg width (mm)	4.48[ab]	4.54[a]	4.36[bc]	4.27[c]	0.03
Shell index	78.52[a]	77.61[a]	78.06[a]	77.84[a]	0.50
Shell weight (g)	7.72[a]	7.38[b]	7.19[b]	7.43[ab]	0.07
Shell ratio	13.22[b]	12.87[b]	12.78[b]	13.44[a]	0.10
Shell thickness (mm)	0.24[a]	0.30[a]	0.26[a]	0.33[a]	0.02

Means with different superscript in a row are significantly different ($p<0.05$)

Table 3: Effect of storage duration on internal quality of egg

Variable	0-week	1-week	2-week	3-week	SEM
Yolk height	15.22[a]	14.37[b]	11.52[c]	10.33[d]	0.23
Albumen height	6.80[a]	4.32[b]	4.30[b]	3.86[b]	0.15
Yolk weight	15.54[b]	16.56[ab]	16.53[ab]	17.09[a]	0.19
Albumen weight	35.09[a]	33.36[ab]	32.61[b]	28.96[c]	0.40
Albumen ratio	60.10[a]	58.15[b]	57.89[b]	54.29[b]	0.37
Yolk ratio	26.71[c]	28.94[b]	29.38[b]	32.04[a]	0.34
Haugh unit	81.48[a]	61.68[b]	63.39[b]	58.98[b]	1.21

Means with different superscript in a row are significantly different ($p<0.05$)

DISCUSSION

The significant effect of duration of storage observed on virtually all egg quality traits observed in this study is in agreement with the works of earlier researchers (Akyurek and Okur, 2009; Silversides and Scott, 2001; Sekeroglu *et al.*, 2008; Sung and Kyung, 2014). The decrease in egg weight observed in this study as egg aged could be attributed to evaporation of water through the shell pores. This is in line with the observation of Sung and Kyung (2014). This could also be responsible for decrease in

Haugh unit, albumin weight, yolk height, albumen height with age. However, yolk weight increased as the duration of egg storage increased,Khan *et al*. (2013) postulated the movement of water from albumen to the yolk as the possible explanation of the increased yolk weight with storage duration. This also accounted for decrease in albumen weight.During aging there is carbodioxide and oxygen exchange and water evaporates through the shell increasing the air chamber and reducing albumen height. The Haugh unit of 61.6 at the seventh day of storage is lower to 66.2 reported by Sung and Kyung, 2014 at room temperature. The discrepancies could be attributed to differences in age and breed of the layers used. The non-significant effect of storage duration on shell thickness and shell index is similar to the observation of Sung and Kyung, 2014 while the significant effect observed in shell weight is contrary to the report of the researchers. It could be concluded that storage reduces the acceptability of egg by consumers as quality is grossly affected.

REFERENCES

Akyurek, H. and A.A. Okur, (2009). Effect of storage time, temperature and hen age on egg quality in freerange layer hens. *J. Anim. Vet. Adv.*, 8: 1953-195

Goldberg, E.M., Gakhar, N., Ryland, D., Aliani, M., Gibson, R.A., House, J.D., (2012). Fattyacid profile and sensory characteristics of table eggs from laying hens fed hempseed and hempseed oil. *J. Food. Sci.* 77:153-160.

Kabir, M., Sulaiman, R.O., Idris, R.K., Abdu, S.B., Daudu, O.M., Yashim, S.M., Hassan, M.R., Adamu, H.Y., Eche, N.M., Olugbemi, T.S. and Adedibu, I.I. (2014). Effects of strain, age and the interrelationships between external and internal qualities of eggs in two strains of layer chickens in northern Guinea savannah zone of Nigeria, *Iranian Journal ofApplied Animal Science*, 4 (1): 179-184.

Khan, M.J.A., S.H. Khan, A. Bukhsh, M.I. Abbass and M. Javed, (2013). Effect of different storage period on egg weight, internal egg quality and hatchability characteristics of Fayumi eggs. *Ital. J. Anim. Sci.*, 12: 51.

Kucukyilmaz, K., Bozkurt, M., Yamaner, C., Cýnar, M., Catl, A.U., Konak, R., (2012).Effect of an organic and conventional rearing system on the mineral content of hen eggs. *Food Chem*. 132:989-992

Ryu, K.N., No, H.K., Prinyawiwatkul, W., (2011). Internal quality and shelf life of eggs coated with oils from different sources. *J. Food. Sci*. 76:325-329.

Sekeroglu, A., M. Sarica, E. Demir, Z. Ulutas, M. Tilki and M. Saatci, (2008). The effects of housing system and storage length on the quality of eggs produced by two lines of laying hens. *Arch. Geflugelk*, 72: 106- 109.

Silversides, F.G. and T.A. Scott, (2001). Effect of storage and layer age on quality of eggs from two lines of hens. *Poult. Sci*., 80: 1240-1245

Smith A.J. (1990). Poultry. Macmillian press limited. page 128-133.

Song, K.T., Choi, S.H. and Oh, H.R. (2000). A comparison of egg quality of Pheasant,

Chykar, Quail and Guinea fowl. *Asian- Australia Animal Science* 13(7): 18-22.

Sung Heon Chung and Kyung-Woo Lee, (2014). Effect of Hen Age, Storage Duration and Temperature onEgg Quality in Laying Hens. *International Journal of Poultry Science* 13 (11): 634-636, 2014

PREDICTION OF BODY WEIGHT OF TWO STRAINS OF LAYERPULLETS USING MORPHOMETRIC TRAITS

Sabo M.N., j., Sani and R. A. Hamzat
Department of Animal Science, Federal University Dutsin-Ma, Katsina State.

ABSTRACT
A total of 200-day old layer chicks comprising of 100 chicks each of Nera Black and Lohmann Brown Classic were used to determine prediction models for body weight from morphometric parameters. Data were collected on body weight and morphometric trait; breast girth, body length, wing length, shank length and thigh length. All the morphometric traits measured in chick were significantly ($P<0.05$) correlated with body weight. The breast girth has better correlation with body weight than other morphometric trait in Nera Black (0.763) and for the two strains combined (0.788). However, body length had the highest correlation with body weight in Lohmann Brown Classic chicks. Breast girth showed the highest coefficient of determination (R^2 value) of 0582 in Nera Black while body length had the highest R value of 0.715 and 0.610 for Lohmann Brown Classic and the two strains combined respectively. This study showed that morphometric trait like body length and breast girth can be used in estimation of body weight.
Keywords: Trait, prediction, correlation, regression, body weight

INTRODUCTION
Morphometric traits also called linear body measurements or conformation traits are important parameters in predicting body weight and this has been observed by commercial breeders and producers. Breeders, therefore, breed desirable sizes of chickens which also have the desirable production traits particularly body weight (Ojedapo *et al.*, 2010). Apart from body weight, a number of conformation traits are also known to be good indicators of good growth (Ibe, 1989). Such conformation traits include shank length, breast width, knee length, wing span, chicken height, body length, and head circumference (Ojo *et al.*, 2010). Linear body measurements have been used to predict live weights in poultry (Okon *et al.*, 1997), Prediction of body weight with morphometric traits in layers is therefore important.The easiest way to assess an animal's body mass is to weigh the animal. However, under some situations scale may not be available and prediction of body weight from body measurements could be preferred practically (Latshaw and Bishop, 2001). The objective of this study therefore to determine the morphometric parameters of egg strain chicks, their correlation between with body weight and develop a prediction equation for body weight from those parameters of egg strain chicks

MATERIAL AND METHODS
The experiment was conducted in the Department of Animal Science Teaching and Research Farm, Federal University Dutsin-ma. It lies within latitude 11° 7' and 13° 22' N and longitude 6° 52' and 9° 2' E (Abaje *et al.*, 2014).
A total of 200 day-old- layer chicks purchased from a reputable hatchery in Nigeria were used in the experiment.Routine management practices were carried out on the layer chicks. The chicks were fed *ad-libitum*. The data of prediction of body weight in egg layer strain chicks using morphometric traits were collected.Birds in each replicate were weighed at the beginning of the experiment and subsequently on weekly basis. Feed intakes were recorded weekly and were determined by the weigh-back technique. Feed conversion ratio was determined. The Linear Body Measurements were taken at week 10. The body parameters were taken in centimetres with the use of tape. Morphometric parameters measured include:thigh weight, shank length, breast girth, wing length and body length. SPSS (2008) Package was used to obtain estimate of correlation and regression between body weight and each of the morphometric trait. The significance of the correlation regression coefficient was determined at P-value of less than 0.05

RESULT AND DISCUSSION

Table 1 shows the comparison of means of body weight and linear body measurements of Nera Black and Lohmann Brown Classic layer strain chicks. Body weight, breast girth, wing length and thigh length were not significantly different between the strains. However, body length was significantly different with Nera Black having longer body length (23.55cm) than Lohmann Brown Classic (22.71cm).

Table 1: Comparison of means of body weight (g) and morphometric traits (cm) of Nera Black and Lohmann brown classic layer strain chicks at 10 week of age.

Trait	Near black	Lohmann brown classic	SEM
Body weight	552.24	531.68	13.55
Body length	23.55[a]	22.71[b]	0.22
Breast girth	19.87	19.73	0.27
Wing length	15.56	15.33	0.13
Shank length	6.88	6.57	0.11
Thigh length	7.25	6.99`	0.11

[a, b] Values with different superscripts differ significantly, SEM= Standard error of mean

Table 2 shows the correlation of the body weight and Morphometric traits of combined layer strain at week 10. Body weight is highly correlated to all the morphometric traits with Breast girth having the highest correlation (0.788).

Table 2: Combined correlation of body weight and morphometric traits of Nera Black and Lohmann Brown classic layer strains chicks at 10 week of age

	BW	BL	BG	WL	SL	TL
BW	1.000					
BL	0.781	1.000				
BG	0.788	0.545	1.000			
WL	0.732	0.795	0.582	1.000		
SL	0.592	0.797	0.298	0.720	1.000	
TL	0.656	0.769	0.369	0.716	0.890	1.000

BWT-body weight; BG-Breast girth; BL-Body length; WL-Wing length; SL-Shank length; TL-Thigh Length; SEM= Standard error of mean

Table 3 shows prediction equations relating the body weight and morphometric traits in combined layer strain at week 10. The R^2 values of range from 0.351 to 0.610 with Body length have the highest R^2 value of 0.610. This implies that body length could be the best predictor of body weight of layer strains.

Table 3: Combined regression of body weight of morphometric traits of Nera Black and Lohmann brown classic layer strains chicks at 10 week of age

Combined of two strain	Regression equation	R^2	SEM	LOS
Nera Black & Lohmann Brown	BWT= -55.794+47.239 BL	.610	0.190	* **
	BWT= -240.086+39.494 BG	.606	0.693	* **
	BWT= -604.590+74.230 WL	.537	0.831	* **
	BWT= 65.667+70.836 SL	.351	0.145	N S
	BWT= -52.822+83.540 TL	.430	0.130	N S

BWT-body weight; BG-Breast girth; BL-Body length; WL-Wing length; SL-Shank length; TL-Length; NS-Non significant; R^2- Regression square; SE-Standard error; LOS-Level of significance; ***Significant at p<0.001; **Significant at P<0.05

DISCUSSION

The high correlation between body weight and morphometric measurements in this study agrees with the earlier report of Yahaya *et al.* (2012) who obtained high correlation coefficients between body weight and morphometric traits in Hubbard and Arbor Acre broiler strains. The estimates contained in their reports were generally higher than the values obtained in the present study. The observed close relationship between body weight and breast girth in both Nera black and Lohmam brown classic agrees with the earlier findings of Adebambo *et al*. (2006) who reported that breast girth is a good indicator of predicting body weight in most poultry species.

The regression result shows that breast girth and body length could be the best predictors of the body weight of layer strain chicks. This result agreed with Udeh and Ogbu (2011) who reported that Arbor Acre strain with R^2 of 96% in breast girth and 92% in body length were the best predictors of the body weight of broiler strains. All other linear body parameters in all studied reported R^2 values above 50% which implies any of linear body parameter could also be used to predict body weight of the layer strain chicks. The result of regression coefficients of the two strains combined agrees with the observation Ubani *et al* (2011) who reported that breast girth and body length recorded the highest R^2 value among Nu-breed, Arbor, Acre and Marshall Strains between 3-5 weeks of age. The body length and breast girth are best for predicting body weight in layer chicks (Nera Black and Lohmann Brown Classic).

The result obtained from this research shows that prediction of body weight is possible from various linear body parameters. Generally breast girth and body length were found to be the best and most reliable parameter in estimates body weight. In terms of hierarchy, breast girth was significantly highest followed by body length in Nera Black and Lohmann Brown Classic at week 10. Application of linear model to all parameters at week 10 was found to be highly significant (P<0.05). All linear body parameter whose R^2 values were above 50% could be used to predict body weight of the layer strain, although the accuracy of prediction increased with an increase in the R^2 value.

CONCLUSION AND RECOMMENDATION

The present study showed that there exists strong correlation between body weight and most of the morphometric indices like body length, breast girth, wing length, shank length and thigh length of Nera Black and Lohmann brown Classic. Prediction of body weight is possible from various linear body parameters. Generally breast girth and body length were found to be the best and most reliable parameter in estimates body weight. It is therefore recommended that body length and breast girth be used in predicting body weight.

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REFERENCES

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology*; Vol. 6, No. 2; 2014

Adebambo A O, Ozoje M O, Adebambo Funmi and Abiola S S (2006). Genetic variations in growth performance of Giriraja, Indian White Leghorn and Improved Indigenous chicken breeds in South West Nigeria. *Nigerian Journal of Genetics* 20: 7-16.

Ibe, S. N. (1989). Measurement of size and confirmation in commercial broilers. *J. Anim. Breed and Genet*. vol. 106, p. 461-469.

Latshaw, J. D. and Bishop, B.L. (2001). Estimating body weight and body composition of chickens by using noninvasive measurements. *Poult. Sci*., 80: 868–873

Ojedapo, L. O., Adedeji, T. A., Ameen, S. A. and Amao, S. R. (2010). Interrelationships between body weight and other body linear measurements in Anak strain of commercial broiler. In:*Proceedings of the 15th AnnualConference of the Animal ScienceAssociation of Nigeria* (15): 61-63.

Ojo, O. A., Akpa, G. N., Adeyinka, I. A., Makinde, F. M., Iyiola,-Tunji, A. O. and Ubani, E. O. A. (2010). Prediction equation for eight weeks

Okon, B., Ogar, I. B. and Mgbere, O. O. (1997). Interrelationship of live bodymeasurements of broiler chickens ina humid tropical environment.*Nigerian Journal of AnimalProduction.,* 24 (10): 7-12.

Ubani, E. O. A., Adeyinka, I. A., Nwagu, B. I., Abeke, F. O. Sekoni, A. A. Out, M. O. and Iyiola – Tunji, A. O. (2011). Estimates of repeatability for some growth traits in naked Neck broiler chickens. *Proceeding of the 36th Conference of Nigerian Society for Animal Production* (NSAP). Univ. of Abuja. Nigeria Pp. 48 – 50.

Udeh, I. and Ogbu, C. C. (2011).Principal Component Analysis of body measurements in three strains of broiler chicken.*World Journal ofScience 6*(2): 11-14.

Yahaya, H. K. Brahim, H. and Abdul Salam, S (2012).Comparative Study of the Body Weight and Body Conformations of Two Broiler Strains under the Same Dietary Condition. *Inter. J. of Ani.and Vet. Advances* 4(3), 195-197.

AGE BASED CLASSIFICATION OF MORPHOMETRIC TRAITS OF DIFFERENT NIGERIA GOAT BREEDS

P.F. Abolusoro[*1]., A.J. Shoyombo[2],O.O. Alabi[2], J. Izebere[2], R.A Animashahun[2], S.O Olawoye[2]H. Yakubu[3], A. A Musa[4] & M.Wheto[5]

[1]Department of Agric Education, Kogi State College of Education Technical, Egbeda, kabba, Kogi State, Nigeria

[2]Department of Animal Science, College of Agricultural Sciences, Landmark University Omu-Aran, Kwara State, Nigeria

[3]Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

[4]Department of Animal Science, Faculty of Agriculture, Kogi State University, Anyigba, Kogi State, Nigeria

[5]Department of Animal breeding and Genetics, Federal university of Agriculture Abeokuta, Ogun State, Nigeria

ABSTRACT

A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age. The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test. The result of this study indicated that the Sahelian breed was superior to other breeds across all age groups in body weight, while the red Sokoto was intermediate followed by the West African Dwarf.

INTRODUCTION

Goats are the largest in number among ruminant livestock in Nigeria totaling about 58.3 million (FAOSTAT, 2008). Goats, predominantly are kept by the rural household and ownership is spread across all human age groups and sexes (Akpa,1999).The importance of goat stem from its ability to convert forages and household by-product into high quality human food and their role as locally available source of food, fibre, power and other products to suit local community needs. The indigenous breeds found in Nigeria are, Red Sokoto, Sahel, and West African Dwarf (WAD) goat (Adu and Ngere, 1979). These differ considerably in size, coat colour, horn length, etc. Their broad genetic variability enables them to survive under stressful environmental condition including high disease incidence, poor nutrition which may increase animal susceptibility to disease, high temperature, and traditional husbandry system.

MATERIALS AND METHODS

The study was carried out in Borno, Sokoto and Ogun States. These states were selected because they are locations having close to pure breeds of the goats. Animals used for this study were sampled in the abattoir, of Borno, Sokoto and Ogun states when brought for slaughter either by the owner or by the slaughter man. It is believed that all animals find their way into the abattoir from villages and local markets, where they are kept in small numbers by local farmers; they are raised under the extensive system of management. A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age.

The following metric characters were measured on each animal: Body Weight (BW), Age, Horn Length (HL), Ear length (EL), Shoulder width (SW), Neck circumference (NC), body length (BL), Withers Height (WH), Heart Girth (HG), Pouch Girth (PG), Tail Length (TL) and Scrotal

circumference (SC). Weights of the animals were taken using a spring balance and Walk-in weighing scale. Flexible measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by two assistants in such a way that their heads, necks, and chest were stretched almost in a straight line. Each measurement was taken at least three times and the mean recorded to the nearest centimeter or kilogram. Reference marks used for body measurement according to the method of and Salako and Ngere (2002).

Data analysis

The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software (SAS, 1990) package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test.

RESULTS AND DISCUSSIONS

Mean body weight in Red Sokoto, Sahel and West African Dwarf goats less than one year are presented in Table 1. The Sahel breed is superior to the other breeds with a body weight of 13.56±0.56Kg and 14.94±0.52Kg in does and bucks respectively. Within the Red Sokoto population, body weight in doe and buck was 13.73±0.51Kg and 12.86±0.42Kg respectively while in West African Dwarf, 10.44Kg±0.22 and 10.62±0.21Kg for does and bucks. Coefficient of variation ranges between 13.98% and 29.40% suggesting the influence of major genes on this trait.

Summarized in Table 2 are Sahel goats had a mean weight of 17.13±0.43Kg and 16.86±0.49Kg followed by West African Dwarf goats with 15.45Kg±0.54 and 17.65±0.44Kg for does and bucks respectively. Red Sokoto goats weighed 13.60±0.46Kg (does) and 13.51±0.43Kg (bucks).

Live weight is important for assessing the condition of the animal and represents a criterion of selection. Mean live weight of 13.73 Kg, 13.56 Kg, 10.44 Kg and 12.86 Kg, 14.94 Kg and 10.44 Kg for does and bucks for the three breeds respectively for age less than one year are within the range of 12-18 Kg reported by Katongole *et al*. (1996) for indigenous goats in Kenya. Mean live weight of 13.60 Kg, 17.13 Kg, 15.45 Kg and 13.51 Kg, 16.84 Kg and 17.65 Kg for does and bucks between the age one through two years are lower than values of 20-40kg reported by several authors (Akpa *et al*., 1998, Otoikhan *et al*., 2008 and Salako *et al*., 2006) in different breeds of goat. Mean live weight of 18.95 Kg, 23.60 Kg, 19.13 Kg and 19.21, 25.12 Kg and 19.35 Kg for does and bucks above two years are closer to the range reported by several authors (Akpa *et al*., 1998, Osuhor *et al*., 2002 and Otoikhan *et al*., 2008), with Sahel breed fell within the specified range of 20-40 Kg. The average body weight at different ages fell within the range of 16-30 Kg specified by Hassan and Ciroma (1990) for both does and bucks from age 1-5 years in different breeds of goats.

CONCLUSION

Present results showed that age has strong influence, as there were consistent increases in all the traits studied as the animals aged. The scenario is however not surprising since the size and shape of the animal is expected to increase as the animal is growing with age. There was wide variability as the age of the animals increased most particularly in the bodyweight. This was in consonance with the report of Orheruata and Olutogun, (1984) in cattle.

REFERENCES

Adu, I.F., and Ngere, L.O. (1979). The indigenous Sheep of Nigeria. World *Review of Animal Production*. 15(3); 52 – 62.

Akpa, G.N. (1999). Evaluation of Dairy Characteristics and lactation curves of small holder Red Sokoto (Maradi) Goats. Ph.D Thesis.Ahmadu Bello University, Zaria pp 64-68.

Akpa, G.N., Ambali, A.L. and Suleiman, I.O. (2013).Body Conformation, Testicular and Semen Characteristics as Influenced by Age, Hair Type and Body Condition of Red Sokoto Goat. N Y Sci J 6(7):44-58]. (ISSN:1554-0200).

Akpa, G.N., Duru, S. and Amos, I.T. (1998). Influence of strain and Sex on estimation of within age-group body weight of Nigerian Maradi goats from hair linear body measurements. *Tropical Agriculture (Trinidad) 74:462-467*

Banerjee, A.K., Animat, G., and Ermias, E. (2000).Selection and Breeding Strategies for increased production of goats in Ethiopia. In: Merkel, R.G., and Goetsch, A.L, (ed). The opportunities and challenges of enhancing goat production in east Africa, PP. 70 – 79. Debub University, Awassa, Ethiopia 10 – 12 November 2000.

Bunge, R., Thomas, D.L., and Stookey, J.M. (1990) Factors Affecting the Productivity of Ram bottle ewes mated to ram Lambs. *J. Anim. Sci*. (68). 2253 – 2262.

Dettmers, A. (1983). Performance of Hair Sheep in Nigerian. In Fitzhugh, H. E. and Bradford, G.E. (eds). Hair Sheep of West Africa and the Americas. Boulder, Col., West View Press pp 201 – 218.

Devendra, C., and Burns, M. (1983).Goat |Production in the Tropics. 2nd ed. Farham Royal, Commonwealth Agricultural Bureau, pp 1 – 60.

Hall, S.J.G. (1991). Body Dimensions of Nigerian Cattle, Sheep and Goats. Anim. Prod. 53:61-69

Hassan, A. and A. Ciroma. 1990. Bodyweight measurements relationship in Nigerian Red Sokoto goats. Department of Animal Science, Usmanu Danfodiyo University, Sokoto, Nigeria http://www.fao.org/wairdocs/ilri/x5 520b/x5520b1d.htm.

Katongole J B D, Sebolai B and Madimabe M J 1996 Morphological characteristics of the Tswana goat. In S H B Lebbie and E Kagwini (eds). Proceedings of the Third Biennial Conference

Morphological traits among Red Sokoto, Sahel and WAD goat (< 1 year)

		RED SOKOTO			SAHEL			WAD		
Parameter		Doe	Buck	Total	Doe	Buck	Total	Doe	Buck	Total
BW	N	50	50	100	50	50	100	50	50	100
	X	13.73	12.86	13.30	13.56	14.94	14.25	10.44	10.62	10.53
	SD	3.62	3.00	3.33	3.90	3.70	3.89	1.53	1.49	1.50
	CV	26.38	23.36	25.12	29.40	24.78	27.30	14.65	13.98	14.27
EL	N	50	50	100	50	50	100	50	50	100
	X	10.22	9.86	10.04	11.52	11.06	11.29	9.56	9.43	9.49
	SD	1.17	1.07	1.13	1.79	1.88	1.83	1.08	1.20	1.13
	CV	11.46	10.81	11.24	15.53	16.96	16.28	11.27	12.70	11.95
SW	N	50	50	100	50	50	100	50	50	100
	X	13.34	13.83	13.59	18.18	18.59	18.39	12.75	12.99	12.87
	SD	3.94	3.40	3.68	3.02	2.57	2.79	3.02	3.40	3.20
	CV	29.57	24.65	27.06	16.60	13.80	15.20	23.70	26.21	24.90
NC	N	50	50	100	50	50	100	50	50	100
	X	22.69	23.43	23.06	21.02	23.31	22.17	23.47	24.39	23.93
	SD	5.10	4.30	4.71	3.67	4.53	4.26	4.16	4.16	4.16
	CV	22.48	18.35	20.41	17.47	19.43	19.22	17.73	17.04	17.40
BL	N	50	50	100	50	50	100	50	50	100
	X	41.92	41.97	41.95	35.36	39.56	37.46	42.04	41.88	41.96
	SD	4.70	3.99	4.33	7.16	9.25	8.50	5.85	5.13	5.48
	CV	11.20	9.50	10.33	20.25	23.39	22.68	13.92	12.27	13.06
WH	N	50	50	100	50	50	100	50	50	100
	X	52.06	51.63	51.85	42.47	45.80	44.13	47.93	48.07	48.00
	SD	6.13	5.69	5.89	10.04	9.44	9.84	7.98	7.53	5.33
	CV	11.78	11.03	11.36	23.64	20.62	22.30	16.65	15.67	16.08
HG	N	50	50	100	50	50	100	50	50	100
	X	53.33	57.53	55.43	49.90	48.77	49.33	50.15	49.71	49.93
	SD	9.24	8.29	8.98	3.46	4.68	4.14	5.51	5.18	5.33
	CV	17.33	14.40	16.21	6.74	9.60	8.39	10.98	10.43	10.67
PG	N	50	50	100	50	50	100	50	50	100
	X	55.37	59.61	57.49	52.20	50.63	51.41	51.42	50.99	51.19
	SD	9.32	8.40	9.08	3.50	4.68	4.18	5.48	5.05	5.25
	CV	16.83	14.09	15.79	6.70	9.24	8.14	10.65	9.91	10.25
TL	N	50	50	100	50	50	100	50	50	100
	X	12.08	11.71	11.807	11.62	11.97	11.79	10.29	10.27	10.28
	SD	1.84	2.13	1.99	2.27	2.28	2.27	1.33	1.46	1.39
	CV	15.24	18.17	16.71	19.52	19.06	19.25	12.90	14.24	13.52

Horn Length (HL), Ear Length (EL) Shoulder Width (SW) Neck Circumference (NC) Body Length (BL) Wither Height (WH) Heart Girth (HG), Pouch Girth (PG), tail length (TL), scrotal circumference (SC) and Body Weight (BW)

EFFECTS OF SEASON, SEX AND AGE ON BODY WEIGHT, PACKED CELL VOLUME, HAEMOGOLOBIN AND FEACAL EGG COUNT IN INDEGENOUS BREEDS OF SHEEP IN GOMBE STATE

[1]Boyi, B., [2]Mbap, S. T., [2]Mancha, Y. P.,[1]Amaza, I. & [1]Maidala, A.
[1]Federal University P. M. B. 1005 Gashua, Yobe State, Nigeria
[2]Abubakar TafawaBalewa University P. M. B. 0248 Bauchi State, Nigeria.
Corresponding author email: benjaminboyi51@gmail.com

ABSTRACT
The study investigated the effects of breed, season, sex and age on body weight, packed cell volume, Haemoglobin concentration and Faecal egg count of some indigenous breeds of sheep in Gombe State between March and October, 2017. Stratified random sampling was applied to collect the 300 samples comprising of 130 Yankasa, and 73 Balami 97 Uda sheep. Faecal egg count was measured using the modified McMaster technique for faecal samples found positive forgastro intestinal parasite eggs. Packed cell volume (PCV) was determined by micro-haematocrit technique. Faecal egg count (FEC) significantly (P<0.001) differed among the breeds with highest value of 1271.65epg recorded in Uda. Balami and Uda had higher values of body weight than Yankasa. There were no breed effects on PCV and HBC recorded in this study. Seasonal effects on BWT, PCV, HbC and FEC was observed with the wet season recording higher values of 32.32kg,36.04%, 11.99g/dl and 1140.95epg.This could be attributed to the fact that wet season is the period of lush pasture which has positive influence on BWT, PCV, and HbC. Furthermore, the wet season is a suitable period for the development of the infective stages of the Gastro intestinal parasites and hence higher burden. Age of sheep affected the values of BWT, PCV, HbC and FEC significantly. The values of 45.02kg,32.43%,10.82g/dl and 725.34epg forBWT, PCV, HbC and FEC respectively were significantly higher in adult than the younger sheep. This could be attributed to the fact that these parameters normally increase with age and physiological changes.

Key note: Season, Sex, breed, Packed cell volume, Haemogolobin Concentration, Faecal egg count.

INTRODUCTION
Nigerian sheep population is estimated at 44.3 million and over 70% is found in the Savanna regions where three of the four breeds of sheep (Balami, Yankasa and Ouda) predominate. Sheep thrive in a wide variety of environments in the tropics and sub tropics and requires less capital as they can be completely maintained on pastures, browse and agricultural waste products (FAO, 2007).Gastro-intestinal infections among other variables are significant constraints to livestock production (Badran*et al*. 2012). The major factor that influences gastrointestinal parasites infection in small ruminants, especially sheep is exposure to faecal contamination of grazing land (Pathak, 2011).Greer (2008) stated that the degree of disease infection varies with the host immune response. Males are generally more susceptible than females due to the production of androgen hormone which lowers immune response (Asif*et al*., 2008). Heavy animals also show more resistance due to sufficient body fat reserves that aids immune responses (Bilbo and Nelson, 2001). During rainfall the number of infective larval stages increase and animal are also more susceptible to infection (Kantzoura*et al*., 2012). Blood properties are indices of the physiological and pathological changes in animals (Cambell, 2007). Haemotological tests have been widely used for the diagnosis of disease and nutritional status of animals. Information gained from blood parameters substantiates physical examination and together with medical history provide the basis for judgment and decision making (Schalm *et al*., 1975). Several researches were conducted on the effects of breed, season, sex and age on PCV, HbC and FEC on sheep in Nigeria particularly the northern part however; there was scant information on that in Gombe state. This study was carried out to bridge the gap in information, provide useful information for further research and to make recommendations.

MATERIALS AND METHODS
Area of the Study
The research covered the three senatorial zones of Gombe State comprising North, Central and South. Gombe State. It is situated in North East region of Nigeria and occupies a total land area of about

20,265 Km^2. The state is located between latitude 9^0 30' and $12^0$30'N and longitude $8^0$45' and $11^0$45'E of the Greenwich Meridian (Abubakar, 1974).

Experimental Animals

Three indigenous breeds of sheep namely Yankasa, Balami and Uda commonly reared by peri urban and urban households in Gombe state were used for this study.

Study Design.

Faecal and blood samples were collected randomly from 300 sheep for laboratory analysis. Stratified random sampling was applied to collect the 300 samples comprising of 130 Yankasa, 73 Balami and 97 Uda sheep. The total sample size was calculated according to Thrusfield (2005) using 95% confidence and expected prevalence of 89.1% from previous study of James (2014) and desired precision of 5% as follows:

$n = 1.96^2 P_{exp} (1- P_{exp}) / d^2$

Where n = sample size

$P_{exp=}$expected prevalence (89.1% of James, 2014)

d = desired absolute precision of 5% (0.05).

$n = 1.96^2$ x 0.891 (1-0.891)/ $(0.05)^2$

n = 3.8416 x 0.891(0.109)/ 0.0025

n = 0.3731/ 0.0025

n = 150 samples approximately

The value of 150 was multiplied by 2 to avoid sampling error in accordance with (Jatau*et al*., 2011).

Faecal sample collection and analysis

Fresh faecal sample (5g) was collected using hand gloves, directly from the rectum of the sheep into clean universal containers, labeled and stored. The samples were subsequently processed for gastro-intestinal parasite presence and identification.Samples found positive were counted using the modified Mcmaster technique according to Soulsby (1986).

Blood sample collection and analysis

Blood samples (5 ml per animal) were obtained from the jugular vein using a10 ml syringeattached to 21gauge x ½ inch needle. Air was first cleared from the syringe before puncturing at 20^0 angle (Pratt, 1985) and the syringe was aspirated to confirm insertion and collection of blood. The blood sample collected was then placed in labeled tubes coated with ethylene-diamine tetra-acetic acid (EDTA) as anticoagulant. Packed cell volume (PCV) was determined at Gombe State Specialist Hospital laboratoryusing the micro-haematocrit technique (Pratt, 1985) and classified into low, normal and high.Haemoglobin concentration wasdeterminedby dividing PCV values by 3 according to (Addass, 2010) and also classified as low, normaland high whilehaemoglobin type was identified through electrophoresis (Wintrobe, 1967).

Data Analysis

Data collected were analyzed using descriptive statistics and were further subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SPSS, version 22 (Allen *et al.,* 2013) as in the following model. Significantly different means were separated using the Duncan multiple range test (DMRT).

$Y_{ijk} = \mu + B_i + E_j + e_{ijk}$

Where;

Y_{ijk}= Observations on dependent variables

μ = common mean

B_i = effect of ith breed

E_j= effects of all other factors, but taken individually; number and types (of factor) varied with the dependent variable.

e_{ijk}= random error term.

The relationships among PCV, HbC, Bwt and FEC were determined using the Pearson's product moment correlation coefficient.

Table 1: Effects of Breed, Season, Sex and Age on BWT, PCV, HbC and FEC

Factor	Parameter							
	BWT		PCV		HbC		FEC	
	X	SD	X	SD	X	SD	X	SD
Overall	35.67	1.052	34.25	0.95	11.43	0.318	1083.446	71.602
Breed:								
Yankasa	***		NS		NS		***	
Balami	28.58	1.04[b]	31.68	0.52	10.58	0.17	678.46	45.79[c]
Uda	32.80	1.57[a]	31.22	0.86	10.35	0.28	903.56	75.08[b]
	36.26	1.46[a]	31.99	0.76	10.64	0.25	1271.65	88.05[a]
Season:			***		***		***	
Dry	*		27.41		9.14		714.80	
Wet	30.99	0.92[b]	0.40[b]		0.14[b]		59.43[b]	
	33.32	1.26[a]	0.44[a]		0.15[a]		53.33[a]	
Sex:			NS		NS		NS	
Male	NS		31.31		10.42		871.13	
Female	30.81	1.00	0.55		0.18		60.30	
	33.37	1.19	0.54		0.18		57.70	
Age:			*		*		***	
Young	***				10.32		1087.07	
Adult	21.79	0.34	31.06	0.51	2.17	10.82	52.37	725.34
	45.02	0.80	32.43	0.59	2.28		63.60	

*** =P<0.001), * =P<0.05, ** =P<0.01, NS =Not significant, PCV =Packed cell volume inpercentage, HbC =Haemoglobin concentration in gramme per decilitre (g/dl), FEC = Feacal egg count, X = Mean, SD = Standard deviation, Bwt (Body weight, in kilogramme) and values in a column within a subset with different superscripts are significantly different.

Table 2: Effects of Faecal egg count on PCV, HbC and BWT

Category	PCV	HbC	Bwt
LS	NS	NS	**
Low	1060.13	1023.97	1023.30[a]
Normal	890.42	894.43	578.93[b]
High	1126.67	1080.00	955.74[a]

LS = Level of significance, PCV = Packed cell volume (percent), HbC = Haemoglobin concentration (gramme per decilitre), Bwt= Body weight (Kilogramme), NS = Non-significant. Values in a column with different superscripts are significantly different.

RESULTS AND DISCUSSIONS

The means and standard deviations of BWT, PCV, HbC and FEC by breed, season, sex and age are presented in Table 1. The overall values of BWT, PCV, HbC and FEC were 35.67Kg, 34.25%, 11.42g/dl and 1083.45 epg.Faecal egg count (FEC) significantly (P<0.001) differed among the breeds with highest value of 1271.65epg recorded in Uda. This finding is similar to observations reported byFantu*et al*. (2012) and Hassan *et al*. (2013) but disagrees with Mbap and Chiroma (1998) who found that Yankasa breed had higher FEC values than the others. The body weights recorded in this study were similar for Balami and Uda but differed significantly from value obtained for Yankasa.Balami and Uda had higher values than Yankasa, this report corroborates with earlier findings of Mason (1997).There were no breed effects on PCV and HbC recorded in this study, similar observations was reported by Kasali*et al*. (1988). The lower FEC in Yankasa in this study could probably be due to breed difference. Significant (P<0.001) seasonal effects on BWT, PCV, HbC and FEC was observed with the wet recording higher values, and this concur with earlier reports of Kasali*et al*. (1988) and Fantu*et al*. (2012). The wet season is the period of lush pasture which has positive influence on BWT, PCV, and HbC (Pathak and Pal, 2008). Furthermore, the wet season is a suitable period for the development of the infective stages of the Gastro intestinal parasites and hence higher burden. Sex had no influence on the parameters assessed in this study, this contradicts earlier reports by (Dangnachew*et al*., 2011; Hassan *et al.*, 2013), the authors reported significant sex variation on faecal egg count. Male sheep are generally more susceptible than females due to the production of androgen which lowers immune response. Oestrogen in females increases resistance to worm burden. However, female sheep become prone to parasitism due to hormonal changes during pregnancy; especially in the later stages (Asif*et al*., 2008). Age of sheep affected the values of BWT, PCV, HbC and FEC significantly; this is in agreement with earlier report of James (2014). Body weight, packed cell volume, haemoglobinand faecal egg count are usually higher in adult than the young because these parameters normally increase with age due to physiological changes (Fantu*et al*., 2012). This is however, contrary to reports of Winkler (1982), Mbap and Chiroma (1998). The authors reported higher FEC in the younger sheep and attributed it to low innate immunity and so-called self-cure phenomenon and/or high acquired immunity which increasewith age. Table 2 shows the influence of PCV, HbC and Bwt on worm burden. There was significant influence of Bwt (P<0.01) on FEC. The value of 578.93 epg, for the medium weight category was lower than 1023.30 and 955.74 epg for the lower and higher respectively. The PCV and HbC however had no significant influence on FEC.The PCV, HbC and Bwt are all indicators of body condition and thus are related to the physical, physiological and health status of animals.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the study revealed that three indigenous breeds of sheep studied harbors gastrointestinal parasite however, the level of infection is more in Uda. Balami and Uda had higher body weights and worm burden. However, breed had non-significant effect on PCV and HbC. Body weight differed among breeds with Balami and Uda recording higher values than Yankasa. Furthermore, Balami and Uda had higher FEC than Yankasa. Season had significant influence on Bwt, PCV, HbC and FEC with the wet season recording higher values. Sex had no influence on the parameters assessed but, there were significant age differences in BWT, FEC, PCV and HbC .Proactive measures are required to sensitize farmers on the need to ensure routine deworming exercise and adherence to good husbandry practicesall year round. Further study should be conducted using molecular marker to determine the genetic distance between the sheep breeds in terms of resistance to gastrointestinal parasite infection.

REFERENCES

Abubakar, Y. A. (1974). The Establishment and Development of Emirate Government Bauchi, Ph.D. Dissertation, Department of History, Ahmadu Bello University, Zaria, Nigeria. 1805-1903.

Addass, P. A., Midau, A. and Babale, D. M. (2010).Haemato-biochemical findings of indigenous goats in Mubi Adamawa State Nigeria.*Journal of Agricultural and Social Science,* **6:14**-16.

Allen, M. S., Greenlees, I. and Jones, M. (2013). Statistical Package for Social Sciences.

Asif, M., Azeem, S., Asif, S. and Nazir, S. (2008).Prevalence of Gastrointestinal Parasites of sheep and goats in and around Rawalpindi and Islamabad.*Pakistan. Journal of Veterinary Science*, **1**: 14-17

Badran, I., Abuamsha, R., Aref, R., Alqisi, W. and Alumor, J. (2012). Prevalence and diversity of gastrointestinal parasites in small ruminants under two different rearing systems in Jenin district of Palestine. *An-Najah University Journal of Research*, **26**:1-18.

Bilbo, S. D. and Nelson, R. J. (2001). Sex Steroids hormones enhance immune functions in male and female hamsters. *American Journal of Physiology*, **280**:207-213.

Campbell, T.W. (1988). **Avian Haematolgy and Cytology**. Iowa State University Press, Annes, I.A., **Pp**. 43-51.

Dagnachew, S., Amamute, A. and Temesgen, W. (2011). Epidemiology of gastro intestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia. *Ethiopia Veterinary Journal*, **15**: 57-68.

F.A.O (2007).Food and Agricultural Organization of the United Nation, Rome.Quartely Bulletin of Statistics, Volume 1.

Fantu, A. K., Yacob, H. T. and Gezahegn M. K. (2012).Experimental infection of Ethiopian highland sheep by different infective doses of Haemonchuscontortus (L3): haematological and parasitological parameters, serum protein concentrations and clinical responses. *Ethiopian Veterinary Journal*, **16** (1): 41-57.

Greer, A. W. (2008). Trade-offs and benefits: implications of promoting a strong immunity to gastrointestinal parasites in sheep. *Parasite Immunology*, **30**:123-132.

Hassan, D. I., Mbap, S.T. and Naibi S.A. (2013).Prevalence of worm infection in Yankasa sheep and West and African dwarf goats in Lafia town and Environs, *Nigeria. Journal of Agriculture and Veterinary Science*, **4**(4): 84-90.

James, G. J. (2014). Studies on Gastrointestinal Helminths of Small Ruminant Slaughtered in Dogarawa Slaughter Slab in Zaria, Nigeria, Nigeria. Msc. Thesis, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria.

Kantzoura, V., Kouam, M. K., Theodoropoulou, H., Feidas, H. andTheodoropoulos, G. (2012). Prevalence and risk factors of gastrointestinal parasitic infections in small ruminants in The Greek temperate Mediterranean environment. *Open Journal of Veterinary Medicine*.**2**:25-33.

Kasali, O., Njau, B. C. and Bekele, T. (1988).Controlling livestock diseases in the tropics breeding: A perspective. In: Thomson E. F and Thomson F. S (eds), Increasing Small Ruminant Productivity in Semi-arid Areas. 2nd edition, Oliver and Boyd Publishers, Edinburgh London.

Mason, P. C. (1997). Internal parasites of goats in New Zealand.In:**Sustainable control of Internal Parasites in Ruminants.** Ed G.K. Barrell. *Animal Industries Workshop*:10th August New Zealand, **5:57**-66.

Mbap, S. T. and Chiroma, B. Y. (1998). Breed and environmental factors on helminth infection of sheep at Bauchi, Nigeria. *Proceeding of the 6th World Congress on Genetics Applied to Livestock Production*Armidale, NSW Australia. 5:261-264.

Pathak, A. K. (2011). Nutritional status and performance of ruminants as influenced by gastrointestinal nematodes: An overview. *Veterinary World*, **13**(3):20-26.

Pathak, A. K. and Pal, S. (2008). Seasonal prevalence of gastrointestinal parasites in goats from Durg District of Chhattisgarh. Veterinary World. **1**(5):136-137.

Pratt, W. P. (1985). **Laboratory Procedures for Animal Health Technicians.**1st Edition, American Veterinary Publication Inc.

Schalm, O. W., Jain, N. C. and Carol, E. I. (1975) **Veterinary Haematology**. 3rd Ed. Lea and Fibiger Philadelphia, **Pp**. 144-167.

Soulsby, E. J. C. (1986). Helminths, Arthropods and Protozoa of Domesticated Animals, 8th EditionBailliereTindall, London, Pp. 119-218.

Thrusfield, M. (2005).Veterinary Epidemiology. 2nd Edition, Blackwell Science Limited, Oxford, United Kingdom, Pp:182-198.

Winkler, J. (1982).Gastrointestinal infection of small ruminant.*Australian Veterinary Journal*, **13**:14-15.

Wintrobe, M. M. (1967). **Clinical Haematology,** 6th Edition, Lea and Febiger, Philadelphia, **Pp** 44-60.

SOME PHENOTYPIC CHARACTERISTICS AND BREEDING METHODS OF EXOTIC BREEDS OF PIGEON IN BAUCHI METROPOLIS, BAUCHI STATE, NIGERIA

Onwuneme,P. C[1]., Abdu, I[1]., Ibrahim, T[1] & Shuaibu, A[2].
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi
[2]Department of Animal Science, Federal University Kashere
***Corresponding author**: iabdu@atbu.edu.ng*

ABSTRACT
The study was conducted to determine the characteristic and economic value of exotic breeds of pigeon in Bauchi Metropolis. Purposive sampling was employed to select farmers of exotic breeds of pigeon in Bauchi metropolis and a total of 60 respondents were used. The study revealed that 100% of the respondents were males and 50% aged between 26-35 years, followed by 16-25 years (25%) while the least (10%) aged between 5-15 years. Majority (51.67%) of the respondents had secondary school certificate while 48.33% attained tertiary education level. Majority (58.33%) of the farmers practiced inbreeding only. However, 41.67% of the respondents practiced both inbreeding and out-breeding. Furthermore this study revealed that 28 different exotic breeds of pigeon with unique features were available in Bauchi metropolis. Majority (66.7%) of the exotic breeds of pigeon with good flying ability were small size while the least (11.1%) was recorded among large ones. However, the large breed recorded highest poor flying ability (60%) followed by (40%) among average size, none of small size breed had poor flying ability. Most (75%) of them had average resistance to prevalence diseases when compared with the local breed. Female farmers should be encouraged to rear exotic breeds of pigeon. Cross breeding of exotic and local breeds of pigeon should be employed to complement each other.
Keywords: Exotic, Breed, Pigeon

INTRODUCTION
The domestic pigeon (*Columba livia domestica*) belongs to class: Aves, order: Columbiformes and family: Columbidae. Pigeons have made contributions of considerable importance to humanity especially in times of war (Levi, 1997). In war the homing ability of pigeons has been put to use by making them messengers. The homing pigeon is a variety of domestic pigeon derived from the rock pigeon, selectively bred to find its way home over extremely long distance (Levi, 1997). Members of this breed of pigeon are still being used in the sport of pigeon racing and the white release-dove ceremony at weddings, anniversaries and funerals. The wild rock pigeons have an innate homing ability (Blechman, 2007) meaning that they will generally return to their nest and mate.

Pigeon can also be reared as a meat. Young pigeons bred for meat are known as squabs. Rearing pigeons for meat is an accepted industry in overseas countries, particularly Europe and the United States (Bolla, 2007). In Kano state, the domestic pigeon (*Columba livia domestica*) is reared for meat production by some household, thereby contributing significantly to the protein need of the local populace (Rabiu and Arzai, 2012). However this aspect is yet to be optimally exploited in Nigeria as a whole. Breeding for fancy pigeon is an overwhelming aspect in pigeon production with a lot of economic and tourist potentials. There has been an insignificant development in the Nigerian fancy pigeon industry since its introduction from overseas some years ago. Most of exotic breeds of fancy pigeon have been proven to be adaptive to our local environment. Those who love bird life can find unlimited pleasure in the breeding of pigeons and besides, as they become more proficient in the art of breeding can earn a nice little income from their birds (Hazard, 1922). Pigeon can be bred for purposes which include: breeding for utility, breeding for fancy, breeding for homing and breeding for racing and show. All these provide wider areas of specialization for breeders and researchers in pigeon production. However, there is limited information today on the characteristic and availability of exotic breeds of pigeon in Nigeria. Their potentials and production are yet to be efficiently exploited in Nigeria. Therefore, this study aimed to determine the phenotypic characteristic and breeding method exotic breed of pigeon in Bauchi metropolis.

MATERIALS AND METHOD

Description of Study Location

The study was carried out from January to August 2019 in Bauchi metropolis. Bauchi state is located in the northern guinea savannah agro-ecological zone of Nigeria. The state is located geographically at approximately 10°17'N, 9°49'E and 690.3m above sea level (Kowal and Knabe, 1972).

Sampling Procedure

The Research-sampling design that was used to select the sample was non-probability purposive sampling. A total of 60 exotic breeds of pigeon farmers were used.

METHODS OF DATA COLLECTION

Data for this study were collected using both primary and secondary sources. The primary data (Type, size, flying ability, and relative disease resistance,) were collected through farm visitation and physical examination of the pigeons. Secondary data (breeding methods) were collected by using a questionnaire.

Statistical Analysis

The data collected were subjected to simple descriptive statistic and χ^2 test for association using SPSS version 17

RESULTS

The socio-Economic characteristic of the exotic breeds of pigeon farmers in Bauchi metropolis were presented in Table 1. The results revealed that 100% of the respondents were male and (50%) were within the age bracket of 26-35 years, followed by 16-25 years (25%) and 36-45 years (25%) while the least (10%) were within 5-15 years old, non-of the farmers was above 45 years.Majority (51.67%) of the respondents had secondary school certificate, 48.33 % were able to attained tertiary education while none of the respondent had non-formal or primary education as highest level of education. The results also showed that (50%) of the respondents were new in the pigeon farming with 0-5 years of experience followed, by 31.7% with 6-10 years of experience while the least (18.3%) had above 10 years of experience.

Table 2 presented the distribution of some phenotypic characteristics of exotic breeds of pigeon in Bauchi metropolis. The results showed that most (78.6%) of the exotic breeds of pigeon in Bauchi metropolis were fancy type while the least 21.4% were utility.With respect to size 39.3% of the breeds were medium, followed by large (35.7%) while 25% were small in size. Majority (53.6%) of the breeds had poor flying ability, 32.1% were good, while 10.7% had average flying ability. Most (75%) of the breeds had average resistance to diseases while 25% were susceptible to prevalence diseases.

Table 1: Socio-Economic Characteristics of the Exotic Pigeon Farmers in Bauchi Metropolis.

Variables	N (%)
Sex	
Male	60 (100)
Female	Nil
Total	60(100)
Age Group (years)	
5-15	6(10)
16-25	15(25)
26-35	30(50)
36-45	9(15)
>45	Nil
Total	60(100)

Level of Education	
Non-formal	Nil
Primary	Nil
Secondary	31(51.67)
Tertiary	29(48.33)
Total	60(100)
Years of Experience	
0-5	30(50)
6-10	19(31.7)
>10	11(18.3)
Total	60(100)

N= Number; % = Percentage

Table 2: Distribution of the Characteristics of Exotic Breeds of Pigeon in Bauchi Metropolis

Characteristic	N (%)
Type	
Fancy	22 (78.6)
Utility	6 (21.4)
Relative Body Size	10 (35.7)
Large	10 (35.7)
Medium	11 (39.3)
Small	7 (25)
Relative Flying Ability	
Good	9 (32.1)
Average	4 (10.7)
Poor	15 (53.6)
Relative Diseases Resistance	
Average	21 (75)
Good	7 (25)

N= Number; % = Percentage

Table 3 presented the association between the body size and flying ability of exotic breeds of pigeon in Bauchi metropolis. Significant ($P > 0.01$) association between body size and flying ability of exotic breeds of pigeon in Bauchi metropolis was detected. Majority (66.7%) of the exotic breeds of pigeon with good flying ability were small size while the least (11.1%) was recorded among large ones. However, the large breed recorded highest poor flying ability (60%) followed by (40%) among average size, none of small size breed had poor flying ability.

Table 4 presented breeding methods employed by exotic breed of pigeon farmers in Bauchi metropolis. The results revealed that (55%) of the respondents practice only inbreeding, followed by 45% practice both inbreeding and out-breeding, while none practice only out-breeding. Out of 45% of the respondents that practice out-breeding, only few (3.33%) performed a planned cross-breeding while majority (41.67%) performed unplanned cross-breeding without targeting any trait.

Table 3. Association between Body Size and Flying Ability of Exotic Breeds of Pigeon

Body Size	Flying Ability			χ^2	LOS
	Good	Average	Poor	17.4	**
Small	6 (66.7%)	1 (25%)	0 (0.0%)		
Medium	2 (22.2%)	3 (75%)	6 (40%)		
Large	1 (11.1)	0 (0.0%)	9 (60%)		
Total	9 (100%)	4 (100%)	15 (100%)		

N= Number; % = Percentage; LOS= Level of Significance; $\chi^{2=}$ Chi-square; **P<0.01

Table 4: Breeding Method of Exotic Breeds of Pigeon in Bauchi Metropolis

Breeding Methods	N (%)
Inbreeding only	33(55)
Out-breeding only	Nil
Both	27(45)
Total	60(100)
Cross-breeding Planning	
Planned cross-breeding	2(3.33)
Unplanned cross-breeding	25(41.67)
Total	27(45)

N= Number; % = Percentage

DISCUSSION

The result obtained from this study that only males embarked on exotic breeds of pigeon farming in Bauchi metropolis is in line with the findings of Bakoji *et al.* (2012) and Suleiman *et al.* (2017) they reported more males participation than females in poultry farming in Bauchi and Kaduna states respectively. The (50%) of exotic breeds of pigeon farmers in Bauchi metropolis were within the age bracket of 26-35 years is similar to findings of Bakoji *et al.* (2012), who reported (48.89%) of quail birds' farmers in Bauchi Local Government were within the age bracket of 31-40 years. . The age distribution might have been influenced by the nature of the business which required highly energetic and independent youths for effective farming and marketing. The high literacy level of the respondents in this study is in line with the findings of Nurudeen (2012) that the majority of the poultry farmers had tertiary education. Bukunmi and Yusuf (2015) reported that level of education had a positive coefficient which could be because education helps the farmers to understand better the innovation introduced to them. Experience in poultry production usually determines the effectiveness of farmers' decision with respect to inputs combinations or resource allocation (Umar, 2012). The(50%) of respondents were still new in the business with 0-5 years of experience. This implied that the business was still at young stage and therefore, more studies were still needed to be done in the exotic pigeon farming for better improvement.

The majority (78.6%) of the exotic breeds of pigeon in Bauchi metropolis were fancy type. Fancy pigeon breeds are kept for their gorgeous colour, form and texture. The higher availability of fancy breeds could be an indication that exotic breed of pigeon production in Nigeria was mostly targeted for pet. Most of these exotic breeds of pigeon had average resistance to diseases when compared with the local breeds is in accordance with the findings Bunza *et al.* (2008) reported zero infestation of tick on local breed of pigeon at Sokoto central market.

The significant association observed between body size and the flying ability of exotic breeds of pigeon. Sudik (2007) reported high and positive correlations between live weight and body size in chickens. Pigeons with larger body size will likely have higher body weight which will make them have poor flying ability. Pigeon with small body size has the tendency of lower body weight and good flying ability. This might serve as vital guide line to future breeders. While selecting for racing pigeon breeding, the size of the pigeon should be considered.

Majority (58.33%) of the respondent practice only inbreeding was to maintain the breed purity and to prevent any limitation on the required features.

CONCLUSION AND RECOMMENDATION

It can be concluded that most of the farmers practice inbreeding. Therefore, Cross breeding of exotic and local breeds of pigeon should be employed to complement each other.

REFERENCES

Bakoji, I., Aliyu, M.K., Haruna, U., Jibril, S.A., Sani, R.M. and Danwanka, H. (2012) "Economic Analysis of Quails Bird (*Cortunix cortunix*) Production in Bauchi local Government Area, Bauchistate, Nigeria".*Research Journal of Agriculture and Environmental Management.* Vol. 2(12), pp. 420-425

Blechman, A.D. (2007). *Pigeons: The fascinating saga of the world's most reverd and reviled bird.* St. Lucia, Queensland: University of Queensland Press.

Bolla, G.(2007). *Squab raising.* New South Wales: Department of Primary Industries. Retrieved from http://www.dpi.nsw.au/primefacts.

Bukunmi, F. R., & Yusuf, H. A. (2015). "Analysis of Socio-Economic Factors Influencing Poultry Egg Production among Poultry Farmers in Ondo State, Nigeria". *British Journal of Applied Scienec and Technology, 10* (3), 1-7.

Bunza, M.D.A, Yahaya, M.M.M, Muhammad, A.S and Saidu, A.R.(2008). "A Survey on Tick Species Infesting Domestic Birds Sold at Sokoto Central Market, Nigeria". *Sokoto Journal of Veterinary Sciences.* 7(2): 52-54

Hazard, F. A. (1922). "Profitable Pigeon Breeding".*American Pigeon Journal Company.* Warrenton, MO, USA.

Levi, W. (1977). *The pigeon.* Sumter, S.C.: Levi Publishing Co, Inc.

Nurudeen, J. A. (2012). "Economics and Social Characteristics of Registered Poultry Producers in Ilorin, Kwara State". *Russian Journal of Agricultural and Socio- Economic Sciences, 11* (11).

Rabiu, B. M. & Arzai, A.H. (2012). "Incidence of Pseudolynchia canariensis (macquart) of Domestic Pigeons (*Columba livia domestica)* in Kano State, Nigeria." *Biological and Environmental Sciences Journal for the Tropics* 9(1).

Sudik, S.D. (2007). Characterization of local chickens in Plateau State, Southern Zone. An Msc Theses. Animal Production Programme, School of Agriculture, ATBU, Bauchi.

Suleiman, R., Mahmud, A. M., Oladimeji, Y.U., Olanrewaju, T.O. & Ojeleye. O. A (2017) "Effects of Socio-Economic Characteristics on the Profitability of Poultry ProductionamongPoultry Farmers in Kaduna State".*Proceedings of the Annual Conference of Agricultural Extension Society of Nigeria.* 22nd Annual Conference.

Umar, M. (2012). *Economic Analysis of Poultry Egg Production in Bauchi Local Government Area, Nigeria. A thesis submitted to the school of postgraduate studies, Ahmadu Bello University Zaria, Kaduna State, Nigeria*

CLASSIFICATION OF DONKEY STRAINS IN NORTHWESTERN NIGERIA THROUGH EUCLIDEAN DISTANCE MEASUREMENTS

[*1]John, P.A, [2]Iyiola-Tunji, A.O., [3]Millam, J.J., [3]Abbaya, H.Y., [4]Iriso, B.V. & [1]Bello, S.S.
[1]Department of Animal Science, Ahmadu Bello University, Zaria.
[2]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria.
[3]Department of Animal Production, Adamawa State University, Mubi.
[4]Department of Animal Science, University of Port Harcourt, Choba.
[*]Corresponding author: johnpaulapagu@gmail.com

ABSTRACT
Proper knowledge of variations and diversities between, among and within the populations of animals helps in classifying animals into their various genetic groups, which helps in identification and conservation of important alleles. A total of seven hundred (700) donkeys consisting of (280) adult, (210) young and (210) weaner donkeys were sampled from Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States of Nigeria using a random sampling techniques. Biometric traits measured among sampled donkeys were body weight, head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and tail length. Data obtained were subjected to statistical analysis to determine the genetic distance estimate across the strains. The classification of Black (Duni), White (Fari), Brown (Idabari), Red (Auraki) and Brown-white (Idabari-fari) donkeys (by using Euclidean as the distance measurement, Single Linkage, Average Linkage, and Complete Linkage were applied, and the obtained results were compared. The simple discriminant analysis procedure was used to classify the strains using the R 2.13.0 (R Development Core Team) package. Homogeneous genetic distance was observed for head width (16, 16) and shoulder width (21, 21) in male red donkeys. Female donkeys showed similar and closed genetic distances for ear length in red (26, 21), black (21, 26) and brown (26, 21) and male Red (26,22), Black (22, 25), White (26, 22) and Brown (22, 25) across the strains. Heart girth, body length and height at wither showedhigh level of genetic variability among the strains. Heaviest body weight was recorded in male red (141.90kg) donkey strain with a distance of 6.75cm compared to other strains of donkeys. Further classification of donkeys into various genetic groups should employ heart girth, body length and height at wither.
Keywords: Donkey, genetic distance, classification, strain, Nigeria.

INTRODUCTION
Knowledge of morphometric characteristics marks the first step in classification of Farm animal genetic resources (FAnGR) (Delgado *et al*., 2001). Genetic distance is a measure of the genetic divergence between species or between populations within a species, whether the distance measures time from common ancestor or degree of differentiation (Nei, 1987). Populations with many similar alleles have small genetic distances. This indicates that they are closely related and have a recent common ancestor. Genetic distance is useful for reconstructing the history of populations. For example, evidence from genetic distance suggests that Sub-Saharan Africa and Eurasian people diverged about 100,000 years ago (Nei, 1974). Genetic distance is also used for understanding the origin of biodiversity. For example, the genetic distances between different breeds of domesticated animals are often investigated in order to determine which breeds should be protected to maintain genetic diversity (Ruane, 1999). Since donkey population has suffered substantial decline in its size, it is expected that the levels of inbreeding and risk of extinction may be high which necessitates a genetic study to assess variability among donkey populations for their conservation along with their breed assignment, better utilization, production and management practices. This study aimed at determining the genetic clustering, extent of genetic diversity and classification of donkeys into various genetic groups using biometric traits.

MATERIALS AND METHODS
Seven hundred donkeys (700) donkeys comprising 280 adults, 210 young and 210 weaner donkeys were used. The study was carried out in the North West of Nigeria. The States where donkeys were sampled were Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States of Nigeria using random sampling techniques. These States in North West Nigeria were selected for this study because of existence of high population of donkeys. The age of the donkeys was determine using teeth count in combination with the information provided by donkey owners. Biometric traits measured were

body weight, head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and tail length using a flexible tailor's tape. The classification of Black (Duni), White (Fari), Brown (Idabari), Red (Auraki) and Brown-White (Idabari-fari) donkeys (by using Euclidean as the distance measurement; Single Linkage, Average Linkage, and Complete Linkage were applied, and the obtained results were compared. The cluster analysis procedure was used to classify the strains using the R 2.13.0 (R Development Core Team, 2015) package. DISCRIM procedure was used to calculate the probabilities of including an animal in determining the strain, taking into account the error made in classification of the strain. Stepwise discriminant procedure (STEPDISC) was applied to determine, which performance traits were used in the final clustering analysis.

RESULTS AND DISCUSSION

The classification by the application of Euclidean to measure distance among biometric traits of male and female donkeys are shown in Table 1. In male black donkey, homogeneous genetic relationships were observed for head width (16, 16), between cluster 1 and 2, and shoulder width (21, 21) in male red donkey. Similar genetic relationships were observed between cluster 1 and 2 for ear length in male red (26, 22), Black (22, 25), White (26, 22), and Brown (22, 25). In female donkeys, the genetic distance between cluster 1 and 2 for ear length in Red (26, 21), Black (21, 26), Brown (26, 21) and Brown-white were similar for neck length (38, 36) and head length (38, 35). Closer and similar genetic distances were also observed for head width in female Black (11, 14) and White (11, 14). Heart girth, body length and height at wither showedhigh level of genetic variability across the strains. Similar report was observed in the findings of Nei, 1987 who reported genetic divergence among animal populations with many similar alleles having small genetic distances. This indicates that they are closely related and have a common ancestor.

The classification by the application of single, average and complete linkage are shown in Table 2. The heaviest body weight was recorded in male red (141.90kg) donkey strain with a distance of 6.75cm compared to other strains of donkeys. Male donkey with the smallest body weight was recorded in white (123.55kg) with a distance of 12.01cm.

Female donkey with the heaviest body weight was recorded in brown donkey strains (123.07kg) with a distance of 16.78cm while the female donkey with the smallest body weight was recorded in brown-white (52.25kg). The high level of genetic variability observed among strains of donkeys signifies that the higher the genetic distance estimates among the strains, the further the genetic distances and the more or better the chances for selection in the population. The result of this study is similar with the findings of John *et al*. (2017) who reported similar and closed genetic distance estimates in the qualitative traits of donkeys.

Table 1: Classification by the application of euclidean to measure distance among biometric traits of male and female donkeys

Red cluster				Black cluster				White cluster				Brown cluster				Brown-white cluster			
Sex	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**	**Sex**	**Traits**	**1**	**2**
Female	HG(cm)	118	92	Male	HW(cm)	110	105	Male	HG(cm)	111	82	Female	HG(cm)	114	73	Female	HW(cm)	89	84
Male	HG(cm)	114	104	Male	BL(cm)	109	100	Male	BL(cm)	109	87	Female	BL(cm)	106	70	Female	HG(cm)	88	79
Male	BL(cm)	109	99	Male	HG(cm)	108	101	Male	HW(cm)	105	80	Female	HW(cm)	104	79	Female	BL(cm)	84	76
Female	BL(cm)	109	89	Female	BL(cm)	87	107	Female	HW(cm)	86	105	Male	HW(cm)	77	99	Female	NC(cm)	49	42
Female	HW(cm)	108	85	Female	HG(cm)	82	115	Female	HG(cm)	84	112	Male	BL(cm)	73	101	Female	TL(cm)	49	42
Male	HW(cm)	107	97	Female	HW(cm)	80	106	Female	BL(cm)	84	112	Male	HG(cm)	69	108	Female	NL(cm)	38	36
Female	NC(cm)	71	35	Male	NC(cm)	62	50	Male	TL(cm)	64	35	Female	TL(cm)	65	39	Female	HL(cm)	38	35
Male	NC(cm)	65	51	Male	HL(cm)	48	46	Male	NC(cm)	60	50	Female	NC(cm)	60	38	Female	EL(cm)	24	22
Female	TL(cm)	63	22	Male	NL(cm)	47	43	Female	NC(cm)	47	61	Female	HL(cm)	49	34	Female	SW(cm)	14	16
Male	TL(cm)	60	49	Male	TL(cm)	46	68	Male	HL(cm)	47	36	Female	NL(cm)	47	33	Female	HWD(cm)	11	10
Male	NL(cm)	49	35	Female	TL(cm)	45	61	Male	NL(cm)	45	35	Male	NC(cm)	39	47				
Female	HL(cm)	49	28	Female	NC(cm)	40	65	Female	TL(cm)	38	68	Male	TL(cm)	33	53				
Male	HL(cm)	48	39	Female	NL(cm)	33	46	Female	NL(cm)	38	46	Male	NL(cm)	32	47				
Female	NL(cm)	47	27	Female	HL(cm)	32	48	Female	HL(cm)	36	48	Male	HL(cm)	28	48				
Male	EL(cm)	26	22	Male	SW(cm)	24	22	Male	EL(cm)	26	22	Female	EL(cm)	26	21				
Female	EL(cm)	26	21	Male	EL(cm)	22	25	Female	EL(cm)	23	26	Male	EL(cm)	22	25				
Female	SW(cm)	24	14	Female	EL(cm)	21	26	Male	SW(cm)	20	17	Female	SW(cm)	20	12				
Male	SW(cm)	21	21	Male	HWD(cm)	16	16	Female	SW(cm)	15	25	Female	HWD(cm)	17	11				
Male	HWD(cm)	16	12	Female	SW(cm)	15	19	Male	HWD(cm)	13	11	Male	SW(cm)	13	23				
Female	HWD(cm)	15	11	Female	HWD(cm)	11	14	Female	HWD(cm)	11	14	Male	HWD(cm)	11	15				

HL: Head length; HWD: Head width; EL: Ear length; NL: Neck length; NC: Neck circumference; SW: Shoulder width; HW: Height at withers; HG: Heart girth; BL: Body length; TL: Tail length. The values for each of the five groups wereranked; the first level of ranking was cluster 1 while the second level was cluster 2.

Table 2. Classification by the application of single, average and complete linkage

Sex	Strain	Body weight (kg)	Distance
Male	Brown	130.29	16.64
	Red	141.90	6.75
	Black	137.87	9.32
	White	123.55	12.01
Female	Brown	123.07	16.78
	Red	115.90	10.91
	Black	109.60	11.40
	White	113.45	12.09
	Brown-white	52.25	0.00

CONCLUSION AND RECOMMENDATION

High level of genetic distance estimates were recorded for heart girth, body length and height at wither among donkey strains in the studied populations. Further classification of donkeys into various genetic groups should employ heart girth, body length and height at wither.

REFERENCES

Delgado, J.V., Barba, C., Camacho, M.E., Sereno, F.TP.S., Martinez, A. and Vega-Pla, J.L (2001). Livestock characterization in Spain. *Agricultural Research Institute*, 2: 7-18.

John, P.A., Akpa, G.N., Iyiola-Tunji, A.O. and Abbaya, H.Y. (2017). Phylogenetic analysis of qualitative traits of donkey in North West Nigeria. *In: Proceedings of 6th ASAN-NIAS Joint Meeting* (Editors: Ososanya, T.O., Bawa, G.S., Yashim, S.M. and Owosibo, A.O.). September, 10-14th 2017. NAF Conference Centre, Plot 496, Ahmadu Bello Way, Kado, Abuja. Pp 292-295.

Nei, M. (1987). Molecular Evolutionary Genetics. (Chapter 9). New York: Columbia University Press.

Nei, M. and Roychoudhury, A.K. (1974). "Genetic variation within and between the three major races of man, Caucasoids, Negroids, and Mongoloids"*. The American Journal of Human Genetics, 26: 421–443.*

R Development Core Team. (2015). *A Language and Environment for Statistical Computing. R Foundation for Statistical Computing*, Vienna, Austria. URL http://www. R-Project.org/.

Ruane, J. (1999). A critical review of the value of genetic distance studies in conservation of animal genetic resources. *Journal of Animal Breeding and Genetics*, 116(5): 317-323.

CONTRACTION RATE AND RE-EPITHELIALIZATION TIME OF FULL THICKNESS EXCISION WOUNDS OF RATS TREATED WITH DIFFERENT CONCENTRATIONS OF HYDROGEN PEROXIDE

Udegbunam SO[1], Ogbobe s[1], Okereke HN[1*], Udegbunam ri[1], Enejere AS[1], Ezeobialu TH[1]
[1] Department of Veterinary Surgery, Faculty of Veterinary Medicine, University of Nigeria, Nsukka.
**Corresponding Author; nnamdi.okereke@unn.edu.ng; +234803-480-6730*

ABSTRACT
The aim of this study was to validate and hence evaluate the effects of different concentrations of hydrogen peroxide on the healing of excision wounds in rats. Following wound creation, the animals in their respective groups were treated as follows; group A-0.9% normal saline (control), group B-1% hydrogen peroxide, group C-3% hydrogen peroxide and group D-5% hydrogen peroxide. Post-wounding, rate of wound contraction and re-epithelialisation time were used to assess the wound healing rate. Group C animals achieved 100% wound contraction on day 21 while 68.75%, 79.33% and 79.00% were obtained on the same day in groups A, B and D respectively. The result of this study has validated 3% hydrogen peroxide as the optimum concentration necessary for wound dressing since it provided the environment necessary for faster rate of wound contraction and healing with no visible side effect in this study.
Keywords: excision wounds, hydrogen peroxide, rat, re-epithelialisation, contraction

INTRODUCTION
A wound is a disruption in the normal continuity of tissues and metabolic function of body structures (Alam*et al*., 2011). Wound healing is the restoration of the disrupted anatomical stability and functional status of damaged tissues (Room and Ukrainsky, 2005). The process of wound healing according to Drouso*et al*. (2003) begins with wound cleansing. This has been made possible clinically by employing various methods and agents that promote healing (Drouso*et al*., 2003). The agents popularly used in wound cleansing since the nineteenth century is antiseptics. Commonly used antiseptics include povidone iodine, chlorhexidine, methylated spirit, chlorine compounds, silver compounds, hydrogen peroxide and a host of others (Zhu *et al*., 2017).
Hydrogen peroxide according to Bruno and Raynard (1994) is the most widely used among all the commercially prepared antiseptics. Zhu *et al*. (2017) proposed that hydrogen peroxide is a typical antiseptic which kills pathogens through oxidative burst and local oxygen production. In recent times, there have been arrears of controversy on the use of hydrogen peroxide as an antiseptic (Drosou*et al*., 2003). Kwakman*et al*. (2011) reported that since hydrogen peroxide is dangerous to new cells, it should not be recommended to clean every wound. Kwakman*et al*. (2011) stated that hydrogen peroxide damages cells that are needed for the wound to heal and hinder them from getting to the areas where the healing needs to take place. Hydrogen peroxide at various concentrations has been claimed by some authors to have both antibacterial and good wound healing effect. A cream containing 1% hydrogen peroxide has been reported by (Neithammer*et al*., 2009) to be effective and safe topical treatment of human *Impetigo contagiosa*caused by*staphyloccusaureus.* Thereport also said that 1% hydrogen peroxide cream showed excellent antibacterial effect and eliminated most of the bacteria from the skin. No side effect such as skin irritation or allergic reaction in human patients was noted with use of 1% hydrogen peroxide cream. A cream containing hydrogen peroxide at 1.5-3% concentration has been reported to increase circulation in ischemic ulcer and surrounding skin in a guinea pig model (Tandara and Mustoe, 2004).
Animal and human studies have also shown hydrogen peroxide to have a negative effect on wound healing at 3% concentration. Hydrogen peroxide was reported not to retard re-epithlialization in a rat model after irrigation but showed minimal bactericidal effect in-vitro (Tidhar*et al*.,2017). Kwakman*et al*. (2011) also found acceleration of re-epthlializationin wounds of rat treated with 3% hydrogen peroxide. In view of the above reports, and with the use of hydrogen peroxide as the most popular antiseptics in wound management, surprisingly few experimental studies have been conducted to examine its efficacy on wound healing process and as a wound antiseptic.
Additionally, we have observed that use of commercially available hydrogen peroxide (6 % concentration) on open wounds without dilution causing severe charring. In view of the above reports, the benefits and demerits of low and high concentrations of hydrogen peroxide on wound healing

needs to be fully investigated. The basic objective of this study was to ascertain the appropriate concentration of hydrogen peroxide which when used on open wounds will facilitate wound proliferation thereby enhance wound healing.

ANIMALS

Adult wistar rats (n=32) weighing between 170-184 g were used for this study. They were fed on commercial growers mash (Vital feeds®) and water was provided *ad libitum*. These rats were acclimatized for 2 weeks in the animal house at the Department of Veterinary Surgery, University of Nigeria, Nsukka.

WOUND HEALING STUDIES

Thirty two rats were anaesthetized by injecting intramuscularly 10 and 50 mg/kg bw of xylazine hydrochloride (Xylazine 20®, Kepro Holland) and ketamine Hydrochloride (Mark pharmaceuticals® Nigeria) respectively. Under general anaesthesia, dorsum of the rats were shaved and with mild antiseptic solution (0.5% chlorhexidine). Full thickness circular excision wound of 2cm in diameter was made on the scrubbed area of each rat and carefully dissected out. The animals were left untreated for 24 hours to allow for bacterial contamination of the wounds. Post wounding, the rats were randomly assigned into 3 groups of 8 animals per group and treated as follows: group A was treated with normal saline while groups B, C and D were treated with 1%, 3% and 5% hydrogen peroxide respectively. The animals were housed individually in clean and dust-free cages in the Department of Veterinary Surgery, University of Nigeria, Nsukka to avoid wound biting and/or licking and treated daily with their respective extract concentrations or drug until complete healing occurred.

ASSESSMENT OF WOUND HEALING

Wound healing was assessed using the percentage wound contraction rate as described by Chah*et al.* (2006) while wound re-epithelialisation was studied as described by Okoli*et al.* (2009).

RESULTS

Rate of wound contraction

Assessment of the effect of the different concentrations of H_2O_2 on the rate of wound contraction showed that increase in the percentage wound contraction was first noticed on day 4 post surgery in groups B and C rats. Day 7 post surgery, group C animals significantly ($P<0.05$) had a higher rate of wound contraction (21.50 %) than those in groups A (8.40%), B (9.33%) and D (5.00%).By day 21, 100% wound contraction was recorded in group C animals while 68.75%, 79.33%, 79.00% and were obtained in groups A, B and D animals respectively. The rate of wound contraction of group C animals remained significantly higher ($P<0.05$) when compared with those of groups A, B and D (Table 1).

Table 1: Percentage rate of wound contraction in rats post wounding.

	Groups			
Days	A(N/saline)	B (1% H_2O_2)	C (3% H_2O_2)	D (5% H_2O_2)
1	-6.86 ± 1.32^{ab}	-5.25 ± 1.93^{ab}	-4.13 ± 0.79^{a}	-7.63 ± 1.35^{b}
4	-3.00 ± 0.79^{b}	1.75 ± 3.22^{ab}	5.13 ± 1.14^{a}	-2.13 ± 0.64^{b}
7	8.40 ± 1.81^{b}	9.33 ± 4.85^{b}	21.50 ± 4.19^{a}	5.00 ± 1.21^{b}
14	48.00 ± 6.55^{b}	57.67 ± 0.67^{b}	71.50 ± 3.23^{a}	55.75 ± 2.25^{b}
21	68.75 ± 4.59^{c}	79.33 ± 2.6^{b}	100.00 ± 0.00^{a}	79.00 ± 2.35^{a}

Different superscripts[a, b,c] in a row indicate significant difference between mean at $P<0.05$

Wound Epithelialization

In this study, group C animals treated with 3% concentration of H_2O_2 had higher rate of wound epithelialization followed by groups A, D and B animals. Wound epithelialization occurred on days 45, 28, 19 and 32 in groups A, B. C and D animals respectively.

Table 2: Wound epithelialization time of rats post wounding.

Groups	**A (n/saline)**	**B (1%)**	**C (3%)**	**D (5%)**
Days of wound epithelialization	44.75 ± 3.20^{b}	28.60 ± 0.29^{ab}	19.00 ± 0.71^{a}	32.00 ± 2.04^{b}

Different superscripts in a ^{a,b} row indicate significant difference between mean at $P<0.05$.

DISCUSSION

The effects of different concentrations of hydrogen peroxide on healing of excision wound were evaluated in this study. Grossly, the effect on contraction and rate of wound epithelialization were studied. Wound contraction and epithelialization play a significant role in healing of excision wounds. According to Eichler*et al*. (2006) contraction of wound begins approximately a week after wounding when fibroblasts have differentiated into myofibroblasts. Wound contraction as documented by Sussman*et al*. (2005) peaks at 5-15 days post wounding. In this study a progressive decrease in wound size was observed on day 7 in all the groups and this finding was in agreement with the works of other researchers as documented above.

The fastest rate of wound contraction observed in 3% H_2O_2 treated group could be attributed to its content of antimicrobial properties. It kills microbes by interrupting cellular respiration of the microbes and as well prevents wound contamination by microorganisms with minimal tissue damage around the wound (Edward and Harding, 2004).

In conclusion, the result of this study validates 3% H_2O_2 as the optimum concentration of hydrogen peroxide necessary for wound dressing as it provides faster rate of wound healing with no visible side effects while 5% concentration should not be used in wound dressing due to its damaging effects on the tissue and blood vessels thus delaying wound healing. Also, 1% hydrogen peroxide and normal saline should not be used as wound dressing agents for excision wounds probably due to their poor antimicrobial property.

REFERENCE

Alam, G., Singh, M. P. and Singh, A. (2011). Wound healing potential of some medicinal plants. *International Journal of Pharmaceutical Sciences Review and Research*.*9*(1): 136–145.

Bruno DW and Raynard RS (1994). Studies on use of hydrogen peroxide as a method for the control see lice on Atlantic Salmon. *Aquacultural International*. 2:10-18.

Chah, K. F., Eze, C. A., Emuelosi, C. E., and Esimone, C. O. (2006). Antibacterial and wound healing properties of methanolic extracts ofsome Nigerian medicinal plants. *J. Ethnopharmacol*. 104(1-2): 164-167.

Drouso A, Fallabella A, and Robert SK (2003). Antiseptic on wound area of controversy. *Wounds*. 15:149-166.

Edward R and Harding GK (2004). Bacterial and wound healing. *Current Opinion in Infectious Disease*. 17:91-96.

Eichler MJ, Carlson MA, and Margret K, (2006). Modeling dermal granulation tissue with the linear populated collagen matrix: *Journal of Dermatological Science*, 41:97-108.

Kwakman PH, TeVelde AA, de Boer L, Vandenbroucke-Grauls CM and Zaat SA (2011). Two major medicinal honeys have different mechanisms of bactericidal activity.2011; https://doi.org/10.1371/journal.pone.0017709

Neithammer P, Grabher C, Look AT and Mitchison TJ (2009). A tissue-scale gradient of hydrogen Peroxide mediates rapid wound detection in Zebrafish. *Nature* 459:996-999.

Okoli, C. O., Ezike, A. C., Akah, P. A., Udegbunam, S. O., Okoye, T. C., Mbanu, T. P., and Ugwu, E. (2009). Studies on wound healing and antiulcer activities of extract of aerial parts of *Phyllanthusniruri*L. (Euphorbiaceae) *Am. J. Pharmacol. Toxicol*. 4: 118-126.

Room TS and Ukrainsky (2005). Modulation of wound response and soft tissue in growth in synthetic allogeneic implants with platelet concentrate. *Archives of facial plastic surgery* 7:163-169.

Sussman, C. and Bates-Jensen, B. M. (2007). Wound healing physiology: acute and chronic. *Wound Care a Collaborative Practice Manual for Health Professionals*. 21–51.

Tandara, A. A. andMustoe, T. A. (2004). Oxygen in wound healing—more than a nutrient. *World Journal of Surgery28*(3): 294–300.

Tidhar, D., Keren, E., Brandin, G., Yogev, M. andArmer, J. M. (2017). Effectiveness of compression bandaging education for wound care nurses. *Journal of Wound Care*, *26*(11): 625–631.

Zhu J, Bin LI, Horby J, Friis E, Pilgaard B, and Jorgenson T (2002). Smoking as a risk factor for wound healing and infection in breast cancer surgery. *European Journal of surgical oncology*. 28:815-820

EFFECT OF VITAMIN E FORTIFIED DIET ON SEMEN QUALITY AND BODY WEIGHT OF GUINEA COCKS

Elile, C.F* Ugwu, S.O.C & Ogbonna, O.C****
**Department of Training and Internship, Nigerian Institute of Animal Science (NIAS), Abuja, Nigeria*
*** Department of Animal Science, University of Nigeria Nsukka (UNN), Enugu State, Nigeria*
Correspondent: E-mail: franciselile4god@yahoo.com, 08033984059

ABSTRACT
In spite of numerous advantages of guinea fowl over chicken, rearing of guinea fowl is believed to be uneconomical due to high information of PUFA that instigates poor semen quality. However, the study was designed to evaluate effect of vitamin E at different levels on semen quality and body weight of guinea cocks. Twenty-four guinea cocks were equally and randomly distributed into T1, T2, T3 and T4 of 0mg, 125mg, 250mg and 350mg vitamin E per kg diet respectively in a completely randomized design. Initial and final body weights were determined and semen samples were collected twice a week. Best values of semen volume, sperm concentration, sperm progressive motility, percentage live and dead sperm cells were obtained from cocks in T2. Reduction ($P<0.05$) in values of semen volume, sperm concentration, sperm progressive motility and percentage live were observed from cocks in T3 and T4 indicating that 250mg and 350mg vitamin E inclusion were in excess and had adverse effect on semen parameters of guinea cocks. Cocks in T2 had highest ($P<0.05$) gains in body weight than the control while cocks in T3 and T4 expressed significant ($P<0.05$) body weight lost. These results therefore prove that semen quality and body weight of guinea cocks were negatively influenced by 250mg and 375mg vitamin E inclusion while 125mg vitamin E inclusion had an improved semen quality at better body weight which is recommendable.
Keywords: Guinea fowl, guinea cock, vitamin E, semen characters, body weight,
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INTRODUCTION
Increase in Nigerian population has not been marched by growth in agricultural productivity especially in the area of animal production. This has caused low intake of animal protein intake in Nigeria as reported by FAO(1989). To correct this shortfall, there is need to improve on indigenous farm animals like guinea fowl (*Numidameleagris*) which is predominantly reared in northern part of Nigeria. Guinea fowl has many advantages over chicken which include low production cost, premium quality meat, greater capacity to scavenge for insects and grains, better ability to protect itself against predators and better resistance to common poultry parasites and diseases (Microlivestock, 1991). Guinea fowl products also have numerous nutritive and socio-cultural values. In spite of these, rearing of guinea fowl is believed to be uneconomical due to their monogamous and seasonal reproductive behavours.
The use of Artificial Insemination (AI) has not been properly explored as better alternative to break the inbreeding and monogamous behaviours of guinea fowl(Aire*et al*., 1983). Rengaraj and Hong (2015) reported thatavians are rich in PUFA which instigate oxidative damages that causes infertility. These damages may be controlled by given certain minerals and vitamins to act as antioxidants which vitamin E is a well unknown one.Vitamin E is a fat soluble vitamin that accumulates in tissues like testes and other reproductive organs (Rengaraj and Hong, 2015). This trace element is necessary for effective functioning of hormonal regulation and the reproductive system (Herrera and Barbas, 2001). This element is to increase the value semen parameters like sperm concentration, sperm livability and semen volume (Danikowski*et al*., 2002).However, excessive inclusion of vitamin E has also been reported to decrease semen quality (Arscot *et al*., 1995) and body weight (Aburto and Britton, 1998)ofguinea cocks.
Information on reproductive responses of chicken, turkey and quail given different levels of vitamin E has been investigated by many authors like Kling *et al*. (1987), Danikowiki *et al*. (2002), Lin*et al*. (2005), Hooda*et al*. (2007) and Biswas*et al*.(2009). Yet, no work has been done on effect of vitamin E inclusion on semenparameters and body weight of guinea cocks reared in humid tropics. Therefore, this work is designed to establish the level of vitamin E inclusion that will improve semen quality recommendable for natural and AI breeding management in guinea cocks with sustainable body fitness.

MATERIALS AND METHODS
Location and duration of the study: This study was conducted in the Poultry Unit of the Teaching and Research Farm of the Department of Animal Science, University of Nigeria Nsukka, Enugu State. Nsukka lies in the derived savannah region, and is located on longitude $6^{o}\,25^{1}$ N and latitude $07^{o}\,24^{1}$ E,

at an altitude of 430m above sea level (Ofomata, 1975). The climate is a typical humid tropical type with a relative humidity range of 56.01% - 103% (Energy Centre UNN, 2008). Average diurnal minimum temperature ranges from 22.0^{o}C–25.2^{o}C while the average diurnal maximum temperature ranges between 33^{0}C-37^{0}C (Energy Centre UNN, 2008). Annual rainfall ranges from 1567.05mm to 1846.98 mm (Energy Centre UNN, 2008). The study lasted 18weeks in which two weeks were used to acclimatize the birds.

Procurement, distribution and management of experimental guinea cocks: A total of twenty-four mature guinea cocks of 35-37 weeks old were procured from dealers in Abuja and acclimatized to the farm environment. The cocks were randomly allotted into four treatments: T1, T2, T3 and T4 of six cocks per treatment at different levels of vitamin E: 0mg, 125mg, 250mg and 375mg inclusion respectively. Initial and final body weights of the cocks were also determined. Diet containing metabolizable energy and crude protein of 2650Kcal/kg and 16.5% respectively was formulated which met the dietary recommendation for guinea fowl breeders under tropical conditions as recommended by NRC (NRC 1994) and served at 110g/day/cock as prescribed by Embury (2001). Water was given *ad libitum*.Other procedures carried out in this study were complied with the provisions of theUniversity of Nigeria, Nsukka Ethical Committee on the use of animals for biomedical research (2005).

Collection of semen samples: The guinea cocks were trained on semen collection within the period used for acclimatizing the birds. Semen samples were obtained by massage technique as described by Burrows and Quinn (1935). Semen samples were collected twice per week i.e. Saturdays and Wednesdays and were evaluated considering the processes described by Ugwu and Oleforu (2008).

Experimental design and statistical analysis: The experimental design that was used is a completely randomized design (CRD): $\mathbf{X_{ij} = \mu + T_i + E_{ij}}$**;** where$\mathbf{X_{ij}}$= individual observations of (ith) guinea cock fed with (jth) different level of vitamin E; **μ**= overall mean of the experiment; **T**i= effect of vitamin E on (ith) individual guinea cock;$\mathbf{E_{ij}}$= experimental error associated with observations of guinea cock fed with (jth) different level of vitamin E. The data were subjected to analysis of variance based on a Completely Randomized Design (CRD) using Statistical Package for Social Sciences (SPSS) computer package (SPSS, 2001). Significant means were separated using the Duncan option of SPSS.

RESULTS AND DISCUSSION

Results in Table 1 showed that there were significant differences (P<0.05) among the cocks in semen volume, progressive motility, sperm concentration, percentage dead sperm cells, percentage live sperm cells and total sperm cells with best mean values obtained for cocks fed with 125mg vitamin E (T2).The mean values of semen volume, live sperm cells and total sperm cells obtained for cocks in T3andT4 were significantly lower (P<0.05) than number of dead sperm cells whencomparedwith the control.Semen of cocks in T3 and T4 had slightdecrease (P<0.05) in progressive motility and sperm concentration values when compared with control treatment. These resultstherefore indicate that inclusion of125mg vitamin E

Table 1: Physical semen characters of the guinea cocks fed with different dietary levels of vitamin E

Semen Characters	T1 (control) (0mg vit. E)	T2 (125mg vit. E)	T3 (250mg vit. E)	T4 (375mg vit. E)
Semen volume (ml)	0.038[a] ±0.01	0.044[a]±0.02	0.022[b]±0.03	0.020[b]±0.02
Progressive motility (%	45.43 [b]±3.25	65.22[a]±4.05	40.40[b]±4.15	40.40 [b]±4.15
Sperm Concentration (x10^6/ml)	2.35[b] ±0.09	4.35[a]±1.13	2.20[b]±0.21	2.00[b]±0.16
Live sperm cells (%)	90.12[a]±3.34	92.56[a]±3.40	82.28[b]±2.28	81.53[b]±2.21
Dead sperm cells (%)	10.34[b] ±0.04	8.29[a]±0.22	18.77[c]±1.58	19.56[c]±1.50
Total sperm cells (10^9/ ejaculate)	0.83[a] ±0.018	0.91[a]±0.025	0.51[b]±0.017	0.41[b] ±0.010

[a, b, c]Means with different superscripts in a row are different (P<0.05).

perkg diet improved semen quality of guinea cocks.Further increase of vitamin E to 250mg and 375mg may progressively reduce values thesesemen parameters. These values were in accordancewith those of Arscot*et al*. (1995) and Danikowski*et al*. (2002) who reported that semen parameters of cocks may be negatively affected when they are given high level of 250mg vitamin E in diet.

Table 2: Daily live-weight gain of guinea cocks fed with different dietary levels of vitamin E

Body weight	T1 control (0mg vit. E)	T2 (125mg vit.E)	T3 (250mgvit. E)	T4 (375mgvit. E)
Initial weight(kg)	0.65±0.075	0.64±0.080	0.63±0.067	0.65±0.082
Final weight(kg)	0.78[b]±0.063	0.82[a]±0.403	0.56[c]±0.055	0.56[c]±0,057
Total weight gain (kg)	0.13[b]±0.021	0.18[a]±0.028	-0.07[c]±0.019	-0.09[c]±0.023
Daily Live-weight gain(g)	3.09[b]±0.19	4.28[a]±0.24	-1.67[c]±0.15	- 2.01[c]±0.07

[a, b, c]Means with different superscripts in a row are different (P<0.05)

Results in Table 2 showed that cocks in T2 had highest (P<0.05) daily live-weight gains (4.28[a]±0.24) while cocks in T3 and T4 had negative values (P<0.05) live-weight gains of -0.71g±0.15 and -0.92g±0.07 respectively indicating a reduction in body weights when compared to 3.98g±0.19 daily live-weight gain for the birds in control treatment. Also, similar trends were observed in final weight and individual weight gain of cocks given the different dietary levels of vitamin E (Table 2). These results agreed with the reports of Yates *et al*. (2009) that body, liver and heart weights of rats given dietary vitamin E were better at lower levels (42 IU and 242 IU) than (2042 IU and 20,042 IU). Similarly, Aburto and Britton (1998) observed that the body weights and bone ash of broilers were reduced significantly at high levels of vitamin E supplementation when compared with increased body weights and bone ash obtained forbroilers fed with lower levels of vitamin E. Dju*et al*. (1950) observed that fowls fed with excess vitamin E for a prolong period eliminate more than 75% of ingested feed through faeces. This may cause great loss of metabolizable nutrients including the energy required for production of quality semen and body development among others. In contrast, Pudelkiewics *et al.* (1960) reported that chicken receiving diet supplemented with 35g of vitamin E/kg diet defecate only 23% of ingested feed. This proves that more nutrients will be stored and utilized for production of semen of good quality and sustaining better body development among the chickens.

CONCLUSION AND RECOMMENDATIONS

These results suggest that guinea cocks required reduced amounts of vitamin E for body growth, gamete production and subsequent fertility. Deficiency or long-term omission of vitamin E in the diets of breeding guinea cocks may not significantly affect semen production, fertility and body weight gains while excessive inclusion of 250mg to 375mg of vitamin E per kg impair semen quality with significant loss of body weight which may further cause emaciation. These results showed that 125mg of vitamin E per kg diets reduces the oxidative damages of PUFA and therefore improves the semen parameters recommendable for natural and AI operations with better body fitness essential for optimum guinea fowl production.

REFERENCES

Aburto A and W. M. Britton1998. Effects of different levels of vitamin A and E on the utilization of cholecalciferol by broiler chickens Poultry Science, **77**: 570-577.

Aire, T. A., J. S. O Ayeni and M. O. Olowo-Okorun, 1983. Some aspects of the reproductive biology of the guinea fowl *(Numidameleagrisgaleatapallas)*. In: The helmet guinea fowl (*Numidameleagrisgaleatapallas*) in Nigeria, Ayeni, J. S. O. (Ed.). Kainji Lake Research Institute, New Bussa, Nigeria. p. 189-193.

Arscott G.H., P. E. Bernier. A. Sherry and A. T. Diplock, 1995. Effects of vitamin E supplementation in fish oil on semen status of white leghorn roosters. Journalof Nutrition, 124(4): 484-94.

Biswas A., J. Mohan , and K. L. Sastry, 2009.Effect of higher dietary vitamin E concentrations on q physical and biochemical characteristics of semen in Kadaknath cockerels. Br. Poultry Science 50:733–738. doi: 10.1080/00071660903264369.

Burrows W.H. and J. P. Quinn, 1935. The collection of spermatozoa from the domestic fowl and turkey. Poultry Science, 16:19-24.

Danikowski S, R. S. Hans-Pete, I. Halle and G. Flachowsky,2002. Influence of high levels of vitamin E on semen parameters of cocks. Journal of Animal Physiology and Animal Nutrition 86(11-12):376-82. DOI:10.1046.

Dju MY, M. L. Quaife, P. L. Harris, 1950.Utilization of pure α β and ∞-tocopherols by laying hens. American Journal of physiology 160, 259-263.

Embury, I. (2001). Raising guinea fowl. New South Wales Agriculture Publications, USA, p. 4.

Energy Research Center, University of Nigeria Nsukka, 2008.Annual weather record of University of Nigeria Nsukka.

Food and Agricultural Organizations (FAO), 1989.Production year book 1989. FAO, Rome. Italy.

Herrera and Barbas C. 2001. "Vitamin E: Action, metabolism and perspectives". Journal of Physiology andBiochemistry **57** (2):43-56.

Hooda S., Tyagi P.K., Mohan J., Mandal A.B., A. V. Elangovan, K. T.Pramod, 2007. Effects of supplemental vitamin E in diet of Japanese quail on male reproduction, fertility and hatchability. Br. Poult. Sci. 2007;48:104–110. doi: 10.1080/00071660601157378.

Kling L.J and J. HSoares, 1980.Vitamin E deficiency in the Japanese quail.Poultry Science. 59:2352–2354. doi: 10.3382/ps.0592352.

Lin Y.F., S. J. Chang, J. R. Yang, Y. P. Lee and A. L. Hsu, 2005. Effects of supplemental vitamin E during the mature period on the reproduction performance of Taiwan native chicken cockerels. Br. Poultry Science.46:366–373. doi: 10.1080/00071660500098186.

Microlivestock, 1991.Little known small animals with promising economic future.Board on Science and Technology for International Development. Washington, DC: National Academy Press, Washington. p. 115-125.

National Research Council (NRC), 1994.Nutrient requirement of poultry. Ninth Revised edition. National Academy Press, Washington D.C.

Ofomata, G. E. K. 1975. Soil erosion In: Nigeria in Maps. Eastern States, Benin, Ethiope Pub. House.p 43-45.

Pudelkiewicz W.J, D.Gaudreau, J. Brown, 1960. A fat-soluble material in alfalfa that reduces the biological availability of tocopherol, Journal of Nutrition 71, 143-148.

Rengaraj D and Y. H. Hong2015.Effect of dietary vitamin E on fertility function in poultry species. Int.J Mol Sci. 16 (5): 9910-9921.

SPSS, Inc. 2001.SPSS/PC+V2.0 computer program. Chicago: SPSS Inc.3.

Ugwu S. C. O and O. Oleforu, 2008.A practical course on semen collection and processing for artificial insemination.In Manual of agricultural practical.Fegno Press Ltd.

Yates D.T., A. F. Montoya, L. J. Yates, C. A. Warner, D. M. Hallfordand T. T Ross, 2009. Effects of dietary vitamin E on daily intake, serum testosterone and epididymal Sprague-Dawley rats subjected to heat stress. Journal of Vet.Med. and Animal healthvol. 2(2) pp11-16.

INFLUENCE OF STRAIN ON HAEMATOLOGICAL VALUES, BLOOD CHEMISTRY AND CARCASS CHARACTERISTICS OF THREE STRAINS OF NOILER CHICKEN

***I Mary., Y.P Mancha., D.J.U Kalla., Ebule K., Igila T.T**

Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author:kwala_laras@yahoo.com mobile No: 08038079331*

ABSTRACT

The experiment evaluated the influence of strain on haematological values, blood chemistry and carcass characteristics of three strains (black, brown and spotted) of Noiler chicken. The experiment was conducted at the poultry section of the Bauchi State Agricultural Development Programme (BSADP) in Bauchi. A total of one hundred and thirty-six (136) eight weeks old Noiler birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system. They were randomly distributed into 3 treatment groups based on strain using a Completely Randomized Design(CRD). The experiment lasted for a period of three months from the first day of lay. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum. At 34 weeks, seventy-two (72) birds were randomly selected from three different strains (24 birds per strain) for haematology and biochemical analysis while at the end of the experiment, a total of fifty-seven (57) birds were randomly selected from different strains (19 per strain) for gut and carcass analysis.The Haemoglobin (Hb) result indicated that all the treatments were within the normal range (10.2 – 15.1g/dl), the packed cell volume (PCV) were within the normal recommended values.The result for lymphocytes fell within the normal value of 40 – 70% indicating that the birds were normal. The lymphocytes, neutrophils, Basophils, Eosinophils and monocytes were all within the normal range. The result showed that strain ($p<0.05$) significantly affected albumin glucose cholesterol and calcium. Dressing percentage, liver, large intestine pancreas and abdominal fat were also influenced by strain. This study therefore concludes that strain affected the haematological values, blood chemistry and carcass characteristics of Noiler chicken.

Keywords: Strain, Noiler, Haematological, Carcass, Blood Chemistry

INTRODUCTION

Chickens are regarded as the most important and widely spread avian species among poultry birds (Dutta*et al.,* 2013).Poultry production is an important agricultural activity of almost all rural communities in Africa and provides scarce animal protein in the form of meat and eggs, and is a reliable source of petty cash, they are said to be one of the important animal genetic resources used as a weapon for fighting poverty and malnutrition, especially in rural areas of most developing countries, which results in the growing interest on the use of chicken as a tool for poverty alleviation in villages throughout the world (Dunya *et al.,* 2015). However, chicken growth and development is a complicated life process and is subject to a significant amount of control by genetic and non-genetic factors (Pourtorabi *et al.,* 2017; Zhenqiang *et al.,* 2013).Poultry production is fast growing in Nigeria as it significantly contribute to animal protein source of the Nigeria population, Most farmers keep broilers for meat and pullets are kept for egg production. With the increasing population, there is need for a low cost feed input breed with increased output of meat and egg production.To achieve this, a dual purpose chicken breed like Noiler is unavoidable. Noiler is a dual purpose breed of chicken developed in Nigeria by a noble hatchery with the sole aim of addressing the challenges of animal food insecurity and also to solve problems of financial challenges especially of rural communities and small holder farmers as Noiler production is highly profitable and can easily substitute local chicken. The haematological profile, both in human and animals is an important index of the physiological state of the individual, the ability to interpret the state of blood profile in normal and diseased conditions is among its primary tasks (khan *et al,* 1987). Hematological indices are an index and a reflection of the status and condition of the blood available for an animal to meet its physiological, biochemical, and metabolic necessities (Euola *et al*,2004). Therefore the objectives of this study was to establish the haematological and serum biochemical values of the three strains of Noiler chicken and to determine the effects of strain on carcass yield and gut characteristics of Noiler chickens.

MATERIALS AND METHODS

The experiment was conducted at the poultry section of the Bauchi State Agricultural Development Programme (BSADP) along Yelwan Makaranta Dass Road, Bauchi State. A total of one hundred and thirty-six (136) eight weeks old Noiler birds were purchased from the Bauchi State Agricultural Development Programme (BSADP). The birds were raised on deep litter system until the age of 18weeks before they were transferred to battery cage housing system where they were randomly distributed into 3 treatment groups based on strain using a Completely Randomized Design(CRD). The experiment lasted for three months from the first day of lay. The birds were fed uniformly with a standard commercial diet and water was supplied ad-libitum.

Data Collection and Analysis

At 34 weeks, seventy-two (72) birds were randomly selected from three different strains (24 birds per strain) for haematology and biochemical analysis. 3ml of blood samples were collected from the basillic vein of the birds into a well labelled sterile bottle containing Anticoagulants. These were used to determine packed cell volume, haemoglobin (hb), white blood cell count (WBC), and the differential counts which are Neutrophils, lymphocites, monocites, Eosinophil and Basophils. Another 3ml sample of blood was collected into sterile labelled bottles without anticoagulants to determine the serum biochemical metabolites as follows: total protein, cholesterol, Glucose, Albumin, calcium, phosphorus, uric acid.

Hematological technique

Total red blood cell count and Total white blood cell count were determined by a manual method using hematocytometer (Campbell,1995). Differential counts were made on monolayer blood films, fixed and stained with leishman – stain. Packed cell volume was measured by a standard manual technique using micro hematocrit capillary tubes and hematocrit reader. Haemoglobin concentration was measured by cyanhemoglobin method (Ritche *et al*.,1994).

Biochemical technique

Total protein, glucose, calcium, phosphorus, cholesterol, and uric acid, were determined by automatic analyzer.

Gut and Carcass Analysis

At the end of the experiment, a total of fifty-seven (57) birds were randomly selected from different strains (19 per strain). They were deprived of feed for twelve hours but provided with drinking water. The chickens were weighed and slaughtered. Slaughtered birds were scalded in hot water (about 50^0c) for 1 minute and plucked manually, offal were then eviscerated for carcass yield and organ weight determination. The carcass yield and organ weight were calculated as percentage of the live weight. Dressing percentage was calculated using the relationships: -

$$\text{Dressing percentage} = \frac{\text{carcass weight}}{\text{live weight}} \text{ x } 100$$

Statistical Analysis

Analysis of variance was carried out on data collected using the general linear model of SPSS 20.0 (2011). Where means differed, Duncan multiple range test (DMRT) was used to separate them (Duncan, 1955).

RESULTS AND DISCUSSION

The result for haematological analysis of three strains of Noiler chicken is presented in Table 1. The result showed ($p<0.05$) significant difference among some of the parameters measured. Haemoglobin (Hb) values were similar among the treatments. The Hb result indicated that all the treatments were within the normal range (10.2 – 15.1g/dl) which is in agreement with the finding of Petra *et al*, (2014). The packed cell volume (PCV) were within the normal recommended values for healthy birds in all the treatments (30 – 49%) as outlined by Petra et al, (2014). The result for white blood cell count (WBC) revealed that all the treatments were within the recommended range ($3 – 11 \times 10^9$). The result for lymphocytes fell within the normal value of 40 – 70% indicating that the birds were in a normal health status. The neutrophils, Basophils, Eosinophils and monocytes are all within the normal range for healthy birds as outlined by Petra et al.

Table 1: Haematological values of three strains of Noiler Chicken

Parameters	Black strain	Sported strain	Brown strain	LS
Hemoglobin (g/dl)	11.13	10.33	11.54	0.3882 7 NS
Packed cell volume%	33.33	30.13	34.13	1.1785 1 NS
Whiteblood cell(x10)	5.41	3.65	3.75	0.5375 8 NS
neutrophil%	39.50	40.25	36.45	0.7578 5 NS
Lymph%	55.45a	51.79b	56.33a	0.8653 4 *
Mono%	3.92a	2.29b	3.45a	0.1738 2*
Basophils	0.02	0.01	0.01	0.0000 0 NS
Eosinophils	0.42a	0.00b	0.00b	0.0603 4 *

Ls= level of significant,NS/=Not significant, a and b= means with different superscript on the same row varies significantly.

Table 2: Blood Chemistry of three strains of Noiler Chicken

Parameters	**Blac k strain**	**Sporte d strain**	**Brown strain**	**SEM**
Total protein (gl)	57.62	60.24	56.67	1.19269 NS
Albumin (mmol/l)	21.62 $_{b}$	22.00$_{b}$	26.19^{a}	0.46649*
Glucose (mmol/l)	1.35^{b}	2.95^{a}	1.65^{b}	0.23103*
Cholesterol (mmol/l)	4.91^{b}	3.45^{c}	6.05^{a}	0.22020*
Calcium (mmol/l)	2.26^{b}	3.00^{a}	2.40^{b}	0.07510*
Phosphorus (mmol/l)	2.42	2.11	2.30	0.13478 NS

NS= not significant ($p<0.05$), SEM= standard error of mean, a, b and c= means with different superscripts on the same row varies significantly, *= significant.

The result for blood chemistry of the three strains of Noiler is shown in Table 2**.** The result showed that strain has effect on most of the serum biochemical parameters measured. The total protein was not significantly different among the three strains, but albumin values were similar in two of the treatments (Black and spotted) but differs significantly ($p<0.05$) with the brown. The result for glucose showed a similar value for the black and brown strain but differs significantly ($p<0.05$) with the spotted. All the treatments were within the normal glucose range for birds. Cholesterol levels were within the normal range but vary significantly ($p<0.05$) among the treatments. Brown strain records higher value for cholesterol compared to the Black and Spotted. Calcium and phosphorus levels were

within the normal range indicating proper metabolism of the calcium and phosphorus and also a proper functioning of the parathyroid gland.

Table 3: Carcass characteristics of three strains Noiler chicken

Parameters	Black strain	Sported strain	Brown strain	SEM
Live weight (g)	2738.5	2853.8	2638.5	0.10608
Pluck weight (g)	2509.2	2500.0	2411.5	0.10449
Eviscerated weight (g)	2249.2	2223.1	2169.2	0.10292
Carcass weight (g)	2107.7	1901.5	1960.0	0.09828
Dressingpercentage (%)	74.92[a]	66.74.[b]	72.76[a]	1.24794*
Head (%)	8.8	7.5	8.9	1.247NS
Leg (%)	8.5	7.5	7.8	4.928NS
Gizzard (%)	3.9a	3.5b	3.9a	2.617NS
Liver (%)	4.9[a]	3.4[b]	3.13[b]	9.400*
Kidney (%)	0.3	0.33	0.33	0.522NS
Small intestine(cm)	8.9	8.6	8.2	4.395NS
Large intestine(cm)	0.8[b]	0.83[b]	0.96[a]	0.220*
Pancreas (%)	0.3[b]	0.31[b]	0.38[a]	0.125*
Abdominal fat (%)	8.26[b]	8.60[a]	8.21[b]	9.85*
Spleen (%)	0.18	0.19	0.19	0.50NS
Caecum (%)	1.78	1.72	1.76	2.73NS
Lungs (%)	1.24	1.08	1.06	0.470NS
Hearts (%)	1.23	1.06	1.21	0.44NS
Testes (%)	0.71	0.73	0.78	2.211NS

SEM= standard error of mean, a and b= means with different superscript on the same row varies significantly. NS- not significant.

The result for carcass characteristics of three strains of Noiler chicken is shown in Table 3. The result showed that there were no significant difference on parameters like liver, plucked, eviscerated and carcass weight. The similarity may be as a result of uniformity in feed, environment and their genetic potentials for growth. The result for organ and gut expressed as percentage of body weight showed no significant difference in kidney, heart, testes, lungs, ceacum, spleen, gizzard, and small intestines. However, significant ($p<0.05$) difference was recorded for liver with the black strain recording the

highest (42.62). Other parameters measured include pancreas, large intestine, abdominal fat which varied significantly ($P<0.05$) among the treatments.

CONCLUSION

In conclusion, strain affected the haematological values, blood chemistry and carcass characteristics of Noiler chicken.

REFERENCES

Campbel, T.W (1995). *Avian Hematology and Cytology, IOWA state university press Ames, IOWA.*

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics 11:1-42.

Dunya, A. M., Mamza, A. O., & Yusuf, S. Z. (2015). Local chicken management in rural Borno state, Nigeria.*J. of Biology, Agriculture and Healthcare*, *5*(4), 113–120.

Dutta, R. K., Islam, M. S., & Kabir, M. A. (2013). Production performance of indigenous chicken (Gallus domesticus l .) in some selected areas of Rajshahi , Bangladesh. *American J. of Experimental Agriculture*,*3*(2), 308–323.

Euola, E.O., Folayan O.A; Gbore, F. Ogunlade, J.T. and Adeneye, T.A (2004). Effects of physiological response of growing West African dwarf goats fed groundnut shell – based diets as the concentrate supplements*: Bowen J. Agric*. 1 (1): 61 – 69.

Khan, J. Mabaurl, K.R…, Humpler, H.E and Bect-jaen, F. (1987). The dose dependant effect on the oxygen carrying capacity and metabolism of RBC in human and rat. *Pakistan journal pharmacology: 4:23-36.*

Petra Hrabcakova, Eva Voslarvoa, Iveta Bedanova, Oladimira Pistekova, Janchloupek and Vladimir Vecerek (2014). Hematological and biochemical parameters during the laying period in common pheasant hens housed in cages in: *The scientific world journal vol. 2014, Article LY 364602, 6 pages.*

Pourtorabi E., N. Farzin & A. Seraj (2017). Effects of genetic and non-genetic factors on body weight and carcass-related Traits in two strains of Japanese quails *Poultry Science J., 5 (1): 17-24.*

Ritchie, B.W. Harrisson, J.G. and Harrison, R.L. (1994). *Avian Medicine wingers publishing inc. Florida.*

SPSS (2011) SPPSS Statistics for windows, version 20.0 Armonk, NY.IBM Corp.

Zhenqiang X., N. Qinghua, and Z. Xiquan (2013). Overview of Genomic Insights into Chicken Growth Traits Based on Genome-Wide Association Study and microRNA Regulation. *Current Genomics, 14: 137-146.*

EFFECTS OF VARYING DIETARY ENERGY AND PROTEIN ON EGG QUALITY PARAMETERS OF QUAILS

***Njam, R.L., **Kalla,D.J.U., **Sanusi,M.,**

**National Veterinary Research Institute, Vom, PMB 01, Plateau State, Nigeria.*

***Department of Animal Production, Abubakar Tafawa Balewa University Bauchi P.M.B 0248, Bauchi State, Nigeria.*

Corresponding author: rahilanjam@gmail.com: GSM: +234(0) 805992170

ABSTRACT

The aim of this study is to seek the effect of dietary energy and protein on the egg qualities. A total of four hundred and eighty day old un-sexed Japanese quails of about the same weight (26.56±0.02) were studied over a period of 12 weeks. After hatching, chicks were raised together during one week and fed with starting diet then divided into four dietary treatments (T1, T2, T3 and T4) with 30 quails in each replicate. Each treatment was replicated four times. T1: Control (Standard diet)SD; T2: High Energy Low Protein diet (HELP) ; T3 : High Energy High Protein diet (HEHP) andT4 : Low Energy High Protein diet (LEHP) in a completely randomized design. After 12 weeks of laying, eggs were collected from each treatment for both the external and internal egg characteristics. Data obtained were analyzed using ANOVA at $\alpha_{0.05.}$

Egg weight was higher (P<0.001) in the HEHP diet, egg height was also higher (P<0.05) in HEHP diet as well. Internal egg qualities, albumin height and albumen length had a significant influence (P< 0.05) in the HEHP diet.The albumen volume and the Yolk weight had the highest level of significance (P<0.001) in the HEHP diet. The shell weight was significant (P<0.001) with the HEHP diet having the highest values. There was also significance (P< 0.001) in the shell membrane and shell percent (P< 0.01) in the LEHP diet. The haugh unit are not significant in all the diets (P>0.05) but HEHP had the highest % of haugh unit.The results indicate that high energy and high protein (HEHP) diets is suitable for optimum performance of Japanese quail in terms of weight gain and egg quality.

INTRODUCTION

Increased poultry production has been advocated as one of the fastest means of providing quality animal protein at minimum cost (Nwachuckwu, 2015). The quail production story is more recent and also has the same characteristics that occurred in the broiler and laying hen production.

The establishment of quail production assumed importance worldwide in the last decade, not only for being a laboratory animal for poultry and biomedical research, but also because it is commercially exploited for production of meat and eggs.

Japanese quails mature in about 6 weeks and are usually in full egg production by 50 days of age. With proper care, hens should lay 200 eggs in their first year of lay. Life expectancy is only 2 to 2½ years (Randall, 2008).Quails produce up to five generations per annum (Saidu, 2014).

The optimum performance of livestock depends largely on the quality and quantity of their dietary nutrients (El-katcha, 2014). Precise nutrient supply reduces feed cost, wastage of nutrients, environmental pollution, and bad aroma in poultry house, and thus improves animal welfare (Kaur, 2015). Nutrition is by far the most important single factor under the environment in which poultry birds are reared, since it accounts for 60-75% of the inputs in poultry industry.

The aim of this study is to seek the effect of dietary energy and protein on the egg qualities.

MATERIALS AND METHODS

Location:

The experiment was carried out in the Poultry Division of the National Veterinary Research Institute Vom which is located in Plateau state ,central Nigeria in Jos South Local Government .Its geographical coordinates are on Latitude 09^0 44' 0'' North ,08^0 4' East .The trial was carried out from September to November 2018 (Maplandia.com).

Animals and management:

A total of four hundred and eighty day old un-sexed Japanese quails of about the same weight (26.56±0.02) were studied over a period of 12 weeks . The birds were sourced and raised in the Poultry Division of the National Veterinary Research Institute Vom in Plateau state. After hatching, chicks were raised together during one week and fed with starting diet then divided into four groups of 30 chicks each.

Experimental diets:

Diets were composed with local available feedstuff such as corn, soya bean cake and offered as mash (Table 1) and were randomly assigned to each treatment. The experiment included 4 dietary treatments (T1 , T2 ,T3 ,and T4) with 30 quails in each replicate. Each treatment was replicated four times.

The experiment consisted of 4 treatments designated as:

T1 : Control (Standard diet)(SD)

T2 : High Energy Low Protein diet (HELP)

T3 : High Energy High Protein diet (HEHP) and

T4 : Low Energy High Protein diet (LEHP)

Egg collections

After 12 weeks of laying ,eggs were collected from each treatment for both the external and internal egg characteristics.

Data collected

External characteristics

Internal characteristics

Statistical analysis

Data collected were analyzed using General linear model of SAS (SAS 2010). Statistical variations were observed and means were separated using Duncan's multiple range test.

RESULTS

The effect of the diets on egg quality is presented on Table 1. The Egg width and Egg shape index were similar for all the groups (P>0.05). Egg weight was higher (P<0.001) in the HEHP diet, Egg height was also higher (P<0.05) in HEHP diet as well. For the internal egg qualities, the Albumin height and the Albumen length had a significant influence (P< 0.05) in the HEHP diet .The Albumen weight was significant (P<0.01) in the LEHP diet .The Albumen volume and the Yolk weight had the highest level of significance (P<0.001) in the HEHP diet. The yolk volume was significant (P<0.01) with the HELP diet having the highest value.

The shell quality showed no significant difference (P>0.05) in the shell thickness, values in all the diets ranged between 0.10mm to 0.15mm. However, the shell weight had values ranging from 1.38g to 1.74g ,and it was significant (P<0.001) with the HEHP diet having the highest values. There was also significance (P< 0.001) in the shell membrane and shell percent (P< 0.01) in the LEHP diet.The Albumen width ,Haugh unit ,Albumen index ,Yolk percent ,Yolk height ,Yolk width ,Yolk length , Yolk colour ,Yolk index ,Yolk /Albumen ratio , were all not significant in all the diets (P>0.05).

Table 1: Effect of dietary energy and protein on egg quality parameters of japanese quails

Parameter	SD	HELP	HEHP	LEHP	±SEM
Egg weight(g)	10.60^{b}	10.42^{b}	11.73^{a}	10.07^{b}	0.12***
Egg Height(mm)	29.12^{ab}	28.43^{ab}	29.92^{a}	26.64^{b}	0.54*
Egg width(mm)	22.61	22.5	23.3	21.35	0.43^{NS}
Egg Shape Index(%)	77.76	78.98	77.7	79.68	0.34^{NS}
INTERNAL QUALITY					
Albumen Height(mm)	3.97^{ab}	3.86^{ab}	4.46^{a}	3.73^{b}	0.12*
Albumen width(mm)	34.59	32.88	34.41	33.63	0.76^{NS}
Albumin Length(mm)	39.80^{a}	37.54^{ab}	39.84^{a}	33.80^{b}	0.79*
Albumin weight(g)	4.08^{b}	4.18^{b}	5.11^{ab}	5.95^{a}	0.24**
Albumin volume(ml)	4.81^{b}	4.66^{ab}	5.61^{a}	4.23^{c}	0.09***

Albumin percent(%)	38.47^{b}	39.52^{b}	43.70^{b}	62.17^{a}	2.90*
Haugh Unit	86.86	86.64	88.74	85.44	0.67^{NS}
Albumin index(%)	9.98	10.09	11.09	9.71	0.33^{NS}
Yolk weight(g)	3.29^{b}	3.49^{ab}	3.94^{a}	3.22^{b}	0.07***
Yolk percent(%)	31.63	34.01	33.41	33.03	0.56^{NS}
Yolk height(mm)	9.81	9.36	9.93	8.86	0.19^{NS}
Yolk width(mm)	21.76	21.37	22.04	20.12	0.43^{NS}
Yolk length(mm)	22.3	21.81	23.1	20.56	0.47^{NS}
Yolk volume(ml)	3.64^{b}	3.80^{ab}	4.08^{a}	3.50^{b}	0.06**
Yolk colour	2.07	1.81	2.04	1.94	0.08^{NS}
Yolk Index(%)	56.7	44.56	45.26	43.39	4.35^{NS}
Yolk/Albumin Ratio	0.95	0.99	0.91	0.98	0.02^{NS}
SHELL QUALITY					
Shell weight(g)	1.40^{b}	1.38^{b}	1.74^{a}	1.57^{ab}	0.04***
Shell Membrane(mm)	0.03^{b}	0.04^{b}	0.02^{b}	0.12^{a}	0.01***
Shell percent(%)	13.51^{b}	14.18^{b}	14.49^{ab}	15.47^{a}	0.19**
Shell Thickness(mm)	0.12	0.15	0.1	0.13	0.01^{NS}

[a, b] means with different superscripts within the same row differ significantly ($p<0.05$)., SEM means standard error of mean

SD= Control (Standard diet); HELP= High Energy Low Protein diet; HEHP= High Energy High Protein diet

LEHP= Low Energy High Protein diet

This present result was in line with Muhammad (2016), who indicated that the protein levels had no significant effect on albumin weight, yolk height, yolk width, yolk weight, yolk index, yolk colour and Haugh unit ($P>0.05$). In this study all that were indicated were not significant except Albumin weight which was significant ($P<0.01$). It was concluded in his study that increasing dietary protein level of 25% will increase the egg production performance of Japanese quails. Similar results was obtained with the report of Lotfi (2018) who reported that the groups of quails that were fed more energetic feeds, significantly higher egg weights were achieved. Gunawardana (2008) reported that dietary energy had no influence on egg weight. Wu *et al.* (2005), and Sohail (2003), who reported that egg weights of hens with high protein diets were greater than of those hens with low protein diets, which is a consequence of the increase in albumen and yolk weights was in line with the results obtained in this study. This study is also in agreement with Lotfi (2018) who reported that the increase of albumen weight might be partially attributed to the improved nutrient (protein, total sulfur amino acids, or lysine) utilization with increased dietary energy. On the other hand, Novak *et al.* (2006) reported that shell quality was affected by protein and its ratio in diet, which could potentially have serious consequences for commercial egg-laying operations which is in line with this study. The work of Lotfi (2018) which stated that the shell protein matrix is comprised of 70% protein ,and also, increasing the sulfate groups existing in the shell matrix significantly increases the Ca binding ability, which in turn may increase both shell percentage and specific gravity and overall shell quality.

CONCLUSION

The results indicate that high energy and high protein (HEHP) diets is suitable for optimum performance of Japanese quail in terms of weight gain and egg quality.

REFERENCES

El-Katcha,M.I., Soltan,M.A., Sheaita,R.S., Karima ,E.N.,and El-Shobokshy ,S.A.(2014).Growth Performance, Blood Biochemical Changes, Carcass Traits and Nutrient Digestibility of Growing Japanese Quail Fed on Various Dietary Protein and Calcium Levels. *Alexandria Journal of Veterinary Sciences* . 44: 38-53

Gunawardana, P., Roland, D.A., and Bryant, M.M. (2008). Effect of energy and protein on performance, egg components, egg solids, egg quality, and profits in molted Hy-Line W-36 hens. *Journal of Applied Poultry Research*. **17,** 432-439.

Kaur,S., and Mandal, A.B.(2015).The Performance of Japanese Quail (White Breasted Line) to DietaryEnergy and Amino Acid Levels on Growth and Immuno-competence.*Journal of Nutrition & Food Sciences*.**5**(4):390

Lotfi ,E., Karimi,N., Parizadian, K. B., and Sharifi, M.R .(2018) Influence of different dietary levels of energy and protein on reproductive and post hatch growth performance in japanese quails. *Iranian journal of applied Animal Science*Volume 8, Issue (1)Pp137-145

Muhammad,N., Altine,S., A. Abubakar ,A., Chafe,U .M., Saulawa ,L.A., Garba ,M.G., Yusuf ,A. (2016). Effect of varying protein levels and preservation methods on egg production performance and internal egg qualities of japanese quails in a semi-arid environment *European Journal of Basic and Applied Sciences* **3** (3) :8-19.

Nwachukwu,E.N., Ogbu1,C.C.E., and Ifeanacho,N.G.(2015). Egg Quality Characteristics and Hatchability of Two Colour Variants of Japanese Quails (*Coturnix coturnix japonica*) . *International Journal of Livestock Research. 5(11)* .

Novak C., Yakout H.M. and Scheideler S.E. (2006). The Effect of dietary protein level and total sulfur amino acid: Lysine ratio on egg production parameters and egg yield in Hy-Line W-98 Hens. *Poult. Sci*. **85,p** 2195-2206.

Saidu ,S. , Afanasyev,G. , Popova ,L., Komarchev,A., Ibrahim.U.(2014) Dynamic of Reproductive Qualities of Japanese Quails. International Conference on Earth, Environment and Life sciences 23-24.

Sohail S.S., Bryant M.M. and Roland D.A. (2003). Influence of dietary fat on economic returns of commercial Leghorns. *J. Appl. Poult. Res*. **12,** 356-361.

Randall ,M., Gerry, B. (2008) Raising Japanese quail. January primefact 602 second edition, www.dpi.nsw.gov.au/primefacts

Wu G., Bryant M.M., Voitle R.A. and Roland D.A. (2005). Effect of dietary energy on performance and egg composition of Bovans White and Dekalb White hens during phase 1. *Poult. Sci*. **84,** 1610-1615.

ESTIMATION OF GENETIC PARAMETERS IN UNN CATTLE POPULATION

Ohagenyi, I.J., & Udeh, V. C.
Department of Animal Science, University of Nigeria, Nsukka, Nigeria.
Correspondence email:** ifemma.ohagenyi@unn.edu.ng; **Tel: +2348160516532

ABSTRACT
This study was conducted to estimate the variance components and heritability for birthweight and weaning weight, as well as the genetic and phenotypic correlations between these traits in N'dama and Muturu crosses at the University of Nigeria Nsukka (UNN) cattle herd. The study lasted for 6 months and the heritability and genetic correlation of the traits were estimated using Restricted Maximum Likelihood (REML) method of SAS mixed model. The direct heritability estimates obtained were 0.15±0.05 and 0.45±0.05 for birth weight and weaning weight respectively. The direct genetic correlation between the two traits was positive (0.53) between birth weights and weaning weights.
Keywords: Genetics, heritability, N'dama, Muturu and Correlation

INTRODUCTION
The beef cattle sub-sector plays important roles in the Nigerian economy, not only in terms of its contribution to the gross domestic products (GDP) but also contributes substantially to the supply of animal protein (FDLPCS, 2002 and Tewe, 2010). In the opinion of Grain de Sel (2010), Nigeria is by far the leading beef cattle producer in Central and West Africa with the cattle herds estimated at over 16 million heads, which is far ahead of Niger (8.7 million), Mali (8.2 million) and Chad (7 million).
However, Nigeria's rapidly growing population which is expected to reach 250+ million persons by 2030 (NLTP, 2019-2028), coupled with rising incomes and urbanization, are translating into increased demand for livestock products (FAO, 2018). Recent estimates suggest that, between 2010 and 2050, beef, poultry meat and milk consumption will increase by 117, 253 and 577 per cent, respectively (ASL2050 FAO, 2018). Hence, there is need to genetically upgrade the performance of our indigenous cattle species to raise the potential for higher meat yield.
Long (1980) opined that the genetic improvement of beef production systems is hinged primarily on two procedures which are; selection within breeds to enhance critical characters and selection among, and combination breeds to produce individuals that better fit production conditions and resources. N'dama and muturu which are predominant in the south eastern Nigeria produce minimally and are usually referred to as unimproved. However they have good adaptive traits that makes them hardy and resistance to certain environmental factors and diseases. Hence, they can be used in advanced beef cattle improvement programmes. Moreover, birth weight and weaning weight traits are recognized as important traits in determining economic efficiency of beef cattle (Oni et al 1988), and also an important selection criteria because of the ease with which they can be measured (Gregory 1965).
The effectiveness of breeding programmes depends on the accuracy of genetic and phenotypic parameter estimates, which include heritability and repeatability (Burrow, 2001). However, since the inception of breed improvement programmes in Nigeria, there has been no comprehensive analysis of the data generated either to obtain estimates of genetic parameters or to evaluate the genetic progress achieved in these populations. Such estimates are not only necessary for planning future breeding strategies but are also relevant for predicting response to selection and for evaluating genetic programmes. Although many genetic parameter estimates are now available in the literature from different breeds and production conditions, estimates of genetic and phenotypic parameters in pure breed indigenous cattle populations are scarce (Bosso et. al., 2002). Hence, the primary objective of this study is to estimate genetic parameters for birth weight and weaning weight of N'dama and Muturu crosses which will be used in subsequent genetic evaluation of the breed.
The objective of this study was to estimate the variance components and heritability for birthweight and weaning weight, as well as the genetic and phenotypic correlations between these traits in UNN cattle population.

MATERIALS AND METHODS

The study area

Data used in this study were obtained from the breeding and production records of beef cattle at the University of Nigeria Animal Science Farm, Nsukka. Nsukka lies within longitude 6˚45'E and 71E and latitude 7˚12.5'N (Ofomata, 1975) and on the altitude 447m above sea level. The climate of the study area is typically tropical, with relative humidity ranging from 65 – 80% and mean daily temperature of 26.8˚C (Agbagha et al., 2000). The rainy season is between April and October while dry season is between November and March with annual rainfall range of 1680 – 1700mm (Breinholt et al., 1981). The experiment lasted for three months.

Management of the herd

A total of 15 cows and 5 sires were used for the experiment. They were bred and managed properly through calving till weaning. Calving occurs all year round as no strict breeding season is enforced. Calves were weighed within 24 h of birth and thereafter weighed at bi-monthly intervals using a 100Kg capacity weighing scale. Calves were identified at birth and branded later, close to weaning. Calves were weaned at about 6 months of age. All animals were treated against ecto- and endoparasites and routine prophylaxis for trypanosomiasis and babesiosis was administered. The vegetation of the research station is described as guinea savannah type. The predominant grass species on UNN pasture are *Panicum maximum, Pennisetum purpureum* and *Cynodon dactylon* interspersed with legume species like *Centrosema pubesence, Mucuna sp., Mimosa sp.* and others.

Statistical analysis

Data were edited such that only animals with complete records on sire, dam and all fixed effects were used. The number of animals in the final data set were analysed by the MIXED model procedure of SAS (SAS University Edition 2019). The model used include the fixed effect of sex (male and female) and random effect of sire. Restricted maximum likelihood (REML) method of SAS mixed model was used to estimate the observable variance components due to sire (σ_s^2) and error (σ_w^2). Estimates of genetic correlations were obtained using varcomp procedure of Harveys computer program (Harvey, 1990). The programme also computed the genetic correlations and the appropriate standard errors of the estimated heritabilities.

$$h^2 = \frac{4\delta_s^2}{\delta_s^2 + \delta_w^2}$$

Where, h^2 is the sire heritability; δ_s^2 is the sire variance component and δ_w^2 is the error variance component.

$$rG = \frac{Cov\ (x\ y)}{\sqrt{\delta_s^2(x)\delta_s^2\ (y)}}$$

Where, *rG* is the genetic correlation; Cov (x y) is the genetic covariance of x and y components; δ_s^2 (x) is the sire variance of x component and δ_s^2 (y) is the sire variance of y component.

The detailed description of animals at UNN population is presented in Table 1 below.

Table 1: Descriptive statistics of the data

	Birth Weight	Weaning weight
No of records	15	15
No of sires	5	5
No of dams	23	23
Progeny per sire	3	3
Progeny per dam	1	1
Mean (kg)	10.77	58.29
Standard deviation	2.37	7.03
Coefficient of variation (%)	22	12.07

RESULTS AND DISCUSSION

Sex effect was not significant (P>0.05) for birthweight. However, there is significant difference (P<0.05) between male and female calf weight at weaning. Male calves weighed 6.87kg (11.8%) heavier. The result is in line with the work of Hopkins (1977), who observed an increased sex differences with increasing growth rate, signifying that male animalse are more responsive to improvement in the environment. The levels of weight advantage of male calves recorded in this study are comparable to what can be estimated from the values of Tawah et al. (1993) in Gudali but lower compared with values estimated by Tuah and Danso (1985) for WASH and Ndama in the humid forest zone of Ghana where favourable rainfall regime allowed greater quantities of high quality forage to be produced throughout the year, thus improving the nutritional environment for greater expression of male calves' responsiveness to improved environment.

Variance components and heritability in UNN cattle population

The variance and heritability estimates for birth and weaning weights are presented in Table 3 below.

Table 2: Variance covariance components and estimates for heritability (± SD) for birth and weaning weights

	Birth Weight		Weaning weight
Variance-covariance estimates			
Additive direct variance	0.8		16.37
Error variance	4.7		19.89
Phenotypic variance	5.5		36.26
Phenotypic correlation		0.05	
Genetic correlation *rG*		0.53	
Heritability estimates			
Direct heritability	0.15 ± 0.05		0.45 ± 0.05
Total heritability	0.15		0.45

Heritability

The variance, covariance and heritability estimates for birth and weaning weights are presented in Table 2. The estimates were low to medium but are in agreement with values reported by other researchers. The heritability value of 0.15 ± 0.05 for Birthweight in this study was close to 0.149 reported by Peters *et al.* (1998) for the same breed in a similar environment but lower than 0.37 reported by Johnson *et al.*(1992). Estimates of direct additive heritability (hi) for weaning weight (0.38 + 0.18) are in agreement with results of Mackinnon et al. (1991). The increase in heritability estimate with increase in age obtained in this study follows the same trend noted by Fogarty (1995).

Correlation

Phenotypic and additive direct genetic correlation coefficients between birth weight and weaning weight were 0.05 and 0.53 respectively. While the phenotypic correlation coefficient was slightly lower than those from other studies, the genetic correlation coefficient was similar to literature values. The unweighted and weighted means obtained from a review by Koots et al. (1994), of all published studies on correlations between birth and weaning weights were 0.36 and 0.46 for phenotypic correlations and 0.47 and 0.55 for genetic correlations, respectively. The lower phenotypic correlation relative to genetic correlation is in agreement with the trend reported in the reviews by Woldehawariat et al. (1977) Mohiud- din (1993) and Koots et al. (1994). The moderate genetic correlation between birth and weaning weights indicates that selection for one trait will result in a moderate positive correlated response in the other trait.

CONCLUSION

Estimates of heritability indicate that additive genetic variance exists for these traits. Selection for these traits, therefore, is likely to result in genetic gain for growth in UNN cattle population under tsetse infection pressure in south-eastern Nigeria and in the humid zone of Africa in general. The high genetic correlations between birth weight and weaning weight indicates that birth weight could be used as a cost effective means for selecting for cattle with high post weaning weight. The differences between male and female calves for weaning was highly significant hence, it is important for sex of calf to be correlated for in analysing preweaning calf data. Genetic improvement of indigenous West African cattle has been attempted in the past by crossbreeding with exotic breeds of cattle with little or no emphasis placed on selection. The estimates of genetic parameters obtained in this study indicate that if genetic improvement through selection for birth and/or weaning weight of indigenous cattle and their crosses is desired, there is high posibility for high genetic progress to be achieved.

REFERENCES

Agbagha, F.M., Ezema F.U. and Omeke, B.C.O. (2000) Studies of Mangaement Effects on Fertility of Purbred and Crossbred Exotic Gilts in Two Breeding Farms at Nsukka. *Nigeria Journal of Animal Production*. 28(1)Pg 20.

Breinholt, K.A., Gowen, F.A. and Nwosu, C.C. (1981). Influence of Environmental and AnimalFactors on Day and Night Grazing Activity of Imported Holstein Freisian Cows in the Humid Lowland Tropics of Nigeria. *Trop. Animal Produc*.6:4.

Ofomata, G.E.K. (1975). Nigeria in Maps. Eastern States, Ethiope Publishing Co. Ltd. Benin.

Johnson, Z.B., Wright, D.W., Brown, C.J., Bertrand, J.K. and Brow, A.H. Jr. (1992) J. Anim. Sci 70 : 78-88.

Burrow, H. M. (2001). Variances and covariances between productive and adaptive traits and temperament in a composite breed of tropical beef cattle. *Livestock Production Science*, v. 70, n. 3, p. 213-233.

FAO. (2018). ASL2050: Livestock Production System Spotlight Ethiopia Cattle Sector. Rome, Italy: Food and Agriculture Organization of United Nation.

Grain de sel (2010). Demand for Farm Animal Products in Nigeria: An Opportunity for Sahel Countries? www.inter-reseaux.org/IMG/pdf/p14-15_Animal.pdf.

NLTP (2019). National Livestock Transformation Plan (NLTP) 2019-2028. Strategy Document, National Economic Council.

Tewe, O.O. (2010). Sustainability and Development: Paradigms from Nigeria's Livestock Industry. Inaugural lecture series; University of Ibadan Press, Ibadan.

Peters, S.O., Nwosu, I.C., Ozoje, M.O. and Ikeobi, C.O..N (1998). Genetic parameter estimates for growth traits in cattle genotypes. Proc 6th WCGALP 26: 101 – 104

EFFECTS OF AGE ON EGG NUMBER AND WEIGHT IN CHICKENS

***Olanihun A.O[1].,D.J.U Kalla[2]., Igila T.T[2]., Ebule K[2]**

[1]Department of Agricultural Extension and Management Federal College of Forestry Jos

[2]Department of Animal Production Abubakar Tafawa Balewa University Bauchi, Bauchi State Nigeria

**Corresponding author:adeolutu@yahoo.com mobile No: 08035317340*

ABSTRACT

The study was conducted at Federal College of Forestry, Jos. The objective of the study was to determine effects of age on egg number and egg weight in chickens. A total of 500 pullets were obtained from a reputable hatchery in Ilorin and received in Jos. They were brooded for six (6) weeks during which all recommended vaccines were and antibiotics were administered, they were further transferred to battery cage at fourteen weeks (14). Records were taken daily for total feed consumed per bird per day by weighing feed left over, mortality, egg lay, weight of egg (egg weight was measured using a digital scale) and clutch length. The experiment lasted for twenty (20) weeks from first day of lay. Birds were fed with predetermined weight of feed once a day. Commercial diet was used as the experimental diet. The result showed that a positive and strong significant ($P < 0.01$) correlation was observed between age of hen and weight of eggs ($r = 0.092$). Weak positive correlation ($P < 0.01$) was observed between age of hen and number of eggs ($r = 0.017$). From the finding of this study, it was concluded that, there was a positive relationship between age of birds and egg number. Positive relationship also exist between age of birds and egg weight. However it should also be noted that the correlation between age and egg weight was stronger than the correlation between age and egg number. Further research was recommended

INTRODUCTION

Poultry production is an important and diverse component of agriculture. Poultry are kept in most areas of the world and provide an acceptable form of protein to most people in the world. Many developed countries have adopted intensive poultry production system in order to meet protein demand for humans. Poultry are able to adapt to most areas of the world at relatively low price, they reproduce rapidly and have a high rate of productivity. Layer chicken hens are efficient egg producers.Breeds used for egg production are mostly based on leghorn and Rhode Island Red but selection and cross breeding have resulted in high productive laying hens (FAO, 1992). In Nigeria, poultry contributes about 15% of the total annual protein intake with approximately 1.3 kg of poultry products consumed per head per annum. In the past decades, there has been a recorded improvement in poultry production in Nigeria with its share of the Gross Domestic Product (GDP) increasing in absolute terms. The contribution of chicken egg and meat to the livestock share of the GDP increased from 26% in 1995 to 27% in 1999 with an increase in egg production alone accounting for about 13% during the period. In spite of the significance of the poultry industry to the national economy, poultry farms face challenges inimical to the growth of the industry. Poultry production in general is faced with low capital base, inefficient management, disease and parasite, housing and marketing problems, etc (Akintunde, *et al.,* 2015). Poultry production has become a fulltime job for many and is considered to be a commercially viable enterprise, contributing significantly to Gross National Product (GNP) (Nwagu *et al*, 2007b). Egg production is believed to have complex qualitative traits which are influenced by several factors such as breed, nutrition, age, weight of bird, management practices and environmental factors. Over the last decades, poultry management techniques in Nigeria have improved significantly, with rapidly increasing production. Under subtropical environments, growth rate as well as egg production are generally depressed by high ambient temperature (Bordas and Merat, 1984; Farooq*et al*, 2001). A significant interaction between environments and lines was found for laying traits, which indicated that the selected line was more sensitive to environmental changes than the control line for production level (Chen *et al.,* 2004). Poultry plays an important role in human nutrition, employment and income generation. Therefore the objective of the study was to determine the effects of Age on Egg number and Egg weight laying birds.

MATERIALS AND METHODS

The study was conducted at Federal College of Forestry, Jos. It is located in the central part of the Nigeria between latitude $8^{o}30^{|}$ and $10^{o}30$N and longitude $8^{o}20$ and $9^{0}30^{|}$E, with a surface area of about 9,400km^2. It has an average elevation of about 1,250 meters above sea level. A total of 500

pullets were obtained from a reputable hatchery in Ilorin and received in Jos. They were brooded for six(6) weeks during which all recommended vaccines were and antibiotics were administered, they were further transferred to battery cage at fourteen weeks (14). Records were taken daily for total feed consumed per bird per day by weighing feed left over, mortality, egg lay, weight of egg (egg weight was measured using a digital scale) and clutch length. The experiment lasted for 20 weeks from first day of lay. Birds were fed with predetermined weight of feed once a day. The experimental diet was of commercial origin.

RESULTS AND DISCUSSION

Table 1: Pearson Correlation Between Age and Weight of Eggs

		Age of birds (in weeks)	Weight of eggs
Age of birds (in weeks)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	4834	
Weight of eggs	Pearson Correlation	0.092**	1
	Sig. (2-tailed)	0.001	
	N	3975	3975

** Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation between age and weight of eggs was presented in table 1. A positive and strong significant ($P < 0.01$) correlation was observed between age of hen and weight of eggs ($r = 0.092$). Also, Pearson correlation between age and number of eggs was presented in table 2. A weak positive correlation ($P < 0.01$) was observed between age of hen and number of eggs ($r = 0.017$). The finding of this study were in agreement with that of Anderle *et al*. (2014) and similar to Zanon *et al*. (2006).

Table 2: Pearson Correlation Between Age and Number of Eggs

		Age of birds (In weeks)	Number of eggs
Age of birds (in weeks)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	4834	
Number of eggs	Pearson Correlation	0.017**	1
	Sig. (2-tailed)	0.227	
	N	4831	4831

** Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION AND RECOMMENDATION

From the finding of this study, it was concluded that, there was a positive relationship between age of birds and egg number. Positive relationship also exist between age of birds and egg weight. However it should also be noted that the correlation between age and egg weight was stronger than the correlation between age and egg number. Further research was recommended.

REFERENCES

Akintunde, O. K., A. I. Adeoti, V. O. Okoruwa, B. T. Omonona and A. O. Abu(2015).Effect of Disease Management on Profitability of Chicken Egg Production in Southwest Nigeria.

Anderle, V. Sonnaiya, E.M and Chawla, R. (2014). Egg quality of gene reserve, the Czech golden spotted hens. *Poultry science*. 17: 84-86

Bordas, A. and Mérat P. (1984). Effects of the naked-neck gene on traits associated with egg laying in dwarf stock at two temperatures. *Breeding Poultry Science*. Pp. 12-15.

Chen, S. E., McMurry, J. P. and Walzem, R. L. (2004). Overfeeding-induced ovarian dysfunction in broiler breeder hens is associated with lipotoxicity. *Poultry Science*.**85**: 70-81

Farooq, M., Mian, M. A., Durrani, F. R., and M. Syed (2001). Prevalent diseases and mortality in egg type layers under subtropical environment

Food and Agricultural Organisation (1992). FAOSTAT, FAO Statistics Division 1992 Viale delle Terme di Caracalla, 00153 Rome, Italy.

Nwagu, B.I., Olorunju, S.A.S., Oni, O.O, Eduvie, L.O., Adeyinka, I.A., Sekoni, A.A. and Abeke, F.O. (2007b). Response of egg number to selection in rhode Island chickens selected for part period egg production. *International Journal of Poultry Science* 6(1): 18 -22.

Zanon, A. Toritsina, E. S and Tumova , E .(2006) Physico-chemical characteristics of eggs from two Italian autochthonous chicken breeds: Modenese and Romagnolo. In *XII European PoultryConference : Book of Abstracts, Verona, Italy, 10-14 September 2006.* Beekbergen: World Poutry Science Association, Pp. 203.

BETAINE HYDROCHLORIDE AMELIORATES THERMOREGULATORY RESPONSES OF BROILER CHICKENS UNDER DEXAMETHASONE INDUCED HEAT STRESS

[1]L.A. Ademu*, [2]O.M. Daudu, [3]G.T. Iyeghe-Erakpotobor, [3]P.P. Barje, [1]J.A. Olusiyi
[1]Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria
[2]Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
[3]National Animal Production and Research Institute, Shika, Zaria Kaduna State, Nigeria
***Corresponding Author**: lawrenceademu@gmail.com*

ABSTRACT
A study was conducted to investigate the ameliorative effect of betaine hydrochloride under dexamethasone induced heat stress. A total of 300 day-old *Arbor acre* broiler chickens randomly assigned to five treatments in a completely randomized design were used in the study. The five treatments with three replicates (n= 20 birds/rep) made up of a treatment containing no dexamethasone and no betaine served as the control. Another treatment was fed 0.30% betaine only supplemented diets, with the other three treatments given daily dexamethasone concentrations at 1, 2 and 3 mg/L in water, respectively. All dexamethasone treated birds were fed 0.30% betaine HCl in their diets. Results indicated a decrease (P>0.05) in rectal temperature and respiratory rate with increasing dose of dexamethasone, especially with the betaine only group. Betaine HCl had a positive effect on thermoregulatory parameters of broiler chickens by ameliorating the negative effect of heat stress.
Keywords: Stress, Dexamethasone, Broilers, Betaine, Osomolyte

INTRODUCTION
Broiler chicken production under high ambient temperature and high relative humidityhas been shown to induce heat stress (Ali *et al*., 2010). Heat stress results in the excess production of reactive oxygen species (ROS) which cause oxidative damage (Zhang *et al*., 2014). Given its similarity to endogenous corticosteroids, dexamethasone's ability to reproduce the effects of high levels of corticosterone, thus mimicking stress associated signalling pathways has been demonstrated (Eid *et al*., 2006; Aengwanich, 2007; Ademu *et al.*, 2018) A. With stress a costly problem for the broiler industry, nutritional strategies to lessen its effects are being developed. Betaine supplementation to diets for livestock has increased during the last decade (Fernandez-Figares *et al.*, 2008). Betaine, the trimethyl derivative of the amino acid glycine, is a naturally occurring compound, which is widely distributed in many plants and animal tissues. Betaine exerts an osmo-regulatory role in cells, regulating water balance, which is beneficial for alleviating physical reactions to heat stress (Ratriyanto and Mosenthin, 2018). The aim of the study was to investigate the ameliorative effect of betaine hydrochloride on the thermoregulatory responses of broiler chickens under induced heat stress conditions.

MATERIALS AND METHODS
The experiment was conducted at the Teaching and Research farm of the Department of Animal Science, Ahmadu Bello University Samaru, Zaria. Three hundred day old *Arbor acre* broiler chicks were used in the experiment. They were randomly allotted to five experimental treatments in a completely randomized design. Each treatment was replicated three times with twenty birds per replicate.A maize/soybean based broiler starter and finisher diet was formulated according to NRC (1994) nutrient requirement for broiler chickens. Birds receiving 0 mg dexamethasone and without betaine supplementation served as the control. Birds administered 1, 2 and 3 mg dexamethasone in drinking water along with a betaine only group were given diets supplemented with Betaine HCl at 0.30%. Daily doses of dexamethasone (1, 2 and 3 mg) was administered by dissolving in a litre of water and supplied for twenty-eight days beginning from when the birds attained 14 days of age.

Thermoregulatory Measurements
Indoor temperature and relative humidity readings were recorded daily using an electronic digital thermo-hygrometer. Both readings were taken in the morning (8.00 am) and afternoon (3.00 pm) throughout the experimental period. Rectal temperatures and respiratory rates were measured by placing a digital thermometer in the rectum and counting of respiration (breath/minute) with the aid of

a stopwatch respectively. Temperature-humidity index (THI) was calculated using the formular of Tao and Xin (2003).

$$THI = 0.85\,T_{db} + 0.15\,T_{wb}$$

Where,
THI = temperature-humidity index in °C,
T_{db} = dry-bulb or ambient temperature in °C and
T_{wb} = wet-bulb temperature in °C.
Wet bulb temperature was determined from ambient temperature and relative humidity using the empirical expression functions by Stull (2011). Heat stress was classified as absence of heat stress (<27.8), moderate heat stress (27.8-28.8), severe heat stress (28.9-29.9) and very severe heat stress (>30.0).

Data Analysis

All data collected from the experiment was subjected to analysis of Variance (ANOVA) using the general linear model procedure of JMP (2012).Where the result of ANOVA was statistically significant, test for multiple comparisons was performed to compare means of all groups using Tukey (1949).

RESULTS AND DISCUSSION

The average temperature humidity index (THI) inside the poultry house during the experimental period for mornings and afternoons is shown in Figure 1. THI in the afternoons were 25.4% higher than in the mornings indicating the absence of heat stress in the morning and the presence of very severe heat stress in the afternoon. Tao and Zin (2003) also observed that the body temperature of broilers tends to rise at THI 30.0.

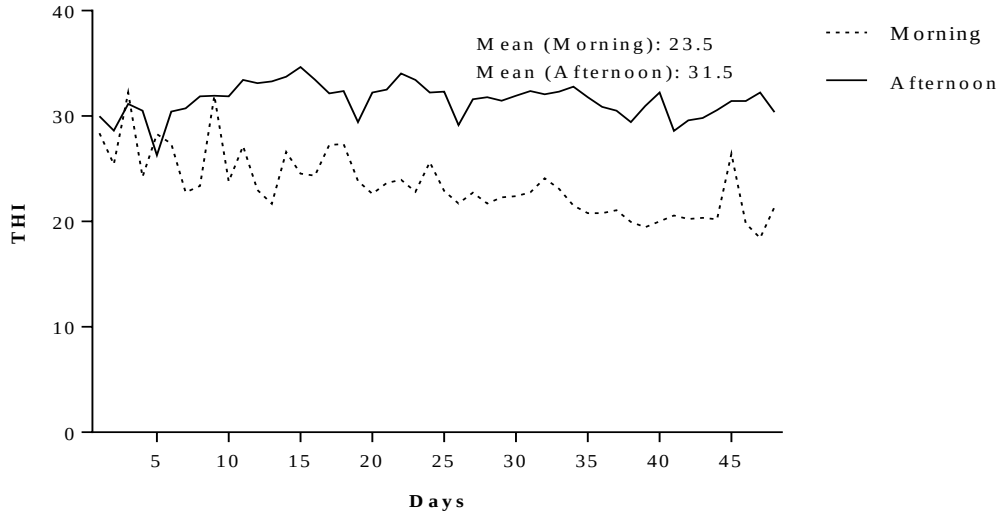


Figure 1: Daily Temperature-humidity index inside the poultry house during the experimental period

The effect of betaine HCl on rectal temperature of broiler chickens **under** dexamethasone **induced stress** is shown in Figure 2. A decrease in rectal temperature with increasing doses of dexamethasone was observed. Birds in the betaine only group had the lowest rectal temperature compared to other treatment groups. This result is supported by Hassan *et al*. (2011) and Nofal *et al*. (2015) who concluded that betaine supplementation in diets reduced rectal temperature. As an osmolyte, betaine may have a stabilizing function on cells subjected to osmotic stressors (Klasing *et al.*,(2002) by regulating the water balance, resulting in the stability of tissue metabolism especially in the gastrointestinal tract (Lipinski *et al.*, 2012), protecting them from heat shock.

The respiratory rate (Figure 3) across the treatment groups was not significant (P>0.05). However, a decrease in respiratory rate with increasing dose of dexamethasone was observed. Birds in the betaine only group had the lowest respiratory rate. One of the visible symptoms of a bird under heat stress is panting or increased respiratory rate (Etches *et al.*,2008)When the environmental temperature exceeds

the comfort limit, chickens suffer heat related stress resulting in physiological and metabolic changes (Borges *et al.,* (2007).

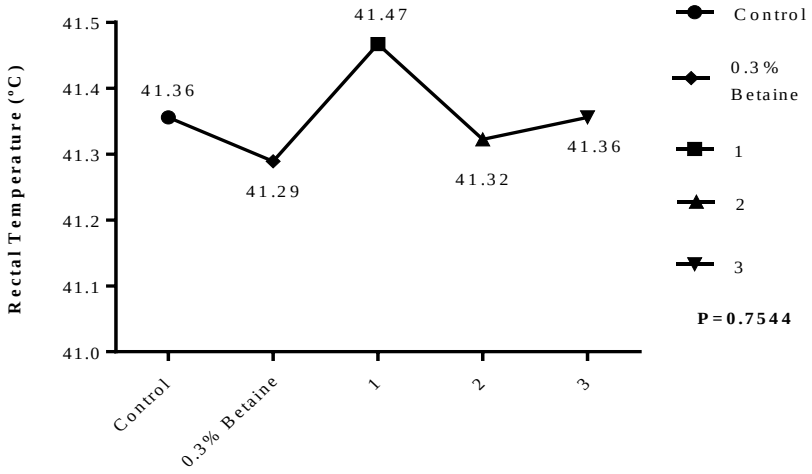


Figure 2: Effect of 0.30% Betaine HCl on Rectal Temperature of Dexamethasone Stress-induced Broiler Chickens

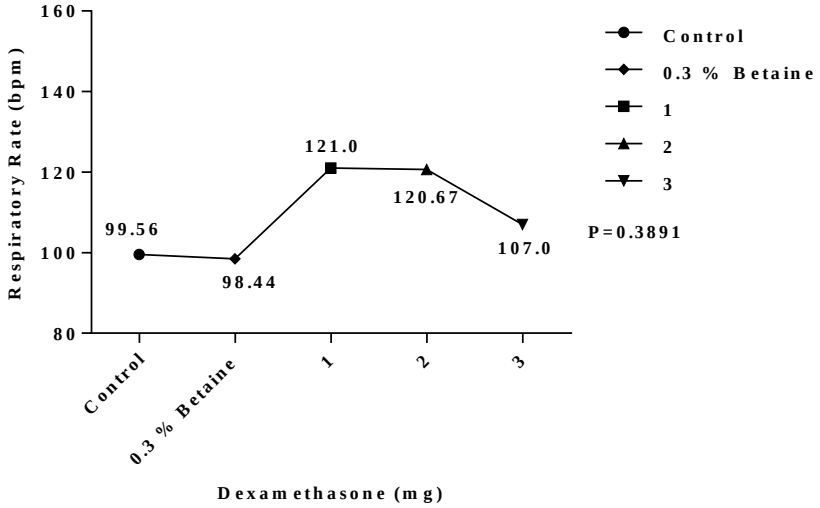


Figure 3: Effect of 0.30% Betaine HCl on Respiratory Rate of Dexamethasone Stress-induced Broiler Chickens

This study also agrees with Aengwanich (2007) who administered dexamethasone at 1-5 mg/kg to broiler chickens. Respiratory rate was found to be reduced even below that of the control group for the betaine only group indicating the ameliorative effect of betaine.

CONCLUSION

The supplementation of betaine HCl in broiler chicken diets had an ameliorative effect on thermoregulatory parameters of broiler chickens.

REFERENCES

Ademu, L.A., Iyeghe-Erakpotobor, G.T., Barje, P.P., Daudu, O.M. and R. J. Wafar (2018). Response of Broiler Chickens underDexamethasone Induced Stress Conditions. *Asian Journal of Research in Animal and VeterinarySciences,* 1(1): 1-9, 2018; Article no.AJRAVS.39782

Aengwanich, W. (2007). Effects of Dexamethasone on Physiological Changes and Productive Performance in Broilers. *Asian Journal of Animal and Veterinary Advances,* 2: 157-161.

Borges, S.A., Da Silva, A.V.F. and Maiorka, A. (2007). 'Acid-base balance in broilers'. *World's Poultry Science Journal*, 63(1): 73-81.

Ali, M.N., Qota, E.M.A. and Hassan, R.A. (2010). Recovery from adverse effects of heat stress on slow-growing chicks using natural antioxidants without or with sulphate. *Int J. Poult. Sci*. 9(2):109–117.

Devenport, L., Knehans, A., Sundstrom, A. and Thomas, T. (1989). Corticosterone's dual metabolic actions. *Life Sciences,* 45(15): 1389–1396.

Eid Y., Ebeid T. and Younis H. (2006). Vitamin E Supplementation Reduces Dexamethasone–induced Oxidative Stress in Chicken Semen. *British Poultry Science,* 47, 350 – 356.

Etches, R.J, John, T.M. and Gibbins, A.M.V. (2008) 'Behavioural, physiological, neuroendocrine and molecular responses to heat stress', in Daghir, N.J. (ed.) *Poultry Production in Hot Climate.* Second edition. Wallingford, UK: CAB international, pp. 31-66.

Fernandez-Figares, I., J. A. Conde-Aguilera, R. Nieto, M. Lachica and J. F. Aguilera (2008). Synergistic effects of betaine and conjugated linoleic acid on growth and carcass composition of growing Iberian pigs. *Journal of Animal Science*, 86: 102-111.

Hassan. R.H., Ebeid, T.A., Abd El-Lateif, A.I. and Ismail. N.B. (2011). Effect of dietary betaine supplementation on growth, carcass and immunity of New Zealand White rabbits under high ambient temperature. *Livestock Science*, 135: 103-109.

JMP® (2012) Software Version 6.12 of the SAS System for Windows. SAS Institute, Inc., Cary, NC, USA.

Klasing, K., Adler, K., Remus, J., and Calvert, C. (2002). Dietary betaine increases intraepithelial lymphocytes in the duodenum of coccidia-infected chicks and increases functional properties of phagocytes. *Journal of Nutrition,* 132: 2274-2282.

Lipinski, K., Szrambo, E., Jerochi, H. and Matasexicius, P. (2012). Effects of betaine on energy utilization in growing pigs- a review. *Annals of Animal Science,* 12:291-300.

NRC (1994). Nutrient Requirements of Poultry (9th Ed.). National Academy Press, Washington, DC.

Nofal, M.E., Magda, A.G., Mousa, S., Doaa, M.M.Y. and Bealsh, A.M.A. (2015). Effect of dietary betaine supplementation on productive, physiological and immunological performance and carcass characteristics of growing developed chicks under the condition of heat stress. *Egyptian Journal of Poultry Science,* 35: 237-259.

Ratriyanto, A.and Mosenthin, R. (2018). Osmoregulatory function of betaine in alleviating heat stress in poultry. *J. Anim. Physiol. Anim Nutr (Berl),* 102(6):1634-1650. doi: 10.1111/jpn.12990.

Stull, R. (2011). Wet-Bulb Temperature from Relative Humidity and Air Temperature. *Journal of applied Meteorology and Climatology,* 50: 2267- 2269.

Tao, X., Xin, H. (2003). Acute synergistic effects of air temperature, humidity and velocity on homeostasis of market–size broilers. *Transactions of the ASAE* 46(2): 491-497.

Tukey, J. (1949). Comparing Individual Means in the Analysis of Variance. Biometrics,5 (2): 99–114.

Zhang, B., Guo, X., Chen, J., Zhao, Y., Cong, X., Jiang, Z., Cao, R., Cui, K., Gao, S., Tian, W. (2014). Saikosaponin-D attenuates heat stress-induced oxidative damagein llc-pk1 cells by increasing the expression of anti-oxidant enzymesand hsp72. *Am. J. Chin. Med.* 42(5):1261–1277.

PHYSICAL ATTRIBUTES OF MEAT FROM BROILER CHICKENS FED DIETS WITH VARYING INCLUSION LEVELS OF CASSAVA (*Manihot esculenta* Crantz) PEAL MEAL

[1,2]Oladimeji S. O., [1]Ogunwole O. A., [2]Raji A. A., [1]Olufeko S. O., [1]Adeyemi A. A. & [1]Tewe O. O.

[1] Agricultural Biochemistry and Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria

[2] Animal Nutrition Department, Amo Byng Nigeria Limited, Awe, Oyo State

ABSTRACT

The physical properties of meat from broiler chickens fed diets based on four cassava peel products were investigated using ten-day old Ross 308 broiler chickens (n=455). The chicks were randomly allotted to 13 treatments of 35 broilers each. Each treatment was replicated five times and a replicate comprised seven chicks. Sundried cassava peel meal (SCPM), whole cassava peel mash (WCPM), fine cassava peel mash (FCPM) and coarse cassava peel mash (CCPM) each replaced dietary maize at 20, 40 and 60% level while the last diet was a maize-based diet. The chicks were fed the respective grower and finisher experimental diet for 10-24 and 24-26 days, respectively. Meat were harvested from the chicken and assessed for physical parameters. Results showed that cooking loss, water holding capacity, thermal shortening, colour, flavour, texture, tenderness, juiciness and overall acceptability were significantly influenced ($P<0.05$) by replacement of maize with the cassava peel products. The cooking loss, water holding capacity, thermal shortening were highest in 40% SCPM (22.00%), 20% FCPM (79.81%) and 40% CCPM (39.00%), respectively. Meat colour, flavour, texture, juiciness and overall acceptability in 60% CCPM (8.50), 40% CCPM (8.50), 20% FCPM (8.00), control (7.00) and 20% WCPM (8.50) were the highest. Meat from birds on control (7.50) and 20%WCPM (7.50) had the highest tenderness score. It was concluded that cassava peel products could be an attractive option in broiler feed, however, the choice and dietary inclusion levels of the products should be dependent on expectations in the meat physical attributes.

Keywords: Cassava peel, High-Quality Cassava peel mash, Meat attributes, organoleptic

Corresponding author: Oladimeji S. O. Email: oladimejioo@gmail.com/+2348062411299

INTRODUCTION

There is a growing demand for poultry product due to the rapid growth in human population. Cakmak (2002) estimated that world population would have grown to 10 billion by the year 2050. Oloyede (2005) also observed that 41-54% of the minimum protein requirement of adult is expected to be sourced from animal protein. One of such source of protein is broiler meat. Production of broiler meat will put pressure on the already scarce and sometimes costlier maize. Maize is an important ingredient required in the formulation of high energy diet required by fast-growing broiler chicken meat production.

There is an increased search for alternatives that could partially or totally replace maize in broiler chicken feed and products. Cassava grit, acha, and cassava peel meal have been considered as suitable alternatives (Salami and Odunsi, 2003; Ogunwole *et al.,* 2016*;* Wumnokol *et al.,* 2019). Cassava peel, which is obtained from generous peeling of cassava tuber could, however, be a viable alternative to maize due to less competition for cassava peel by humans as food, relative to alternatives. The cyanide scare and challenges associated with usage of cassava peel in livestock has led to the deployment of processing methods such as sun-drying, soaking and fermentation (Udedibia *et al.,* 2004; Aniebo, 2012; Oladimeji *et al.,* 2019) with various degree of success.

Subjecting cassava peel to various physical treatment could ensure high quality product that is low in aflatoxin and could be used in poultry feed (Okike *et al.,* 2015; Oladimeji *et al.,* 2019). Though Oladimeji *et al.* (2019) reported on the carcass characteristics of the broiler chicken fed cassava peel products, however, there is also the need to determine the physical attributes of meat from broiler

chickens' when fed diets with varying inclusion levels of cassava (*Manihot esculenta* Crantz) peel meal, which is the aim of this study.

MATERIAL AND METHODS

Test materials

Cassava peel products used for the study were obtained from freshly peeled cassava tuber after which one part was sundried till constant weight was attained and named sundried cassava peel meal (SCPM). Other products, namely whole cassava peel mash (WCPM), fine cassava peel mash (FCPM) and coarse cassava peel mash (CCPM) were obtained using the method of Okike *et al.* (2015) as modified Oladimeji *et al.* (2019)

Experimental Animal

Ten-day old Ross 308 broiler chickens (n=455) were used for the study. They were obtained at 1-day old and raised on commercial feed for ten days after which they were randomly allotted to 13 dietary treatments. Each treatment was replicated five times. Each replicates comprised seven chicks. The chicks were offered feed and water *ad-libitum* throughout the period of the study.

Experimental Diets

Thirteen iso-caloric and iso-nitrogenous diets were formulated for the grower and finisher chickens. The cassava peel products SCPM, WCPM, FCPM and CCPM were used to replace 20, 40 and 60% dietary maize in the control diet. Details of the basal experimental formulation have been documented (Oladimeji *et al.*, 2019), the metabolizable energy and crude protein of the grower was 3050.5 Kcal/Kg and 20.9% while finisher was 3103.9 Kcal/Kg and 19.51% respectively. Grower diets were offered from day 10 to 24 and the finisher from day 24 to 46.

Meat analyses

At day 46 of the experiment, two chickens per replicate with body weights closest to the group average weight were selected, tagged and starved of feed over-night. The chickens were subsequently sacrificed by severing the jugular vein and allowed to bleed after which they were de-feathered and properly dissected. The breast meats were afterwards harvested for cooking loss **(**Omojola and Adesehinwa, 2007), water holding capacity (Hamm, 1986) and thermal shortening (Allen *et al.*, 1998)

Organoleptic Studies

Twenty semi-trained individuals aged between 24 to 30 years were used to assess four replicate of prepared meat sample from the birds fed the 13 different dietary treatments. The samples were evaluated using a nine-point hedonic scale for flavour, colour, juiciness, tenderness and overall acceptability according to the procedure of Cross *et al.* (1986). The evaluation of each meat samples was independent of each other. The poorest condition was scored 1 and the best 9.

Experimental Design

The experimental design was a 1+(4x3) augmented factorial arrangement in a completely randomized design. Data were subjected to analysis of variance using SAS (2002) while means were separated at $\alpha_{0.05}$.

RESULTS AND DISCUSSION

The effect of varying inclusion levels of cassava peel products on physical properties of meat of broiler chickens were presented in Tables 1 and 2. Results showed a significant effect of replacement of maize with all the test cassava peel products on the physical properties evaluated. Cooking loss is a measure of juiciness of meat sample (Bertram *et al.*, 2004). Broiler on 40% SCPM (22.00%) recorded the highest ($P<0.05$) cooking loss while those on 60% FCPM (7.00%) were least. The higher the cooking loss the more juicy the meat. Water holding capacity (WHC) is a measure of ability of meat to retain moisture, meat from broilers on 20% FCPM (79.81%) had the highest WHC ($P<0.05$) while those on 60% SCPM (60.03%) had the least. The thermal shortening of meat from birds on 40% CCPM (39.00%) was highest.

The meat colour of birds on 60% WCPM (8.50) was significantly higher ($P<0.05$). Kartika *et al.* (2016) submitted that meat colour is dependent on the myoglobin type, chemical and physical state of

component of meat. The meat of chickens on 40% SCPM had the highest flavour score (8.50) while those on 60% SCPM (4.50), 40% CCPM (4.00), 40% WCPM (4.50) and 40% FCPM were the least. The texture of the meat from broiler on 20% FCPM (8.00) had the highest score while those on 40% SCPM (4.50), 60% SCPM (5.00), 40% FCPM (5.00) and 60% FCPM (5.00) had the least score.

Table 1: Effect of graded dietary inclusion levels of cassava peel products on physical characteristics of meat of broiler chickens (%)

Cassava Peel Product	Inclusion level	Cooking loss (%)	Water holding capacity (%)	Thermal Shortening (%)
Control	0	12.00^{cd}	76.56^{ab}	27.00^{cdef}
Sundried	20	14.00^{bc}	71.84^{abc}	20.00^{f}
	40	22.00^{a}	69.16^{abc}	31.00^{bcd}
	60	13.00^{c}	60.03^{c}	36.00^{ab}
Coarse	20	19.00^{ab}	73.80^{abc}	22.00^{ef}
	40	19.00^{ab}	60.72^{c}	39.00^{a}
	60	16.00^{bc}	63.93^{bc}	28.00^{cde}
Whole	20	11.00^{cd}	66.59^{abc}	29.00^{bcde}
	40	15.00^{bc}	74.64^{abc}	25.00^{def}
	60	14.00^{bc}	64.38^{abc}	31.00^{bcd}
Fine	20	12.00^{cd}	79.81^{a}	27.00^{cdef}
	40	12.00^{cd}	78.60^{ab}	31.00^{bcd}
	60	7.00^{d}	68.15^{abc}	33.00^{abc}
	SEM	0.74	1.48	0.96

^{abc} Means with the same superscripts in the same column are not significantly different (P>0.05) SEM= Standard error of mean

Table 2: Effect of interactions of cassava peel products and inclusion levels on organoleptic properties of meat from broiler chickens

Cassava Peel Product	Inclusion level	Colour	Flavour	Texture	Tenderness	Juiciness	Overall acceptability
Control	0	6.50^{bcd}	6.00^{bc}	6.00^{ab}	7.50^{a}	7.00^{a}	7.00^{abcd}
Sundried	20	3.00^{g}	7.00^{b}	5.50^{ab}	5.50^{ab}	2.50^{c}	6.50^{bcd}
	40	7.00^{bc}	8.50^{a}	4.50^{b}	5.50^{ab}	4.50^{bc}	7.00^{abcd}
	60	6.00^{cde}	4.50^{d}	5.00^{b}	5.00^{b}	6.50^{ab}	6.50^{bcd}
Coarse	20	6.00^{cde}	5.00^{cd}	6.00^{ab}	6.00^{ab}	6.50^{ab}	6.00^{dc}
	40	5.00^{ef}	4.00^{d}	7.00^{ab}	4.50^{b}	6.50^{ab}	5.50^{d}
	60	8.50^{a}	7.00^{b}	6.50^{ab}	6.00^{ab}	5.00^{ab}	7.00^{abcd}
Whole	20	7.50^{ab}	7.00^{b}	5.50^{ab}	7.50^{a}	7.00^{a}	8.50^{a}
	40	4.50^{f}	4.50^{d}	5.50^{ab}	5.50^{ab}	5.00^{ab}	6.50^{bcd}
	60	5.50^{def}	6.00^{bc}	6.50^{ab}	4.50^{b}	5.00^{ab}	6.00^{cd}
Fine	20	7.00^{bc}	5.00^{cd}	8.00^{a}	5.00^{b}	6.50^{ab}	8.00^{ab}
	40	7.00^{bc}	4.00^{d}	5.00^{b}	6.50^{ab}	5.50^{ab}	7.50^{abc}
	60	7.50^{ab}	5.00^{cd}	5.00^{b}	4.50^{b}	6.00^{ab}	6.50^{bcd}
SEM		0.25	0.24	0.24	0.22	0.25	0.18

^{abc} Means with the same superscripts in the same column are not significantly different (P>0.05) SEM= Standard error of mean

Tenderness of meat from chickens on control diets (7.50), 20% WCPM (7.50) as well as the juiciness of those on the control (7.00), 20% WCPM (7.00) were the highest. Sensitivity of the mouth, texture of meat, meat water holding capacity and fat content could have contributed to the observed differences (P<0.05) in the tenderness and juiciness of the meat, as they play an important role to

lubrication when chewing (Juarez *et al.*, 2015). Cross *et al.* (1986) reported that meat is directly related to intramuscular lipid and moisture content which was corroborated by Omojola and Adesshinwa (2007) that the combination of water and melted lipids form broth which are retained in the meat and released when chewed. The overall acceptability of meat from birds on 20% WCPM (8.50) was highest and least in those on 40% CCPM (5.50). The fibrous nature of coarse cassava peel mash perhaps contributed to lower meat acceptability recorded by broiler on 40% CCPM.

CONCLUSION AND RECOMMENDATION

Cassava peel products could be a viable alternative to maize in broiler feed, however, choice of products and replacement level for inclusion should be based on the expected use of the meat.

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REFERENCES

Allen C. D., Russell S. M., and Fletcher D. L. (1997).The Relationship of Broiler Breast Meat Colour and pH to Shelf-Life and Odour Development. *Poultry Science Journal* 76, 1042–1046.

Aniebo A.O. (2012). Appraisal of palm oil and methionine as detoxifying agents of residual cyanide in cassava-based broiler starter diets. *International Journal of Food, Agriculture and Veterinary Sciences.* 2(1), 153-161.

Bertram H. C., Engelsen S. B., Busk H., Karlssona A. H., Andersen H. J. (2004). Water properties during cooking of pork studies by low-field NMR relaxation: Effects of curing and the RN-gene. *Meat Sci.* 66:437-446.

Cakmak, I. (2002). Plant nutrition research: Priorities to meet human needs for food in sustainable ways. *Plant and Soil* 247, 3–24 (2002) DOI:10.1023/A:1021194511492.

Cross H. R. and Overby A. J. (1986). World animal science-B3, meat science, milk science tech, Elsevier science publishers, Amsterdam, The Netherland. Dave's Garden.

Hamm, R. (1986). Functional properties of the myofibrillar system and their measurements. *In P. J. Bechtel (Ed.), Muscle as food* (pp. 135–199). New York: Academic Press, Inc.

Juárez M, Aldai N., López-Campos Ó., Dugan M.E.R., Uttaro B., and Aalhus J.L. (2015) Beef texture and juiciness. Handbook of Meat and Meat Processing, Second Ed. 9: 177-205

Karthika, S., Chandirasekaran, V. and Sureshkumar S. ., Sensory attributes of Namakkal Quail-1 meat. International Journal of Advanced Veterinary Science and Technology, 2016, 5(2), 266-269.

Ogunwole O. A., Idowu, A. I., Olumide, M. D., Lawal, H. O., Oladimeji S. O., Abayomi, F. D. and O. O. Tewe. (2016). Calcium and Phosphorus Utilization by Broiler Chickens Fed β-Carotene Biofortified Cassava (*Manihot Esculenta* Crantz) Grits Based Diets. *Ibadan Journal of Agricultural Research*; Vol. 12 (1).

Okike I., A. Samireddypalle, L.Kaptoge, C. Fauquet, J. Atehnkeng, R.Bandyopadhyay, P.Kulakow, A. Duncan, T. Alabi, and M. Blummel. (2015). Technical innovations for small-scale producers and households to process wet cassava peels into high-quality animal feed ingredients andaflasafe™ substrate. *Food chain* 5(1-2):71-90.

Oladimeji S. O., Ogunwole O. A., Amole T. A. and Tewe O. O. (2019). Carcass characteristics and organ weights of broiler chickens fed varying inclusion levels of cassava *(Manihot esculenta* Crantz) peel based diets. Proceedings of the 8th ASAN-NIAS Joint Annual Meeting, September 8-12, 2019. pp 147-154.

Oloyede, H. O. B. (2005). All for the love of nutrients, The 78th Inaugural lecture, Library and Publication Committee, University of Ilorin.

Omojola, A. B. and Adesehinwa, A. O. K. (2007). Performance and carcass characteristics of broiler chickens fed diets supplemented with graded levels of Roxayme G®. *International Journal of Poultry Science.* 6 (5):335-339.

Salami, R. I. and Odunsi, A. A. (2003). Evaluation of processed cassava peel meals as substitutes for maize in the diets of layers. *International Journal of Poultry Science* 2 (2): 112-116.

SAS Institute, Inc. (2002). SAS language: reference, Version 6, 1st Edition. SAS Institute Inc., Cary, North Carolina. USA.

Udedibie A. B. I., Anyaegbu B. C., Onyechekwa G. C. and Egbuokporo O. R. (2004). Effect of feeding different levels of fermented and unfermented cassava tuber meals on performance of broilers. *Nigerian Journal of Animal Production* 31(2004), 211-219.

Wumnokol, D.P., Guluwa, L. Y. and Latu, M. Y. (2019). Performance and haematology of broiler starter fed acha (*Digitaria exilis* Staph) grains as replacement for maize. *NJAP*. 46 (2); 87-91.

EVALUATION OF CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF *TSIRE* SOLD IN KANO METROPOLIS

Abba A. I. Inusa S.K., Abdullahi, M. H. & Adamu A.S.
Department of Animal Science, Faculty of Agriculture,
Bayero University, PMB 3011, Kano.
karkarna63@gmail.com

ABSTRACT
The study was conducted to evaluate the chemical and microbiological properties of *Tsire*, a ready-to-eat meat product snack sold in Kano metropolis northwest Nigeria. Samples for the study were purchased at four different locations, Gwarzo Road, Sabon Gari Market, Rimi Market and Zoo Road within the metropolis. At each location, samples were collected in triplicates and were subjected to proximate and microbiological analyses. The proximate analysis revealed that there were significant (P<0.05) differences in protein content of the samples. Zoo Road had the highest protein content (38.59%), while Rimi Market had the least (31.73%). The highest ether extract and ash contents were recorded in *Tsire* samples from Rimi market, whereas Zoo Road had the lowest. There was no significant (P<0.05) differences in moisture content across the samples. The indicator organisms were identified as *Staphylococcus aureus* and *Escherichia coli*. Higher counts *Staphylococcus aureus* was obtained from Rimi market and was significantly difference (P< 0.05) from counts at other locations. Also, there was significant difference in *Fecal coliform* where by Sabon Gari Market samples had the highest (23 MPN/g). *E. coli* was significantly (P< 0.05) lower than *S. aureus* at all the locations. This study shows the Tsire, harbors microorganism of public health importance in numbers that could likely cause health problems. Therefore, proper hygiene in the process-line and the processing environment of *Tsire* is recommended to prevent the likely detrimental health implications to consumers.

Key words: *Escherichia coli*, meat, public health, *Staphylococcus aureus*, *Tsire*.

INTRODUCTION

Meat plays an important role in human diet by contributing high quality protein and macro and micro nutrients that are required for growth and good health maintenance. The rate of increase in *per capita* consumption of meat was found to be very high in developed countries when compared with the developing nations (Anjaneyulu *et al.*, 2007). Meat is high in nutrients, especially proteins, minerals and vitamins. It is however prone to spoilage (Anna *et al.*, 2005). Meat is considered to be spoiled when it is unfit for human consumption. Meat is subjected to changes by its own enzyme, by microbial action and its fat may be oxidized chemically. Microorganisms grow on and meat cause visual, textural and organoleptic changes when they release metabolites (Jackson and Mcgowan, 2001).

Tsire is a consumer meat product fast food which is processed and sold along streets often under unhygienic conditions (Uzeh *et al.*, 2006). At sales location, *Tsire* is usually packaged with old newspapers, brown papers and other used paper materials. Also, processing the product, the materials used, the handlers and the environment where it is processed and sold can serve as sources of contamination (Uzeh *et al.*, 2006). It was reported by Omojola (2008) that the meat and some of the ingredients used for processing *Tsire* can also serve as the product contaminants, especially defatted groundnut cake powder.

The fact that *Tsire* is not consumed immediately after preparation but held at ambient temperature for more than 5 hours before serving has previously been reported (Edema *et al.*, 2008). This practice might create an avenue for microbial contamination. These micro-organisms are capable of endangering human lives by causing health problems.

This experiment was conducted to evaluate the chemical and microbiological properties of *Tsire* sold in Kano Metropolis.

MATERIALS AND METHODS

The experiment was conducted at Food and Science Laboratory, Kano State University of Science and Technology, Wudil, Kano State. Kano state lies between longitude $9^0 30^{'}$ and $12^0 30^{'}$ North and latitude $9^0 30'$ and $8^0 42^{'}$ East. The area is characterized by tropical wet and dry climate. The State occupies a land area of 20,400km^2 with a population of over 9,383,682 (NPC, 2006). Hausa-Fulani are the major ethnic groups in the area and Islam is the dominant religion.

Ready-to-eat *Tsire* samples were purchased at four different locations in Kano Metropolis. These places are Gwarzo Road, Sabon Gari market, Rimi Market, and Zoo Road. The sampling was triplicated at each of the designated locations. All the purchased samples were transported to the Laboratory in labeled sealed bags for analyses. All the *Tsire* samples were subjected to proximate analysis according to the procedures of AOAC (2007), while microbial analysis was conducted according to the procedures of APHA (2005).

Completely Randomized Design (CRD) was used for the experimental design. Data obtained were analyzed with SAS (2002), while the means were separated using the Least Significance Difference (LSD) method.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of *Tsire* sold at different locations in Kano Metropolis. The value obtained revealed significant (P<0.05) differences in protein content and ether extract across the locations where *Tsire* samples were collected. The highest and lowest protein contents (38.59% and 31.73%) of *Tsire* samples were recorded at Zoo road and Rimi Market. The ether extract was highest (2.10%) in *Tsire* samples obtained from Rimi Market. The percentage protein content of the samples agreed with 31.8% reported by Abdulahi *et al.* (2004). Also the values obtained (Abdulahi *et al.*, 2004) for fat and ash level which respectively were 23.7% and 2.4%, agreed closely with that obtained by Abdullah *et al.* (2004). There was no significant (P<0.05) differences in moisture content across all the locations. This closely agreed with the finding of Apata, et al. (2013). Rimi Market recorded the highest ash (5.13 %) while there were no significant differences among the others values.

Table 1: Proximate Composition results of *Tsire* sold in Kano Metropolis.

Nutrients	**Locations**				
	Gwarzo Road	**S/Gari Market**	**Rimi Market**	**Zoo Road**	**LSD**
Protein	33.90^c	35.74^b	31.73^d	38.59^a	0.972
Ether extract	23.96^b	20.57^c	25.37^a	18.31^d	1.111
Moisture	35.62	37.09	34.68	36.07	3.567
Ash	1.80^b	1.70^b	2.10^a	1.90^b	0.633

a, b, c and d means in the same row with different superscripts are significantly different (P<0.05)

Table 2 shows the microbial counts of *Staphylococcus aureus, Salmonella spp* (cfu/g) and fecal coliform MPN/g in the *Tsire* samples. There was significant (P<0.05) differences in *Staphylococcus aureus* and *Salmonella spp* (cfu/g) across the locations. Results obtained for highest *S. aureus* count of 2.26 x 10^4 cfu/g was slightly higher than the 1.97 x 10^4 reported previously (Edema *et al.*, 2008). Similar, high *S. aureus* values were reported by Yousuf *et al.* (2008) and Okonko *et al.* (2009). The reason for the high counts of these organisms in the *Tsire* could be environmental, handling

contamination issue and holding time. Rimi and Sabon Gari markets are situated closer to waste dumping sites and gutters more than the two other locations, hence contributing to the higher microbial counts. It showed that Rimi Market had the highest count (2.26×10^4) of *Staphylococcus aureus* while Gwarzo Road recorded the least *Staphylococcus aureus* (1.14×10^4). There was no *fecal coliform* MPN/g in *Tsire* samples obtained from Gwarzo Road while Sabon Gari with 23 MPN/g *Fecal coliform* had the highest count. No *Salmonella spp* were isolated from all the *Tsire* samples.

Table 2: Microbial counts of *Staphylococcus aureus, Salmonella spp* (cfu/g) and Fecal coliform MPN/g of *Tsire* samples

	Location			
Indicator organisms	**Gwarzo Road**	**S/Gari Market**	**Rimi Market**	**Zoo Road**
Staphylococcus (cfu/g)	1.14×10^4	2.13×10^4	2.26×10^4	1.73×10^3
Fecal coliform MPN/g	_	23	<3	4
Salmonella (cfu/g)	_	_	_	_

S/Gari market = Sabon Gari market

Table 3 shows the occurrence of indicator organisms. The results revealed that *Staphylococcus aureus* was the most predominant pathogen because it occurred in all the *Tsire* samples. This agrees with previous report by Clarence *et al*. (2009) who reported *S. aureus, E. coli, Klebsiella spp* and *Pseudomonas spp* in meat pie. *Escherichia coli* occurred in the *Tsire* samples obtained from Sabon Gari market and Zoo road, while *Salmonella spp* was not present in all the *Tsire* samples.

Table 3: Occurrence of Indicator Organisms in Experimental *Tsire* Samples.

	***Tsire* samples**											
Isolates	**GR 1**	**GR 2**	**GR 3**	**SBG 1**	**SBG2**	**SBG 3**	**RM 1**	**RM 2**	**RM 3**	**ZR 1**	**ZR 2**	**ZR 3**
Staphylococcus aureus (cfu/g)	+	+	+	+	+	+	+	+	+	+	+	+
Escherichia coli	_	_	_	+	_	_	_	_	_	+	_	_
Salmonella (cfu/g)	_	_	_	_	_	_	_	_	_	_	_	_

GR= Gwarzo Road, SBG = Sabon gari Market, RM = Rimi Market and ZR = Zoo Road.

CONCLUSION AND RECOMMENDATIONS

Some of the bacteria isolated and identified in Tsire are of public health importance and their presence can cause food poisoning and food borne diseases. There is need for proper handling and the establishment of legislation regarding the sale of *Tsire* and other meat products at strategic locations to reduce the level of contamination in such product

REFERENCES

Abdullahi I.O., Umoh V.J., and Galadima M. (2004). Hazards associated with *kilishi* preparation in Zaria, Nigeria. *Nigerian Journal of Microbiology* **18** (1-2): 338-345.

Anjaneyulu, A. S. R., Thomas, R., and Kondaiah. (2007). Technologies for Value Added Buffalo meat products-A Review. *American Journal of Food Technology, **2***(3), 104-114. Retrieved on 14/04/2012 http://dx.doi.org/10.3923/ajft.2007.104.114

Anna, A. M., Lackshmannan, V., Mendiratta, S. K., Anjaneyulu, A. S. R., and Bisht, G. S. (2005). Development and quality characteristics of extruded tripe snack from buffalo rumen meat and corn flour. *Journal of Food Science and Technology, 42*, 263-267.

AOAC (2007). Association of Official Analytical Chemists. Methods of Analysis, 15th Edition Washington D.C.

Apata E. S., Kuku I. A., Apata O. C. and Adeyemi K. O. (2013): An Intermediate Moisture Meat Product in Ogun State, *Nigeria Journal of Food Research*; **2**(1):234-250

APHA. (2005). Compendium of method for the microbiological examination of foods, 3rd edition American Public Health Association. In C. Vanderzant, & D. F. Splitsloesser (Eds.). Michigan, USA. Retrieved fromhttp://www.apha.org

Clarence S. Y., Obinna C.N., and Shalom N.C. (2009). Assessment of bacteriological quality of ready to eat food (Meat pie) in Benin City metropolis, Nigeria. *African Journal of Microbiology*. Res., 2009; **3**(6): 390-395

Edema M.O, Osho A.T and Diala C.I. (2008). Evaluation of microbial hazard associated with processing of suya (a grilled meat product). Scientific Research and Essay. **3** (12):621-626.

Jackson D., Mcgowan C.H. (2001). Diet management effects on carcass attributes and meat quality of young goats. *Small Ruminant Research*; **28**(1):93-98

NPC (2006). National Population Commission, National Census. Retrieved on 02/04/2014 http://www.population.gov.ng

Okonko I. O., Ogunjobi A. A., Fajobi E. A., Onoja B. A., Babalola E. T., Adedeji A. O. (2009) Comparative studies and microbial risk assessment of different Ready-to-Eat (RTE) frozen sea-foods processed in Ijora-olopa, Lagos State, Nigeria. *African Journal of Biotechnology*, **7**(16): 2898-2901

Omojola, A. B. (2008). Yield and Organoleptic Characteristics of Suya (an intermediate moisture meat) prepared from three different muscles of a matured bull. *African Journal Biotechnology, **7***(13), 2254-2257.

SAS (2002). Statistical Analysis System, Computer software, version 9: Statistic SAS Institute Inc. Cary, NC2751, U.S.A

Uzeh, R. E., Ohenhen, R. E., and Adeniji, O. O. (2006). Bacterial Contamination of *Tsire -Suya* a Nigerian Meat Product. *Pakistan Journal Nutrition, **5***(5), 458-460. Retrieved on 14/04/2011 http://dx.doi.org/10.3923/pjn.2006.458.460

Yousuf A.H.M., Ahmed M.K, Yeasmin, S., Ahsan, N, Rahman, M.M., Islam M.M. (2008). Prevalence of Microbial Load inShrimp, *Penaeus monodon* and Prawn, *Macrobrachium rosenbergii* from Bangladesh. *World Journal of Agricultural Sciences*: **4(**3): 852-855.

NUTRITIONAL QUALITYAND MICROBIOLOGICAL PROPERTIES OF MEAT FLOSS PREPARED FROM MUTTON

***Akinleye S. B., Omojola, A. B., Kassim O. R. & Iyanda O. D.**
Meat Science Laboratory, Department of Animal Science, University of Ibadan, Oyo State.
Corresponding Author: bamideleakinleye@yahoo.com

ABSTRACT
Mutton is an excellent source of biological value with its inherent low fat content, however, it has untapped market as a good potential for value added meat products. Therefore, it is necessary to appraise the nutrient composition of meat floss (MF) from different breeds of ram. Five kilogram of *Semitendonisus* muscle was harvested from carcasses of four breeds of rams consisting of West African Dwarf (WAD), Yankasa (YK), Uda (UD) and Balami (BA) intensively fattened for ninety days. Cooking loss (CL), water holding capacity (WHC), moisture contents (MC), crude protein (CP) and ether extract (EE) of mutton and freshly prepared meat floss (MF) were determined. Thiobarbituric Acid Reactive Substances (TBARmgMDA/100g) and microbiological counts (MC) (log 10^2cfu/g): Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungal Counts (TFC)) at the seventh day were determined. The CL (38.19%, 39.51%) of WAD and YK mutton were significantly higher ($P<0.05$) while their WHC (61.49%, 59.97%) were lower than UD and BA. The CP (23.16%) and EE (5.85%) of BAM were higher ($P<0.05$). The CP were (46.75%, 48.73%, 47.82%, 49.60%) and EE (25.69%, 25.46%, 25.88%, 27.35%) for WAD, YK, UD and BA, respectively. The TBAR ranged from 1.12-1.17 mgMDA/100g. The mean MC (log 10^2cfu/g) on the MF from WMF was 6.76cfu/g while YMF, UMFand BMF for TAC were 4.38, 3.96 and 3.58cfu/g, respectively. The keeping qualities value of the MF does not exceed the threshold values of stored meat products, therefore, it can be inferred that MF from mutton has a high nutrient and keeping qualities profile.

Keywords: Keeping quality, Mutton, Nutrient profile, *Semitendinosus*

INTRODUCTION
Sheep production is indispensable to meet protein and some domestic needs of people throughout the world as they are sources of income and raw materials (Mapiliyao *et al*., 2012). Mutton has a high biological value with its inherent low fat contents. However, it has received little attention in consumption pattern as compared with other sources of meat such as beef and chevon, therefore has an untapped market value as a good potential for value added meat products. MF is among the popular traditional foods that constitutes an important part of Nigerian meal. Considerable progress has been made in standardization of product profile and mechanization of traditional meat products. In Nigeria, particularly in rural communities and towns, processing of carcass usually takes place under very unhygienic conditions. This coupled with high ambient temperature, high humidity, shortage of portable water and poor handling practices exposes meat products like MF to microbial contamination and rapid deterioration. Therefore, the microbiological testing at various stages of food production is relevant to reveal and understand the characteristic trends in distribution of microbiological contamination (ICMSF, 2011). Information available on meat floss specifically is usually centred on other sources of meat while little or none is available on processed mutton. However, if such information is available, it might bring into limelight the nutritional quality inherent in mutton and also help in changing the consumption pattern of the meat. Therefore, this study aimed at assessing the nutritional and keeping qualities of meat floss prepared from mutton of different breeds of ram.

MATERIALS AND METHODS
Experimental design
The study was a completely randomized design and each treatment was replicated thrice.
Meat sample: source, collection and preparation
The *Semitendinosus* used for this study was harvested from the skinned mutton carcasses of four breeds of rams (BA, UD, YK and WAD breeds) intensively fattened for ninety days. They were cut into chunks with average weight of 100g. Thirty chunks were randomly selected to have three kilograms of fresh mutton for each breed.

Non-meat ingredients

Table1: Composition of cooking and shredding recipes used for meat floss production

Ingredients /seasoning	Scientific/*Botanical names	Quantity (g/100g)
	Cooking Recipe	
Salt	Sodium Chloride	10.00
Maggi (Knorrs®)	Maggi	15.00
Thyme	*Thymus vulgaris* L.	12.50
Curry	*Murraya koenigii* (L.) Spreng.	12.50
Onions	*Allium cepa* L. var. *Cepa*	50.00
Total		**100.00**
	Shredding Recipe	
Red Pepper	*Piper nigrum* L.	35.00
Maggi (Knorr®)	Maggi	30.00
African Nut Meg	*Monodora myristica* (Gaertn.) Dunal	2.50
Ginger	*Zingiber officinale* Rosc.	4.00
Garlic	*Allium sativum* L.	3.00
Cloves	*Syzygium aromaticum* (L.) Merr. et L.M. Perry	2.50
Curry powder	*Murraya koenigii* L.	3.50
Thyme leaves	*Thymus vulgaris* L.	2.50
Salt	Sodium Chloride	5.00
Onions	*Allium cepa* L. var. *cepa*	12.00
Total		**100.00**

Source: Kassim (2013). * All botanical names according to Rehm and Espig (1991)

PRODUCTION OF MEAT FLOSS

The steps involved in production of the meat floss were spice mixture preparation, meat preparation, cooking, shredding, frying and de-oiling following Kassim (2013). The meat chunks were cooked in a pot on an electirc hot plate (Pifco Japan Model number ECP 2002) with water added at the ratio of 1.5 litres to 1.0 kg of meat and the cooking recipe added at a ratio of 1 g to 100 g of meat. The cooking was done at an internal temperature of 72°C until the broth completely dried on the broiled mutton. The meat samples were removed from the pot and spread on a tray to equilibrate to room temperature. The cooled meat was shredded separately by pounding with a local mortar and pestle with shredding recipe at a ratio of 1.00g to 20.00g meat. The shredded meat was deep-fried in soya oil (pre-heated to 180°C) in the ratio of 1 litre to 500g of meat. The meat was fried at 70 strokes per minute for 20 minutes until they turned golden brown in colour. The products were emptied into a colander, pressure applied to drain oil and obtain a dry spongy product. Upon cooling the meat floss were separated into strands and immediately packed into an air tight container and left at room temperature.

PARAMETERS MEASURED

Meat Quality

Cooking loss (CL)

Cooking loss was determined (following the procedure of Honikel, 1987) in the *Semitendinosus* muscles of each breed and samples were taken in triplicates.

Thermal shortening

This was carried out according to the procedure described by Mahendraker *et al*. (1988). Cores of 0.5 cm in diameter were taken from the *semitendinosus* muscle of each breed. Each breed was replicated thrice and the average taken.

Water holding capacity (WHC)

WHC was evaluated using a method adapted from Hamm (1960), based on meat water loss when pressure is applied on it. This was determined by the press method described by Wierbicki and Deatherage (1958) as modified by Tsai and Ockerman (1981).

Product yield

The product yields of the meat floss were determined by measuring the weight of the MF for each treatment and were calculated as the ratio of cooked weight to raw weight expressed as percentage.

Microbial analysis

The microbial quality determination was carried out on the freshly prepared meat floss. The Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungi Counts (TFC) were carried out following the procedure of Garbutt (1997).

Statistical analysis

Data collected were analysed using Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The physical measured traits of mutton used in the production of meat floss are presented in Table (2). The CL ($P<0.05$) of *Semitendinosus* from YK (39.59%) and WAD (38.19%) were significantly different than 34.70% and 30.20% obtained for UD and BA, respectively. This same trend could be noticed in their TS with YK (34.67%) and WAD (33.34%) having the highest TS shrinkage than UD (29.62%) and BA (26.40%). WHC is one of the major quality characteristics of fresh meat, as it affects some major characteristics of cooked meat such as product yield, appearance and sensory properties. WHC obtained from *Semitendinosus* muscles of mutton used in this study were between 59.97 and 71.60%. BA and UD had the highest ($P<0.05$) value while WAD and YK had similar ($P>0.05$) values which were the least (Table2). The denaturation and aggregation of sarcomere could be responsible for the shrinkage observed in the thermal shortening of the mutton because the extent of sarcoplasmic and myofibrillar protein during cooking depends on the resistance of the muscle fibres to compression (Sheffler and Gerrard, 2007).

Table 2: Physical properties of raw *Semitendinosus* muscles from different breeds of rams used in meat floss production

Parameter (%)	WAD	YK	UD	BA	SEM
Cooking Loss	38.19^{a}	39.51^{a}	34.70^{b}	30.20^{c}	0.25
Thermal Shortening	34.67^{a}	33.34^{a}	29.62^{b}	26.40^{c}	0.18
Water Holding Capacity	61.49^{c}	59.97^{c}	65.60^{b}	71.76^{a}	0.14

[a, b, c] Means with different superscripts in the same row are significantly different ($P<0.05$)
WAD: West African Dwarf; YK: Yankasa; UD: Uda; BA:Balami

Chemical composition of raw *Semitendinosus* muscles from different breeds of rams used for the production of meat floss

The chemical compositions of the mutton used are displayed in Table 3. The moisture content of the muscles ranged from 69.57% to 69.86% while the crude protein contents, ash, ether extracts and cholesterol of the muscles differ significantly ($P<0.05$). It ranged from 22.58% to 23.16%; 1.13%-1.30%, 5.85%to 6.44% and 0.21% to 0.29% for crude protein, ash, ether extracts and cholesterol, respectively. The average chemical analysis values for the *Semitendonisus* muscle in the present study are in agreement with the reported values in food composition tables of National Food Institute, (2009 and Chuaynukool *et al*., 2007). The differences in fat content in the meat samples could be due to the differences in genetic and non-genetic factors as reported by Bogosavljevic-Boskovic *et al*. (2010). The low moisture contents of the meat floss as compared to its raw muscles could be attributed to the fact that MF preparation involves a high thermal processing method and most of the water contained in the meat would have been dried-off during the process. It was observed that MF from BA muscle had the highest nutrient profile especially in crude protein contents, ash and ether extracts. This could be attributed to the fact that it was the muscle that has the highest nutrient profile in the raw state. It could also be as a result of its high water holding capacity because nutrient composition of a muscle after thermal treatment depend on the ability of the muscle to hold on to its inherent water which

contain the nutrients of the muscle. During thermal treatment, water would be lost with some nutrients but a muscle with high water holding capacity would have a low cooking loss thereby retaining most of its nutrients. The high product yield of MF from the mutton could be attributed to the procedure because water holding capacity and cooking loss are inversely correlated (Nasiru *et al*., 2011). The lower product yield of meat floss from WAD muscle might be attributed to the excessive fat separation and water release during cooking (Pietrasik and Shand, 2003). The increase in the ash contents of the MF compared to the raw meat could have been contributed by the added ingredients used during production. Similar observations were reported by Ogunsola and Omojola (2008) who reported that the high ash contents of kilishi is due to individual mineral levels of the spices used to give accumulative mineral level during processing. Also, the average total ash values of MF in the present study is in agreement with the reported values in food composition tables of National Food Institute, (2011) for meat products. The increasing level of cholesterol in processed samples might be as a result of the conversion of other substances from food into cholesterol during thermal degradation (Chizzolini *et al*, 1999).

Table 3: Product yield and chemical composition of freshly prepared meat floss from four *Semitendinosus* muscles of different breeds of rams

Parameter (%)	WMF	YMF	UMF	BMF	SEM
Moisture Content	10.52^{a}	10.49^{ab}	10.63^{a}	10.20^{b}	0.05
Crude Protein	46.75^{d}	48.73^{b}	47.82^{c}	49.60^{a}	0.04
Ether Extract	25.69^{c}	25.46^{d}	25.88^{b}	27.35^{a}	0.03
Ash	7.28^{c}	7.31^{c}	7.96^{a}	7.75^{b}	0.03
Cholesterol mg/g	10.11^{ab}	8.33^{c}	11.33^{a}	9.00^{bc}	0.01
Product Yield	67.07^{b}	68.42^{b}	72.31^{a}	74.44^{a}	0.58

[a, b, c] Means with different superscripts in the same row are significantly different (P<0.05). WMF = West African Dwarf Meat floss; YMF = Yankasa Meat floss; UMF =Uda Meat floss

Microbial loads of mf produced from different breeds of ram

The microbiological counts (10^2cfu/g) and the TBARS (mg/kg) of the meat floss is displayed in Table (4). The result revealed that there were significant differences (P<0.05) in all the microbial assessment among the products. The total aerobic counts (TAC) were 1.13, 0.73, 0.66, 0.60; while the total coliforms counts (TCC) were 0.20, 0.20, 0.36, 0.23 and the total fungal counts were 1.03, 0.46, 0.29, 0.20 for WFM, YMF, UMF and BMF meat floss, respectively. Microbial assessment of food provide a general indication of the microbiological quality of the products. The microoganisms isolated in food could come from different sources such as processing, cooking and the environment. The high fat content also can acts as a medium for the growth of microorganisms (Kumar and Sharma, 2004). The microbial counts recorded for coliforms and fungi were well below the levels of $\log10^4$ cfu/g and $\log10^3$ cfu/g that could cause microbial spoilage (Jay, 1996). Lipid oxidation is a major cause of food deterioration as it decreases nutritional properties of foods and the generation of potentially toxic reaction products. TBARS values of MF samples were illustrated in Table 4, from which it is apparent that BMF samples exhibit 0.39 mg MDA/kg meat. However, the mean TBARS values of all the MF samples in this study were found to be lower than 2.0 mg MDA/kg, accepted as the critical value of lipid oxidation for meat and meat products (D'agata *et al*., 2010).

Table 4: Microbiological quality (log 10^2cfu/g) and Thiobarbituric reactive substances of meat floss prepared from *Semitendinosus* muscles of different breeds of rams

Parameter	WMF	YMF	UMF	BMF	SEM
Total Aerobic Counts	1.13^{a}	0.73^{b}	0.66^{c}	0.60^{c}	0.22
Total Coliform Counts	0.20^{b}	0.20^{b}	0.36^{a}	0.23^{b}	0.24
Total Fungal Counts	1.03^{a}	0.46^{b}	0.29^{c}	0.20^{d}	0.06
TBARS(mg MDA/100g)	0.38	0.37	0.38	0.39	0.03

[a, b, c] Means with different superscripts in the same row are significantly different (P<0.05). WMF=West African Dwarf Meat floss; YMF = Yankasa Meat floss UMF = Uda Meat floss; BMF = Balami Meat floss

CONCLUSION

The nutritional and keeping qualities of meat floss as revealed in this study indicated that mutton is a meat with high biological value which is inversely proportional to its consumption pattern. It could be recommended that the spices should be subjected to treatment that would reduce the microbial load of the products to avoid introduction of pathogens that might bring about spoilage and contamination of the product.

REFERENCES

Alabdulkarim, B., Abdel Nabi Bakeet, Z. and Arzoo, S. (2012): Effect of Frying oils on quality characteristics of frozen chicken patties incorporated with honey. *African Journal of Biotechnology* 11(12): 2985-2992.

A.O.A.C. (2005). Association of Official Analytical Chemist. Officials Methods of Anslysis 18th Edition AOAC Inc, Arlington, Virgina USA. 1094pp.

Bogosavljevic-Boskovic, S., Mitrovic, S., Djokovic, R., Doskovic, V., Djermanovic, V. (2010): Chemical composition of chicken meat produced in xtensive indoor and free range rearing system. *Afr. J. Biotechnol*. 10(20): 9069-9075

Brnčić, M., Karlović, S., Bosiljkov, T., Tripalo, B., Ježek, D., Cugelj, I., Obradović, V. (2008) Obogaćivanje ekstrudiranih proizvoda proteinima sirutke. *Mljekarstvo*, 58 (3): 275-295.

Chizzolini R, Zanardi E, Dorigoni V, Ghidini S. (1999): Calorific value and cholesterol content of normal and low-fat meat and meat products. *Trends Food Sci* 10 (1) 19–28.

Chuaynukool, K., Wattanachant, S., Siripongvutikorn, S. (2007). Chemical and properties of raw and cooked spent hen, broiler and Thai indigenous chicken muscles in mixed herbs acidified soup (Tom Yum). *J. Food Tech*. 5:180-186.

D'agata, M., Nuvoloni, R., Pedonese, F., Russo, C., D'ascenzi, C. and Preziuso, G., (2010).Effect ofpackaging and storage time on beef qualitative and microbial traits. *J. Food Quality* 33: 352–366.

Decker, E. A., Chan, W. K. M., Livisay, S. A., Butterfield, D. A., & Faustman, C. (1995). Interactions between carnosine and the different redox states of myoglobin. *J. Food Sci.* 60: 1201–1204.

Ebabhamiegbebho, P. A; Igene, J. O; Evivie, S. E. (2011). The Effect of Preservative Methods on the Yield, Water Content and Microbial Stability of Dairy Products. *J. Appl. Sci. Environ. Manage*. 15 (2): 265 – 271.

EFFECT OF SUPPLEMENTATION OF DIET WITH MUCUNA (*Mucuna cochinchinensis*), CASSAVA (*Manihot esculenta*) AND NEEM (*Azadirachta indica*) LEAF MEALS ON SHELF LIFE OF CHICKEN EGGS

Shaahu, D.T., * Arziki, H., Carew, S.N., & Attah, S.
Department of Animal Production, University of Agriculture P.M.B. 2373 Makurdi, Benue State, Nigeria
Helen. Arziki.*cheduhel@gmail.com* 08065598460

ABSTRACT
A 72 – day feeding trial was conducted using 240, 35week-old Lohmann® brown layer chickens, to study the effect of supplementing diet with three types of leaf meal on the shelf life of chicken eggs. The birds were grouped into 16 replicates of similar live body weight, and 4 replicates were randomly allocated to each of four treatments using the Completely Randomized Design. Treatment 1 served as control, with no leaf meal added to the diet. Treatments 2, 3 and 4 were, respectively, supplemented with 5% of leaf meal mucuna (*Mucuna cochinchinensis*), Cassava (*Manihot esculenta*) or Neem (*Azadirachta indica*). Eggs from all treatments were gathered on the same day and kept in plastic egg crates place on a wooden table in the same room at room temperature. The eggs were sampled on the same day and weekly for six weeks and analysed for yolk colour, yolk index and Haugh unit score. There was Significantly difference ($P<0.05$) for yolk colour, yolk index and haugh unit for eggs from birds fed leaf meals, with cassava leaf meal giving the best results for up to six weeks of the experimental period.

Key words: Egg-quality, Feed-additive, Leaf -Meal, Egg-shelf-life.

INTRODUCTION
Majority of people, in the world, generally like to eat eggs and foods that contains eggs, because they are not only tasty and nutritious, they are also quick and easy to boiled or cooked. Eggs contain all the essential nutrients, like protein, mineral and vitamins, in the best proportions to promote growth and good health in humans (FAO, 2011).

Efforts to boost animal protein intake in human diets must involve increased production and productivity of animals, improvements in quality of animal products and better processing and preservation techniques. This will lower animal product prices and enhance affordability and, therefore, consumption.

All foods have limited shelf life, which varies depending on the type of food and storage conditions. The egg is a very perishable food product which loses quality rapidly during the period between being laid and consumption. Egg quality is negatively affected by length of storage, and the rate of deterioration depends on environmental conditions such as ambient temperature and humidity. Storage modifies some characteristics of the egg including water content and pH of the albumen (Decuypere *et al*., 2001). Shell life of egg in the shell is 3 to 4 weeks at a temperature of 28-31°C, and that of egg white is 3 to 4 days and egg yolk is 2 to 4 days.

A wide range of supplements are added to the feeds of commercial egg production flocks. According to Slattery *et al* (2000), these materials are included to promote properties such as appearance, flavour, shelf life and to suppress the population of harmful microorganisms. Consumers, however, are becoming increasingly cautious about foods which contain artificial additives. As a result, there is an increasing interest in additives of natural origin (Balyavin and Marangos, 1988). Ingredients and additives that would be good replacements for artificial ones must not be a staple item of human food, should be readily available and inexpensive to procure.

The aim of this study is to assess the effect of mucuna *(Mucuna cochinchinensis),* cassava *(Manihot esculenta)* and Neems*(Azadirachta indica*) leaf meals, when used as feed supplements, on the shelf life of chicken eggs.

MATERIALS AND METHODS

The leaves were harvested and dried in the shade, in order to avoid bleaching of the green colour, until they became crisp. The dried leaves were milled to produce leaf meals which were mixed with other feed ingredients to produce the experimental diets (Table 1).

Table1: Ingredient and calculated nutrient composition of experimental diets (%)

	Control	MLM	CLM	NLM
Ingredient				
Maize	39.77	36.29	37.88	34.97
Maize offal	10.00	10.00	10.00	10.00
Full fat Soya bean	15.62	17.55	15.16	19.76
Brewers Dried Grains	23.70	19.18	19.98	17.82
Leaf meal	-	5.00	5.00	5.00
Bone Ash	4.95	5.05	5.11	5.01
Limestone	4.96	5.93	5.81	6.47
Premix*	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Methionine	0.35	0.36	0.37	0.36
Lysine	0.10	0.09	0.14	0.06
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrient Composition (%)				
Crude Protein	17.00	17.00	17.00	17.00
Crude fibre	5.80	7.50	7.50	7.50
Ether Extract	6.40	6.45	6.22	6.40
Calcium	3.82	3.65	4.01	4.21
Phosphorus	1.00	1.00	1.00	1.00
Methionine + cysteine	0.60	0.60	0.60	0.60
Lysine	0.80	0.80	0.80	0.80
ME (kcal/kg)	2600	2600	2600	2600

Two hundred and forty (240) 35-weeks old Lohman® brown chicken hens were used for the experiment. They were kept on deep litter in a tropical type poultry house with dwarf walls and open sides which was covered with wire mesh. The house was orientated in the east-west direction. The birds were grouped into 16 replicates of similar mean live body weight, and 4 replicates were randomly allocated to each of four treatments using the Completely Randomized Design. Treatment 1 served as control, with no leaf meal added to the diet, while the diet of birds in Treatments 2, 3 and 4 were, respectively, supplemented with 5% of the leaf meal of mucuna (*Mucuna cochinchinensis*), Cassava (*Manihot esculenta*) or Neem (*Azadirachta indica*).

Eggs for shelf life assessment were collected from all replicates on the same day and stored in plastic egg crates placed on a wooden table under room temperature (28-31°C) in the same room. Samples were taken on the same day and weekly for six weeks and analysed for yolk colour, yolk index and Haugh unit score.

Data for yolk colour, yolk index and haugh unit were subjected to analysis of variance (ANOVA) using Minitab statistical software (2006). Sets of means that were significantly different from each other were separated using Duncan's Multiply Range test.

RESULTS AND DISCUSSION

The result of estimates of internal egg quality are presented in Tables 2, 3 and 4. Internal egg quality deteriorated each week over the six weeks storage period and this was especially pronounced during the first week.

Yolk index was unaffected by treatment during all stages of storage with the exception of 2 week old eggs where it appeared that the feeding of mucuna and neem leafmeals accelerated the deterioration of yolk index.

The beneficial effects of feeding leafmeals on yolk colour and Haugh unit score were significantly ($p<0.05$) apparent at all storage stages, and cassava leafmeal always gave the best results. For yolk colour, mucuna and neem leafmeals followed in that order, with the control treatment always bringing up the rear. For Haugh unit score, for 2 weeks the leafmeals conferred better scores, with cassava leafmeal being best, mucuna and neem leafmeals tied for second place and the control bringing up the rear. From the third week to the end of the study in the sixth week the pattern was simply that of eggs from hens fed cassava leafmeal having a superior score above the others.

Table 2: Effect of Duration of Storage on Egg Yolk Colour

Duration (Week)	T_1	T_2	T_3	T_4	P	SEM
Week 0	2.30^{d}	5.05^{b}	5.90^{a}	4.50^{c}	0.00	0.17*
Week 1	3.00^{c}	5.00^{b}	5.88^{a}	5.00^{b}	0.00	0.13*
Week 2	2.13^{c}	4.63^{ab}	5.75^{a}	4.38^{b}	0.00	0.03*
Week 3	1.75^{c}	4.38^{b}	5.50^{a}	4.00^{c}	0.00	0.39*
Week 4	1.50^{c}	4.13^{b}	5.25^{a}	4.18^{b}	0.00	0.35*
Week 5	1.38^{c}	4.05^{b}	5.13^{a}	4.05^{b}	0.00	0.30*
Week 6	1.13^{c}	3.75^{b}	5.13^{a}	4.00^{b}	0.00	0.30*

^{a,b,c,} means in the same row bearing different superscripts are significantly different ($P<0.05$)

Table 3: Effect of Duration of Storage on Egg Yolk Index

Duration (Week)	T_1	T_2	T_3	T_4	P	SEM
Week 0	0.39	0.39	0.40	0.40	0.69	0.02^{ns}
Week 1	0.39	0.39	0.40	0.40	0.68	0.02^{ns}
Week 2	0.33^{a}	0.30^{ab}	0.34^{a}	0.26^{b}	0.00	0.03*
Week 3	0.28	0.25	0.28	0.24	0.20	0.03^{ns}
Week 4	0.25	0.22	0.25	0.22	0.29	0.03^{ns}
Week 5	0.21	0.20	0.22	0.18	0.31	0.03^{ns}
Week 6	0.18	0.17	0.20	0.16	0.26	0.03^{ns}

^{a,b,c,} means in the same row bearing different superscripts are significantly different ($P<0.05$)

The higher yolk colour score for eggs from birds fed leaf meals is an indication of absorption and utilization of the pigmenting xanthophylls present in the leaf meal. This is similar to what was reported by Austic and Neisheim (1990), when they supplemented layers feed with sunflower leaf meal. Mcdowell *et al* (1990) and Bailey *et al* (1989) also found that adding aquatic plants to the diets increase yolk pigmentation. A detailed chemical analysis of the leafmeals will be necessary before the reasons for the superiority of cassava over the other leaf meals could be speculated upon.

CONCLUSION AND APPLICATION

The inclusion of leaf meals, especially cassava leaf meal, improved the quality and shelf life of eggs. It is recommended that egg producers should include 5% of either cassava, mucuna, or neem leaf meal, in that order of preference, as cost and availability dictates, in the diet of their laying hens. The improvement in shelf life conferred will enable them to keep their eggs longer during periods of glut or enable them transport their eggs further afield in search of better markets.

Table 4: Effect of Duration of storage on Egg Haugh Unit (HU)

Duration (Week)	T_1	T_2	T_3	T_4	P	SEM
Week 0	93.44	96.57	93.08	95.51	0.11	2.14^{ns}
Week 1	62.07^{b}	70.62^{a}	70.62^{a}	69.23^{a}	0.00	2.75*
Week 2	60.10^{c}	66.00^{b}	69.23^{a}	67.67^{ab}	0.00	1.34*
Week 3	58.93^{b}	62.21^{ab}	64.41^{a}	59.40^{b}	0.00	1.60*
Week 4	57.28^{b}	58.04^{b}	62.59^{a}	58.19^{b}	0.00	1.52*
Week 5	50.71^{b}	50.88^{b}	55.89^{a}	51.33^{b}	0.00	1.07*
Week 6	47.50^{b}	49.06^{ab}	51.16^{a}	48.10^{ab}	0.03	1.57*

^{a,b,c,} means in the same row bearing different superscripts are significantly different ($P<0.05$)

REFERENCES

Akyurek, H., and Okur, A.A.(2009). Effect of storage time, temperature and hen age on egg quality in free-range layer hens *Journal of Animal Veterinary 8*:1953-1958.

Bailey, C.A. and Chen B. H. (1989). Chromatographic analyses of xanthophyll in egg yolks from laying hens fed Turf Bermudagrass (*Cynodondactylon*) meal *International Journal of food Science 54*(3):584-586.

Balyavin, C. and Marangos, T. (1988).The value of animal products for yolk pigmentation. In Recent Advances in poultry nutrition (eds) Cole D.J.A and Haresign W. Butterworths Press London Pp. 11-12.

Decuypere, E. K., Tona, V., Bruggeman and Bamelis, F. (2001). The day-old chick: A crucial hinge between breeders and broilers. *World's Poultry Science Journal 57*:127 – 138.

FAO, (2011). Food Security Indicators, country Profile: Nigeria.

Mcdowell, L.R., Lizama, L.C., Marion J.E. and Wilcox C.J., (1990). Utilization of acquatic plants in diet for laying hen. *Journal Poultry Science 69*:673-678.

Minitab, (2006). Minitab Statistical Software Reference Manual PC version. Release 14. Media Cybernetics, New York.

Slattery, M. L., Benson, J., Curtin , K., Ma, K.N., Schaeffer, D. and Potter, J.D. (2000). Carotenoid and colon cancer. American Journal Clinical Nutrition 71(2):575 -582.

TEACHING ANIMAL PRODUCTS IN NIGERIA: FROM MEAT SCIENCE TO TROPICAL ANIMAL PRODUCTS INDUSTRY

Sonaiya, E.B.
Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Osun State.

ABSTRACT
At the introduction of courses in animal products (AP) in Nigeria, meat science was the main focus of the training. In response to graduate unemployment and the paradigm shift to entrepreneurship, self-employment and job creation for university graduates the curriculum was expanded to include topics in economics and marketing and to emphasize the business dimension of AP. For the curriculum review to be successful there was the need to generate greater passion on the part of the teacher and the student to teach and learn, respectively, all the technical, as well as the business aspects of courses in AP. One well-tested way to generate student interest is to make textbooks available online in Open Access format that can be downloaded onto the smart phone. An Open Access e-book on the tropical animal products industry in Nigeria developed in compliance with instructional design directives evoked a higher student performance.
Key words: Teaching, Products, Course, e-book, Open-access

INTRODUCTION
In the early 1970s and 1980s, the first lecturers in animal products in Nigeria were trained in meat science (mostly in the US); for example: Professors Okubanjo (UI), Igene (UniMaid and UniBen), Sonaiya (OAU) and Aduku (ABU). Typical textbooks used and recommended were: Judkins and Keener, 1961, *Milk Production and Processing*; Lawrie, 1966, *Meat Science;* Zottola, 1972, *Introduction to Meat Microbiology*; Kramlich, et.al., 1973, *Processed Meats;* Forrest et al., 1975, *Principles of Meat Science*; Mountney, 1976, *Poultry Products Technology*; Price and Schweigert, 1978, *The Science of Meat and Meat Products*; and Frazier and Westhoff, 1978, *Food Microbiology*. By the middle to late 1980s, efforts were made to produce original textbooks that would accommodate the peculiarities of handling animal products in Nigeria. Three such texts were: Sonaiya, 1984, *Animal Products*; Ikeme, 1990, *Meat Science and Technology – A comprehensive Approach*; and Aduku and Olukosi, 1991, *Animal Products - Processing & Handling in the Tropics*. It was clear that the curriculum needed to be expanded to include topics in economics and marketing of animal products. In the same period, Taylor and Kauffman (1983) reported that the challenges facing the teaching of animal science included increased need for computer integration, improved communication skills, integration of business and economics into the livestock management systems and the approaches that will motivate students to learn and think. In Nigeria, the value chain approach to AP opens up investment opportunities in the AP industry (Sonaiya, 1998).
A hypothesis of this paper is that making textbooks available online in an Open Access format with lots of illustrations and downloadable onto the smart phone will lead to improved student performance.

MATERIALS AND METHODS
The response to changing needs for course content and student orientation must be accompanied by textbooks / instructional materials that are available online as electronic books in an Open Access format that makes access via the Internet as easy for the student as Facebook. To prepare adequate AP instructional materials requires the author to be familiar with curriculum and instructional design. In curriculum design, a course like Animal Products, as a segment of a B.Sc. / B. Agric. Animal Science (which can be visualized thus: Programme ← Courses ← Modules ← Study Units ← Sections ← Sub-Sections), must contain at least 3 modules. A module is a number of logically and thematically related study units. A study unit is the smallest segment of a course material that treats a topic which should adequately engage a learner for 3–4 hours of study. Each study unit can be viewed as an individual lecture and, depending on the topic, can be up to 25 pages (Times Roman,13-point size, single spacing) or as brief as 7 pages. The content of a typical study unit (NOUN, 2012) is shown in Table 1.

Table 1. Content of a typical study unit.

Study Unit Title:
1.0 Introduction
2.0 Objectives
3.0 Main Content
- 3.1
- 3.2
  - 3.2.1
  - 3.2.2
  - 3.2.3
- 3.3
- 3.4

4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Readings

Table 2. Content of "Tropical Animal Products Industry in Nigeria".

Module 1. Introduction to animal products, animal by-products and animal products industry
Units
1. Introduction to animal products and by-products
2. Introduction to the animal products industry
3. Products of captured, hunted and harvested free-living animals
4. Products of domesticated food animals
5. Products from other domesticated ruminants and herbivores
6. Products from insects and special animals
7. Animal fibres and inedible animal products

Module 2. Meat production and primary processing
8. Animal growth and development
9. Animal body composition
10. Primary processing systems
11. Slaughter and conversion of muscle to meat
12. Meat processing, preservation and storage

Module 3. Secondary processing, product hygiene and safety
13. Secondary processing of meat animal products
14. Processing of egg and milk
15. Animal products hygiene and inspection

Module 4. Technical and economic aspects of animal products industry
16. Distribution and sale of animals and animal products
17. Economic and social value of animal products
18. Animal products science &technology

The textbook author's role is to analyse the course description and break it into appropriate study units, write appropriate learning objectives for each unit, select relevant content to attain these objectives and design relevant questions / activities to assess learners' attainment of stated objectives. Course learning materials are to be self-instructional; i.e. to "replicate what the teacher does in the classroom". The materials must be interactive and must stimulate independent learning; should be self-explanatory, self-contained, self-directing, self-motivating and self-evaluating. Self-assessment exercises (SAE) use questions, exercises and activities to enable learners review what they have learnt and assess/evaluate themselves. Tutor-marked assignments (TMA) are needed at the end of every study unit and at the end of every module. These are short answer or essay questions, projects or practicals for students to carry out which can serve the purpose of continuous assessment (CA). Summative assessment (SA) is the end of semester examination. The content of "Tropical Animal Products Industry in Nigeria" (Sonaiya et. al. 2019), an Open Access e-book that was developed in line with instructional design directive, is shown in Table 2. The material was made available to the class via Google drive and class performance without (in the 2017/2018 session) and with the drive (in the 2018/2019 session) was recorded and charted.

RESULT

The class performance without and with The Tropical Animal Products Industry in Nigeria (TAPIN) drive is shown on Figures 1 and 2. With an enrolment of 43 students in Figure 1, 54% of the class scored less than 50% and only 2% scored 70% of the 50 marks obtainable. In Figure 2, enrolment was 51 and 0% of the class scored less than 50% while 23% scored 70% and above of the 72 marks obtainable.

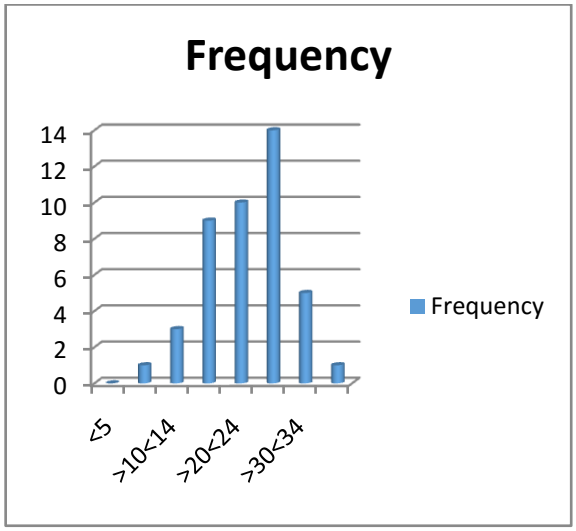


Figure 1. Class score without use of TAPIN

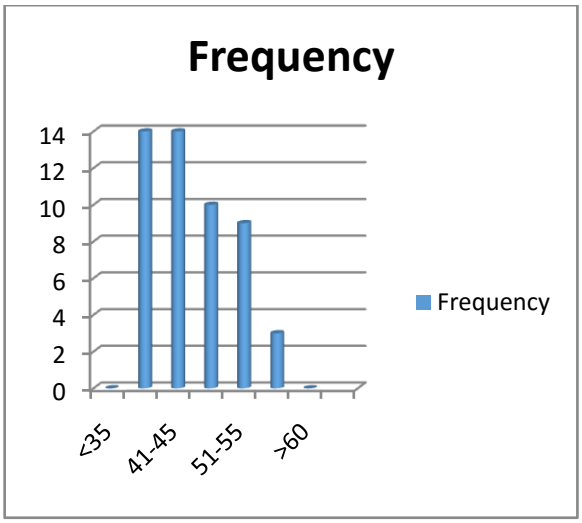


Figure 2. Class score with use of TAPIN

DISCUSSION

Animal products – meat, egg and milk – have great potential for balanced human nutrition, physical and mental development in the tropical countries of the third world. The next generation of Nigerians needs animal production scientists that are well trained and knowledgeable about the science, business, economics and politics of animal products and can leverage their knowledge to create viable businesses in "Animal Agriculture [which is] the goldmine of Nigeria's agro-revolution".

CONCLUSION AND RECOMMENDATION

In order to promote entrepreneurship in the AP industry, animal product scientists must apply the value chain approach in teaching about meat, milk and egg. To achieve this, Open Access e-books on the tropical animal products industry in Nigeria are needed. For the entire animal production science profession, a redesign of the curriculum is also recommended.

REFERENCES

Aduku, A.O. and Olukosi, J.O. 1991. *Animal Products Processing and Handling in the Tropics*. Living Books Series, GU Publications, Abuja. ISBN 978-2022-35-7.

Forrest, J.C., Aberle, E.D., Hendrick, H.B., Judge, M.D. and Merkel, R.A. 1975. *Principles of Meat Science*, W. H. Freeman & Co. San Francisco.

Frazier, W.C. and Westhoff, D.C. 1978. *Food Microbiology*, McGraw-Hill Inc., New York.

Ikeme A. I. 1990. *Meat Science and Technology: A Comprehensive Approach.* African-Fep. Publishers Limited. ISBN 978-175-259-9.

Judkins, H.F. and Keener, H.A. 1961. *Milk Production and Processing*, John Wiley & Sons, New York.

Kramlich, W.E. Pearson A.M. and Tauber, F.W. 1973. *Processed Meats*, AVI Publ. Co. Westport, Connecticut.

Lawrie, R.A. 1966. *Meat Science*, 1st Edition. Pergamon Press, Oxford.

Mountney, G.J. 1976. *Poultry Products Technology*. The AVI Publishing Co. Inc., Westport, Connecticut.

NOUN. 2011. NOUN Course Writer's Directives. Report of the implementation team for the establishment of School of Agricultural Sciences in the National Open University of Nigeria (NOUN), Victoria Island, Lagos.

Price, J.F and Schweigert, B.S. 1971. *The Science of Meat and Meat Products*. 2nd Edition, W.H. Freeman & Co. San Fransisco.

Sonaiya, E. B. 1984. *Animal Products*. Thelia House Publishers, Ile-Ife.

Sonaiya, E.B. 1998. *Energy Flux and Animal Products*. Inaugural Lecture 125, Obafemi Awolowo University, Ile-Ife, Nigeria. https://ir.oauife.edu.ng/bitstream/handle/123456789/4113/Emmanuel%20Babafunso%20Sonaiya.pdf?sequence=1&isAllowed=y

Sonaiya, E.B., Makinde, O.A. and Oyebanji, B.O. 2019. *The Tropical Animal Products Industry in Nigeria.* Reviewed by Springer Animal Sciences Editorial, Heidelberg, and Open Access publication by Syl Multimedia Ltd, Yaba, Lagos.

Taylor, R.E and Kauffman, R.G. 1983. Teaching Animal Science: Changes and Challenges. *Journal of Animal Science* Vol. 57, Suppl 2: 171-196. https://doi.org/10.2527/animalsci1983.57Supplement_2171x.

Zottola, E.A. 1972. *Introduction to Meat Microbiology*. American Meat Institute, Chicago.

Bibliography (For the next generation of textbook writers)

Clemson University. Animal Co-Products Research and Education Center. http://www.clemson.edu/public/acrec/.

CODEX ALIMENTARIUS – International Food Standards – http://www.codexalimentarius.org/

Department of Animal Product Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan. http://www.sau.edu.pk/faculties/dvm/aproduct/aproduct.html

Early R. (1998). *The Technology of Dairy Products.* (2nd ed.). London: Blackie Academic and Professional

eCow, eBeef, ePoultry etc. http://eanimalproducts.com/

Farah, Z. and A. Fischer (Editors). "Milk and meat from camel: Hand book on products and processing" http://www.camelgate.com/pdf/flyer.pdf

Federal Department of Livestock. 2008. Preliminary Report on the Survey of Slaughterhouses in Northern States and Federal Capital Territory by El-Waiy Associates. Federal Ministry of Agriculture and Water Resources, Abuja. December 2008.

Forrest J.C., Aberle E.D., Gerrard D.E., Mills W.E., Hedrick H.B., Judge M.D. Merke R.A. (2001). *The Principles of Meat Science.* (4 ed.) U.S.A.: Kendall/Hunt Publishing Company.

HACCP. Hazard Analysis Critical Control Point. Food Safety. http://www.standards.org/standards/listing/haccp

Heinz G. and Hautzinger, P. (2007). *Meat Processing Technology: For Small- to Medium-Scale Producers.* Food and Agriculture Organization, Bangkok

Mann, I. 1962. Animal Byproducts: Processing and Utilization. FAO, Rome.

Merkel R. A. (2001). The Principles of Meat Science. (4 ed.) U.S.A.: Kendall/Hunt Publishing Company.

Mian N Riaz, Riaz N Riaz, Muhammad M Chaudry. *Halal Food Production*, CRC Press, 2004. ISBN 1-58716-029-3

NLS and MB. Pork Industry Group, 1977. Hog is Man's Best Friend. Monograph.

Nwanta, J.A, J.I. Onunkwo, V.E Ezenduka, P.O Phil-Eze and S.C Egege. 2008. Abattoir operations and waste management in Nigeria: A review of challenges and prospects. S*okoto Journal of Veterinary Sciences* 7(2): 61-67.

Ockerman, Herbert and Hansen, Conly L. *Animal By-product Processing & Utilization*. Technomic Publishing Company Inc., 2000.

Ogbuewu, I.P., V.U. Odoemenam, A.A. Omede, C.S. Durunna, O.O. Emenalom, M.C. Uchegbu, I.C. Okoli, M.U. Iloeje. 2012. Animal waste and its impact on the environment. Scientific Journal of Review Vol 1, No 2 (2012). http://www.sjournals.com/index.php/SJR/issue/view/21

Packaging of fresh and processed meat. http://www.fao.org/docrep/010/ai407e/AI407E21.htm

Poltava State Agrarian Academy, Ukraine. Technology of Production and Processing of Animal Products Department. http://www.pdaa.edu.ua/eng/content/technology-production-and-processing-animal-products-department

Porter, J.W.G. 1975. Milk and Dairy Foods. Oxford University Press

Price, M.A. 1980. Lecture Synopsis for Animal Science 380 – Livestock Growth and Meat Production. University of Alberta, Canada.

Processed meat 'early death' link. James Gallagher, Health and science reporter, BBC News http://www.bbc.co.uk/news/health-21682779 accessed 12/07/2013

Robinson R. K. (2002). *Dairy Microbiology Handbook. (*3rd ed.) New York: Wiley-Interscience, A John Wiley & Sons, Inc., Publication Tetra Pak Processing

Roman, J.R. and P.T. Ziegler. 1974. The Meat We Eat. 10th Edition.

Ryan A. Meunier, R.A. and Latour, M.A. Commercial Egg Production and Processing**,** Department of Curriculum & Instruction and Department of Animal Sciences, Purdue University. http://ag.ansc.purdue.edu/poultry/publication/commegg/ accessed 25.06.2013

Ryoba, R. and R.L. Kurwijila. Milk processing requirements for satisfying the demand for various dairy products in Tanzania http://www.fao.org/docrep/X5661E/x5661e0o.htm accessed 22/07/2013

Salimonu Company Nigeria Ltd; a Meat processing company in Nigeria. http://www.salimonu.com/product_meat.php

Shallo, P.L. 1987. Pastoral Methods of handling and preserving milk. In: *Dairy Development in E. Africa. Proc. IDF Seminar*, Nairobi 9-13 IDF/FIL Bull. 221.

Swatland, H. J. (1995). On-line evaluation of meat. USA: Technomic Publishing Company, Inc.

Temple Grandin. 1993. "Teaching Principles of Behaviour and Equipment Design for Handling Livestock". *J. Anim. Sci*. J. Anim. Sci. Retrieved 2012-12-10.

The technology of traditional milk products in developing countries. III Level of Processing. Southern and Eastern Africa. www.fao.org/docrep/003/t0251e/T0251E03.htm accessed 22/07/13

Vowles, W. J., and T. J. Hollier. 1982. The influence of yard design on the movement of animals. Proc. Aust. Soc. Anim. Prod. 14:597.

Wehr, H. M., and Frank, J. H. (2004). *Standard Methods for the Examination of Dairy Products.* (17th Ed.) Washington, DC: American Public Health Association

Wroclaw University of Environmental and Life Sciences, Hungary. Department of Animal Products Technology and Quality Management. http://www.up.wroc.pl/research/9347/departament_of_animal_products_technology_and_quality_managment.html

SURVEY OF CHEESE PRODUCERS IN OYO TOWN, OYO STATE, NIGERIA

***Okunlola, O. O. & Akindele W. O.**
Department of Agricultural Education, School of Vocational and Technical Education, The College of Education, Lanlate
Corresponding author:*greenfields2012@gmail.com

ABSTRACT
Cheese production in Oyo town is presently at a subsistence level and the producers are not well organized and employ mostly the traditional method of production of the snack. This study was aimed at collecting vital statistics that may help attract the attention of the concerned authorities to cheese producers, not only in Oyo town, but in Oyo state in general. Snowball sampling of the producers were employed and a total of twenty cheese producers were reached with interview schedule covering vital aspects like their bio data and cheese production activities. The results obtained show that all the respondents were female traders. Also, majority of them (75%) were within the age range of 20-39 years and married. All the respondents sourced their milk from cow while 45% and 35% of them used 20-29litres and 30-39litres of milk for production during the rainy and dry seasons respectively. Lack of capital to expand the business (40%) and inappropriate pricing of the product (25%) were major problems faced by the respondents. The study also revealed that all the respondents agreed that cheese production is profitable with majority of the making a profit ranging from 100-1000 naira and 1,100- 2000 naira during the dry and rainy seasons, respectively.
Key words: *cheese producers, Oyo town, production characteristics, production challenges, production finances*

INTRODUCTION
Cheese is a word derived from a Latin word *caseus* which translates, to ferment. It is also derived from the ancient English word *chese*, meaning "product derived from sour milk." Cheese is a hard consumable by-product of milk which is made by coagulating milk into solid form (Miaschi, 2017). Cheese is produced basically from milk, coagulant (animal or plant based enzyme) and salt.

About 20 million MT of natural cheeses was produced globally in 2011 and Cheese from cow´s milk accounts for above 80% of the global natural cheese production. Other sources of milk for cheese production include sheep, goat, and buffalo. Europe and Northern America produce more than 75% of the world cheese production (PM Food & Dairy Consulting, 2014). The North America and Europe are seen as major contributors to the global cheese production with their market share of not less than 75%. It was estimated that there were about 2000 varieties of cheese globally (OÃ¢Â Â™Connor, 1993, as cited by Orhevba and Taiwo, 2016). Cheese is mainly produced in Nigeria by the spouses of the Fulani nomads, which, apart from creating a variety into which milk is consumed, also serves the purpose of preserving excess milk produced due to poor storage facilities (Orhevba and Taiwo, 2016). It's been observed that culture greatly influences milk and milk products consumption in Africa (Ndambi *et al.*, 2007).

The study was carried out in Oyo town which has three Local Government Areas namely, Oyo East, Oyo West and Atiba. The town is the fourth largest in Oyo state and has an area of 1,757km2 and a population of 168,246 according to the 2006 census. The actual sampling was carried out in Akesan market, which was the largest and most cosmopolitan market, in terms of those who patronize it, in Oyo town. Snowball sampling technique was adopted in the study area. A total of 20 interview schedules were administered on the respondents. Information such as socio-economic characteristics, cheese production and cheese production finance were elicited from the respondents. Collected data were processed and subjected to descriptive analysis using frequency counts and percentages.

Result and discussion

Table 1: Bio data of cheese producers in the study area

Item	Criterion	No.	%
Gender	Female	20	100
Marital status	Single	02	10
	Married	15	75
	Separated	03	15
Age (years)	20-39	15	75
	40-59	05	25
Religion	Islam	12	60
	Christianity	06	30
	Traditional	01	05
	Atheist	01	05
Occupation	Trader	20	100
Household size	Below 5	09	45
	5-9	07	35
	10 above	04	20

Table 1 above shows the bio data of respondents in the study area. From the table, it was observed that all of the cheese producers were female traders. This signified that the business of cheese production was regarded as one for the womenfolk and that the producers engaged in cheese trading as a source of income. Also, majority of the respondents were between the age range of 20-39 years (75%), married (75%) and had household size below 5 (45%). The age range signified that the respondents were in their youthful age while the small household size was an indication that family labour was most probably not adopted in the production of cheese. Although, majority of the producers were Muslims (60%), the result obtained shows that other religions, including atheism were represented amongst the cheese producers. This was an indication that there was no religious discrimination against cheese production in the study area.

Table 2: Cheese Production in the study area

Item	Criterion	No.	%
Source of your milk	Cow	20	100
Volume (liters) of milk used in cheese production during dry season	10-29	13	65
	30-59	07	35
Volume (liters) of milk used in cheese production during raining season?	10-29	12	60
	30-59	08	40
Method of production	Traditional	20	100
Benefits of cheese production	Source of food	07	35
	Source of income	06	30
	Body development and freshness	06	30
	Source of strength	01	5
Challenges of cheese production	Lack of capital to improve the business	08	40
	Poor road network to transfer raw milk from farm	01	5
	Inappropriate market pricing	05	25
	No problem encountered	07	30
How do you feel the problem can be solved?	Provision of soft loan from government	06	30
	Membership of co-operative societies	12	60
	Good road infrastructure for transporting raw milk	08	40
Any assistance from government?	No	20	100

Table 2 above shows data on cheese production in the study area. Data from the table shows that the respondents' only source of milk was from cow and they all employed the traditional method of cheese production. Also, the average litre of milk used for production in the dry season was within the range 20-29 litres (45%), while the average used during the rainy season was within the range 30-39 (35%). Also, the average worth of cheese that a litre of milk could produce was ₦200 (55%) and majority (40%) of them claimed that capital was the major problem facing cheese production. Also, majority of the respondents claimed the problems facing them could be solved by making funds available for them. However, all the respondents claimed that cheese production was profitable during both dry and rainy seasons. The main benefits of production of cheese were income (30%) and food source (35%) and the average profit range during dry season was ₦600-1000 (70%), while the average profit during rainy season was within the range ₦1100-2000 (70%).

Table 3: Cheese production finance in the study area

Item	Criterion	No.	%
Is cheese production profitable?	Yes	20	100
Litre price of milk (₦) during dry season?	100	10	50
	150	9	45
	200	1	5
Litre price of milk (₦) during raining season?	100	8	40
	150	9	45
	200	3	15
On the average, how much worth (₦) of cheese can a litre of milk produce?	150	6	30
	200	11	55
	250	1	5
Profit (₦) per day from cheese during dry season?	100-1000	14	70
	1100-2000	4	20
	2100-3000	2	10
Profit (₦) per day from cheese during raining season?	100-1000	7	35
	1100-2000	13	65

Table 3 shows the financial implication of cheese production in the study area. From the table, all the respondents claimed that cheese production was profitable. It was also observed, from the table, that the average cost of a litre of milk was ₦100 (50%) and ₦150 during the rainy and dry seasons, respectively. The result from the table also shows that, on the average, a litre of milk produced ₦ 200 worth of cheese and the average profit range for the cheese producers per day were ₦100-1000 and ₦1,100-2,000 during the dry and rainy seasons respectively.

CONCLUSION AND RECOMMENDATIONS

The result from the study shows that young, married women were engaged in cheese production in the study area. It was also observed that there was no religious bias against the production of cheese in the study area as the various religious groups were represented amongst the producers. Also, cheese production was considered profitable by the producers and the major problems militating against the business were capital to expand their businesses and inappropriate pricing of their products by the retailers. It is therefore recommended that the appropriate authorities should make soft loans available to the producers in order to enhance their businesses. Also, the producers should organize themselves into cooperative units in order to easily access loans and work against the inappropriate pricing of their products by the retailers and unit buyers.

REFERENCES

Miaschi, J. (2017). Countries who eat the most cheese. WorldAtlas. www.worldatlas.com/articles/countries-who-consume-the-most-cheese.html. Accessed on 09/08/2019.

Orhevba, B. A. and Taiwo, A. D. (2016). Comparative assessment of wara (local cheese) produced using three natural additives as coagulants. *Journal of Food and Dairy Tech*.

PM Food & Dairy Consulting (2014). World cheese market 2000-2020. www.pmfood.dk/upl/9735/WCMINFORMATION.pdf. Accessed on 20/11/2019.

Preben M. ( ). World cheese production Special focus on Asia and the Middle East, PM Food & Dairy Consulting. www.mfood.dk/upl/9739/CHEESEARTICLE1.pdf. Accessed on 05/01/2020.

PRELIMINARY STUDY ON CHEESE CONSUMPTION PATTERN AMONGST RESIDENTS OF OYO TOWN, OYO STATE, NIGERIA

Okunlola, O. O.
Department of Agricultural Education, School of Vocational and Technical Education,
The College of Education, Lanlate
greenfields2012@gmail.com

ABSTRACT
Cheese is a popular snack that is eaten by many in Oyo town of Oyo state. However, the preferences of consumption in terms of quantity, benefits and disadvantages of consumption were different in the study area. A total of 100, respondents were randomly selected from whom information such as socio-economic characteristics and consumption pattern of cheese were elicited. Structured questionnaires were used to elicit information from the respondents. A multistage sampling was adopted with the study area divided into three in the first stage while 30 questionnaires were administered to respondents in Oyo East and Oyo West LGAs each and 40 in Atiba LGA. Collected data were processed and subjected to descriptive analysis using frequency counts and percentages. The results indicated that majority of the cheese consumers were male (58%) and within the age range of 40-59 (40%). Also, majority of the respondents were traders (46%) and with a household 6-10 (40%). The results also showed that majority (38%) of the respondents consumed cheese at least once per week. All the respondents also stated that cheese consumption had benefits which included good nutrition (96%) and good flavour (4%). Also, 10% of the respondents indicated that cheese consumption had some disadvantages which included, body hitching (40%) and cough (20%).
Key words: *cheese consumption, consumption benefits, consumption disadvantages, Oyo town*

INTRODUCTION
Milk, from which cheese is obtained, is the first natural food of all mammals as it contains vital nutrients for the sustainability especially at infancy, although adult humans consume processed milk in various forms (Adewumi et al., 2001). It is an important element of the pastoral civilizations in Africa, where it serves economic, social and cultural purposes (Mattiello *et al.*, 2018). A 2016 report by FAOSTAT showed that Africa produced 46,907,955 millions tonnes of milk which accounted for only 6% of world average production. The same report indicated that about 50% of total milk production in Africa were produced by six countries, Sudan (4,391,000 tonnes), Egypt (5,598, 477 tonnes), kenya (4,925,692 tonnes), Ethiopia (3,699,373 tonnes), South Africa (3,337,018 tonnes) and Algeria (4,241,414 tonnes). The report also put dairy cows as the highest milk suppliers with 74.05% of the world's total production, followed by goat (8.74%), buffalo (6.23%), camel (5.76%) and sheep (5.23%).
Cheese is a dairy product derived from milk that is produced in a wide range of flavours, textures and forms by coagulation of the milk protein casein (Encyclopedia Wikipedia, 2019). It is a major source of animal protein especially in rural communities (Akintunde *et al.*, 2010) and mostly processed by Fulani women, especially in this part of the world with the adoption of traditional method of production (Awoyele *et al.*, 2014). Cheese, commonly called *wara* or *warankasi* in Nigeria, is of soft type and so has poor shelf-life and mostly produced by the local Fulani women through the coagulation of milk induced by juice extract from the leaves of Sodom Apple plant (*Calotropis procera*) which contains enzyme calotropain (Iwuoha and Eke, 1996). Cheeses are mostly consumed by residents of the temperate countries with the first four highest consumers in terms of per capita consumption being Denmark (28.1 kg), Iceland (27.7 kg), Finland (27.3kg) and France (27.2kg) (Miaschi, 2017). The objective of the study was to determine the consumption pattern of cheese in Oyo town, Oyo state, Nigeria. Vital statistics considered were the biodata of respondents and cheese consumption in general.
The study was carried out in Oyo town which has three Local Government Areas (LGAs) namely, Oyo East, Oyo West and Atiba. It has an area of 1,757km2 and a population of 168,246 according to the 2006 census (FRN, 2009). Oyo town is highly cosmopolitan having people from various parts of the country living there. Also, it is a transit route from the south, to the north and vice versa making it have influx of people from time to time. Multistage sampling method was adopted. The study area was divided into three, on LGAs basis in the first stage while the second stage had 30 structured questionnaires purposively distributed to respondents in Oyo West and Oyo East LGAs and 40 in

Atiba LGA making a total of 100. Information such as socio-economic characteristics and consumption pattern of cheese were elicited from the respondents. Collected data were processed and subjected to descriptive analysis using frequency counts and percentages.

RESULTS AND DISCUSSION

Table 1: Bio Data of Cheese Consumers In The Study Area

Item	Criterion	No.	%
Sex	Male	58	58
	Female	42	42
Marital status	Single	50	50
	Married	40	40
	Separated	6	6
	Divorced	4	4
Age (years)	Below 20	28	28
	20-39	28	28
	40-59	40	40
	60 above	4	4
Religion	Islam	56	56
	Christianity	38	38
	Traditional	6	6
Occupation	Student	24	24
	Civil servant	8	8
	Trader	46	46
	Farmer	4	4
	Jobless	18	18
What is your household size?	Below 5	32	32
	5-9	40	40
	10 above	28	28

Table 1 above shows the bio data of respondents in the study area. From the table, it was observed that majority of the cheese consumers were male (58%), single (50%) and within the age range of 40-59 (40%). It can be deduced that the single males took cheese as a nutritious replacement for main menu, as some may find it difficult to cook. This result was in alignment with the results obtained by Adeosun (2018) who reported an age range of 21-30 for dairy products consumers in Iwajowa LGA of Oyo. Also, majority of the respondents were traders (46%) with household size that ranged between 5 and 9. Being traders, the respondents spent most of their daytime in the vicinity where cheeses were sold thereby making it easy for them to purchase. Regarding religious beliefs of the respondents, 56% of them were Muslims, 38% Christians and 6% traditionalists. This implies that there was no religious bias against cheese consumption in the study area.

Table 2: Cheese Consumption Pattern In The Study Area

Item	Criterion	No.	%
How often do you eat cheese?	Daily	20	20.00
	Weekly	38	38.00
	Monthly	08	08.00
	Once in while	34	34.00
What time of the day do you like to eat cheese?	Morning	36	36.00
	Afternoon	46	46.00
	Night	18	18.00
Reasons for afternoon purchases (n= 46)	Fresh	23	50.00
	Availability	20	43.48
	No reason	03	06.52
Any benefit of cheese consumption?	Yes	100	100.00
Benefits of cheese consumption	Good for health	96	96.00
	Good flavour	4	04.00
Any disadvantage of cheese consumption?	Yes	10	10.00
	No	90	90.00
Disadvantages of cheese consumption	Body itching	4	40.00
	Eye problem	2	20.00
	Cough	2	20.00
	Vomiting	2	20.00
Where do you buy your cheese?	Car parks	34	34.00
	Mobile retail seller	14	14.00
	Market	20	20.00
	By the road side	28	28.00

Table 2 shows the information about cheese consumption in the study area. Data obtained from the table show that majority of the respondents consumed cheese at least once per week (38%), purchased it at carparks (34%). All the respondents also concluded that cheese has health benefits although 10% of them also claimed that cheese consumption has side effects, which included allergies like body hitching (40%), cough (20%) and vomiting (20%). Benefits derivable from cheese consumption, according to the respondents, were good nutrition (96%) and good flavor (4%). Also, majority of the respondents liked to eat cheese in the afternoon (48%) and the reasons adduced for this were freshness (50%) and availability (43.48%).

CONCLUSION AND RECOMMENDATIONS

The study revealed that there was no religious bias against cheese consumption in the study area. Also, it was revealed that many of the residents of the study area consumed cheese that were worth between 200 to 290 naira weekly and mostly in the afternoon because of their desire for freshness of the product. Cheese consumption was considered to be of great benefits to health due to its nutritive values. However, some of the consumers of cheese reported allergies to the consumption which included, body hitching and vomiting. It is recommended that more awareness on the health benefits of cheese consumption be done by the concerned authorities so that the populace may live a more productive life.

REFERENCES

Adeosun, A. (2018). Dairy Products Consumption Pattern and Consumers' Perception of Milk from Small Ruminants in Iwajowa Local Government Area of Oyo State. *Greener J. of Agric. Sc.*, 8(11): 310-316, http://doi.org/10.15580/GJAS.2018.11.061118081.

Adewumi, O. O., Ologun, A. G. and Alokan, A. J. (2001). Sensory evaluation and marketability of sheep milk in Akure. *J. Agric. for Fish*. 2:5-7

kintunde, T. I., Bisi-Johnson, O., Besong, P. O, Enwe, Okoli P. N., Uaboegbenni, P. O. (2010).

Proximate Analysis and Microbiological Quality of Cheese Produce from Raw Cow milk obtained from Fulani settlement in Ogun State Nigeria. Using Acid Bacterial and Extract from Sodom Apple Leaf calotropis. *J. of Nutri. Pakistan*. 9(9): 920-925.

Awoyele, A. A., Adekunle, A. J., Ajunwa, O. M., Cadmus, S. B. (2014). Mini Review: Theoretical and Onsite Evaluation of Hazard Potential in the Local Production of Wara: An Indigenous Africa soft cheese. *British Microbiol. Res. J.* 3(3): 218-233.

Encyclopedia Wikipedia (2019). Cheesemaking. Https://en.wikipedia.org/wiki/Cheesemaking. Accessed on 14/12/2019.

FAOSTAT (2016). Food and Agriculture Organization of the United Nations. Statistics Division. http://faostat3.fao.org/home/E. Accessed on 24/12/2018.

Federal Republic of Nigeria (2009). Legal notice on publication of 2006 census final results. *Federal Republic of Nigeria official gazette*. 96.

Iwuoha, C.I. and Eke, S.O. (1996). Nigerian Indigenous Fermented Foods, Their traditional process operation, inherent problems, Improvements and current status. Food Res. Int. 29: 527 -540

Mattiello, S., Caroprese, M., Matteo, C. G., Fortina, R., Martini, A., Martini, M., Parisi, G., Russo, C., Zecchini, M. & ASPA Commission (2018). Animal Productions in Development Cooperation Projects" Typical dairy products in Africa from local animal resources. *Italian J. of Animal Sc.* 17:3, 740-754, DOI: 10.1080/1828051X.2017.1401910

Miaschi, J. (2017). "Countries Who Eat the Most Cheese." WorldAtlas, Dec.12, worldatlas.com/articles/countries-who-consume-the-most-cheese.html.

EFFECT OF FRYING TIME ON PROXIMATE AND ORGANOLEPTIC PROPERTIES OF BEEF FRIED WITH SHEA BUTTER OIL

[1]Oyinlola, O.O, [2]Oshinbanjo, D.O, [1]Okunlola, O.O
[1]Department of Animal Health and Production, Oyo State College of Agriculture and Technology, Igboora, Oyo state
[2]Department of Animal Production, Faculty of Agriculture, University of Jos, Jos, Plateau State.
Corresponding author: oyinlolaopeyemi77@gmail.com , Telephone: 08034278434

ABSTRACT
The effect of frying time on proximate and organoleptic properties of beef fried with Shea butter oil was investigated. The meat type was purchased from Abattoir in Igboora 45 minutes after slaughtering, chilled and transported to the meat laboratory. The meat type was cut into 3 – 4 cm length, washed with distilled water, then boiled for 30 minutes with other ingredients and later fried with Shea butter oil at different frying time of 10 minutes, 15 minutes and 20 minutes in a completely randomized design. The fried meat was subjected to proximate and organoleptic analysis. Crude protein was significantly higher in 15 minutes frying time with least at 20 minutes frying time. Although, there was no significant different in ash, ether extract and crude fibre but 20 minutes frying time had the least values. 10 minutes frying time had the highest moisture content while 20 minutes frying time had the lowest. The highest colour, juiciness and texture was recorded in 20 minutes frying time while flavor, tenderness and overall acceptability was higher in 10 minutes frying time. In conclusion, in terms of proximate analysis, 15 minutes frying time was well favored while 10 minutes frying time was well favored in organoleptic evaluation.

Keywords: Beef , Bull, Shea butter oil, Organoleptic, Proximate, distilled water

INTRODUCTION
Beef is the culinary name for a meat from cattle. Beef can be harvested from bulls, cow, heifers, or steers is acceptability as a food source varies in different parts of the world. Beef Muscle meat can be cut into roasts, short ribs or steak (Field mignon sirlion steak, hanger steak e.t.c), some cuts are processed (corned beef or beef jerky) and trimmings, usually mixed with meat from older, learner cattle, or used in sausages. The beef can be boiled, grilled and fried. The oils can be used to fry beef such as olive oil, groundnut oils, soya oil and shea butter oil.

Shea butter is the fat extracted from the nut of the African Shea tree (*Vitellaria paradox*). It is usually yellow in color when raw, with unrefined, refined and ultra-refined Shea butter being ivory or white in color. Shea butter is a triglyceride (fat) derived mainly from stearic acid or oleic acid. It is widely used in cosmetics as a moisturizer, salva or lotion. Shea butter is edible and is used in food preparation in some African countries. Occasionally, the chocolate industry uses Shea butter mixed with other oils as a substitute for cocoa butter, although the taste is noticeably different.
The aim of this study is to assess the best frying time on proximate and organoleptic analysis of fried beef using shea butter oil.

MATERIALS AND METHODS
Experimental Site
The experiment was carried at the Department of Animal Production Technology of Oyo State College of Agricultural and Technology, Igboora, Oyo – State.

Materials and Equipment
Meat type (Beef), Onion, star anise, shea butter, distilled water, charcoal, salt, maggi, garlic, Ginger, and Black pepper.

Meat Preparation

Meat type (Beef) was purchase from Igboora Abattoir 45 minutes after slaughtering, chilled and transported to the meat laboratory at Oyo State College of Agriculture and Technology Igboora. All bones were removed and the fleshy part was washed and rinsed with distilled water. Meat type was washed and cut into chunks around 3 – 4cm and put in the pot, ingredients such as Maggi, garlic, ginger, coriander, star-anise, were added and cooked for about 30 minutes. Shea butter was melted to oil and the meat was fried with the oil at different frying time of 10 minutes, 15 minutes and 20 minutes in a completely randomized design.

Taste Panel Evaluation

A taste panel was set up consisting of 20 peoples to determine the organoleptic properties of the meat (beef) fried with shea butter oil using a nine point Hedonic scale. Parameters evaluated are:
Taste, Flavor, Colour, Juiciness, Texture, Acceptability

Statistical Analysis

Data obtained was subjected to analysis of variance and the mean value showing significant difference ($p<0.05$) was separated using Duncan's multiple range test (Duncan 1995)

RESULTS

Crude protein was significantly higher in 15 minutes frying time with least at 20 minutes frying time. Although, there was no significant different in ash, ether extract and crude fibre but 20 minutes frying time had the least values. 10 minutes frying time had the highest moisture content while 20 minutes frying time had the lowest.

Table 1: the proximate composition of fried meat at different time using shea butter oil

Parameters	10 minutes frying	15 minutes frying	20 minutes frying	SEM
Crude protein	60.34b	70.09a	56.18c	2.08
Ash	2.98	3.52	2.65	0.32
Ether extract	10.28	9.96	8.9	0.36
Crude fibre	0.02	0.01	0.02	0.00
Moisture content	15.92a	10.96b	14.88b	0.81

Figure 1 shows the Organoleptic Properties of Beef fried with Shea butter. The highest colour, juiciness and texture was recorded in 20 minutes frying time while flavor, tenderness and overall acceptability was higher in 10 minutes frying time. In conclusion, in terms of proximate 15 minutes frying time was well favored while 10 minutes frying time was well favored in organoleptic evaluation.

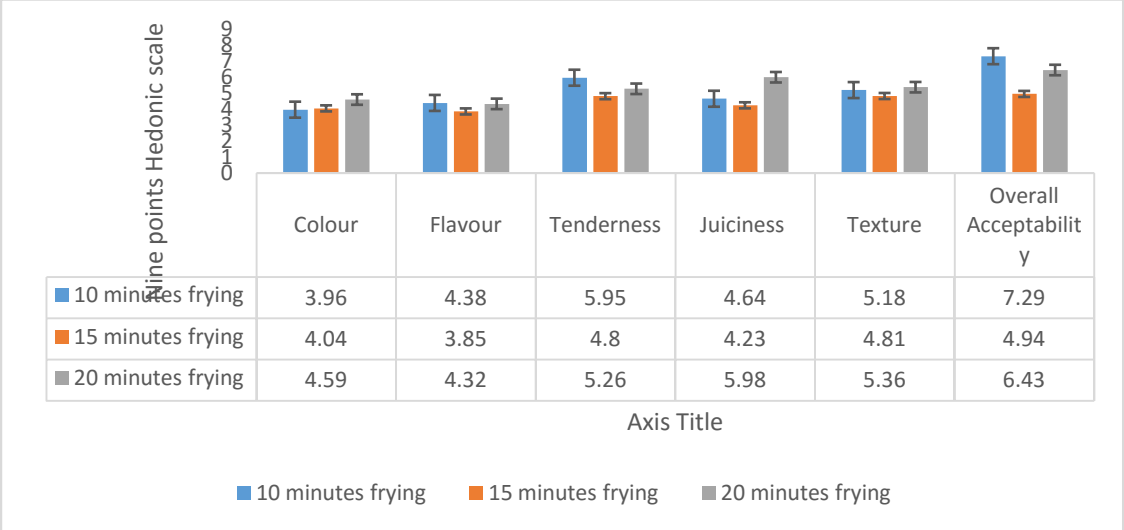


Figure 1: Sensory evaluation of fried meat at different time using shea butter oil

DISCUSSION

The Crude protein Content result obtained could be due to interaction of protein molecules (action and myosin) in meat to form actionomysin Complex and increases myofibrila Proteins which have been covered by denatured Sarcoplasmic protein. Although, there was no significant different in ash, ether extract and crude fibre but 20 minutes frying time had the least values. The result obtained for the moisture content could be as a result of frying time that affected the moisture retained in the meat (Kassama and Ngadi, 2004).

The Organoleptic Scores Showed that most of the parameters were not statistically different. The higher Colour was recorded in T_3. Swan (1993) revealed that colour intensity depends on the way the incident light is absorbed or Scattered and this is influenced by P^H. The highest juiciness score was recorded in Treatment 3. It is directly related to the intramuscular lipid and moisture intent of the meat (Cross *et al.*, 1986). Treatment 1 was more tender, tenderness is known to be the most important sensory attributes that affect meat acceptability (Quali, 1990). The highest flavour attribute was also recorded in Treatment 1 although the value was not significantly different from other treatments. Meat Flavour had taste and aroma as components (Warris, 2000).

CONCLUSION AND RECOMMENDATION

In conclusion, in terms of proximate, 15 minutes frying time was well favored while 10 minutes frying time was well favored in organoleptic evaluation. It is recommended that Shea butter oil can be used in frying meat. Further research should be carried out on the use of Shea butter oil in frying for preservation of meat.

REFERENCES

Cross, H. R., J. W. Savell and J. Francis, (1986). National Consumer retails Beef study. Proceedings, 38th Annual Reciprocal Meat Conference, 39:112-114.

Duncan, G. B. (1995) Duncan Multiple Range test. Biometric 11:1 – 42

Kassama, L. S. and Ngadi, M. O. (2004) Pore Development in Chicken Meat during Deep-fat Frying. LWT Food Science and Technology, 37, 841-847

Quali. A., (1990): Post Mortem Changes in Muscle Tissues. *J. Muscle foods, 1:129-134.*

Swan, J. E. (1993): p^H variability in muscles; a literature review. Meat industry Research Institute of New Zealand. 935: Pp 1-40.

Warriss, P. D, (2000). Meat Science: An introductory text. Cab- international, Cambridge University press, Cambridge, Pp: 1-223.

EFFECT OF PACKAGING MATERIALS AND STORAGE LENGTH ON OXIDATIVE RANCIDITY AND SENSORY EVALUATIONOF *BALANGU* READY-TO-EAT MEAT

Ribah M. I.*[1], Jibir M. [2] and Jega I. S.[3]

[1]*Department of Animal Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, PMB 1144 Birnin kebbi, Nigeria.*

[2]*Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, PMB 2346, Sokoto, Nigeria.*

[3]*Department of Forestry and Fisheries, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, PMB 1144 Birnin kebbi, Nigeria.*

**Corresponding author: ibrahim.ribah73@gmail.com*

ABSTRACT

A study was conducted to evaluate the influence of packaging materials and storage period on Storage stability (Thiobarbituric Reactive Substances), Appearance and ordor of *balangu* RTE-MP in a 3×4 factorial arrangement involving three packaging materials (aluminium foil, kraft paper and polyethylene film) and four storage length (0 , 24, 48 and 72 hrs) in a completely randomised design. Packaging materials and storage period had significant effect (P<0.05) on the Thiobarbituric Reactive Substances (TBARS), appearance (colour) and odour of *balangu* samples (Table 1). The TBARS value was significantly higher in samples packaged in polyethylene film than aluminium foil packaged samples, which was higher than samples packaged in paper. Appearance was scored significantly higher by paper packaged samples than aluminium foil packaged samples which did not differ significantly with paper and polyethylene film packaging, but higher than polyethylene film packaged samples. Similarly, samples packaged in paper had scored significantly higher than aluminium foil and polyethylene film which did not differ significantly. At storage, TBARS values, appearance and odor score increased from control with increase in storage period. There was also a significant interaction (P<0.01) between packaging materials and storage period on all the parameters measured after the storage period.The study concluded that the favourable combination of packaging material and storage length that could optimize storage stability, appearance and odor of *balangu* could be packaging in kraft paper or aluminium foil and utilized within up to 24 hrs of post-production.

Keywords: Packaging, Storage Length, Storage Stability, Appearance, Odour, *Balangu*,

INTRODUCTION

According to Adejumo and Ola (2008), in Nigeria there are diverse and numerous types of locally produced Ready-to-eat foods sold in public places for immediate consumption, and the packaging used for these foods is traditionally meant for take away, with little or no attention paid to the safety of the consumers and the shelf-life of the food. Furthermore, the hygienic state of the packaging materials and their appropriateness for the food products are not considered in their selection. Almost all the food products packaged by the local processors and vendors of Ready-to-eat meat products RTE-MPs in Nigeria are unlabeled. No indication is given of the names of the products, their sources, composition nor any information on appropriate storage conditions and instructions for use. Consequently, the role of packaging in the food industry, which includes protection, containments, transportation, preservation and advertisement are not achieved by most of the packaging materials and methods used by street food vendors in Nigeria. This in turn results in a huge loss of the food product not only during packaging processes but also during transportation and sales as a result of contamination by food spoilage microorganisms, dust and chemical contamination (Adejumo and Ola, 2008).

In Nigeria, RTE-MPs are widely produced and consumed with little or no due inspection. The highest regulatory body responsible for food safety, the National Agency for Food and Drugs Administration and Control (NAFDAC) is only concerned with pre-packaged foods in the registered companies. Little or no attention is paid to the control and or inspection of the local industries of RTE-MPs production where there is almost complete noncompliance with safety guidelines for the production of the RTE-MPs. This situation could place the consuming population at high risk of infection by foodborne pathogens which could be present in the RTE-MPs as a result of unhygienic processing,

handling, packaging and or storage. Abubakar *et al.* (2011) reported that appropriate and affordable technologies that are simple, cheap and effective in processing and preserving animal products must be sought and evaluated. Little or no attention is paid to the processing and packaging technics and there is scanty information concerning evaluating effectiveness of post-lethality packaging treatments that will allow products to be held for a shorter period of time without proliferation of bacteria. It is based on this that this research was designed, to conduct a study to compare packaging materials and storage period for physico-chemical, storage stability and sensory characteristics of balangu.

MATERIALS AND METHODS

The study was conducted in Kebbi and Sokoto States, North-West region of Nigeria. This study investigated the influence of packaging materials on storage stability, and sensory characteristics of *balangu*.

Experimental design

This study consisted of three packaging materials: Aluminum foil (ALF), kraft paper (KPA) and polyethylene film (PEF) with four storage times (0, 24, 48, and 72 hours). A total of twelve treatment combinations were obtained in a 3×4 factorial experiment involving three packaging materials and four storage periods in a completely randomized design.

Preparation of samples, packaging materials and packaging

The packaging materials used for the experiment were purchased from metropolitan supermarkets and processed according to required dimensions. A package consisted of a sheet of a material with the dimension of 25×25cm^2. *Balangu* was prepared from sliced beef in a portable drum kiln specifically designed to process the product under good hygienic condition. The sliced beef was placed on a brown craft paper sheet that has been spread over the wire mesh two feet above glowing fire from firewood. After two hours with regular turning interval of 15 minutes, *balangu* was produced. After gradual cooling for 30 minutes in the kiln, a clean knife was used to cut pieces of samples with dimension of 3×3cm^2. A total of 120 *balangu* samples were prepared and ten samples were randomly allotted to each of the already prepared packaging material, carefully wrapped and represented a packaging treatment according to the 12 treatment combinations. All 12 wrapped packages were then arranged in a flat platform at room temperature for their respective storage period. After each storage period, three samples were randomly taken from each treatment combination and evaluated for storage stability and seven samples were used for sensory evaluation.

Determination of storage stability (Lipid oxidation)

The oxidation of lipids was measured by determining the amount of the Thiobarbituric acid reactive substances (TBARS), expressed as mg malondialdehyde per kilogram (mgMDA/kg) of muscle or TBA units. Thiobarbituric acid reactive substances values were measured using the method of Witte *et al.* (1970).

Determination of sensory characteristics

Determination of sensory characteristics was subjectively conducted using the method of quantitative descriptive analysis (QDA) based on the principle of a panelist's ability to verbalize perceptions of a product. Hedonic scales according to Watts *et al.* (1989) were used to evaluate the colour appearance and odor of the product after each storage period using a panel of seven (7) judges.

Data Analysis

Data on sensory and storage stability were transformed and analyzed using non-parametric analysis to obtain means. The means were subjected to the GLM procedure to compare the effect of packaging and storage period on the RTE-MP. Significant means were separated using Tukey test at 5% level of significance.

RESULTS AND DISCUSSION

Storage stability (Thiobarbituric Reactive Substances)

Packaging materials and storage period had significant effect ($P<0.05$) on the Thiobarbituric Reactive Substances (TBARS), appearance (colour) and ordour of *balangu* samples (Table 1). The TBARS value was significantly higher in samples packaged in polyethylene film than aluminium foil packaged samples, which was higher than samples packaged in paper. Appearance was scored significantly higher by paper packaged samples than aluminium foil packaged samples which did not differ significantly with paper and polyethylene film packaging, but higher than polyethylene film

packaged samples. Similarly, samples packaged in paper had scored significantly higher than aluminium foil and polyethylene film which did not differ significantly. At storage, TBARS values, appearance and odour score increased from control with increase in storage period. There was also a significant interaction (P<0.01) between packaging materials and storage period on all the parameters tested after the storage period.

Table 1 Effects of packaging materials and storage period on the storage stability and sensory qualities of *balangu*

Treatments	Parameters		
	TBARS (mgMDA/kg)	Appearance (colour)	Odour
Packaging materials			
Aluminum foil	1.133[b]	4.071[ab]	2.321[b]
Paper	0.232[c]	4.429[a]	2.643[a]
Polyethylene film	2.133[a]	3.750[b]	2.286[b]
SE	0.049	0.134	0.104
Storage period (hours)			
0 (control)	0.058[a]	7.762[a]	4.238[a]
24	0.766[b]	4.762[b]	2.952[b]
48	1.843[c]	2.333[c]	1.476[c]
72	2.664[d]	1.476[d]	1.000[d]
SE	0.057	0.155	0.120
Interaction			
Packaging × Storage period	**	NS	**

a,b,c,d = means with different superscript along the same column within a subset differ (P<0.05)
** = P<0.001
NS= Not significant

In the current study, balangu packaged in polyethylene film and aluminum foil had developed higher TBARS (2.133 and 1.133g MDA/kg, respectively) than paper packaging (0.232g MDA/kg). This might be due to the fact that packaging *Balangu* which is an intermediate moisture meat product and hence, has relatively high moisture content with other concentrated nutrients like protein which could probably result in the production of free radicals (Min, 2008) or porosity of packaging materials (Ahn *et al*., 2000; Muhammad and Muhammad, 2007). TBARS values increased with increase in storage time. The storage period of 72 hours had higher value (2.664g MDA/kg) than 48 and 24 hours (1.843 and 0.766g MDA/kg, respectively). Controls had lower TBARS value (0.058g MDA/kg). The higher TBARS value could be as a result of extension of storage time leading to the production of free radicals (Kanatt *et al.* 2006). Several research findings (Kim *et al.*, 2014; Bağdatli and Kayaardi, 2015; Akinneye and Aringbagba, 2015) had reported similar trends of TBARS values in relation to storage time using different meat and other food products.

Appearance and Odour

In the current study, results of indicated that all packaging materials scored values that were below the desirable levels in the appearance scale after storage. However, paper had scored higher (4.429) than aluminum foil and polyethylene film packaging materials (4.071 and 3.750, respectively). At the storage length, samples in control (0 hrs) had shown better performance in color appearance (7.762) equivalent to extremely desirable. After 24 hours, the samples scored 4.762 equivalents to slightly desirable on the rating scale. This indicated that though balangu is produced for immediate consumption, yet, its colour appeal could extend up to 24 hrs stored at room temperature. At 48 and 72 hrs storage, the samples were rated extremely undesirable. It could be as a result of complete deterioration of the meat pigments and prolonged storage.

The current study shows that paper packaged balangu performed better (2.643) demonstrating that the samples have developed less off-odor than the aluminum foil and polyethylene film packaged balangu which scored 2.320 and 2.286, respectively and were categorized as having moderate odor development after storage. Apart from the control (0 hrs), other storage period indicated samples stored after 24 hrs had developed small odor (2.952) while those stored for 48 and 72 hrs had extreme odors scoring 1.476 and 1.000, respectively. The odors could be due to the production of low-molecular-weight volatile substances (Lamikanra and Dupuy, 1990).

REFERENCES

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2011a). Processing and Evaluation of *Dambu*, *Tsire* and *Balangu* from Non-Ruminant Animals. *ACT- Biotechnology Research Communications*, 1(1):49-55.

Adejumo, B. A. and Ola, F. A. (2008). The Appraisal of Local Food Packaging Materials in Nigeria. *Continental Journal of Engineering Sciences*, 3:13–20.

Ahn, D. U., C. Jo, and D. G. Olson. (2000). Analysis of volatile components and the sensory characteristics of irradiated raw pork. *Meat Science*, 54:209–215

Akinneye, J. A. and Aringbangba, R. O. (2015). Effects of Packaging Materials On Proximate, Mineral And Physicochemical Properties Of Plantain Chips (*Musa Paradisiaca*) In Storage. *FUTA Journal of Research in Sciences*, 2015 (1): 55-59

Bağdatli, A. and Kayaardi, S. (2015). Influence of Storage Period and Packaging Methods on Quality Attributes of Fresh Beef Steaks, CyTA - *Journal of Food*, 13:1, 124-133.

Kanatt, S. R. Chawla, S. P. ,Chander, P. and Sharma, A. (2006). Development of Shelf- stable, Ready-to-Eat (RTE) Shrimps (*Penaeus indicus*) Using Radiation as One of the Hurdles. *LWT* 39:621–626.

Kim, I., Jin, S., Yang, M., Uk Ahn, D., Park, J. and Kang, S. (2014). Effect of Packaging Method and Storage Time on Physicochemical Characteristics of Dry-Cured Pork Neck Products at 10°C. *Asian Australas Journal of Animal Science*, 27(11): 1623- 1629.

Lamikanra, V. T. and Dupuy, H. T. (1990). Analysis of Volatiles Related to Warmed over Flavor of Cooked Chevon. *Journal of Food Science*, 55:861-866.

Min, B. R., Nam, K. C., Cordray, J. C. and Ahn, D. U. (2008). Factors Affecting Oxidative Stability of Pork, Beef, and Chicken Meat, Animal Industry Report: AS 654, ASL R2257. Available at: http://lib.dr.iastate.edu/ans_air/vol654/iss1/6

Muhammad, B. F. and Muhammad, A. M. (2007). Effect of Packaging Material and Storage Period on Microbial Load and Organoleptic Properties of Kilishi. *Tropical Journal of Animal Science*, 10 (1&2): 217-270.

Watts, B. M., Ylinaki, G. L., Jeffery, L. E. and Elias, L. G. (1989). *Basic Sensory Methods For Food Evaluation*. Ottawa, Canada: International Development Research Centre (IDRC). (p. 163).

Witte, V. C., Krause, G. F. and Bailey. M. F. (1970). A New Extraction Methods for Determining 2-Thiobarbituric Acid Values of Pork and Beef During Storage. *Journal of Food Science*, 35:582-585.

ASSESSMENT OF *olea africana* (CHARCOAL) AND *xylopia aethopion* ('KIMBA') AS PRESERVATIVES ON MICROBIOLOGICAL SAFETY OF MILK

Ribah, M. I.,*[1] Garba, G. G. [1], Kadi, N. [1], & Suleiman, S. & Bunza, F. S. [1]
[1]*Department of Animal Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, PMB 1144 Birnin kebbi, Nigeria.*
**Corresponding author: ibrahim.ribah73@gmail.com (07036333707)*

ABSTRACT
A Comparative study of two traditional methods of milk preservation on microbiological safety was designed and conducted in two stages. The first stage was a survey which identified various methods of preservation of milk as well as the consumption pattern of traditional milk products in the study area. The second stage was a laboratory activity where two traditional preservatives (*Xylopia aethopica* (kimba) and charcoal) were used to preserve milk for 24 hours at six hours interval to investigate the microbiological safety of milk. Data from the survey were expressed in descriptive statistics while data on microbiological analysis was analyzed using ANOVA. The survey result shows that (70%) of the respondents were female and mostly used traditional methods (82.5%) in preserving milk. 77.5% do not add any substance to the milk for preservation, but (22.5%) of respondents add traditional substances to preserve milk. The main reason mentioned by the respondents was to add flavor (70 %) and extend the shelf-life of milk. Data on microbial load shows that except at zero hours, there was significant difference ($P < 0.05$) among all treatments. A trend was observed in that, for control samples, increase in preservation time lead to increase in microbial count, however, for the treated samples, a decrease in microbial count was observed with increase in preservation time, suggesting that the traditional preservatives had antimicrobial effect. *Staphylococcus, E.coli* and *Bacillus spp.* were the bacteria isolated from the milk. It was concluded that a decrease in microbial count was observed with increase in preservation time for treated samples with *xylopia aethopion* ('kimba') having lower bacterial count.
Keywords: *Olea Africana, Xylopia Aethopion,* Preservatives, Microbiological Safety, Milk

INTRODUCTION
Background of the Study
Milk is a nutrient rich, white liquid food produced by the mammary glands of mammals. It is the primary source of nutrient for infant mammals (including humans who are breast fed) before they are able to digest other types of food. Early lactation milk contains colostrum, which carries the mother's antibodies to its young and can reduce the risk of many diseases. It contains many other nutrients including protein and lactose (Pehrson, *et al.*, 2000). As an Agricultural product, milk also called dairy milks, is extracted from farm animals during or soon after pregnancy.

Milk consumption occurs in two distinct overall types, a natural source of nutrition for all infant mammals and a food product obtained from other mammals for consumption by humans of all ages. Many food products are perishable by nature and require protection from spoilage during their preparation, storage and distribution to give them desired shelf life. Since milk is often sold in areas of the world for distance from the production sites, the also extended safe shelf life for milk has also expand (Rassoli, 2007). Milk has a complex biochemical composition and its high water activity and nutritional value serves as an excellent medium for growth and multiplication of many kind of micro-organisms when suitable condition exist (Parekh and subhash, 2008). Because of the hand milking system pastoralists, it's not easy to avoid contamination of milk with micro-organisms therefore the microbial content of milk is a major feature in determining it equipment, feed, soil, cow faeces, and grass (Khan *et al.*, 2008).

Thus, although milk and milk products are minor constituent in most diets but contaminated milk is responsible for up to 90% of all dairy related disease of humans (Shirima, *et al.*, 2003). The risk of infection by milk borne zoonotic disease such as tuberculosis and brucellosis among other disease is one of the reasons for public health regulations, which discourage the informal milk markets and consumption of raw or unpasteurized milk (Shirima, et al., 2003).

Traditional milk processing methods, the pastoral are the most important sources of domestic milk in Nigeria. The wives of pastoralist usually process fresh milk into various traditional milk products.

These include nono (sour milk), kindirmo (sour yoghurt), manshanu (local butter), cuku (Fulani cheese) and wara (Yoruba cheese).these product are usually hawked around the local area by women or are sold in a specific location (CBN, 1999).

In rural settings particularly in several pastoralist communities, use of medicinal plants is the commonly used technique for different food preservation including milk. Several plants, herbs and spice extracts have been reported to possess antimicrobial activity against a range of bacteria, yeast and molds (Burt, 2004). Charcoal from *Oleaeuropea, lagenariasiceria* and *Olea Africana* were documented to be used to coat the inside of milk storage gourds to add flavor/ aroma and also to protect the milk against spoilage micro-organisms. Therefore, it is important to evaluate antimicrobial activities of indigenous plant which are commonly used by pastoral communities for milk preservation. Therefore, this study is aimed at assessing two local milk preservation substances for total microbiological load of milk.

MATERIALS AND METHODS

Study Area

The study was carried in Animal Science Laboratory of Kebbi State University of Science and Technology Aliero. Aliero Is Town in Kebbi state, Northern Nigeria.

Experimental Design

The experiment was conducted using a completely randomize design (CRD) consisting of three treatments replicated four times. The treatments were two traditional milk preservation substances (*Olea Africana* (Charcoal) and *xylopia aethopion* ('kimba'). The three (3) litres of milk was divided i to two (1 liter each) for the two treatments respectively. Each treatment was replicated four (4) times i.e. 250ml and one (1g) of *xylopia aethopica* (kimba) was added to first treatment and one (1g) of *Olea Africana* charchol was added to second treatment with the exception of control. Data was taken after an interval of 6 hours. The experiment lasted for 24 hours.

Microbiological Analysis

Nutrient agar medium

The medium was prepared by 7g of nutrient agar in 240mls of distal water. The mixture was dissolved on hot plate and mouth of the conical flask was covered as curved with cotton wool and aluminum. The medium was sterilized using an autoclave at 121°c for 15 minutes. The medium was allowed to cold to 45°c and dispensed into sterile petri-dishes in the manner of (Oyeleke and Manga, 2008). Five folds serial diilution were prepared and labeled as 10^{-1} , 10^{-2}, 10^{-3}, $10^{-4,}$ and 10^{-5} in order to obtain discrete colony. An inoculum (0.1ml) from the last dilution (10^{-5} was be pipette and dispense onto the solidified nutrient agar medium, sterile bent glass rod was used to spread the inoculums for even growth. This was incubated at 37°c for 24hrs. After incubation plate showing between 3 – 11 colonies on agar plates was counted. The colonies are efficiently counted by inverting the plate and each colony counted was marked with marker to avoid recounting. Biochemical tests were carried out as outlined by Cheesebrough *et, al*. (2002).

RESULT AND DISCUSSION

Heterotrophic bacterial count from milk samples preserved using traditional preservatives.

Table 1 shows the result of Heterotrophic bacterial count from milk samples preserved using two traditional preservatives (*Olea Africana* (Charcoal) and *xylopia aethopion* ('kimba'). Results indicate that there was no significant difference ($P > 0.05$) between treatments at 0 hours of preservation. However, there was significant difference ($P < 0.05$) among all hours of preservation across all treatments. The mean total bacterial count is also significantly different indicating that *xylopia aethopica* ('kimba') has lower bacterial count than *Olea Africana* (Charcoal).

Table 1: Heterotrophic bacterial count from milk samples preserved using traditional preservatives.

Treatment (cfu/ml)	Times (hrs)					
	0hr	6hrs	12hrs	18hrs	24hrs	Mean
Control	7.3	6.8^{c}	7.5^{c}	8.0^{c}	8.8^{c}	7.7^{c}
X. aethopica	7.4	7.8^{b}	6.4^{a}	5.0^{a}	4.5^{a}	6.3^{a}
Olea Africana	7.5	7.3^{a}	7.1^{b}	6.5^{b}	5.5^{b}	6.8^{b}
S.E	0.117	0.047	0.061	0.058	0.047	0.047

The significant differences observed at 6, 12, 18 and 24 hours among the treatments with *Xylopia aethopica* recording lower (6.3cfu/ml) than *Olea Africana* (6.8 cfu/ml) and control (7.7 cfu/ml) might be as a result of *xylopia aethopica* having antimicrobial effect as widely reported (Samah *et al.*, 2019; Davide *et al.*, 2016; Kassahun, 2013). A trend was also observed in the bacterial count across the treatments. Bacterial count in control increased with increase in storage time. But, bacterial count decreases with increased in storage time there by suggesting that the preservatives might have exhibited their antimicrobial effect as the storage time is prolonged.

Incidence of some bacteria in milk samples treated with two traditional preservatives

Results in Table 4.3 shows the morphological characteristics of some bacteria isolated from milk samples treated with two traditional preservatives (*Olea Africana* (Charcoal) and *xylopia aethopion* ('kimba'). The result indicated that *Staphylococcus*, *E.coli* and *Bacillus spp.* were the bacteria isolated with *Staphylococcus* and *E.coli* having more incidence of occurrence.

Table 4.3 Incidence of some bacteria in milk samples treated with two traditional preservatives

Treatments	**Incidence**		
	E.coli	*Staphylococcus* spp	*Bacillus*
Control	0	4	0
Olea Africana	3	1	1
xylopia aethopion	1	3	1
Percentage(%)	**33.33(%)**	**66.66(%)**	**16.66(%)**

From the results, it was observed that *E.coli* and *Bacillus spp.* were not found in the control samples but were however observed in treated samples. The presence of these pathogens in the samples could only mean that they might be introduced along with the test preservative which might not be qualitative as reported by Samah *et al*, (2019) that only the highest quality herbs or spices can be added to dairy products to combat contaminating microorganisms.

CONCLUSION

From the research findings, it was concluded that preservation time lead to increase in bacterial count in control samples. However, for the treated samples, a decrease in microbial count was observed with increase in preservation time. The mean total bacterial count among the treatments indicated that *xylopia aethopion* ('kimba') has lower bacterial count than *Olea Africana* (Charcoal).

REFERENCES

Burt, S. (2004). Essential Oils: the antibacterial properties and potential applications in foods a review. *International Journal Food Microbiology,* 94: 223- 253.

N (Central Bank of Nigeria). 1999. Annual report 1999. CBN, Lagos. Nigeria.

Cheesbrough, M. (2002). *District Laboratory Practices in Tropical Countries Part 2*. Cambridge University Press, UK.

Davide, G., Danka, B., Sahdeo P. and Amit, K. T. (2016). Beneficial Effects of Spices in Food Preservation and Safety *Front Microbiology*, 7: 1394.

Kassahun, M. (2013). Sources of milk products, milk and milk products handling preservation and spices added to the milk products in Ada'a Woreda, Ethiopia. *International Journal of Agriculture: Research and Review*. 3(1):6-12.

Khan, M., Zinnah, M, siddique, M., Islam, M. and choudhury, K. (2008). Physical and microbial qualities of raw milk collected from Bangladesh Agricultural University Dairy Farm and the Surrounding Villages. *Bangladesh Journal of Veterinary Medicine*, 6(2): 217- 221.

Oyeleke, S. B. and Manga, B. S. (2008). *Essential of Laboratory Practical in Microbiology*. (1st edition) Tsobest Publication, Nigeria.

Parekh, T.S.and Subbash, R.(2008). Molecular and Bacteriology examination of milk from different milking animals with reference to coliforms. *Current Research in Bacteriology*. 1 (2): 56- 63, 2008.

Pehrsson, P.R.; Haytowitz, D.B.; Holden, J.M.; Perry, C.R.; Beckler, D.G. (2000). "USDA's National Food and Nutrient Analysis Program: Food Sampling" (PDF). *Journal of Food Composition and Analysis*.13 (4): 379–89.

Rassoli, I. (2007). *Food Preservation –A Biopresevative Approach. Food.* Food @2007 global science books. Department of Biology, Tehran, Iran. PP 1- 26.

Samah, M.E. and Ahmed M.Y. (2019). Potential application of herbs and spices and their effects in functional dairy products. Heliyon, 5(6):

Shirima, G.M., Fitzpatrick,J., Cleaveland, S., Kambarage, D.M., Kazwala, R.R Kunda, J. and French, N. (2003). Patricipatory Survey on Zoonotic Disease Affecting livestock Keeping Communities in Tanzania. *Jounal of Animal and Veterinary Advances* 2(4): 253 –258.

EVALUATION OF HYGIENE AND GRADE CHARACTERISTICS OF EGGS PRODUCED FROM COMMERCIAL POULTRY FARMS WITHIN AND AROUND BIRNIN KEBBI METROPOLIS

Ribah, M. I.,*[1] Usman, R. I. I[1]., Muftau, M. A. [1], Bello, S. & Kwaido, A. A. [1]
[1]Department of Animal Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, PMB 1144 Birnin kebbi, Nigeria.
**corresponding author: ibrahim.ribah73@gmail.com (09060694910)*

ABSTRACT
The study was conducted to investigated the physical hygiene and grade characteristics of eggs produced from commercial poultry farms within and around Brinin Kebbi metropolis. All viable commercial poultry farms covering 50 kilometers radius in and around Birnin kebbi metropolis were surveyed in a preliminary survey, and five (5) farms were identified to be operating in a relatively consistent commercial quantities. Three crates of fresh eggs (containing 30 eggs per each crate) were purchased from each farm. Therefore, a total of 450 eggs were used for the study. The physical characteristics determined include egg size, cracks, stains, dirt, texture, ridges, colour and shape of eggs while the eggs from various farms were graded using the USDA standard grading characteristics based on size classification of the eggs. Results on physical characteristics indicated that there was significant differences ($P<0.05$) on egg weight and number of dirty eggs among farms. However, there was no significant differences ($P>0.05$) between the farms on egg cracks, egg stains, egg textures and ridges on eggs. Farm B had higher egg weight (66.1g) while Farm E had the least (2.67) dirty eggs. Generally, egg size classification across the farms studied conforms to the USDA standards of jumbo, Extra-large and Large eggs. No medium eggs, small eggs and pwewee eggs were recorded among the farms studied. The study concluded that most of the eggs produced from selected farms are of good size and weight but have stains, dirts and cracks which could raise safety concerns. All eggs from the farms studied favorably conform to the USDA standards based on the size of the eggs.

Keywords: Hygiene, Grade Characteristics, Eggs, Poultry Farms

INTRODUCTION
Eggs are very important for feeding people as they have high nutritive value and are suitable for Processing and 50g of the edible part of a hen egg contains 72.5-75.0 g of water, 12.5-13.3 g of protein,10.7-11.6 g of fat, 0.7 g of carbohydrates and 1.0-1.1 g of mineral substance. The human body also makes good use of the nutritive value of eggs: proteins are utilized at 97%, fats 95%, carbohydrates 98% and minerals 76%. The content of essential amino acids in eggs is also very important, especially leucine, isoleucine, lysine, arginine, valine and phenylalanine. Eggs are also rich in vitamins - especially A, K and B complex - and also in different micro- and macro-minerals (USDA, 2015). According to Dudusola (2010) and Pasquoal *et al.*, (2012), eggs are highly versatile food containing many essential nutrients. Eggs of most species of birds may have similarities in nutritional composition and potential food usage, however, information on egg quality characteristics and utilization of egg for food and other purposes have been limited mostly to chicken eggs. Egg quality is composed of those characteristics of an egg that affects its acceptability to consumers such as cleanliness, freshness, egg weight, shell quality; yolk index, albumen index, Haugh unit and chemical composition (Mahdabi *et al.*, 2012, Song et al., 2000).

Grading refers to the process of grouping eggs according to similar characteristics, such as quality and weight. Egg grading is dependent upon examination of internal quality factors (e.g., condition of the egg white and yolk, air cell size). According to Abanikannda and Leigh (2012), egg grading generally involves the sorting of products according to quality, size, weight and other factors that determine the relative value of the product (USDA, 2005). It entails the grouping of eggs into lots, having similar quality and weight. The grade of an egg is determined by factors like its quality, soundness and weight, but the factor with the lowest grade determines the overall grade of the egg (Jacob *et al.*, 2002). Chukwuka *et al.*, 2011) reported that under the European Union of egg marketing regulations enforced in all European Union countries, eggs are classified as either class A or B eggs (CEU 2006) and eggs graded as A can be sold for direct human consumption or retailed (CEU, 2006). Similarly, the United States Department of Agriculture (USDA) has developed three grades of eggs based on the

interior quality of the egg, appearance and condition of the egg shell. The USDA grade AA and US grade

According to Abisogun *et al.* (2012), the major challenges of marketing livestock products are appropriate pricing, preservation and storage. The usual practice of small holder poultry farms is to sell eggs unsorted which results in loss of income, decreased marketability and increased wastages. Sorting and grading of eggs in to fairly homogenous sizes by small holder commercial egg producers could lead to an increase in the consumer's preference which will consequently result in increased marketability and revenue. Hence, this research will attempt to study the practice of egg grading in kebbi state by obtaining first-hand information on the knowledge attitude and practice of egg grading from the commercial egg producers and also to determine the quality of the eggs produced if they conform to the international standards. Therefore**,** this study seek to evaluate physical hygiene grade characteristics and determination of the conformity of egg from commercial poultry farms around Birnin Kebbi metropolis to USDA standards.

MATERIALS AND METHODS

Study Area

The study was conducted at the Animal Science Laboratory of Kebbi State University of Science and Technology, Aliero, Kebbi State. The study evaluated some hygiene and grade characteristics of eggs produced from selected commercial poultry farms around Birnin kebbi metropolis.

Sampling and Sample Size

All viable commercial poultry farms covering 50 kilometers radius in and around Birnin kebbi metropolis were surveyed in a preliminary survey, and five (5) farms were identified to be operating in a relatively consistent commercial quantities. Three crates of fresh eggs (containing 30 eggs per each crate) was purchased from each farm as per the arrangement of the eggs by the farms. Therefore, a total of 450 eggs were used for the study.

Data Collection

Hygiene grade characteristics of eggs

The physical characteristics determined, include egg size, cracks, stains, dirt, texture, ridges, colour and shape of eggs. Egg size was determined by measuring the weight of each individual egg using a sensitive digital weighing balance. Cracks were determined by counting the number of eggs that have any visible crack on the shell surface. Stains were determined by counting the number of eggs that have any prominent, moderate and localized stains on the surfaces of egg shells. Dirty eggs were determined by counting the number of eggs that had adhering dirt or foreign materials on the shell. Texture of the eggs was determined by counting the number of eggs that have extremely rough surfaces and large calcium deposits. Ridges on eggs were determined by observing the eggs that have pronounced ridges on the shells.

USDA Grade characteristics of eggs

The eggs from various farms was graded using the standard grading characteristics based on size on the size of eggs. Eggs were measured by weight using digital weighing balance and classified as follows: Jumbo (>71g), Extra Large (61 – 70g), Large (51 – 60g), Medium (40 – 50g), Small (30 – 40g) and Pwewee (< 30g).

Data Analysis

Analysis of Variance (ANOVA) was used to compare the Physical characteristics and to determine the conformity between eggs produced from selected commercial poultry farms.

RESULTS AND DISCUSSION

Evaluation of Hygiene and Grade Characteristics of Egg Produced From Commercial Poultry Farms Within and around Birnin Kebbi Metropolis.

The results on the Table 1 indicate that there was significant differences (P<0.05) on egg weight and number of dirty eggs among farms. However, there was no significant differences (P>0.05) between the farms on egg cracks, egg stains, egg textures and ridges on eggs.

Table 1: physical Hygiene characteristics of egg produced from commercial poultry farms within and around Birnin Kebbi Metropolis.

FARM	PARAMETERS					
	Weight (G)	Cracks	Stains	Dirty Egg	Texture	Ridges
A	59.5^{bc}	2.00	25.00	16.00^{b}	12.7	5.32
B	66.1^{a}	1.00	24.33	15.33^{b}	3.67	4.99
C	60.3^{b}	0.00	21.67	11.33^{ab}	2.00	8.66
D	55.9^{bc}	1.00	20.33	8.67^{ab}	0.33	6.99
E	55.1^{c}	1.67	19.67	2.67^{a}	0.00	7.66
SEM	**1.04**	**0.650**	**2.211**	**2.271**	**0.856**	**1.342**

Means with difference superscript along the same column with a subset differ significantly (P<0.05)

Egg Weight in farm B had higher weight (66.1g) than other farms. This might be as a result of weight, breed and age of the laying birds from which the eggs were obtained. It has been demonstrated that there is correlation between body size and egg size within the breed, and also, age may have tendency to influence producing heavy weight eggs (Blanco *et al.*, 2014; Aygun and Yetisir, 2010; Begli *et al.*, 2010; Alkan *et al.*,2010). Majority of the farms studied had recorded cracks eggs. This could probably be as a result of poor handling during egg collection.

Determination of Conformity of Eggs Produced From Commercial Poultry Farms around Birnin Kebbi Metropolis to USDA grade standards

Results on the Table 2 shows that there was significant differences (P< 0.05) on egg size across the farms studied for jumbo, extra-large and large eggs. However, there was no significant differences (P>0.05) among the farms on Medium, small and peewee eggs.

Table 2: USDA standard grade characterization of eggs produced from commercial poultry farms within and around Birnin Kebbi Metropolis .

FARM	PARAMETERS					
	Jumbo	Ex-Large	Large	Medium	Small	Pwewee
A	1.33^{b}	18.33^{a}	24.33^{a}	3.33	0.000	0.000
B	6.33^{a}	12.33^{ab}	22.00^{a}	3.00	0.000	0.000
C	1.00^{b}	10.33^{ab}	15.33^{a}	2.00	0.000	0.000
D	0.00^{b}	4.67^{b}	15.00^{a}	1.00	0.000	0.000
E	0.00^{b}	2.00^{b}	5.00^{b}	0.00	0.000	0.000
S.E	**0.56**	**2.41**	**2.08**	**1.11**	**0.00**	**0.00**

Means with difference superscript along the same column with a subset differ significantly (P<0.05)

Based on Jumbo size eggs, farm B had higher (6.33) number of Jumbo eggs followed by farm A (1.33) and C (1.00). The high number may be due to breed or age of the laying birds. Based on Extra-large eggs, farm A had higher number of eggs (18.33), followed by farm B (12.33) and C (10.33). Farm E had lesser (2.00) number of eggs. Based on Large eggs, farm A had higher (24.33) number of eggs, followed by farm B (22.00) and C (15.33). Farm E had lesser (5.00) number of eggs. There was no small and pwewee eggs recorded among all the farms studied in the current study. This shows that,

most eggs produced by commercial farms within and around Birnin Kebbi metropolis fairly conform to the UDSA standard.

CONCLUSION

The study concluded that there is awareness of egg grading among poultry personnel but the system is not adequately practiced. Most of the eggs produced from selected farms are good size and weight but have stains, dirt's and cracks which could raise safety concerns. All eggs from the farms studied favourably conforms to the USDA standards based on the size of the eggs.

REFERENCES

Abanikannda, O. T. F. and Leigh, A. O. (2012).Grading of table eggs as a marketing strategy for Nigerian smallholder farmers. *International Journal of Livestock Production*, 3(4):43-46.

Abisogun H, K, Chris T, Moghun N, J (2012) Major challenges of marketing livestock,86:562

Alkan, S., K. Karabağ, A. Galiç, T. Karsli and Balcioğlu, M.S. (2010). Effects of selection for body weight and egg production on egg quality traits in Japanese quails (Coturnix coturnix japonica) of different lines and relationships between these traits. *Kafkas Univ. Vet. Fak. Derg*., 16(2):239-244

Aygun, A., and Yetisir, R. (2010). The Relationship among egg quality characteristic of different hybrid layers to forced molting programs with and without feed withdrawal. Journal of Animal and Veterinary Advances 9, 710-715.

Begli, H.E., S. Zerehdaran, S. Hassani, M.A. Abbasi, and Khan Ahmadi, A.R. (2010). Heritability, genetic and phenotypic correlations of egg quality traits in Iranian native fowl. *British Poultry Science* 51: 740-744.

Blanco, A.E., W. Icken, D. Ould-Ali, D. Cavero, and Schmutz, M. (2014). Genetic parameters of egg quality traits on different pedigree layers with special focus on dynamic stiffness. *Poultry Science*, 93:2457-2463.

CEU (2006). Egg are classified as either class A or B eggs (search online).

Chukwuka, O. K., Okoli, I. C., Okeudu, N. J., Udedibie, A. B. I., Ogbuewu, I. P., Aladi, N. O., Iheshiulor, O. O. M. and Omede, A. A. (2011). Egg quality defects in poultry management and food safety. *Asian Journal of Agricultural Research*, 5(1):1-1

Dudusola, I. O. (2010).Comparative evaluation of internal and external qualities of eggs from quail and guinea fowl .*International Research Journal of Plant Science*,1(5):112-115

Jacob S. and Toni K.Y.(2002). Factor with the lowest grade determine the overall grade of eggs.

Mahdabi, M., Jalali M. Safaei, H. G., Shamloo, E. (2012) Microbial quality and prevalence of salmonella and listeria in eggs. *International Journal of environment and health engineering*, (serial online 2012)

Pasquoal, C, M., Evilda, Rodrigues, L., Juliana, P. M., Wasnessa, N.k.O., Joaduim, E. N.(2012). Egg quality of laying hens in different conditions of storage, ages and housing densities. *Sociedade Brasileira de Zootecnia.* 41(9,) 2064-2069.

Song, K. T., Choi, S. H. and Oh, H. R. (2000).A Comparison of Egg quality of Pheasant, Chukar, Quail and Guinea fowl .*Asian – Australian Journal of Animal Science*, 13(7):986 – 990.

USDA (2015). United States Department of Agriculture, Food Safety and Inspection Services.

USDA (2006). United States Department of Agriculture, *Egg Grading Manual*

QUALITY ATTRIBUTES OF GROUND TURKEY PATTIES AS AFFECTED BY HOUSING SYSTEM AND CUT-PART USED

[*]Safiyu K. K., [**]Sogunle, O. M., [**]Egbeyale, L.T., [***]Shittu, T. A., [**]Olaifa, R. O., [**]Odutayo, O. J., [**]Ogunjimi O. C. & [**]Azeez, N. T.

[*]Department of Animal Production and Livestock Management, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

[**]Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

[***]Department of Food Science and Technology, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

** Correspondence: safiyukamorudeen@gmail.com, +2348060396895*

ABSTRACT

To determine the effects of housing system and cut-part used on quality attributes of ground turkey patties, 200 four-week old poults were raised in two different housing systems (deep litter and outdoor run) for 10 weeks. Afterwards, fresh breast and thigh from slaughtered carcasses were collected and used as the raw material for ground patties which were subjected to physiochemical and sensory analysis. Data obtained were arranged in a 2 × 2 factorial layout and subjected to Analysis of Variance. Results showed housing system effect was negligible ($p>0.05$) on physicochemical and sensory analysis of ground turkey patties. However, ranges of values recorded for pH (6.45 – 6.74), cooking loss (25.06 – 28.85%), chilling loss (4.41 – 7.92%), and diameter shrinkage (11.77 – 14.58%) revealed patties prepared from thigh was significantly ($p<0.05$) higher. Sensory scores; appearance (3.90 – 4.92), flavour (5.53 – 6.23) and overall acceptability (5.48 - 6.65) were significantly ($p<0.05$) higher in breast patties while oiliness was significantly ($p<0.05$) higher in thigh patties. Therefore, the use of turkey breast for ground patties production is recommended.

Keywords: turkey, housing system, cut-up part, ground patties, sensory

INTRODUCTION

Value-added poultry products present enormous opportunities for poultry producers, processors and sellers. Unlike fresh meat, many meat products can be made shelf-stable (Heinz and Hautzinger, 2007). A typical example is patties; a minced meat mixed with condiments and spices, shaped and then cooked by frying, grilling or baking (Gujral *et al*., 2002). However, since meat quality is influenced by many interacting factors before and after slaughter, the consumers of many meat products are getting more concerned about the origin and safety of the meat used for processing (Araújo *et al.*, 2011). Thus, the purpose of investigation was to determine the quality attributes of ground turkey patties as affected by housing system and cut-parts used on.

MATERIALS AND METHODS

Experimental Site

Turkeys were reared in the Turkey Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta while patties production and analysis were carried out in the Animal Products and Processing Laboratory of the Department of Animal Production and Health of the same institution.

Ground patties preparation

A total of 200 four-weeks old poults from local strain were divided into two different housing systems (deep litter and outdoor run) and fed commercial turkey starter *ad libitum* for 10 weeks. The birds were each subdivided into 10 replicates consisting of 10 birds per replicate. At the end of the trial, two birds per replicate were selected and slaughtered. The birds were bled completely followed by removal of skin. Fresh breast and thigh were collected and used as the raw material for patties production. Two hundred grams (200 g) of fresh breast and thigh, respectively from each replicate were processed into patties as described by Heinz and Hautzinger (2007). The meats were manually

cut into small pieces and minced using a food processor and seasonings (2.4 g Salt, 0.3 g black pepper, 0.06 g nutmeg, 0.1 g ginger and 0.06 g coriander) were added to the minced followed by mixing for 5 minutes. Afterwards, fat (10 g of butter) was added and mixed for another 10 min until they homogenized. The homogenous mixture (approximately 80 g) was transferred to a patty shaper, pressed and a round-shaped patty was obtained. The shaped patties were cooked to an internal temperature of 74º C in a microwave.

Data collection

1. Physicochemical analyses:

- pH Measurement: Ten (10) g of prepared patty samples were homogenized with 90 ml of distilled water (in the ratio of 1:9), using a laboratory blender for 1 min at low speed setting. Digital pH meter was used after standardizing it with two-buffer solutions; one in pH 7.0, and the other in pH 4.0. The pH of patties was obtained in the slurry with the direct insertion probe electrode of the pH meter.
- Chilling Loss (%) = $\frac{(\text{Weight of raw patty} - \text{Weight of chilled patty after 24 hours})}{\text{Weight of raw patty}} \times 100$
- Cooking loss (%) = $\frac{(\text{Weight of raw patty} - \text{Cooked Patty weight})}{\text{Weight of raw patty}} \times 100$
- Diameter shrinkage (%) = $\frac{(\text{Diameter of raw patty} - \text{Diameter of cooked patty})}{\text{Diameter of raw patty}} \times 100$

2. Sensory Evaluation:

A total of 20 untrained panellists, all of whom were college students' ages ranging 18 to 30 years and 60% of whom were male, evaluated the patties. Panellist were screened and trained accordingly. Hedonic testing was used to assess the consumer acceptance of patties from each treatment. The patties were cut into cubes (1.3 cm × 1.3 cm x cooked patties thickness) and panellists were instructed to taste patty samples from left to right and to take water between each sample. The serving order of patties was also rotated to reduce potential bias caused by positions. Panellists rated sensory attributes using hedonic scales based on a 9-point Likert scale for appearance (1 = extremely bumpy, 9 = extremely smooth), oiliness (1 = extremely dry, 9 = extremely oily), chewiness (1 = extremely chewy, 9 = extremely crumbly), flavour (1 = extremely bland, 9 = extremely tasty), and overall acceptability (1 = dislike extremely, 9 = like extremely).

Statistical Analysis

The data obtained were arranged in a 2 × 2 factorial were analyzed with Analysis of Variance (ANOVA) using the GLM procedure of statistical analysis software Minitab® version 17.1.0. Significant ($p<0.05$) differences among treatment means were determined using Tukey Test as contained in the Minitab® software.

RESULTS AND DISCUSSION

Though literature (Sogunle *et al*., 2012; Damaziak *et al*., 2013) has firmly established housing system as a major factor influencing physical and sensory properties of meat, this study observed housing system effect was negligible on physiochemical properties of ground turkey patties (Table 1). This could be due to the fact that raw meats that were obtained from turkey carcasses were processed into patties using similar degree of mincing to achieve similar particle size and structure. This corroborates the report of Fernández–López *et al.* (2000) that cutting and mincing of raw meat were particularly important processes that greatly tenderized the initial material thus leading to a homogenous final product. However, the effect of cut-part used significantly ($p<0.05$) affected all parameters measured. Ranges of values recorded for pH (6.45 – 6.74), cooking loss (25.06 – 28.85%), chilling loss (4.41 – 7.92%), and diameter shrinkage (11.77 – 14.58) revealed patties prepared from thigh was significantly ($p<0.05$) higher.

In Table 2, housing system effects on sensory analysis of ground turkey patties was not significant. However, the effect of cut-part significantly ($p<0.05$) affected all parameters measured except chewiness. The range of sensory scores; appearance (3.90 – 4.92), oiliness (4.28 – 6.20), flavour (5.53 – 6.23) and overall acceptability (5.48 - 6.65) were significantly ($p<0.05$) higher in breast patties. However, the score for oiliness was higher in thigh patties which could be traced to the fat content of the raw material used for patty production. Earlier studies (Huda *et al.,* 2011; Chen *et al.,* 2016)

reported higher fat content in the thigh of poultry when comparing with breast. Thus, indicating that a raw material with a high fat content will equally increase the oiliness of the final product. Furthermore, interaction between sex and muscle type significantly ($p<0.05$) influenced patty appearance.

CONCLUSION AND RECOMMENDATION

From this study, breast patties had reduced oiliness score as well as better pH and overall acceptability. Therefore, the use of turkey breast as raw material for ground patties production was recommended.

REFERENCES

Araújo, W.A.G., Albino, L.F.T., Sakomura, N. K., Paulino, P.V.R. and Campos, A.M. 2011. Meat quality in "indoor" and "outdoor" production systems of poultry and swine. *Open Journal of Animal Science* 1(3): 75-88

Chen, Y., Qiao, Y., Xiao, Y., Chen, H., Zhao, L., Huang, M. and Zhou, G. 2016. Differences in Physicochemical and Nutritional Properties of Breast and Thigh Meat from Crossbred Chickens, Commercial Broilers, and Spent Hens. *Asian-Australasian Journal of Animal Sciences 29:855-864*

Damaziak, K., Pietrzak, D., Michalczuk, M., Mroczek J. and Niemiec, J. 2013. Effect of genotype and sex on selected quality attributes of turkey meat. *Archiv fur Geflügelkunde* 77(3): 206–214.

Fernández-López J., Pérez-Alvarez J.A. and ArandaCatala V. 2000. Effect of mincing degree on colour properties in pork meat. *Colour Research and Application*, 25: 376–380.

Gujral, H. S., Kaur, A., Singh, N. and Sodhi, N. S. 2002. Effect of liquid whole egg, fat and textured soy protein on the textural and cooking properties of raw and baked patties from goat meat. *Journal of Food Engineering* 53(4): 377-385.

Heinz, G. and Hautzinger, P. 2007. Meat Processing Technology. For Small-To Medium scale Producers. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific.

Huda, N., A. Putra, and R. Ahmad. 2011. Proximate and physicochemical properties of Peking and Muscovy duck breasts and thighs for further processing. *Journal of Food, Agriculture and Environment* 9:82-88.

Sogunle, O.M., Olaniyi, O.A., Shittu, T.A. and Abiola, S.S. 2012. Performance and meat attributes of chickens reared on deep litter and free range. *Archivos de zootecnia* 61 (3): 569-576.

Table 1: Effects of housing system and cut-part used on physiochemical properties of ground turkey patties

Parameters		pH	Cooking loss (%)	Chilling loss (%)	Diameter shrinkage (%)
Housing system	Deep litter	6.58	26.00	6.75	13.80
	Outdoor run	6.62	27.92	5.57	12.54
Cut-part	Thigh	6.74[a]	28.85[a]	7.92[a]	14.58[a]
	Breast	6.45[b]	25.06[b]	4.41[b]	11.77[b]
SEM		0.03	0.75	1.05	0.65
			P value		
HS		0.302	0.083	0.436	0.179
CP		<0.0001	0.001	0.027	0.005
HS×CP		0.014	0.804	0.285	0.153

Means on the same column having different superscript differ significantly at $P < 0.05$.
HS = Housing system, CP = Cut-part

Table 2: Effects of housing system and cut-part used on sensory analysis of ground turkey patties

Parameters		Appearance	Oiliness	chewiness	Flavour	Overall acceptability
Housing system	Deep litter	4.50	5.20	4.08	5.97	6.12
	Outdoor run	4.32	5.28	4.37	5.80	6.02
Cut-part	Thigh	3.90[b]	6.20[a]	4.37	5.53[b]	5.48[b]
	Breast	4.92[a]	4.28[b]	4.08	6.23[a]	6.65[a]
SEM		0.25	0.20	0.26	0.21	0.22
			P value			
HS		0.607	0.763	0.442	0.578	0.745
CP		0.005	<0.0001	0.442	0.021	<0.0001
HS×CP		0.963	0.366	0.514	0.739	0.194

Means on the same column having different superscript differ significantly at $P < 0.05$.
HS = Housing system, CP = Cut-part

EVALUATION OF *OCIMUM GRATISSIMUM* AND *OCIMUM CANUM* ON THE CARCASS AND ORGANOLEPTIC PROPERTIES OF BROILER CHICKENS MEAT

Salihu, E.A., Onimisi, P.A., Omage, J.J., Taruwa, A., Yaqoob, R.
Department of Animal Science, Ahmadu Bello University, Zaria

ABSTRACT
The study was carried out to determine the effect of *Ocimum gratissimum* and *Ocimum canum* on the carcass characteristics and organoleptic properties of broiler chickens. A total of 396 day old Cobb 500 broiler chicks were randomly allotted to six dietary treatments each replicated thrice with 22 birds in a completely randomized design. Six treatment diets were formulated containing 0g of experimental materials as control, 400 and 800g of *O. gratissimum* (T2 and T3), 400 and 800g of *O. canum* (T4 and T5) while oxytetracycline as recommended by the manufacturer was used as positive control (T6). All data collected were subjected to analysis of variance and significant differences among treatment means were compared using Tukey procedures. Carcass characteristics of cut parts showed that birds on 400g of *O. gratissimum*, 800g of *O. canum* and antibiotics growth promoters (AGPs) had higher ($p<0.05$) drumstick and breast cut percentages. Organ weights were significantly higher ($p<0.05$) for birds fed diets containing *Ocimum spp.* at 800g/100kg diets. Abdominal fat were lower for birds fed diets containing *O. gratissimum* and *O. canum* at 800g/100kg diets. The result of sensory analysis showed that the meat of broiler chickens in the treatment groups supplemented with *O. gratissimum* and *O. canum* had higher eating and sensory attributes. Inclusion of *O. gratissimum* and *O. canum* in broiler chickens diets significantly improved carcass traits and eating quality.
Keywords: Sensory, quality, essential oil, antibiotics, phytobiotics.

INTRODUCTION
Antibiotics growth promoters (AGPs) have been used for about 50 years to enhance growth performance (Dibner and Richards, 2005). It has been used widely not only to prevent and treat poultry diseases, but also for the improvement of meat and egg production (Ogle, 2013). Natural growth promoters (NGPs) such as prebiotics, probiotics, synbiotics, enzymes and plant extracts can be used to feed broilers without any adverse effect on the performance of birds (Akhtar *et al*., 1984). *Ocimum gratissimum* and *Ocimum canum* as NGPs can be used as an alternative to common artificial growth promoters like antibiotics both to improve growth performance, carcass characteristics and eating quality. These aromatic leaves has been reported to retain their flavor and other qualities even after drying (Mandal *et al*., 2010). The study was undertaken therefore to evaluate the essential oil of *Ocimum gratissimum* and *Ocimum canum* leaves as additives on the carcass and organoleptic assessment of broiler chickens meat.

MATERIALS AND METHODS
Experimental site
The experiment was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State. Zaria is in the Northern Guinea Savannah zone, on longitude 11° 09' 01.78'' N and 7°39'14.79''E 671m above sea level with a mean annual rainfall of 700-1400mm (IARMS, 2019).
Experimental design and management of birds
Three hundred and ninety six day old Cobb 500 broiler chicks were allotted to six dietary treatments with 3 replicates of 22 birds each in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practices. Feed and water were provided *ad libitum* throughout the experimental period. Six treatment diets were formulated to meet the requirements of the birds for the starter and finisher phases respectively containing 0g, 400g and 800g of *Ocimum gratissimum* and 400g and 800g of *Ocimum canum* as additives and oxytetracycline as recommended by manufacturer as positive control.

Carcass analysis
At the end of the finisher phase, 3 chickens were randomly selected from each treatment, representing the average weight of the group for carcass evaluation. The selected birds were starved of feed, bled by severing the jugular vein and then scalded in hot water to remove the feathers. Live weight for

each chicken, dressed weight, prime cuts and weight of organs were measured. Dressing percentage was calculated. The organs and cut parts were expressed as a percentage of live weight and dressed weight respectively.

Sensory evaluation

The meat was assessed for flavour, tenderness, juiceness, texture, colour and overall acceptability with a structured questionnaire on a 5-point Hedonic scale (5-like very much, 4-like, 3-neither like nor dislike, 2-dislike, 1-dislike very much) using 30 semi-trained panelists in the Faculty of Agriculture, Ahmadu Bello University, Zaria. All needed accessories were provided; clean water, tooth-picks, detergent, biscuit and serviette were provided for the entire panelist before the evaluation. Each sample was blind coded by the researcher to reduce bias. The samples were processed by grilling at the animal product and processing laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria.

Statistical Analysis

All data obtained from the experiment were statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems software package while significant difference between treatments means were separated using Tukey Procedure (SAS, 2002).

RESULTS AND DISCUSSION

Carcass characteristics of broiler chickens fed diets containing *Ocimum gratissimum* and *Ocimum canum*

The carcass characteristics of broiler chickens fed diets containing *Ocimum gratissimum* and *Ocimum canum* is presented in Table 1. There were significant differences ($p<0.05$) in all parameters measured except for thigh, back, gizzard and lungs percentages. The results obtained showed that birds fed dietary supplements of *Ocimum canum* at 800g/100kg diet and AGPs had higher ($p<0.05$) dressed weight and dressing percentage than those fed diets containing *Ocimum gratissimum* and the control. Result of the cut parts showed that birds on 400g of *Ocimum gratissimum*, 800g of *Ocimum canum* and AGPs had higher ($p<0.05$) drumstick and breast cut percentages. Organ weights were significantly higher ($p<0.05$) for birds fed diets containing *Ocimum gratissimum* and *Ocimum canum* at 800g/100kg diets. The enlargement of these organs may be due to their involvement in detoxification of the materials. Studies have reported that the use of antibiotics as a growth promoter has ability to improve weight gain as well as carcass yield of birds (Al-Kassie, 2010). The result is in agreement with Khaksar *et al*. (2012) who reported significant improvements in some carcass traits due to inclusion of thyme essential oils. However, Schulze *et al*. (2008) did not observe a significant effect in the broiler carcass yield due to the dietary inclusion of essential oil blend based on thyme and cinnamon. Abdominal fat were lower for birds fed diets containing *Ocimum gratissimum* and *Ocimum canum* at 800g/100kg diets. Percent abdominal fats reduces as the inclusion levels of the experimental materials increases. The findings of this study agrees with that of Myandoab and HosseiniMansoub (2012) who reported that licorice extract lowered abdominal fat level.

Table 1: Carcass and organs characteristics of broiler chickens fed diet containing *Ocimum gratissimum* and *Ocimum canum*

Parameters	Inclusion levels of experimental materials (g/100kg diet)						SEM
	0	*Ocimum gratissimum*		*Ocimum Canum*		Oxytet	
		400	800	400	800		
Live wt. (g/bird)	2350.00^{c}	2400.00^{bc}	2533.33^{a}	2416.67^{bc}	2466.67^{ab}	2516.67^{a}	50.46
Dressed weight (g/bird)	1702.33^{c}	1722.00^{c}	1828.00^{ab}	1775.67^{bc}	1860.00^{a}	1868.00^{a}	45.33
Dressing percent (%)	72.43^{b}	71.77^{b}	72.14^{b}	73.49^{ab}	75.44^{a}	74.20^{a}	1.14
Cut parts expressed as percentage of dressed weight (%)							
Thigh	12.33	11.67	12.23	12.36	12.17	12.69	0.29
Drum stick	9.59^{b}	10.20^{a}	9.48^{b}	9.65^{b}	10.33^{a}	9.78^{ab}	0.30
Breast	24.57^{a}	23.98^{ab}	24.92^{a}	22.50^{b}	24.77^{a}	25.53^{a}	0.75
Back	11.58	12.02	12.10	12.16	11.70	11.35	0.34
Organ weights expressed as percentage of live weight (%)							
Liver	2.27^{b}	2.28^{b}	2.87^{a}	2.34^{b}	2.50^{ab}	2.17^{b}	0.25
Lungs	0.61	0.69	0.76	0.70	0.70	0.70	0.14
Kidney	0.67^{b}	0.71^{ab}	0.78^{a}	0.73^{ab}	0.74^{a}	0.64^{b}	0.05
Gizzard	2.24	2.32	2.41	2.29	2.43	2.23	0.10
Heart	0.45^{c}	0.55^{ab}	0.51^{bc}	0.51^{bc}	0.64^{a}	0.50^{bc}	0.05
Abdominal fat	1.29^{c}	0.95^{b}	0.63^{a}	1.01^{b}	0.76^{a}	1.01^{b}	0.13

^{abc}Means with the same superscripts along the rows are not significantly different (p>0.05), SEM: standard error of means, Oxytet: Oxytetracycline.

Sensory attributes of meat from broiler chickens fed diets containing *Ocimum gratissimum* and *Ocimum canum*

The organoleptic evaluation of food products to any food processing technology is very important in determining the consumer acceptability. The result of sensory analysis for the meat of broiler chickens fed dietary supplement of *Ocimum gratissimum* and *Ocimum canum* is presented in Table 2. The results obtained shows that there were significant differences (P< 0.05) for all the sensory parameters evaluated. Meat of the broiler chickens in the treatment groups supplemented with *Ocimum gratissimum* and *Ocimum canum* had higher eating and sensory attributes. Sensory parameters had higher organoleptic attributes for the birds in the treatment groups fed diets supplemented with *Ocimum gratissimum* and *Ocimum canum* than the control and AGP groups. This implies that addition of these phytogenic feed materials improved the eating quality of broiler chicken meat which may be due to higher aromatic fluids and essential oil in these botanical which makes them to maintain desirable culinary properties. Okubanjo *et al*. (2010) in their study also reported higher culinary properties for spent layers chicken meat tenderized with an additive.

Table 2: Sensory evaluation of broiler chicken meat fed diet containing *Ocimum gratissimum* and *Ocimum canum*

Parameters	Inclusion levels of experimental materials (g/100kg diet)						SEM
		Ocimum gratissimum		*Ocimum canum*			
	0	400	800	400	800	Oxytet	
Colour	4.13^{bc}	4.68^{ab}	4.87^{a}	4.61^{ab}	4.84^{a}	3.87^{c}	0.34
Texture	3.97^{bc}	4.65^{ab}	4.87^{a}	4.55^{ab}	4.77^{a}	3.84^{c}	0.35
Flavour	3.45^{c}	4.85^{a}	4.87^{a}	4.58^{ab}	4.81^{a}	3.77^{bc}	0.42
Tenderness	3.74^{c}	4.42^{b}	4.87^{a}	4.74^{ab}	4.65^{ab}	3.97^{c}	0.34
Juiciness	3.32^{c}	4.55^{a}	4.88^{a}	4.61^{a}	4.84^{a}	4.03^{b}	0.37
Acceptability	3.45^{b}	4.77^{a}	4.94^{a}	4.84^{a}	4.94^{a}	3.48^{b}	0.37

^{abc}Means with the same superscripts along the rows are not significantly different (p>0.05), SEM: standard error of means, Oxytet-Oxytetracycline.

CONCLUSION

Addition of *Ocimum gratissimum* and *Ocimum canum* in broiler chickens diets at 800g/100kg diet significantly improved carcass characteristics and organoleptic properties of broiler chicken meat.

RECOMMENDATIONS

Ocimum gratissimum and *Ocimum canum* at 800g/100kg diets as an alternative to synthetic antibiotic growth promoters for improved carcass traits and better eating quality of broiler meat.

REFERENCES

Akhtar, M.S., Afzal, H. and Chaudry, F. (1984). Preliminary *in vitro* antibacterial screening of Bakain and Zarisk against *Salmonella*. *Medicose*, 9: 6-7.

Al-Kassie, G.A.M. (2010). The role of peppermint (*Mentha Piperita*) on performance in broiler diets. *Agricultural Biology Journal North America*, 1: 1009-1013.

Dibner, J.J. and Richards, J.D. (2005). Antibiotic growth promoters in agriculture: History and mode of action. *Poultry Science*, 84:634-643.

Institute for Agricultural Research Metrological Station, IARMS (2019). Metrological data from IAR metrological station, Ahmadu Bello University, Samaru, Zaria, Nigeria.

Khaksar, V., Van Krimpen, M.M., Hashemipour, H. and Pilevar, M. (2012). Effects of thyme essential oil on performance, some blood parameters and ileal microflora of Japanese quail. *Journal of Poultry Science*, 49: 106-110.

Mandal, S., Nayak, A., Kar, M., Banerjee, S.K., Das, A. and Upadhyay, S.N. (2010). Antidiarrhoeal activity of carbazole alkaloids from *Ocimum canum* Spreng (Rutaceae) seeds. *Fitoterapia*, 8:72-74.

Myandoab, M.P. and Hosseinimansoub, N. (2012). Comparative Effect of Liquorice Root Extract Medicinal Plants and Probiotic in Diets on Performance, Carcass Traits and Serum Composition of Japanese Quails. *Global Veterinary*, p8: 39-42.

Ogle, M. (2013). Riots, Range Resistance: A brief history of how antibiotics arrived in the farm. *Scientific American*. https://en.wikipedia.org/wiki/Antibiotic_use_in_livestock Retrieved April 5, 2019.

Okubanjo, A.O., Omojola, A.B., Olusola, O.O. and Oladepo, O.O. (2010). Post- mortem tenderization of spent layer's breast meat with calcium chloride. *African Journal of Food Science*, 5(2): 45-49.

S.A.S., (2002). Statistical Analysis System Institute, User's Guide. Version 9 for Windows. North Carolina, U.S.A.

Schulze, H. P., Plumstead, H., Bento, V. and Ravindran, G. (2008). Effects of Dietary Inclusion of Essential Oil Blends on Broiler Performance, Carcass Characteristics and Sensory Quality of Meat. Proceedings of the Poultry Science Association Annual Meeting, July 20-23, 2008, *Poultry Science Association*, Pp: 76-78.

SENSORY CHARACTERISTICS OF MEAT CHICKENS OBTAINED FROM BROILERS FED MANNAN OLIGOSACCHARIDES, GINGER AND GARLIC SUPPLEMENTED WITH ENZYMES

***Sanwo, K. A., Adegoke A. V., Oso, O. A., Sobayo, R. A., Siluade, T.A., & Adegbite, J. A.,**
Department of Animal Production & Health, Federal University of Agriculture, PMB 2240, Abeokuta, Ogun State,Nigeria
**Corresponding author e mail: bumogardens@yahoo.com*

ABSTRACT
This study was conducted to investigate the sensory characteristics of muscle obtained from broiler breast meat fed Mannan oligosaccharides (MOS), ginger and garlic supplemented with ROVABIO enzymes. One hundred and twenty (120) broiler birds were assigned to four treatment groups of ten birds per replicate of three replicates per treatment. In treatment 1, the birds were fed control diets with ROVABIO enzymes only, while treatments 2, 3 and 4 were fed control diets supplemented with MOS, ginger and garlic supplemented with ROVABIO enzyme respectively. Sensory characteristics such as Color, juiciness, Meaty flavor, Tenderness, Saltiness, overall flavor and acceptability were measured using a 9 point hedonic scale. Results showed no significant difference (P>0.05) amongst treatment means.
***Keywords**:* Mannan Oligosaccharides, Ginger and Garlic, Enzymes

INTRODUCTION
There has been a resurgence of interest in improving the physicochemical and sensory properties of meat, as well as its storage life. In pursuit of improved chicken healthiness and in order to fulfil consumer expectations in relation to food quality, poultry producers more and more commonly apply natural feeding supplements, mainly herbs (Gardzielewska *et al*., 2003). Spices are very common as useful additives in broiler diets (Zhang *et al*., 2009). The supplementation of spices and herbs have many benefits to broilers health and performance such as having anti oxidative potential (Hui, 1996), antimicrobial activity and enhancing digestion by stimulating endogenous enzymes (Dorman and Deans, 2000). A major problem in the meat industry is a reduction in the acceptability and nutritional quality of meat as well as changes in flavor due to the process of lipid oxidation. Therefore, the development of new convenient meat and meat products with natural flavor and taste. (Cannon *et al*., 1995). As a result, an approach to overcoming the lipid oxidation problem of the meat industry is to use dietary garlic and ginger supplementation in animals which can reduce lipid stability (Kim *et al*., 2005).

Mannan Oligosaccharides (MOS) are widely used in nutrition as natural additives and has been used in poultry which showed an improvement in performance, feed conversion and meat quality. Pelicano *et al*. (2003) reported that the concomitant use of MOS in water and feed increases meat quality in relation to color, pH and tenderness. ROVABIO® enzyme is a unique enzyme known to reduce feed costs while consistently maintaining or increasing animal performance and high carcass yield. Hence this study.

MATERIALS AND METHODS
This study was carried out at the meat quality laboratory of the Department of Animal Production and Health, Federal University of Agriculture (FUNAAB), Abeokuta, Ogun State.
A total of 120 broiler birds, were divided into four treatment groups. Each group containing three (3) replicates of 10 birds.
Experimental Layout and Birds Management: Each birds were fed diets containing; Treatment l = Control feed supplemented with ROVABIO® enzyme; Treatment 2 = Feed supplemented with ROVABIO® enzyme containing 0.5g/kg Mannan Oligosaccharide (MOS); Treatment 3 = Feed supplemented with ROVABIO® enzyme containing 0.5g/kg ginger; Treatment 4 = Feed supplemented with ROVABIO® enzyme containing 0.5g/kg garlic were fed to all the birds for 6 weeks after brooding with commercial ration for 2 weeks. The experimental diet used for this study is stated thus:Crude protein 23, 5%, Crude fat 4.31 and Metabolisable Energy (MJ/kg) 10.94Mj/ kg.

Daily routine management was carried out such as supply of clean water, feed, observing for sick birds, checking for mortalities and appropriate record keeping.

Slaughtering and processing of birds: At the end of the 8th week, three birds per treatment were killed using the traditional method. Feathers were removed by scalding in hot water at 60°C. Breast muscle was excised to determine sensory quality characteristics.

Sensory evaluations: samples of chicken meat cooked at 70° C for 30 minutes were assessed by ten (10) panelists, where some meat qualities parameters such as color, juiciness, meaty flavor, tenderness, saltiness, overall flavor and overall acceptability were scored using a 9-point Hedonic scale (1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=intermediate, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely) as described by Sanwo *et al.* (Sanwo *et al*., 2014)

Statistical Analysis

All the data obtained were subjected to a completely randomized design in a one way analysis of variance using SPSS 16 (2005) the means were separated using the Duncan's Multiple Range Test (DMRT) (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

The results of the sensory evaluation of broiler breast muscle fed Mannan oligosaccharides, ginger and garlic with enzyme is presented in Table 1. All values obtained were not significant (P>0.05) in this study. However numerically, meat obtained from birds fed the control diet were most preferred in color, juiciness, meaty flavor, and overall acceptability except for saltiness and overall flavor which were most preferred in meat of birds fed diet containing control diet, Mannan Oligosaccharides and Enzyme. Birrenkott *et al*. (2000) reported no difference in flavor in eggs from hens consuming up to 3% dietary garlic powder. Their results may be because of differences in supplemental levels, feeding duration, or preparation method. Nassu *et al*. (2003) reported that an antioxidant such as garlic directly retards oxidized aroma and flavor. Although, results did not show significant differences, the increase in flavor of ginger and garlic-treated samples could be attributed to flavor-producing reactions that occur during cooking (Pawer *et al*., 2007). However, closely similar values were obtained for overall flavor in treatments 3 and 4. Also, difference in sensory attributes between the treatments recorded higher tenderness score for the samples obtained from treatment 4 which had garlic supplementation (7.19) but had the lowest value for juiciness. Dietary supplementation with MOS treatment resulted in a less desirable color and flavor score (5.71 and 5.77 respectively). Meat from birds fed MOS were saltier than meat from birds fed other supplements with ginger having the lowest value for saltiness.

In conclusion meat of chickens obtained from broilers birds fed mannan oligosaccharides, ginger and garlic supplemented with enzymes did not have any effect on the sensory characteristics

REFERENCES

Birrenkott, G., Brockenfett, G.E., Owens, M and Halpin, E. 2000. Yolk and blood cholesterol levels and organoleptic assessment of eggs from hens fed a garlic supplement diet. *Poultry Science* 79:75. *(Abstract)*

Cannon, J. E; Morgan J.B; Delmore R.J; Sofos J.N, Smith G.C and Williams S.N. 1995. Vacuum packaged precooked from hogs fed supplemental Vit E: Chemical shelf-life and sensory properties. *Journal of Food Science* 60:1179-1182

Dorman, H.J.D. and S.G. Deans, 2000. Antimicrobialagents from plants: Antibacterial activity of plant volatile oils. *Journal of Applied Microbiology. 88: 308-316.*

Gardzielewska, J., Pridyszak, K., Majewska, T., Jakubowska, M and Pomianowski, J. 2003. Effect of plant supplemented feeding on fresh and frozen storage quality of broilers chicken meat. *Electronic Journal of Polish Agricultural Universities* 6(2): 12.

Hui, Y.H., 1996. Oleoresins and essential oils. In: Hui YH, editor. Bailey's industrial oil and fat products. New York: Wiley-Interscience Publication, cap. 6, pp: 145-153.

Kim B.C., Ryu, Y.C., Cho, Y.J and Rhee, M.S. 2005. Influence of dietary alpha tocopherol supplementation on cholesterol oxidation in retail packed chicken meat during refrigerated storage. *Biosciences, Biotechnology and Biochemistry* 70:808-814.

Nassu, R. T., Goncalves, A.G., Pereira, M.A.A and José Beserra, F. 2003. Oxidative stability of fermented goat meat sausage with different levels of natural antioxidant. *Meat Science* 63:43–49.

Pawer, V.D., Mule, B.D and Machewed, G.M. 2007. Effect of marination with ginger rhizome extract on properties of raw and cooked cheven. *Journal of Muscle Foods* 18:349–369.

Pelicano, E.R.L., Souza, PA de., Souza HBA de., Oba, A., Norkus, E.A., Kodawara, C.M and Lima TMA de. 2003. Effect of different probiotics on broiler carcass and meat quality. *Reveista Brasileira de Cienca Avicola* 5(3):515-516

Sanwo, K.A., Iposu, S.O.,Olayemi, O and Adegbite, J.A. (2014). Effects of substituting Wheat flour with Millet flour in Beef sausage production. ***Nigerian Journal of Animal Science, 16(2) 338 – 334.*** Published by Animal Science Association of Nigeria. Available on www.animalscienceassociation.org.ng

Steel, R.G.D., Torrie J.H and Dickey, D.A. 1997. Principles and Procedures of Statistics.A Biochemical Approach. 2nd Ed., McGraw Hill Book Co. Inc. New York, USA.

Zhang, G.F., Yang, Z.B., Wang, Y., Yang, W.R and Jiang, S.Z. 2008. Effect of ginger root and oil on antioxidant status and meat quality of broilers. Asian-Aust. Journal of Animal Science 18:699-703.

Table 1. Sensory evaluation of broiler breast muscle fed mannan oligosaccharides, ginger and garlic with enzyme

	Treatments				
Parameters	**1**	**2**	**3**	**4**	**SEM**
Color	6.42	5.71	5.85	6.06	0.17
Juiciness	6.35	6.01	6.13	5.71	0.16
Meaty flavor	6.49	5.77	6.42	6.21	0.23
Tenderness	6.71	6.34	6.21	7.19	0.28
Saltiness	5.28	5.39	5.21	5.35	0.08
Overall flavor	5.97	6.28	6.13	6.14	0.13
Overall acceptability	6.99	6.40	6.14	6.52	0.19

SEM: Standard error mean

Treatment 1: Control; Treatment 2: Mannan Oligosaccharides; Treatment 3: Ginger

Treatment 4: Garlic

EFFECT OF STORAGE DAYS AND TEMPERATURE ON THE SENSORY EVALUATION OF FERTILE AND NON-FERTILE CHICKEN EGGS IN JOS PLATEAU STATE

Sati N. M[1], Emennaa P. E[1], Mbuka J. J.[1], Ene P. N.[2], Adesope A.I[3] & Oshibanjo D.O[2*]
National Veterinary Research Institute, Vom Jos Plateau State Nigeria[1]
Department of Animal Production, University of Jos, Jos Plateau State Nigeria[2]*
Department of Animal Science, University of Ibadan, Ibadan Oyo State Nigeria[3]
oshibanjoo@unijos.edu.ng
+2348055438564

ABSTRACT
This study aims at identifying a suitable method that will significantly reduce the rate at which biological and physiochemical changes occur within the egg with respect to storage and temperature. A total of 600 fertile and non-fertile eggs of Lohmann brown hen were collected from Poultry Division of National Veterinary Research Institute, Plateau State (NVRI) in four successive weeks and used for this study. The eggs were stored at room temperature (ambient) and refrigeration at 10°C for 0, 5, 10, 15 and 20 days. Egg were boiled, served to taste panelists of 20 trained personals in a 2 x 2 Factorial arrangement in a completely randomized design. Data obtained were analyzed using ANOVA at $\alpha_{0.05.}$ The results reveals that there was no significant difference ($p>0.05$) existed among odour, aroma, taste, texture and overall acceptability for all the treatments. However, there was significant difference ($p<0.05$) between fertile and non-fertile eggs colour. The colour and texture was observed to be statistically significant ($p<0.05$) in all the storage days 0, 5, 10, 15 and 20 for both fertile and non-fertile eggs stored in room and refrigerator temperature. The colour of non-fertile eggs was recorded to be the highest at day 10 of refrigerator temperature. While the texture of fertile eggs was recorded to be the highest at day 10 and 15 of room temperature. There is no adverse effect of storage days and temperature on sensory evaluation of eggs from both the fertile and non-fertile.

Keywords: Sensory evaluation, storage days, storage temperature, fertile eggs and non-fertile eggs.

INTRODUCTION
Eggs are highly palatable and can be prepared or utilized in a number of ways. Eggs are perfectly balanced foods containing proteins, vitamins (except vitamin C) and minerals required for good health by both the young and old (NECC, 2014). Eggs could be fertile, non-fertile and unfertile. If the egg is infertile, the germinal disk contains the genetic material from the hen only. If the egg is fertile, it contains genetic material from both parents and is where embryonic development begins. The yolk material serves as a food source for embryonic development (Jacqueline *et al.*, 1998).

The main degradation factors for eggs are storage days (time), Bell (1996), temperature, humidity, air movement, and handling (Stadelman 1995; Samli *et al.*, 2005). Internal quality deterioration of eggs can be retarded significantly by maintaining storage temperature, because quality deterioration occurs faster at high temperatures than at refrigerated temperatures during storage (Zeidler, 20023). Therefore, the present study has been undertaken to determine the effects of storage days and temperature on sensory qualities of fertile and non-fertile eggs.

MATERIALS AND METHODS
Experimental site: The experiment was conducted at microbiology and biotechnology laboratory of the Pharmaceutical sciences, University of Jos, Jos-North Local Government Area (LGA) of Plateau State. It is situated at the extreme North of the State and located between latitude 9^0 E55' North of the Greenwich meridian and longitude 8^0 E54' East of the Equator (Haruna *et al.*, 2007).
Collection of experimental material
A total of 600 fertile and non-fertile eggs was collected from Poultry Division of National Veterinary Research Institute, Plateau State (NVRI) in four successive weeks were used for this study. Eggs were

obtained from Isa brown female chickens. The eggs were stored at room temperature (ambient) and refrigeration at 10°C for 0, 5, 10, 15 and 20 days and humidity was 55 to 60% for all treatments.

Sensory evaluation

A total of 20 trained individuals aged between 20 and 40 years were used to assess two replicate of the prepared eggs. The samples were evaluated using a 9-point hedonic scale for flavor, colour, juiciness, tenderness, and overall acceptability The scale had a maximum score of 9 while the lowest score of 1 was assigned to the poorest condition (Mahendraker *et al.*, 1988).

Experimental design

2 x 2 Factorial arrangement in a completely randomized design.

Statistical analysis

Data collected were analyzed using General linear model of SAS (SAS 2010). Statistical variations were observed and means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSIONS

The main effect of temperature difference on sensory evaluation of fertile and non-fertile eggs are shown in Table 1. There was no significant difference ($p>0.05$) that existed for odour, aroma, taste, texture and overall acceptability for all the treatments. However, there was significant difference ($p<0.05$) between fertile and non-fertile eggs colour. The highest colour was recorded non-fertile egg stored under room temperature which the least colour was observed on fertile egg stored under room temperature. The result obtained for colour could be due to fertilization process and moisture content that losses during storage.

The interaction effect of storage days and temperature difference on sensory evaluation of fertile and non-fertile eggs is presented in Table 2. The colour and texture was observed to be statistically significant ($p<0.05$) in all the storage days 0, 5, 10, 15 and 20 for both fertile and non-fertile eggs stored in room and refrigerator temperature. The colour of non-fertile eggs was recorded to be the highest at day 10 of refrigerator temperature. While the texture of fertile eggs was recorded to be the highest at day 10 and 15 of room temperature.

Table 1: Main effect of temperature difference on sensory evaluation of fertile and non-fertile eggs

Parameter	Fertile Egg		Non-Fertile Egg		SEM
	Room Temperature	Refrigerator Temperature	Room Temperature	Refrigerator Temperature	
Colour	4.42[b]	4.70[b]	5.82[a]	5.06[ab]	0.19
Odour	2.24	2.60	2.43	2.80	0.15
Aroma	4.12	3.90	3.76	4.00	0.11
Taste	5.97	6.24	5.80	6.15	0.21
Texture	5.81	5.64	5.65	5.36	0.14
Overall Acceptability	6.91	6.93	6.74	6.70	0.13

[a, b] means with different superscripts within the same row differ significantly ($p<0.05$)., SEM means standard error of mean

CONCLUSION

There is no adverse effect of storage days and temperature on sensory evaluation of eggs from both the fertile and non-fertile.

REFERENCES

Bell, D. (1996). Effects of temperature and storage time on egg weight loss. *Poultry International* **35**(14):56-64.

Haruna, U., Daneji M.I. & Idi .S (2007*).* Comparative Economic Analysis of Adopters and Non-adopters in Bauchi LGA, Bauchi State. Proceedings of the 8th Annual conference Nigerian Society for Animal Production, AESON, pp: 55-62.

Jacqueline P. Jacob, Richard D. Miles and F. Ben Mather(1998):*egg quality*, one of a series of the Animal Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida,24 (1):1-12.

Joseph, J. K. and Ogundele, O. G. (1996). Shelf life of hen's egg as influenced by coating with shear butter fat, palm kernel oil and film packaging. *Nigerian Journal of Pure and Applied Science* **11**:398-404.

Mahendrakar, N.S., Khabade, U.S and Dam, N.P (1988). Studies on the effect of fatting on carcass characteristics and quality of meat from Bannur lambs. *J. Food Sci. Tech.25: 225-231.*

National Egg Coordination Committee, NECC, (2014): Food and Egg Nutrition. Available at http://www.e2necc. Com/egg –index html. Retrieved 20/09/19.

Samli, H. E., Agna, A. &Senkoylu, N. 2005.Effects of storage time and temperature on egg quality in old laying hens. *Journal of Applied Poultry Research* **14**:548-533.

SAS (2010). SAS/STAT User's Guide:Version 9.2. SAS Institute Inc., Cary. NC., USA;2010.

Stadelman, W.J and Coterill, O.J. (1986): The preservation of quality of Shell eggs. In: Stadelmann and Coterill O.J. (eds). Egg Science and Technology.Avi Publishing com., Inc, WestPort, Connecticut, USA.United States of Department of Agriculture- Agriculture Marketing Service, USDA-AMS (2000): Egg grading manual. Agricultural Marketing Division.Agricultural Handbook NO.75, U.S.Department of Washington D.C.

Zeidler, G. (2002). Shell quality and preservation. In Bell, D. D. & Weaver, W. D. Jr. (eds). Commercial Chicken Meat and Egg Production. 5th rev. edn. Kluwer Academic Publishers, Norwell, pp. 1199-1217.

Table 2: Interaction effect of storage days and temperature difference on sensory evaluation of fertile and non-fertile eggs

		Fertile Egg		Non-Fertile Egg		
Parameter	**Days**	**Room Temperature**	**Refrigerator Temperature**	**Room Temperature**	**Refrigerator Temperature**	**SEM**
Colour	0	2.00^{abi}	2.00^{bi}	1.33^{bi}	1.33^{ai}	0.48
	5	1.5^{bi}	1.50^{bi}	2.50^{bi}	2.83^{abi}	0.48
	10	2.83^{ai}	3.50^{ai}	3.67^{aij}	4.50^{ai}	0.42
	15	2.22^{abj}	2.56^{aij}	2.67^{abij}	1.56^{ai}	0.31
	20	2.67^{abi}	3.42^{ai}	2.00^{ai}	3.58^{ai}	0.19
	SEM	0.32	0.42	0.35	0.35	
Odour	0	2.00	2.00	1.33	1.33	0.10
	5	1.50	1.50	2.50	2.83	0.30
	10	2.83	3.50	3.67	4.50	0.30
	15	2.22	2.56	2.67	1.56	0.28
	20	2.67	3.42	2.00	3.58	0.31
	SEM	0.23	0.29	0.29	0.38	
Aroma	0	4.00	4.00	4.00	4.00	0.10
	5	3.67	3.17	3.67	3.00	0.30
	10	4.17	4.33	3.67	4.83	0.30
	15	4.11	3.67	3.56	4.00	0.28
	20	4.67	4.25	3.92	4.08	0.31
	SEM	0.21	0.22	0.20	0.25	
Taste	0	6.67	6.67	6.00	6.00	0.00
	5	4.83	6.33	4.83	5.83	0.26
	10	6.17	6.33	6.33	6.17	0.27
	15	6.11	5.56	5.00	6.44	0.26
	20	6.08	6.33	6.83	6.33	0.26
	SEM	0.66	0.21	0.28	0.21	
Texture	0	6.17^{ai}	6.17^{ai}	4.83^{ai}	4.83^{ai}	0.20
	5	5.50^{ai}	4.67^{ai}	6.50^{ai}	4.70^{ai}	0.33
	10	6.89^{ai}	6.67^{ai}	6.67^{ai}	6.00^{ai}	0.26
	15	6.89^{ai}	5.89^{aij}	4.67^{aj}	5.11^{aij}	0.35
	20	4.83^{ai}	4.83^{ai}	5.58^{ai}	6.17^{ai}	0.30
	SEM	0.27	0.28	0.29	0.25	
Overall Acceptability	0	5.83	5.83	6.83	6.83	0.15
	5	7.00	7.67	5.5	6.33	0.35
	10	8.00	7.33	6.83	6.17	0.31
	15	7.67	7.00	7.56	7.44	0.26
	20	6.08	6.83	7.00	6.75	0.27
	SEM	0.30	0.26	0.27	0.23	

^{bcd} means with different superscripts within the same row differ significantly ($p<0.05$)., SEM means standard error of mean
^{ijk} means with different superscripts within the same column differ significantly ($p<0.05$)., SEM means standard error of mean

EFFECT OF TURMERIC (*Curcuma longa*) MARINADE ON SPENT LAYERS' MEAT

Seizing D.N[1], Oyinlola O. O[2]. Akwashiki M[1]., Oche G. O[1]., Satkyes A. K[1]., Pam Beatrice[1], Nanbol N.D[1]., Ikwuje, P. A[1], Muazu A. A[1], Izang Atang Iliya [1] Rev. Monk AlbericMary Ejembi & Oshibanjo D.O[1]*

[1]*Animal Production Department, Faculty of Agriculture, University of Jos, Jos Plateau State Nigeria*
[2]*Department of Animal Health and Production, Oyo State College of Agriculture amd Technology, Igboora Oyo State Nigeria*
[3]*Our Lady of the Angels Cistercian Monastery, P. O. Box 6976, Nsugbe, Onitsha Anambra State, Nigeria.*
Oshibanjoo@unijos.edu.ng*

ABSTRACT

This experiment was carried out at Post-Graduate Laboratory, Department of Chemistry, University of Jos, Jos Plateau state. Twenty spent layers' hen was used for this study. The fresh turmeric was purchased at Fari gada market, washed and blended with distilled water and the deboned spent hen meat was cut into primal cut. The breast, thigh and drumstick were mainly used. The marinated carcass was kept in the refrigerator at the temperature of 10^0C overnight in 0%, 5%, 10% and 15% of 1L inclusion levels respectively. On the basis of this experiment, the following meat quality and tenderness parameters were evaluated, shear force (SF), water holding capacity (WHC), extract released volume (ERV) and pH, in a completely randomized design. Data were analyzed using descriptive statistic and ANOVA at $\alpha_{0.05.}$ As the levels of inclusions increased, the shear force value decreases. 15% of turmeric extract had the lowest shear force value while control without turmeric extract had the highest shear force values. As the inclusion level increased, the water holding capacity increases. More so, the extract released volume result shows that the control had the lowest value of (17.50%) without turmeric extract while spent layer meat tendered with turmeric extract at 5% had the highest value of (43.75%). The mean pH value was higher in meat from 15% turmeric extract while the control meat had the lowest pH value. In conclusion, spent layers meat can be marinated in turmeric extract up to 10 – 15% /L due to improvement of tenderness.

Keywords: Turmeric extract, spent layer, tenderness, marinate and shear force

INTRODUCTION

Tenderness has been shown to have the largest role in consumer purchasing decisions (Mennecke, Townsend, Hayes, & Lonergan, 2007). The tenderness of a piece of meat is a result of several factors which can be considered sequentially. Spent layers are raised to lay eggs, and when their productivity declines, they are processed for their meat which is tough. A number of attempts have been made to tenderize and improve the qualities of meat such as spent layer meat.

There have also been attempts to physically tenderize meat by pressure treatments, electrical stimulation and the use of enzymes Proteolytic enzymes derived from plants such as papain, bromelain and ficin have been widely used as meat tenderizers in most parts of the world (Wada *et al.*, 2002). Such Proteolytic plant enzymes can be found in turmeric. The aim of the study is to seek the effect of the endogenous enzyme level of turmeric as a meat tenderizer on spent layer meat.

MATERIALS AND METHODS

Experimental site

This experiment was carried out at Post-Graduate Laboratory, Department of Chemistry, Faculty of Natural Science, University of Jos, Jos Plateau state. On latitude 9.9181^0N and longitude 8.8804^0E

Methodology

Twenty spent layers' was used for this study. The birds were slaughtered following standard procedure, dressed hygienically and manually deboned. The fresh turmeric was obtained from Our Lady of the Angels Cistercian Monastery, P. O. Box 6976, Nsugbe, Onitsha Anambra State, Nigeria., washed and blended with distilled water and the deboned spent hen meat was cut into primal cut. The breast, thigh and drumstick were mainly used. The marinated carcass was kept in the refrigerator at the temperature of 4^0C overnight to ensure easy mincing and marinated in 0%, 5%, 10%and 15% of 1L inclusion levels respectively.

On the basis of this experiment, the following meat quality and tenderness parameters were evaluated.

Shear Force Value

The objective evaluation of tenderness was performed using the modified Warner Bratzler shear force procedure (Bouton and Haris, 1978).

Physical evaluation

1. **Water holding capacity**

Water Holding Capacity (WHC) was determined according to Wardlaw, Maccaskill, and Acton (1973).

2. **Determination of extract release volume (ERV)**

The technique was first described in Jay, 1964, has been shown to be a value in determining incipient spoilage in meat as well as in predicting refrigerator shelf life.

3. **pH**

pH value was taken according to method described by AOAC (2000).

Experimental Design and layout

Completely randomized design.

Data analysis

The data obtained was statistically analyzed with the SPSS program for Windows (SPSS version 11.5, SPSS Inc., Chicago, IL, USA). Duncan's multiple-range test was used to compare the different between the means.

EFFECT OF MAIZE REPLACED WITH COCONUT CAKE MEAL ON GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND ECONOMICS OF PRODUCTION OF NOILER STRAIN OF CHICKEN

M. A. Ayoola (PhD) & O. A. Dada

Animal Production Unit, Department of Agriculture, Adeyemi College of Education, Ondo.
Email: mayoola1@yahoo.co.uk

ABSTRACT
A research was conducted to evaluate the effect of replacing maize with varying levels of coconut cake meal (CCM) in the diet on the performance, carcass characteristics and economics of production of noiler strain of chicken. Five treatment diets were formulated in which CCM replaced maize at 0, 10, 20, 30 and 40% levels using a completely randomized design in two replications with ten birds per replicate. The study lasted for 8 weeks during which growth performance, carcass characteristics and economics of production were assessed after the experiment. The results showed that feed intake were significantly higher ($P<0.05$) in noiler fed 30-40% levels of maize replaced with CCM when compared with the control. Also, tested diets have no significant effect on the final weight, total and daily weight gain of birds fed the 40% level of maize replacement with CCM when compared with the control. Price/Kg feed reduced with increased level of CCM in the diet. Also, Price/Kg bird produced reduced for birds at 40% level of maize replacement but not statistically ($P>0.05$) different. Tested diets exert no significant difference ($P>0.05$) on the percentage weight of primal parts and vital organs of the noiler birds. It could therefore be suggested that maize could be replaced with CCM up to 40% level in noiler diet as this will reduce the Price/Kg of feed and the competition for maize between man and livestock industry.
Keywords: Carcass Characteristics, Coconut Cake Meal, Growth Performance, Maize, Noiler.

INTRODUCTION
Poultry is one of the fastest means to achieving appreciable improvement in the nutritional standard of the populace because of its short generation interval, quick turnover rate and relatively low capital investment (Ani and Okeke, 2011).

In Nigeria, where the production of animal protein falls far short of meeting the demands of a rapidly growing population, poultry is the most common livestock kept (Obi, 2001). With the increasing population in Nigeria, there is need to fast track the process of poultry production especially meat and egg so as to meet up with protein needs of the population. To achieve this, a dual purpose chicken breed like Noiler is unavoidable. Noiler is an hybrid of broiler and cockerel with high resistance of cockerel and meat characteristics of broilers (Agricinfo.com, 2018).

Feed remains the most expensive input in poultry production with cereal grain constituting more than 40% of the feed cost (Oyedeji *et al,* 2003). Several workers have emphasized the need for utilizing alternative feed ingredients which have no competition between human and livestock industry (Fanimo *et al., 2007*; Nsa *et al.*, 2010).

Coconut meal is a by-product of coconut extraction. It is relatively high in residual oil which makes it a valuable energy source with high potential to serve as alternative to maize in ration formulation (Daghir, 2008)and noiler diet. Sundu *et al.*, (2009) reported possible utilization of coconut meal in broiler diet, However little or no information is available on the utilization of coconut cake meal as partial replacement of maize in noiler diet. This research is therefore conducted to assess the effect of replacing maize with coconut cake meal on growth performance, carcass characteristics and economics of production of noiler strain of chicken.

MATERIALS AND METHODS
One hundred, five weeks old noilers were used for this experiment. The birds were randomly allotted to five experimental groups, replicated twice with ten (10) birds per replicate in a completely randomized design.. The initial weights of the birds were taken before the commencement of the trail. Experimental diets were formulated such that maize was replaced with coconut cake meal at 0, 10, 20, 30, and 40% levels.

Table 1: Percentage Composition of Experimental Diet

Ingredients	Levels of Replacement (%)				
	0	10	20	30	40
Maize	65.0	58.5	52.0	45.5	39.0
Coconut Cake	0.0	6.5	13.0	19.5	26.0
Concentrate	27.5	27.5	27.5	27.5	27.5
Wheat Offal	7.5	7.5	7.5	7.5	7.5
Total	100	100	100	100	100

Birds were fed twice daily for a period of 56 days. Feeds were weighed before given to birds and the weight of leftover were also taken on daily basis to determine the feed consumption. Weekly weight gain were determined throughout the experimental period.

At the end of the eight weeks feeding trial, 4 birds were selected per treatment making a total of 20 birds for carcass and organ evaluation. The birds were slaughtered following the conventional method and allowed to bleed. These were later defeathered eviscerated and cut into primal parts. The weights of parts and organs were taken. Cost of diets was calculated by summing up the cost of each ingredient that make up 25kg of each treatment diet, which was thereafter reduced to cost in naira per kilogramme of diet.
Data collected were analyzed using Analysis of Variance (ANOVA) and the significant differences between means were separated using Duncan Multiple Range Test with the aid of Statistical Package for Social Sciences (SPSS) Version 20.

RESULTS AND DISCUSSION

Table 2: Effect of replacing maize with coconut cake meal on the growth performance and economics of production of Noiler strain of chicken.

Parameters	Levels of Replacement (%)					SEM
	0	10	20	30	40	
Initial Weight (g)	460.50	466.25	472.0	455.5	477.5	6.20NS
Final Weight (g)	1881.0^{b}	1746.0^{ab}	1885.0^{b}	1673.0^{a}	1768.0^{ab}	24.09
Total Weight Gain (g)	1419.5^{b}	1279.75^{ab}	1414.15^{ab}	1233.5^{a}	1290.5^{ab}	23.81
Weekly Weight Gain (g)	177.44^{b}	159.97^{ab}	176.63^{b}	151.82^{a}	157.06^{ab}	2.96
Daily Weight Gain (g)	25.35^{b}	22.85^{ab}	25.23^{b}	21.69^{a}	23.05^{ab}	0.43
Total Feed Intake (g)	5223.2^{a}	5425.85^{b}	5538.5^{c}	5571.0^{c}	5657.50^{d}	16.17
Weekly Feed Intake (g)	672.0^{a}	676.55^{a}	692.10^{b}	696.38^{b}	706.10^{c}	1.84
Daily Feed Intake (g)	95.10^{a}	96.65^{a}	98.87^{b}	99.49^{b}	100.10^{c}	0.026
Feed/ Gain Ratio	3.88^{a}	4.39^{abc}	4.04^{ab}	4.66^{c}	4.54^{bc}	0.08
Feed Efficiency	0.27^{c}	0.24^{ab}	0.26^{bc}	0.22^{a}	0.25^{a}	0.01
Price/Kg Feed (₦)	126.1^{e}	118.93^{b}	111.78^{c}	104.64^{b}	97.68^{a}	1.01
Feed /Kg Bird (₦)	489.90^{ab}	522.10^{b}	451.37^{ab}	485.59^{ab}	443.47^{a}	9.08

abc: Mean value within row carrying different super scripts differ significantly (P<0.05).
NS: Non Significant

The result shows that there is no significant (P>0.05) difference in the initial weight of birds used for this experiment and thus has no influence on final weight gain.

There is no significant difference in the final weight, total and daily weight gain of birds fed 40% level of maize replaced with coconut cake meal when compared with those fed the control. This result is contrary to the observation of Bernade *et al,* (2001) who reported that the final weight of the broiler birds fed coconut cake meal based diet was significantly higher when compared with the control.

Result shows that the total and daily feed intake of noiler fed maize replaced with coconut cake diet at 30-40% level of replacement were significantly higher when compared with the control. This result is similar to that of Bawa *et al.*,(2006) who reported that feed intake is significantly higher in rabbit fed 40% levels of graded palm kernel cake when compared with the control while feed efficiency is significantly lower at these levels of replacement when compared with the control. Price/Kg feed reduced with increased levels of coconut cake meal in the diets. The cost of the diets was influenced by the low cost of CCM when compared with maize that was replaced Price/Kg bird produced in naira is lower in birds fed 40% level of maize replacement when compared with the control though not statistically (P>0.05) different. This results was in conformity with that of Onunkwo *et al* (2018) when they fed duck with maize replaced with Palm Kernel Cake Meal (PKCM) . They reported significant low reduction in the price of feed and that of duck eggs produce with maize replace with PCKM diets.

Table 3: Effect of replacing maize with coconut cake meal on carcass characteristics of Noiler strain of chicken.

	Levels of Replacement (%)					
Parameters	**0**	**10**	**20**	**30**	**40**	**SEM**
Live Shrunk Weight (g)	1812.50^{a}	1853.75^{ab}	1950.00^{b}	1750.00^{a}	1980.00^{b}	36.27
Defeathered WT (g)	1905.00^{c}	1740.00^{b}	1785.00^{bc}	1582.50^{a}	1725.00^{ab}	30.45
Dress Carcass (g)	1319.26	1273.52	1313.87	1169.12	1310.37	28.26 NS
Thigh Weight (%)	16.75	16.65	16.24	14.59	14.60	0.41 NS
Drum Stick WT (%)	16.34	14.06	15.03	15.38	16.51	0.39 NS
Breast WT (%)	26.39	25.10	23.17	26.24	24.34	0.55 NS
Back WT (%)	18.24	17.32	19.80	19.74	20.21	0.52 NS
Wing WT (%)	17.49	17.71	16.40	15.81	15.73	0.49 NS
Neck WT (%)	8.31	8.70	9.33	8.24	8.17	0.26 NS
Gizzard WT (%)	2.97	2.56	2.48	3.25	3.11	0.17 NS
Liver WT (%)	1.80	2.01	1.80	1.85	1.93	0.08 NS
Heart WT (%)	1.30	0.51	0.46	0.47	0.47	0.17 NS
Shank WT (%)	4.06	4.49	4.50	5.53	4.75	0.22 NS
Pluck WT (%)	0.59	0.58	0.50	0.41	0.44	0.02 NS
Heat WT (%)	3.23	3.50	3.61	3.78	3.44	0.11 NS
Fat WT (%)	1.38	1.80	1.98	2.39	2.38	0.22 NS
Intestine WT (%)	3.93	4.28	4.77	4.23	3.90	0.16NS

abc: Mean within a row carrying different super scripts differ significantly (P<0.05).
NS: Non Significant; SEM- Standard Error of the Mean

The result shows that there is no significant difference in the percentage weight of primal parts of noiler fed maize replaced with coconut cake meal across the treatments. Test diets exert no significant difference on the internal and external offals of the experimental bird. This result is in agreement with Medegu, (2010) who reported no significant difference in the fat weight of broiler placed on varying levels of coconut cake meal diet.
Percentage weight of vital organs like heart and liver were not influenced by the diets which suggests that inclusion of coconut cake meal in noiler diet is not deleterious to the birds.

CONCLUSION

Coconut cake inclusion in noiler diet significantly increased bird feed intake at 30-40% levels of maize replacement. However, the diet exerts no significant difference in birds final weight, total and daily weight gain at 40%level of maize replacement when compared with the control. Birds primal parts and offals percentage weights were not influenced by the tested diets. It could therefore be suggested that coconut cake meal could be incorporated in noiler die up to 40% level of inclusiont,

this will reduce the Price per Kg of feed and the Price/Kg of birds produced, particularly in Nigeria where the waste is of no economic value in human diet.

RECOMMENDATION

The following recommendations were made

i. Coconut cake meal may replace maize up to 40% with satisfactory results in the diets of noiler.
ii. Maize replaced with coconut cake meal at 40% gave the satisfactory result economically.
iii. Coconut cake meal to be used should not be stored for long time before use to avoid rancidity of the feed ingredient.

REFERENCES

Ani, A and Okeke O (2011). Feed particle size, whole wheat inclusion and Xylase supplementation in broiler diets: Influence on performance, Digesta Characteristics and digestive tract development. PhD Thesis Massey University, Palmerston North, Newzealand. Pp 11-17

Agricinfo.com (2018). LIFA's Livestock Industry Foundation for Africa's Acess on January 20, 2018. http:/blog.lifango.org/2018/01/noiler-suitable-breed-for-lifas-livestock-mixed-portfolio-concept/.

Bawa, G.S., Adeyinka F.D and Daudu, O.M (2006). Effect of graded levels of palm kernel cake on performance of grower rabbits. *Pakistan Journal of Nutrition*, 5 (1) 71-74

Bernabe, B, Cocjin, F.E., Evangelio C and Rola B. S (2001). Fresh coconut meal in poultry rations. West Vishay University Iloilo City. Pp 189-198.

Daghir, N.J. (2008). **Poultry Production in Hot Climates**. (N.J. Daghir, Ed) 2nd Edition. CAB International, Wallingford, UK. Pp.133-179.

Medegu I, Kwari, I. D, Nkama, I, Mohammed I.D, Hamakes, B (2012). Performance and economics of production of broiler chicken fed millet of sorghum as replacement for maize in the semi-arid zone of Nigeria. *Agriculture and Biology* 11(4): 445-450.

Obi, C.I. (2003). Game production: An alternative beef cattle production in Southern Nigeria. *Academic Forum 4*:36-40.

Onunkwo, D.N., Ugwuene, M.C., Eze, J.C and Okpechi, F.C (2018) Replacement Value of Palm Kernel Meal for Maize on Growth, Egg Quality and Economic Parameters of Local Duck Hens. *Nigerian J. Anim.Sci.* 20 (1) 145-151

Sundu, B.; Kumar, A.; Dingle, J.(2009). Feeding value of copra meal for broilers. World. *Poult. Sci. J.*, 65 (3):481-491

NUTRITIONAL QUALITYAND MICROBIOLOGICAL PROPERTIES OF MEAT FLOSS PREPARED FROM MUTTON

***Akinleye S. B., Omojola, A. B., Kassim O. R. & Iyanda O. D.**
Meat Science Laboratory, Department of Animal Science, University of Ibadan, Oyo State.
Corresponding Author: bamideleakinleye@yahoo.com

ABSTRACT
Mutton is an excellent source of biological value with its inherent low fat content, however, it has untapped market as a good potential for value added meat products. Therefore, it is necessary to appraise the nutrient composition of meat floss (MF) from different breeds of ram.
Five kilogram of *Semitendonisus* muscle was harvested from carcasses of four breeds of rams consisting of West African Dwarf (WAD), Yankasa (YK), Uda (UD) and Balami (BA) intensively fattened for ninety days. Cooking loss (CL), water holding capacity (WHC), moisture contents (MC), crude protein (CP) and ether extract (EE) of mutton and freshly prepared meat floss (MF) were determined. Thiobarbituric Acid Reactive Substances (TBARmgMDA/100g) and microbiological counts (MC) (log 10^2cfu/g): Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungal Counts (TFC)) at the seventh day were determined. The CL (38.19%, 39.51%) of WAD and YK mutton were significantly higher ($P<0.05$) while their WHC (61.49%, 59.97%) were lower than UD and BA. The CP (23.16%) and EE (5.85%) of BAM were higher ($P<0.05$). The CP were (46.75%, 48.73%, 47.82%, 49.60%) and EE (25.69%, 25.46%, 25.88%, 27.35%) for WAD, YK, UD and BA, respectively. The TBAR ranged from 1.12-1.17 mgMDA/100g. The mean MC (log 10^2cfu/g) on the MF from WMF was 6.76cfu/g while YMF, UMFand BMF for TAC were 4.38, 3.96 and 3.58cfu/g, respectively. The keeping qualities value of the MF does not exceed the threshold values of stored meat products, therefore, it can be inferred that MF from mutton has a high nutrient and keeping qualities profile.
Keywords: Keeping quality, Mutton, Nutrient profile, *Semitendinosus*

INTRODUCTION
Sheep production is indispensable to meet protein and some domestic needs of people throughout the world as they are sources of income and raw materials (Mapiliyao *et al*., 2012). Mutton has a high biological value with its inherent low fat contents. However, it has received little attention in consumption pattern as compared with other sources of meat such as beef and chevon, therefore has an untapped market value as a good potential for value added meat products. MF is among the popular traditional foods that constitutes an important part of Nigerian meal. Considerable progress has been made in standardization of product profile and mechanization of traditional meat products. In Nigeria, particularly in rural communities and towns, processing of carcass usually takes place under very unhygienic conditions. This coupled with high ambient temperature, high humidity, shortage of portable water and poor handling practices exposes meat products like MF to microbial contamination and rapid deterioration. Therefore, the microbiological testing at various stages of food production is relevant to reveal and understand the characteristic trends in distribution of microbiological contamination (ICMSF, 2011). Information available on meat floss specifically is usually centred on other sources of meat while little or none is available on processed mutton. However, if such information is available, it might bring into limelight the nutritional quality inherent in mutton and also help in changing the consumption pattern of the meat. Therefore, this study aimed at assessing the nutritional and keeping qualities of meat floss prepared from mutton of different breeds of ram.

MATERIALS AND METHODS
Experimental design
The study was a completely randomized design and each treatment was replicated thrice.
Meat sample: source, collection and preparation
The *Semitendinosus* used for this study was harvested from the skinned mutton carcasses of four breeds of rams (BA, UD, YK and WAD breeds) intensively fattened for ninety days. They were cut into chunks with average weight of 100g. Thirty chunks were randomly selected to have three kilograms of fresh mutton for each breed.

Non-meat ingredients

Table1: Composition of cooking and shredding recipes used for meat floss production

Ingredients /seasoning	Scientific/*Botanical names	Quantity (g/100g)
	Cooking Recipe	
Salt	Sodium Chloride	10.00
Maggi (Knorrs®)	Maggi	15.00
Thyme	*Thymus vulgaris* L.	12.50
Curry	*Murraya koenigii* (L.) Spreng.	12.50
Onions	*Allium cepa* L. var. *Cepa*	50.00
Total		**100.00**
	Shredding Recipe	
Red Pepper	*Piper nigrum* L.	35.00
Maggi (Knorr®)	Maggi	30.00
African Nut Meg	*Monodora myristica* (Gaertn.) Dunal	2.50
Ginger	*Zingiber officinale* Rosc.	4.00
Garlic	*Allium sativum* L.	3.00
Cloves	*Syzygium aromaticum* (L.) Merr. et L.M. Perry	2.50
Curry powder	*Murraya koenigii* L.	3.50
Thyme leaves	*Thymus vulgaris* L.	2.50
Salt	Sodium Chloride	5.00
Onions	*Allium cepa* L. var. *cepa*	12.00
Total		**100.00**

Source: Kassim (2013). * All botanical names according to Rehm and Espig (1991)

Production of meat floss

The steps involved in production of the meat floss were spice mixture preparation, meat preparation, cooking, shredding, frying and de-oiling following Kassim (2013). The meat chunks were cooked in a pot on an electirc hot plate (Pifco Japan Model number ECP 2002) with water added at the ratio of 1.5 litres to 1.0 kg of meat and the cooking recipe added at a ratio of 1 g to 100 g of meat. The cooking was done at an internal temperature of 72°C until the broth completely dried on the broiled mutton. The meat samples were removed from the pot and spread on a tray to equilibrate to room temperature. The cooled meat was shredded separately by pounding with a local mortar and pestle with shredding recipe at a ratio of 1.00g to 20.00g meat. The shredded meat was deep-fried in soya oil (pre-heated to 180°C) in the ratio of 1 litre to 500g of meat. The meat was fried at 70 strokes per minute for 20 minutes until they turned golden brown in colour. The products were emptied into a colander, pressure applied to drain oil and obtain a dry spongy product. Upon cooling the meat floss were separated into strands and immediately packed into an air tight container and left at room temperature.

Parameters measured

Meat Quality

Cooking loss (CL)

Cooking loss was determined (following the procedure of Honikel, 1987) in the *Semitendinosus* muscles of each breed and samples were taken in triplicates.

Thermal shortening

This was carried out according to the procedure described by Mahendraker *et al*. (1988). Cores of 0.5 cm in diameter were taken from the *semitendinosus* muscle of each breed. Each breed was replicated thrice and the average taken.

Water holding capacity (WHC)
WHC was evaluated using a method adapted from Hamm (1960), based on meat water loss when pressure is applied on it. This was determined by the press method described by Wierbicki and Deatherage (1958) as modified by Tsai and Ockerman (1981).

Product yield
The product yields of the meat floss were determined by measuring the weight of the MF for each treatment and were calculated as the ratio of cooked weight to raw weight expressed as percentage.

Microbial analysis
The microbial quality determination was carried out on the freshly prepared meat floss. The Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungi Counts (TFC) were carried out following the procedure of Garbutt (1997).

Statistical analysis
Data collected were analysed using Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The physical measured traits of mutton used in the production of meat floss are presented in Table (2). The CL ($P<0.05$) of *Semitendinosus* from YK (39.59%) and WAD (38.19%) were significantly different than 34.70% and 30.20% obtained for UD and BA, respectively. This same trend could be noticed in their TS with YK (34.67%) and WAD (33.34%) having the highest TS shrinkage than UD (29.62%) and BA (26.40%). WHC is one of the major quality characteristics of fresh meat, as it affects some major characteristics of cooked meat such as product yield, appearance and sensory properties. WHC obtained from *Semitendinosus* muscles of mutton used in this study were between 59.97 and 71.60%. BA and UD had the highest ($P<0.05$) value while WAD and YK had similar ($P>0.05$) values which were the least (Table2). The denaturation and aggregation of sarcomere could be responsible for the shrinkage observed in the thermal shortening of the mutton because the extent of sarcoplasmic and myofibrillar protein during cooking depends on the resistance of the muscle fibres to compression (Sheffler and Gerrard, 2007).

Table 2: Physical properties of raw *Semitendinosus* muscles from different breeds of rams used in meat floss production

Parameter (%)	WAD	YK	UD	BA	SEM
Cooking Loss	38.19^{a}	39.51^{a}	34.70^{b}	30.20^{c}	0.25
Thermal Shortening	34.67^{a}	33.34^{a}	29.62^{b}	26.40^{c}	0.18
Water Holding Capacity	61.49^{c}	59.97^{c}	65.60^{b}	71.76^{a}	0.14

[a, b, c] Means with different superscripts in the same row are significantly different ($P<0.05$) WAD: West African Dwarf; YK: Yankasa; UD: Uda; BA:Balami

Chemical composition of raw *Semitendinosus* muscles from different breeds of rams used for the production of meat floss
The chemical compositions of the mutton used are displayed in Table 3. The moisture content of the muscles ranged from 69.57% to 69.86% while the crude protein contents, ash, ether extracts and cholesterol of the muscles differ significantly ($P<0.05$). It ranged from 22.58% to 23.16%; 1.13%-1.30%, 5.85%to 6.44% and 0.21% to 0.29% for crude protein, ash, ether extracts and cholesterol, respectively. The average chemical analysis values for the *Semitendonisus* muscle in the present study are in agreement with the reported values in food composition tables of National Food Institute, (2009 and Chuaynukool *et al*., 2007). The differences in fat content in the meat samples could be due to the differences in genetic and non-genetic factors as reported by Bogosavljevic-Boskovic *et al*. (2010). The low moisture contents of the meat floss as compared to its raw muscles could be attributed to the fact that MF preparation involves a high thermal processing method and most of the water contained in the meat would have been dried-off during the process. It was observed that MF from BA muscle had the highest nutrient profile especially in crude protein contents, ash and ether extracts. This could be attributed to the fact that it was the muscle that has the highest nutrient profile in the raw state. It could also be as a result of its high water holding capacity because nutrient composition of a muscle

after thermal treatment depend on the ability of the muscle to hold on to its inherent water which contain the nutrients of the muscle. During thermal treatment, water would be lost with some nutrients but a muscle with high water holding capacity would have a low cooking loss thereby retaining most of its nutrients. The high product yield of MF from the mutton could be attributed to the procedure because water holding capacity and cooking loss are inversely correlated (Nasiru *et al*., 2011). The lower product yield of meat floss from WAD muscle might be attributed to the excessive fat separation and water release during cooking (Pietrasik and Shand, 2003). The increase in the ash contents of the MF compared to the raw meat could have been contributed by the added ingredients used during production. Similar observations were reported by Ogunsola and Omojola (2008) who reported that the high ash contents of kilishi is due to individual mineral levels of the spices used to give accumulative mineral level during processing. Also, the average total ash values of MF in the present study is in agreement with the reported values in food composition tables of National Food Institute, (2011) for meat products. The increasing level of cholesterol in processed samples might be as a result of the conversion of other substances from food into cholesterol during thermal degradation (Chizzolini *et al*, 1999).

Table 3: Product yield and chemical composition of freshly prepared meat floss from four *Semitendinosus* muscles of different breeds of rams

Parameter (%)	WMF	YMF	UMF	BMF	SEM
Moisture Content	10.52^{a}	10.49^{ab}	10.63^{a}	10.20^{b}	0.05
Crude Protein	46.75^{d}	48.73^{b}	47.82^{c}	49.60^{a}	0.04
Ether Extract	25.69^{c}	25.46^{d}	25.88^{b}	27.35^{a}	0.03
Ash	7.28^{c}	7.31^{c}	7.96^{a}	7.75^{b}	0.03
Cholesterol mg/g	10.11^{ab}	8.33^{c}	11.33^{a}	9.00^{bc}	0.01
Product Yield	67.07^{b}	68.42^{b}	72.31^{a}	74.44^{a}	0.58

$^{a, b, c}$ Means with different superscripts in the same row are significantly different (P<0.05). WMF = West African Dwarf Meat floss; YMF = Yankasa Meat floss; UMF =Uda Meat floss

Microbial loads of mf produced from different breeds of ram

The microbiological counts (10^{2}cfu/g) and the TBARS (mg/kg) of the meat floss is displayed in Table (4). The result revealed that there were significant differences (P<0.05) in all the microbial assessment among the products. The total aerobic counts (TAC) were 1.13, 0.73, 0.66, 0.60; while the total coliforms counts (TCC) were 0.20, 0.20, 0.36, 0.23 and the total fungal counts were 1.03, 0.46, 0.29, 0.20 for WFM, YMF, UMF and BMF meat floss, respectively. Microbial assessment of food provide a general indication of the microbiological quality of the products. The microoganisms isolated in food could come from different sources such as processing, cooking and the environment. The high fat content also can acts as a medium for the growth of microorganisms (Kumar and Sharma, 2004). The microbial counts recorded for coliforms and fungi were well below the levels of $\log10^{4}$ cfu/g and $\log10^{3}$ cfu/g that could cause microbial spoilage (Jay, 1996). Lipid oxidation is a major cause of food deterioration as it decreases nutritional properties of foods and the generation of potentially toxic reaction products. TBARS values of MF samples were illustrated in Table 4, from which it is apparent that BMF samples exhibit 0.39 mg MDA/kg meat. However, the mean TBARS values of all the MF samples in this study were found to be lower than 2.0 mg MDA/kg, accepted as the critical value of lipid oxidation for meat and meat products (D'agata *et al*., 2010).

Table 4: Microbiological quality (log 10^{2}cfu/g) and Thiobarbituric reactive substances of meat floss prepared from *Semitendinosus* muscles of different breeds of rams

Parameter	WMF	YMF	UMF	BMF	SEM
Total Aerobic Counts	1.13^{a}	0.73^{b}	0.66^{c}	0.60^{c}	0.22
Total Coliform Counts	0.20^{b}	0.20^{b}	0.36^{a}	0.23^{b}	0.24
Total Fungal Counts	1.03^{a}	0.46^{b}	0.29^{c}	0.20^{d}	0.06
TBARS(mg MDA/100g)	0.38	0.37	0.38	0.39	0.03

$^{a, b, c}$ Means with different superscripts in the same row are significantly different (P<0.05). WMF=West African Dwarf Meat floss; YMF = Yankasa Meat floss UMF = Uda Meat floss; BMF = Balami Meat floss

CONCLUSION

The nutritional and keeping qualities of meat floss as revealed in this study indicated that mutton is a meat with high biological value which is inversely proportional to its consumption pattern. It could be recommended that the spices should be subjected to treatment that would reduce the microbial load of the products to avoid introduction of pathogens that might bring about spoilage and contamination of the product.

REFERENCES

Alabdulkarim, B., Abdel Nabi Bakeet, Z. and Arzoo, S. (2012): Effect of Frying oils on quality characteristics of frozen chicken patties incorporated with honey. *African Journal of Biotechnology* 11(12): 2985-2992.

A.O.A.C. (2005). Association of Official Analytical Chemist. Officials Methods of Anslysis 18th Edition AOAC Inc, Arlington, Virgina USA. 1094pp.

Bogosavljevic-Boskovic, S., Mitrovic, S., Djokovic, R., Doskovic, V., Djermanovic, V. (2010): Chemical composition of chicken meat produced in xtensive indoor and free range rearing system. *Afr. J. Biotechnol*. 10(20): 9069-9075

Brnčić, M., Karlović, S., Bosiljkov, T., Tripalo, B., Ježek, D., Cugelj, I., Obradović, V. (2008) Obogaćivanje ekstrudiranih proizvoda proteinima sirutke. *Mljekarstvo,* 58 (3): 275-295.

Chizzolini R, Zanardi E, Dorigoni V, Ghidini S. (1999): Calorific value and cholesterol content of normal and low-fat meat and meat products. *Trends Food Sci* 10 (1) 19–28.

Chuaynukool, K., Wattanachant, S., Siripongvutikorn, S. (2007). Chemical and properties of raw and cooked spent hen, broiler and Thai indigenous chicken muscles in mixed herbs acidified soup (Tom Yum). *J. Food Tech*. 5:180-186.

D'agata, M., Nuvoloni, R., Pedonese, F., Russo, C., D'ascenzi, C. and Preziuso, G., (2010).Effect ofpackaging and storage time on beef qualitative and microbial traits. *J. Food Quality* 33: 352–366.

Decker, E. A., Chan, W. K. M., Livisay, S. A., Butterfield, D. A., & Faustman, C. (1995). Interactions between carnosine and the different redox states of myoglobin. *J. Food Sci*. 60: 1201–1204.

Ebabhamiegbebho, P. A; Igene, J. O; Evivie, S. E. (2011). The Effect of Preservative Methods on the Yield, Water Content and Microbial Stability of Dairy Products. *J. Appl. Sci. Environ. Manage*. 15 (2): 265 – 271

ACCEPTANCE OF YOGHURT PRODUCTION AS EMPOWERMENT BY WOMEN GROUPS IN RANO LOCAL GOVERNMENT AREA OF KANO STATE

Daninna[1], A.U. Garba[2] Y. & Umar[3]A.M.

1. *School of Rural Technology and Entrepreneurship Development, Kano State Polytechnic, Kano, Nigeria.*
2. *Centre for Dryland Agriculture, Bayero University, Kano.*
3. *Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.*
4. Corresponding author: sazeeq@yahoo.com Phone no: 08032801005

ABSTRACT

This Supervised Enterprise Project (SEP) was conducted in order to create awareness, empower and impart the skills and knowledge of sustainable techniques of milk processing by converting it to yoghurt. The project empowered thirty rural women leaders in Rano town, Rano LGA of Kano State on how to make yoghurt from fermented cows' milk (nono), thus helping them economically. One hundred questionnaires were distributed to one hundred households in order to assess socio-economic aspects of milk producers in Rano LGA. Chi-square and simple descriptive statistics were used to analyse and describe the data collected. Majority of the farmers had poor knowledge of improved yoghurt processing prior to this project. However, all the farmers reported to have improved their yoghurt processing skills after the project. Furthermore, majority of the farmers indicated willingness to adopt the technology acquired. Chi-square analysis showed that there was a significant ($p<0.05$) difference in willingness to adopt the yoghurt technology between owners of large and small herds, which indicates that, farmers with large number of animals in their herd were more willing to adopt yoghurt technologies than those with fewer animals.

Keywords: Yoghurt, women, empowerment

INTRODUCTION

Fresh Milk is highly perishable, as such, it should be immediately consumed in its fresh form (Yahuza, 2000). Fresh Milk can also be processed into fermented products which could improve the quality and nutritive value (Cashman, 2002).

The problem of low milk yield and of low quality in dairy cattle under tropical environment is held as one of the most important limiting factor to the rapid growth of the dairy industry in Nigeria, and the problem is attributed to a number of factors, which included climate, genetic potential of breeds, inadequate nutrition, diseases and poor management (National Livestock Project Division, 1992). In recent time under nutrition and low protein caloric intake has been recognized in developing countries of the world. The measures to be adopted to correct the nutritional deficiencies in both child and adult population in these countries are still subject to widely differing opinions.

On one hand, loss of milk quality largely due to lack of techniques for improving preservation and lifespan of fermented cow's milk (nono) was identified as a major challenge that requires intervention. Furthermore, improved milk processing techniques can increase output and quality of the milk and hence invariably increase sales and consumption. When there is an increase in sales, the women's income will increase, thus their livelihoods and that of their families will be improved. Milk processing into yoghurt may be of immense help to curb the problem of milk spoilage which leads to immeasurable losses to farmers. The project will also improve the storability of milk for the producers to target better markets and prices. More so, an increased consumption of milk and yoghurt by the people will increase their protein intake and thus increase their health (Barr *et al*., 2000).

Project Context

The project was conducted as a Supervised Enterprise Project which is an organizational component of Sasakawa Africa Fund for Extension Education (SAFE). The project empowered rural women on how to make yoghurt from fermented cows' milk (nono), thus helping them economically.

MATERIALS AND METHODS

The Study Area

The training was conducted in Rano town, Rano Local Government Area (LGA) of Kano State. Kano is located in the North-Western part of Nigeria at latitude 12°3'N and longitude 8°32'E with an average temperature of 26.2 °C with warmest temperature being 38 °C in April and the coolest temperature being 13 °C in January and December. The state also receives an average of 873 mm of precipitation annually. The months with the driest weather are January and December. Mean relative humidity was recorded as 31.1% (KNARDA, 2008). On the other hand, Rano has an area of 520Km^2 and a tropical climate. The temperature and rainfall averages are 25.8 °C and 865 mm respectively (Climate-Data.org, 2015). Inhabitants are mostly Fulani cattle rearers and, therefore milk production is one of the major economic activities in the area.

Preliminary Activities

A need assessment exercise was carried out at Unguwar Dam, Rano Local Government area, Kano State. The inhabitants were mostly farmers engaging in both crops and animal husbandry. They cultivate crops in both raining and dry seasons. A stakeholders meeting was conducted to identify the areas of priority which people of the study area will mostly benefit from. Both the first and the second stakeholders meetings employed the use of focus group discussion. The first community meeting was conducted on 20th May, 2016 including various stakeholders of the projects. The target farmers were women cooperative societies to assess their various needs.

The project began by introducing the research student to women groups in the LGA and a convenient location was selected for a one-day training. Thirty women leaders were selected after they have obtained proper recommendations from their district heads and Local Government supervisors. Materials required for the training were purchased in Singer market in Kano and a date was set and communicated to all the participants via short message service (SMS).

Sampling

One hundred questionnaires were distributed to one hundred households to assess socio-economic aspects of milk production in Rano LGA. The questionnaires were distributed in all the ten (10) wards of the LGA. Ten questionnaires were distributed in each of the wards and the ten households selected within each ward were randomly selected.

Inputs Used

The materials to use include water, Potassium sorbate powder ($C_6H_7KO_2$ _ preservative), Sodium Benzoate powder ($C_7H_5NaO_2$ _to hinder sourness), evaporated milk, powdered coconut flavour, sugar, cow milk (nono) and custard powder (predominantly made of starch). Equipment includes hand gloves, fine wire mesh sieve, 25 litres plastic containers, spatula, and spoon.

Yoghurt Preparation Methods

On the day of the training, the participants were seated and provided with sample materials that they will practice with. The participants were told the importance of the training and the objectives. The need to train them, so that they train their group members was then emphasized. The student trainer led the training and demonstrated the step-by-step procedures of making yoghurt from cow milk (nono) while each participant used the equipment and materials provided to practically do what the trainer did. Each participant wore hand gloves and was lectured on the importance of hygiene. Furthermore, the training was video recorded to the participants in case they wish to refer to the procedures later.

Participants were guided on how to make a sample of 20 litres of yoghurt from cow milk (nono) as a group. One kilogramme of custard powder was put in a 25 litre plastic container. Five litres of cold water were poured onto the custard and smoothly mixed into paste. Ten litres of previously boiled (100°C) water was then poured to form a thick liquid paste, which was continuously stirred to avoid lumps. Five litres of finely churned cow milk (nono) was then added to the mixture and then thoroughly mixed. After a fine mixture was obtained, a fine sieve was then used to pass the liquid and to ensure no lumps were left in the liquid. Thereafter, two tins of evaporated milk (410g, 380ml) were also added.

Ten grammes of Potassium sorbate powder (as a preservative), and ten grammes of Sodium benzoate powder (to hinder sourness) together with thirty grammes of coconut flavour were mixed with half

cup of cold water and added to the mixture. Three hundred grammes of sugar was then added to taste. The diagrammatic representation of the procedure is shown in figure 1 below:

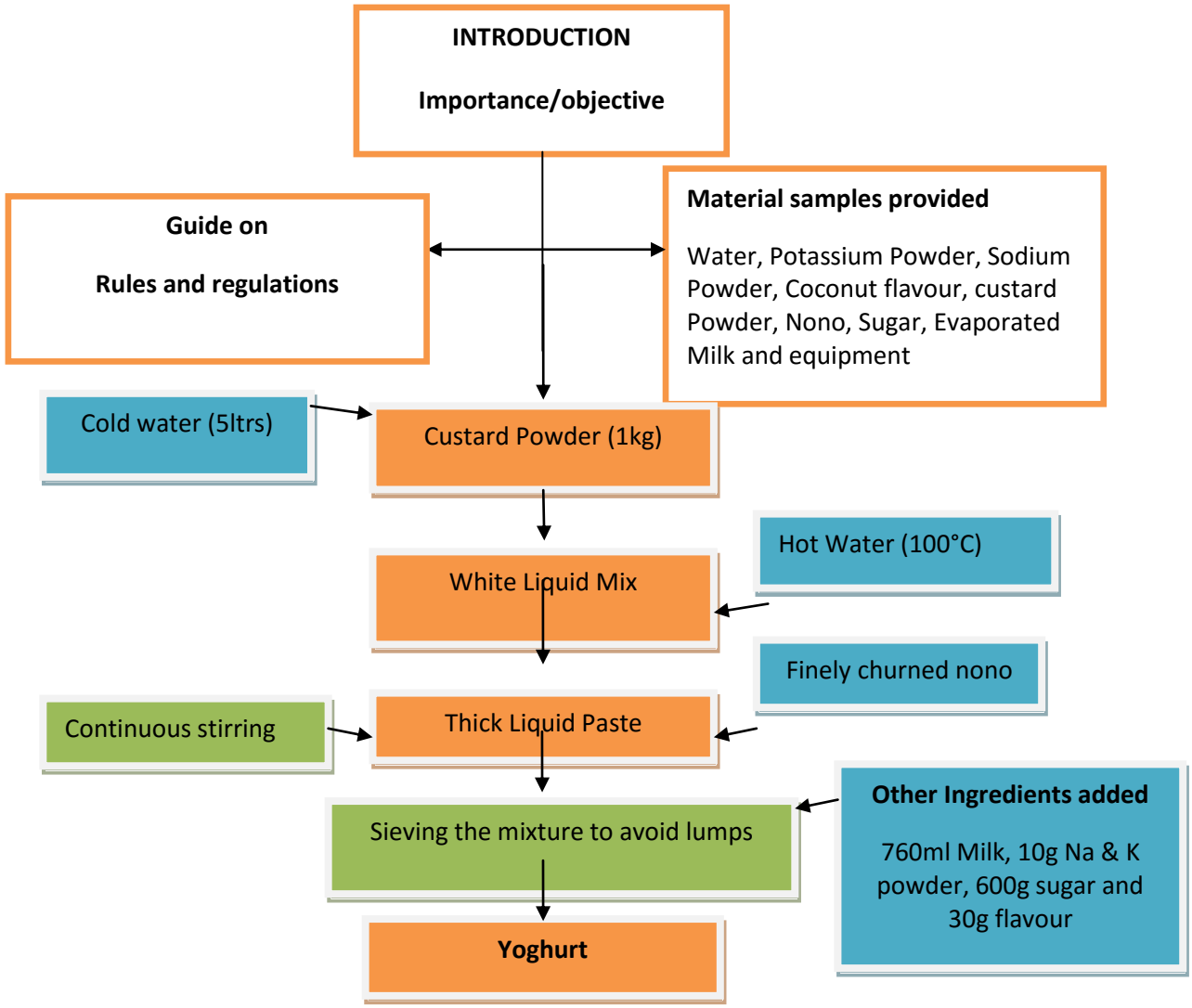


Figure 1: Diagrammatic representation of yoghurt making process

Packaging

An optional way of packaging and branding the yoghurt was taught to the participants. Participants were shown how to keep yoghurt by simply pouring it in used water bottles and then sold. A second option was to buy new empty bottles with sealing caps. Yoghurt should be filled up in the bottles and sold. Additionally, a trade name could be obtained and printed slips could then be attached to the bottles to further enhance the brand. However, license and approval must be sought for from relevant agencies.

Tools of Data Collection

Questionnaire/interview schedule were used to collect primary data from the respondents. Secondary data was also collected from journals, textbooks and relevant websites.

Data Analysis

Simple descriptive statistics were used to describe the socioeconomic data of the respondents. Chi-square analysis was used to establish relationship between herd size and willingness to adopt yoghurt processing technology by the farmers with the aid of MAXSTAT©, VERSION 3.06 Statistical Package. Cost benefit analysis was used to ascertain the profitability of yoghurt production.

RESULTS AND DISCUSSION

Attempt was made to measure the impact of the yoghurt processing project on the participant farmers' experience, interest and willingness to adopt the new skills taught.

From table 1 below, majority (61.4%) of the participant farmers had poor experience of improved yoghurt processing before this project. This was followed by those with good experience level that were around 22.8%, excellent level 10.5% and fair level with 5.3%.

Also, after the training, majority (54.4%) of the participants reported to have gained improvement in their yoghurt processing skills. The fact that majority of the participants' skills were improved could be attributed to the techniques involved which ensured learning by doing through participatory action research as opined by Attah-Krah and Francis (1987). However, 45.6% of them reported no improvement in their skills. This non-improvement in skills as reported by the minority might be connected with the fact that, some participants did not fully participate in the training or some were naturally laggards.

Table 1: Impact Assessment of Yoghurt processing amongst farmers in Rano town, Rano LGA, Kano State

Variable	Frequency	Percentage (%)
Experience before Training		
Excellent	6	10.5
Good	13	22.8
Fair	3	5.3
Poor	35	61.4
Total	57	100
Skills Improvement after the Training		
Yes	31	54.4
No	26	45.6
Total	57	100
Intention to Adopt the Technologies		
Yes	30	52.6
No	27	47.4
Total	57	100
Reasons for adoption		
Improve income	20	35.1
Reduce spoilage	24	42.1
Better Market	9	15.8
Others	4	7.0
Total	57	100

Source: Field Survey (2017)

From Table 1 above, 30 farmers (52.6%) showed willingness to adopt the new yoghurt technology they were taught during this project. This was probably due to simplicity of the procedures employed, availability and affordability of the ingredients and the practical and participatory approach used in the training sessions. Those who showed no interest to adopt the technology formed the minority (47.4%). Most of those willing to adopt the yoghurt technology mentioned that their reason was to improve income (35.1%) which was slightly lower than those who wanted to reduce spoilage (42.1%). A fraction of the farmers, i.e. 15.8% and 7.0% were willing to adopt the technology for a better market and other reasons respectively.

Table 2: Chi-Square Analysis of Willingness to adopt Yoghurt Technology between Small and Large Herd Owners amongst farmers in Rano town, Rano LGA, Kano State.

Response	Expected Frequencies	
	Small Herd Owners	Large Herd Owners
Yes	14.74	15.26
No	13.26	13.74

Chi square value = 14.75; Critical Chi square value= 3.84*; P value= 0.0001

The Chi-square analysis (Table 2) shows that, there was a significant ($p<0.05$) difference in the willingness to adopt the yoghurt technology between small herd and large herd owners in the study area. Thus, Number of cows owned by a farmer determines farmers' willingness to adopt milk processing technologies in the area. Those possessing large number of animals (above ten) were more willing to adopt the technology than those with fewer animals (below ten). It could be concluded that, farmers with large herd size were willing to put in their efforts to commercialize their venture as against the small herd owners who might be keeping the animals for subsistence and farm labour.

CONCLUSION

The thirty women trained were technically and economically empowered with the technical-know-how of yoghurt production that increased their potentials which resulted into more sources of household income and subsequent betterment of living standards. Furthermore, estimates of cost and return of yoghurt production indicated that the venture was profitable and worth adopting by farmers. Additionally, farmers who had larger herds were more willing to commercialize their yoghurt production venture as against the small herd owners who might be keeping the animals for subsistence and farm labour.

RECOMMENDATIONS

The following recommendations were made with regards to the project:

1) The accessibility of yoghurt production materials should be increased, such that the people living in rural communities can purchase the materials and get involved in the production.
2) Furthermore, government intervention is necessary in all aspects of production to provide support to yoghurt producers in terms of materials of production, storage and marketing.
3) The marketing chain needs to be organised such that cooperatives and associations will be created to regulate production and pricing.

REFERNCES

Attah-Krah, A. N., & Francis, P. A. (1987). The role of on-farm trials in the evaluation of composite technologies. *Agricultural Systems*, **15**: 133-152.

Barr, S.I., Mccarron, D.A., Heaney, R.P., Dawson-Hughes, B., Berga, S.L., Stern,J.S. and Oparil, S. (2000). Effects of Increased Consumption of Fluid Milk on Energy and Nutrient Intake, Body Weight, and Cardiovascular Risk Factors in Healthy Older Adults. *Journal of the Academy of Nutrition and Dietetics*, **100**(7): 810–817.

Cashman, K. D. (2002). Calcium intake, calcium bioavailability and bone health, *British Journal of Nutrition*, **87**(2):69-77.

Climate-data.org. (2015). Rano. (Retrieved 28th August,2016) from: http://en.climate-data.org/location/382057/

KNARDA. (2008). Kano State Agricultural and Rural Development Authority, Danbatta Station Meteorological Report.

NLPD (National Livestock Project Division). (1992). National diary survey . NLDP, Kaduna, Nigeria.

Yahuza, M.I. (2000). Small Holder Day Production and Marketing Constraints in Nigeria National Livestock Project Division (WLPD); Yakubu Gowon Way Kaduna Nigeria.

EFFECT OF COLD WATER NEEM (*Azadirachta indica)* LEAVES EXTRACT ON MEAT QUALITY OF BROILER CHICKENS

Egbeyale, L. T*., Ojetunji, O. C., Adeleye, O.O., Ayo-Ajasa, O. Y. & Adewole, F. A.
Department of Animal Production and Health, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.
*Corresponding author: *egbeyalelt@funaab.edu.ng*. Phone No: 08060743664

ABSTRACT
This study was conducted to determine the effect of cold water neem leaf extract on meat quality of broiler chicken. One hundred and sixty broiler chicks (Cobb) were randomly divided into four groups of 40 birds per treatment. Each group was sub-divided into four replicates of 10 birds. The birds in group 1 served as control and antibiotics were administered to them while 0.1, 0.2 and 0.3% concentration of neem leaf extract were administered to bird on groups 2, 3 and 4, respectively. The period of experiment was six weeks. The birds were fed *ad libitum*. One bird close to average final weight was selected randomly in each replicate and was slaughter at 42nd day of the experiment. Meat samples from breast muscle of the bird were subjected to cooking weight loss, refrigeration weight loss and sensory evaluation. The data obtained were subjected to one-way Analysis of Variance in a completely randomized design (RCD). The cooking loss increased ($P<0.05$) with higher concentration of the extract while refrigeration weight loss percentages were similar ($P>0.05$) across the treatments. The result on Sensory evaluation showed that only colour, tenderness and overall flavour were significantly ($P<0.05$) influenced. The study concluded that aqueous Neem (*Azadirachta indica*) leaf extract (ANLE) administration in drinking water of broiler chicken as alternative to antibiotics did not pose any adverse threat on the meat quality.
Keywords: neem extract, refrigeration and cooking losses, sensory evaluation, broiler chicken

INTRODUCTION
Medicinal plants extracts were developed and proposed for use in food as natural antimicrobials (Hsieh and Mau, 2001). Beneficial effects of herbal extracts or active substances in animal nutrition includes the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, anti-viral, antioxidant and anthelminthic actions. Generally, plant extracts have no problem of antimicrobial resistance (Tipu *et al*., 2006) and broilers fed on herbal feed additives were accepted well by consumers (Hernandez *et al.,* 2004).

Aqueous extract of Neem leaves has a good therapeutic potential as anti-hyperglycemic agent, antibacterial agent and could be used for controlling airborne bacterial contamination in the residential premise (Mishra *et al.,* 2013). It was shown that Neem leaves extract acts as a growth promoter (Landy *et al.,* 2011), improves performance and hematological parameters (Nayaka *et al.,* 2013) and immune response (Jawad *et al*., 2013) in broilers. Due to paucity of information on the effect of neem leaf extract on meat quality, this study was designed to investigated the effect of cold water extraction of neem leaves on eat quality of broiler chickens.

MATERIALS AND METHODS
Experimental site: The rearing of birds took place at the Poultry Units of the Teaching and Research Farm, while the meat quality section was carried out at the Meat Processing Laboratory, Department of Animal Production and Health, College of Animal Science and livestock Production, of Federal University of Agriculture Abeokuta (FUNAAB).

Source and preparation of the extract: Fresh neem (*Azadirachta indica*) leaves were harvested, rinsed thoroughly with water to remove all the dirt from it then pounded in a mortar with pestle to increase the surface area for better extraction. The pounded leaves were weighed on the sensitive scale at 1, 2 and 3g, which were needed for the experiment. The weighed freshly pounded neem leaves were added to clean cold water (at room temperature) at 1g of neem leaves to 1 litre of water, 2g of neem leaves to 1 litre of water, and 3g of neem leaves to 1 litre of water and thereafter was left for 12 hours at room temperature and was sieve before it was offered to the birds.

Experimental Design: A Completely Randomized Design (CRD) was adopted for this experiment. The one hundred and sixty 7 days old broiler chicks of Cobb strain were allocated into four treatments with each treatment contains 40 birds. Each treatment was further sub-divided into four replicates of ten birds each. The period of the experiment lasted for six weeks. The treatment groups are; Treatment 1 (Control) was administered antibiotics (Enrofloxacin at the manufacture's recommendation), Treatment 2 (0.1%) of neem extract in drinking water, Treatment 3 (0.2%) of neem extract in drinking water and Treatment 4 (0.3%) of neem extract in drinking water. Starter broiler diet of 23% CP and 11.47 MJ/Kg was supplied *ad libitum* for the first three weeks while finisher broiler diet of 20.10%CP and 11.62 MJ/Kg was supplied during the last three weeks of the experiment.

Data Collection: At the 42nd day of the experiment, one broiler chicken close to average final weight was selected randomly from each replicate and was slaughtered. After dressing, breast meat sample of 54.13-54.80g from each broiler chicken was cooked separately at 70°C for 15 minutes in a water bath (Egbeyale *et al*., 2012). The difference between the weights before and after cooking gave the cooking weight loss of the meat samples. Meat samples of another set of 51.20-54.50g were cut from the breast muscles of the slaughtered broiler chicken. Each sample was weighed and labeled according to the treatment before being stored in a refrigerator at about 10°C for 24 hours (Egbeyale *et al*., 2012).

Sensory evaluation: For sensory evaluation, a uniform size of cooked chicken breast meat was sliced into cubes and the cooked chicken breast meat was labeled according to each treatment and samples were allowed to cool before serving the panel. Eight educated panelists were isolated from each other, so as to prevent communication and each panelist was asked to rinse his/her mouth with ordinary water after each sample testing to avoid any carry over effects. The panelist evaluated the meat colour, flavour, juiciness, aroma, texture, saltiness and overall acceptability. The evaluators were asked to score the sample on nine points scale according to Egbeyale *et al*. (2012)

Statistical analysis: Data collected were subjected to one-way Analysis of Variance (ANOVA) and differences in means were separated using Duncan Multiple Range Test (SAS 2012) at 5% significance level.

RESULTS

The effect of aqueous neem leaf extract (ANLE) on cooking and refrigeration weight losses of broiler chicken is present in Table 1. Cooking weight loss (CWL) was significantly ($p<0.05$) influenced. The CWL of meat from birds on 0.3%ANLE were significantly higher than the control. However, the meat from birds that drank water containing 0.1 and 0.2% ANLE recorded values similar to both control and 0.3%ANLE group. The refrigeration weight loss and percentage refrigeration loss did not show any significant ($p>0.05$) different among the treatments.

Table 1: Effect of cold water neem (A*zadirachta indica*) leave extract on cooking and refrigeration loss of broiler chicken

	Inclusion level of NLE (%)			
Parameters	0	0.1	0.2	0.3
Cooking				
Weight before cooking (g)	54.80±0.47	54.13±0.78	55.33±1.36	54.30±1.11
Weight after cooking (g)	49. 15±0.37	47. 13±0.95	48. 90±1.26	46.98±1.36
Cooking weight loss (g)	5.65±0.37^{b}	7.00±0.61^{ab}	6.43±0.18^{ab}	7.33±0.55^{a}
Percentage weight loss (%)	10.30±0.61^{b}	12.94±1.12^{ab}	11.62±0.27^{ab}	13.52±1.11^{a}
Refrigeration				
Weight before refrigeration (g)	53.80±1.35	51.20±0.58	54.08±0.91	54.50±0.55
Weight after refrigeration (g)	52.75±1.18^{a}	48.75±1.03^{b}	51.50±1.19^{a}	52.50±0.87^{a}
Refrigeration weight loss (g)	1.05±0.35	2.45±0.73	2.58±1.52	2.00±0.34
Percentage weight loss (%)	1.93±0.62	4.80±1.45	4.68±2.79	3.69±0.68

$^{a,b;}$ Means on the same row with different superscripts are significantly ($p<0.05$) different

*the initial weight of the refrigeration was used as co-variate

The effect of aqueous neem leaf extract (ANLE) on sensory characteristics of broiler chicken meat is present in Table 2. The juiciness, meaty flavour, saltiness and overall acceptability were not significantly ($p>0.05$) influenced across parameters measured, while colour, tenderness and overall flavour were significantly ($p<0.05$) influenced.

Table 2: Effect of cold water neem (A*zadirachta indica*) leaves extract on sensory quality of broiler chicken

	Inclusion level of NLE (%)			
Parameters	0	0.1	0.2	0.3
Colour	5. 14±0.22^{ab}	4.79±0.31^{ab}	5.50±0.23^{a}	4.32±0.35^{b}
Juiciness	5. 39±0.30	6. 04±0.34	6. 11±0.24	5.93±0.38
Tenderness	5.14±0.38^{b}	5.71±0.35^{ab}	6.39±0.34^{a}	5.18±0.35^{b}
Overall Flavour	5.18±0.26^{ab}	4.86±0.30^{b}	5.75±0.28^{a}	5.07±0.33^{ab}
Meaty Flavour	6.14±0.29	6.36±0.31	6.50±0.20	6.17±0.30
Saltiness	5.04±0.28	5.04±0.26	4.54±0.20	4.75±0.40
Overall acceptability	5.18±0.33	4.96±0.36	5.68±0.32	4.79±0.34

$^{a,b;}$ Means on the same row with different superscripts are significantly ($p<0.05$) different

DISCUSSION

The cooking loss values reported in this study are lower than the values reported by Gohar *et al*. (2012) who compared cooking loss in broiler and layer meat and reported that cooking loss in broiler meat was in the range of 15.55 to 36.00%. The increase in the cooking weight losses with increasing levels of ANLE obtained in this study is in accordance with the results of the work of Ncube *et al*. (2018) who studied the effect of *Acacia angustissima* leaf meal on yield of carcass components and meat quality of broilers and reported that increasing levels of the leaf meal resulted in drier meat. High cooking loss also implies the less ability of the meat to hold water during processing and storage (Abu *et al*., 2015). According to Michalczuk *et al*. (2014), high meat cooking loss has an adverse effect on sensory perception as it reduces juiciness. The influence of ANLE on tenderness and overall flavour is consistent with results published by Jang *et al.* (2008) on the enhancement of flavour after feeding a mixture of herbal tree extracts to broilers. Similarly, the result agrees with Aderinola *et al.* (2013) who reported enhanced flavour of meat from *Moringa oleifera*-fed broilers. These similarities in juiciness and meaty flavour are in agreement with findings of Bonsu *et al*. (2012) who studied the medicinal response of broiler chickens to diets containing neem (*Azadirachta indica*) leaf meal. Egbeyale *et al*. (2012) in their study of meat qualities characteristics of broiler chicken fed varying levels of *Ocimum gratissimum* reported that parameters such as juiciness, saltiness and overall acceptability were not significantly influenced. However, the authors reported that overall flavour were significantly influenced which is in accordance with the results of this study.

CONCLUSION AND RECOMMENDATION

Aqueous extracts of neem (*Azadirachta indica*) leaf at 0.3% could be administered in the drinking water of broiler since it does not compromise the quality of meat.

REFERENCES

Abu, O.A., Olaleru, I.F. and Omojola, A.B. 2015. Carcass characteristics and meat quality of broilers fed cassava peel and leaf meal as replacements for maize and soybean meal. *Journal of Agricultural Veterinary Science*, 8(3): 41-46.

Aderinola, O.A., Rafiu, T.A., Akinwumi, A.O., Alabi, T.A. and Adeagbo, O.A. 2013. Utilization of *Moringa oleifera* leaf as supplement in broiler diet. *International Journal Food, Agriculture Veterinary Science*, 3(3):94-102.

Bonsu, F.R.K., Kagya-Agyemang, J.K., Kwenin, W.K.J. and Zanu, H.K. 2012. Medicinal response of broiler chickens to diets containing Neem *(Azadirachta indica*) leaf meal, haematology and meat sensory analysis *World Applied Science Journal*, 19(6):800-805.

Egbeyale, L.T., Sogunle, O.M., Adeleye, O.O., Oseni, M.A., Fajohunbo, G.O., Oyeleye, A.M. and Oduwaye S.A. 2012. Meat qualities characteristics of broiler chicken fed varying levels of *Ocimum gratissimum. International Journal of Applied Animal Science*, 1(2): 63-67.

Gohar, R., Abdul, B., Inayat, U.R., Mudassir, K. and Sayed, A.K. 2012. Comparative study on cooking loss in broiler and layer meat. A project report submitted through the department of veterinary science, faculty of animal husbandry and veterinary science, to Sindh agriculture university Tandojam in connection with partial, fulfilment of the requirements for the Id subject of final Prof. D.V.M 2012

Hernandez, F., Madrid. J., Garcia, V., Orengo, J. and Megias, M. D. 2004. Influence of two plant extracts on broiler performance, digestibility and digestive organ size. *Poultry Science*, 83: 169-174.

Hsieh, P.C. and Mau, J.L. 2001. Antimicrobial effect of various combinations of plant extracts. *Food microbiology*, 18: 35-43.

Jang, A., Liu, X. D., Shin, M. H., Lee, S. K., Lee, J. H. and Jo, C. 2008. Anti-oxidative potential of raw breast meat from broiler chicks fed a dietary medicinal herb extract mixture. *Poultry Science*, 87, 2380-2389.

Jawad. Z., Younus, M., Rehman, M.U., Maqbool, A., Munir, R., Muhammad, K., Korejo, R.A. and Qazi, I.H. 2013. Effect of Neem leaves (*Azadirachta indica*) on immunity of commercial broilers against newcastle disease and infectious bursal disease. *African Journal of Agricultural Research*, 8: 4596-4603.

Landy, N., Ghalamkari, G., Toghiani, M. and Yazdi, F.F. 2011. Humoral immune responses of broiler chickens fed with antibiotic and neem fruit powder (*Azadirachta indica*) as feed additive supplemented diet. IPCBEE 3:153-155.

Michalczuk, M., Lukasiewicz, M., Zdanowska-Sasiadek, Z. and Niemiec, J. 2014. Comparison of selected quality attributes of chicken meat as affected by rearing systems. *Poultry Journal Food Nutrition Science*, 64 (2), 121-126.

Mishra, A., Mamta, Neema, Niketa, Poonam, Pranjul, Priyanka. 2013. Antibacterial effects of crude extract of *Azadirachta indica* against *Escherichia coli* and *Staphylococcus aureus*. *International Journal of Science, Environment and Technology*, 2: 989–993.

Nayaka, H.B.S. Umakantha, B., Ruban, S.W., Murthy, H.N.N. and Narayanaswamy, H.D. 2013. Performance and hematological parameters of broilers fed Neem, turmeric, vitamin E and their combinations. *Emirates Journal of Food and Agriculture*, 25: 483-488.

Ncube, S., Halimat, T.E., Chikosi, E.V.I. and Saidi, P.T. 2018. Effect of *Acacia angustissima* leaf meal on performance yield of carcass components and meat quality of broilers. *South African Journal of Animal Science*, Vol.48 (No.2).

SAS, 2012. Statistical Analysis System, User's Guide. Statistical version 9.1th *Statistical Analysis System Institute Inc. Cary, North Cariolina, United State of America*.

Tipu, M. A., Akhtar, M. S., Anjum, M. I. and Raja, M. L. 2006. New dimension of medicinal plants as animal feed. *Pakistan Veterinary Journal*, 26 (3): 144-148.

PROXIMATE COMPOSITION OF GINGER ROOT AND GARLIC BULB POWDER FOR MEAT PROCESSING IN EDO STATE

Adomeh, E.E. & Oguntade, D.O.
Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State, Nigeria.
Corresponding Author: Adomeh E.E., Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State, Nigeria. Email: evaadomeh@aauekpoma.edu.ng
Phone: 08056349610

ABSTRACT
The study conducted investigation on proximate composition of ginger root and garlic bulb powder as phytobiotics for processing meat in Edo State. The copped ginger root and garlic bulb were sun dried for three weeks, milled separately into powder form using a milling machine with particle of 0.15mm sieve powder size. It was established that the moisture content of ginger root and garlic bulb powder were (22.5, 48.00 %), crude fiber (5.50, 3.00%), Ash (8.00, 6.00 %), crude protein (9.10,16.28%),ether extract (7.00,5.00%) and nitrogen free extract (70.40,69.72%). The analysis of ginger and garlic used in this study showed that ginger and garlic contained considerable amount of crude protein (CP) and thus can be used to augment protein content of poultry products.
Keywords: Ginger root, Garlic bulb, Crude fibre, Crude Protein and Proximate.

INTRODUCTION

Poultry production in the developing countries has been gaining popularity due to its contribution to meeting protein requirement of man, job creation, as well as socio-cultural and religious functions. According to Oboh and Igene (2006), poultry industry in Nigeria comprises of production of chickens, turkeys, ducks, and pigeons to mention a few. 84% of these are indigenous and 16% are exotic groups (Food and Agricultural Organization, FAO, 2008). Antibiotics as feed additives are widely used as therapeutic agent and also as growth promoters in poultry production all over the world but over the years, there has been growing concern about the public health risk resulting from antibiotic resistance. Antibiotics sometimes cause drug interactions that make medication ineffective, cause side effects or cause damage to a patient's biological systems. Mixing alcohol with antibiotics may decrease their effectiveness or may cause nausea, vomiting and respiratory effects. Antibiotics sometimes make birth control pills ineffective. Carcinogenic responses and other side effects of antibiotic residues in poultry products and meat make its use a serious call for concern. The extensive use of antibiotic growth promoters in poultry industry has resulted in rapid appearance of resistant form of microorganisms less sensitive to antibiotics (Sudipto, 2010). Over the years, there has been need for the use of alternative form of antibiotics and spices and some plant leaves have been found to be phytobiotic and various researchers have reported their success stories. Otoikhian, Emakpo and Imasuen (2007) for example, reported that ginger can successfully be used as a phytobiotic substance in poultry production. Natural products plant origin like spices, herbs and many plant extracts can be considered as alternative to antibiotics as well as growth promoters in improving broiler performance (Fenelli, Castro, Toranzo and Castro, 1998). Garlic is active against microorganisms that are resistant to synthetic antibiotics and the combination of garlic extracts with antibiotics has been reported to lead to partial and total synergism (Didry, Dubreuil, and Pinkas, 1992). Ginger is used worldwide as a cooking spice, condiment and herbal remedy. The Chinese have used ginger as a spice in processing broiler meat for at least 2,500 years as a digestive aid and anti-nausea remedy and to treat bleeding disorders and rheumatism. It has also been used to treat baldness, toothache, snake bite and respiratory conditions (Duke and Ayensu, 1985). In Traditional Chinese Medicine (TCM), ginger is considered a pungent dry warming herb used for ailments triggered by cold and damp weather. Ginger is used extensively in *Ayurveda*, the traditional medicine of India, to block excessive clotting (i.e. heart disease), reduce cholesterol and fight arthritis. In Malaysia and Indonesia, ginger soup is given to nursing mothers for 30 days after their delivery to keep them warm and to help them sweat out impurities. In Arabian medicine, ginger is considered an aphrodisiac (Qureshi, Shah, Tariq and Ageel, 1989). Also, in Africa, it is believed that eating broiler meat processed with ginger regularly will help repel mosquitoes (Duke and Ayensu 1985). The Eclectic

physicians of the 19th century relied on ginger to induce sweating, improve the appetite and curb nausea, and as a tropical counterirritant. Garlic can rightfully be called one of nature's wonderful plants with healing power. Therefore using Garlic in processing broiler meat can inhibit and kill bacteria, fungi, lower blood pressure, blood cholesterol and blood sugar, prevent blood clotting, and contains anti-tumor properties. It can also boost the immune system to fight off potential disease and maintain human health (Abdullah, Kandil, Elkadi, and Carter, 1988). It has the ability to stimulate the lymphatic system which expedites the removal of waste products from the human body. It is also considered an effective antioxidant to protect cells against free radical damage. Garlic can help to prevent some forms of cancer, heart disease, strokes and viral infections (Galeone *et al.*, 2006). The white garlic is said to have medicinal properties while the black fermented garlic is more commonly used for cooking by the Japanese as results have shown that processing broiler meat with this black fermented garlic could result in drop in blood pressure, anti-aging, prevent blood clots, cancer prevention, fall in blood sugar, and enhances immunity of the body (Zhengzou Love Herb Company Limited, 2013).

MATERIALS AND METHODS

The proximate analysis was carried out in Federal University of Agriculture Abeokuita, Ogun State. The ginger and garlic were milled separately into powder form. They were stored in air tight containers prior to the proximate analysis. Aliquet were taken for the proximate analysis which was determined, using the method described by AOAC (2000). The result is presented in the Table below.

RESULT

Proximate composition of ginger and garlic powder used in the study

The result of proximate composition of ginger root and garlic bulb powder used in the formulation of the experimental diets in this study is presented in Table 17. The ginger powder has 5.5% crude fibre, 8.00% crude ash, 9.10% crude protein, 7.00% ether extract and 70.40% Nitrogen free extract. Also the garlic bulb powder used in this study contained 3.00% crude fibre, 6.00% crude ash, 16.28% crude protein, 5.00% ether extract and 69.72% Nitrogen free extract.

Table: Proximate Composition of Ginger and Garlic (g/100g)

Composition	Ginger	Garlic
Moisture (%)	22.5	48.00
Crude fibre (%)	5.50	3.00
Ash (%)	8.00	6.00
Crude protein (%)	9.10	16.28
Ether extract (%)	7.00	5.00
NFE	70.40	69.72

DISCUSSION

Proximate Analysis of Ginger Root and Garlic Bulb Powder

The crude protein content of garlic is more than that of ginger and also more than the crude protein in maize. The values of CP obtained in ginger and garlic bulb powder used in this study were more than the values reported by Otunola et al. (2010). This may be due to different form of processing used in both studies. The high crude protein content of garlic may be due to the presence of active proteinous metabolites such as allicin. The additives also contained appreciable amount of fat and crude ash

which form the minerals that are inorganic components. Also, the low fibre contents in both additives imply that the additives can be used in the diets to complement total dietary fibre. Otunola et al. (2010) also observed low fibre contents in ginger, garlic and pepper.

CONCLUSION

The analysis of ginger and garlic used in this study showed that ginger and garlic contained considerable amount of crude protein (CP) and thus can be used to augment protein content of poultry products.

REFERENCES

Abdullah, T.H.; Kandil, O.; Elkadi, A. and Carter, J. (1988). Garlic revisited: therapeutic for the major diseases of our times? *Journal of National Medical Association* 80: 439-445.

AOAC, (2000). *Official methods of Analysis of the Association of Official Analytical Chesmists.* 17th edition. Gaithersburg, MD, USA: AOAC.

Didry, N.; Dubreuil, L., and Pinkas, M. (1992). Antimicrobial activity of naphthaquinones and *Allium* extracts combined with antibiotics. Retrived from https://www.ncbi.nlm.nih.gov/pmc/articles.PMC4171852. On Janurary 10, 2018.

FAO, (2008). Food and Agricultural Organization. Economic and Social Department: The Statistic Division. Top ten ginger producers. Rome, Italy.

Fenelli, S.L.; Castro, G.D.; Toranzo, E.G. and Castro, J. A. (1998). Mechanism of the preventive propert ies of some garlic compoundsin the carbon tetrachloride promoted oxidative stress. Diallyl sulfide. *Research Community of Molecular Pathology and Pharmacology* 110, 163 – 169.

Galeone, C.; Pelucchi, C.; Levi, F.; Negr, I.E.; Francesch, I.S.; Talamini, R.; Giacosa, A. and La Vecchia, C. (2006). Onion and garlic use and human cancer. *American Journal of Clinical Nutrition* 84(5): 1027-1032.

Oboh, S.O and Igene, F.U (2006). *Poultry production, the Nigerian Industry.*Ibadan: G.C.J General Service Ltd.

Otoikhinan, C.S.O.; Emakpo, L.E. and Imasuen, J.A. (2007). Breed responses to use of curative herbs for poultry coccidiosis by Nigeria Small-Holder Peri-Urban farmers: *Proceeding of 2nd (NIPS).* Abeokuta, Ogun State. 73-77.

Otunola, G.A.; Oloyede, O.B.; Oladiji, A.T. and Afolayan, A.J. (2010). Comparative analysis of the chemical composition of three spices – Allium sativum L. Zingiber officinale Rosc. and Capsicum frutescens L. commonly consumed in Nigeria. *African Journal of Biotechnology* 9(41): 6927 – 6931.

Zhengzou and Herb, (2013). The difference between black and white garlic Retrieved 15 11 2016 from http://www.iblackgarlic.com

EFFECT OF GINGER POWDER-BASED DIET AS NATURAL TENDERIZER OF MEAT FROM SPENT LAYER HENS

Oshibanjo D.O.[1*], Okpanachi U. [1], Kaze A. D.[1], Sam Etop[2], Adeshola Ayobami[2], Adeniyi A. K., Clement E. Nwaoru[3], Odeh, J. E. [4]

[1] Animal Production Department, Faculty of Agriculture, University of Jos, Jos Plateau state, Nigeria.*

[2]Animal Science Department, Faculty of Agriculture, University of Ibadan, Ibadan Oyo state, Nigeria.

[3] Department of Agribusiness and Management, Micheal Okpara University of Agriculture, Umudike.

[4]Animal Production and Health College, Vom, Jos Plateau state, Nigeria.

[*]oshibanjoo@unijos.edu.ng

+23408055438564

ABSTRACT

This study evaluated the effect of ginger powder- based diet as a natural tenderizer of spent layer hens' meat. Seventy-two spent layer hens were assigned to four (4) dietary treatment groups with six (6) birds per replicate and three (3) replicates per treatment in a completely randomized design. Dried ginger was milled and added as additive to the basal diet of the birds at 5%, 10% and 15% inclusion levels. After two weeks of feeding trial, the birds were slaughtered and the meat subjected to shear force, extract release volume (ERV) and water holding capacity (WHC) measurements using standard procedures. Data were analyzed using descriptive statistics and ANOVA at $\alpha_{0.05.}$ Based on the result obtained, as the ginger inclusion level increased, the meat tenderness increased. Control was significantly higher in shear force value with least value in meat from birds fed 15% ginger-based diet. Both ERV and WHC values increased as inclusion level of ginger increased. In conclusion, up to 15% ginger powder can be included in diet of spent layer hens to achieve meat tenderness two weeks prior to slaughter.

Keywords: ginger powder, spent layer, tenderization, water holding capacity and shear force

INTRODUCTION

Tenderness is considered to be the most important organoleptic characteristics of meat (Lawrie, 1991). Meat tenderisation could decrease the toughness of meat from spent layer hens as they are known to possess tough meat as a result of the work done during the months of laying. Many enzymes are being used commercially for meat tenderisation through their effect on the structural integrity of collagen, which can be unaffected during post mortem aging of meat (Bailey *et al.*, 1985). Changes in collagen's physicochemical (Stanton and Light, 1990), mechanical (Nishimura *et al.*, 1998) and ultra-structural (Liu *et al.*, 1995) properties have been observed.

A promising protease "Zingibain" isolated from *Zingiber officinale* roscoe (Ginger rhizome) has been reported to have proteolytic activity. Its proteolytic activity on collagen was found to act on actomyosin, and the combined proteolytic of these two muscle proteins improved the tenderness of meat. Besides tenderizing properties, antioxidant and anti-microbial characteristics of ginger extract have been reported by different workers (Mendiratta *et al*,.2000). However, ginger rhizome is used primarily as a flavouring agent for bakery products and as a sausage seasoning. Its utilisation as a meat tenderizing agent is not fully appreciated and the literature available is limited. Therefore, the aim of this study was to evaluate the meat tenderising effect of ginger powder included in diets for spent layer hens.

MATERIALS AND METHODS

Experiment site: The research was carried out in the Poultry Section of Livestock Investigation Department (LID), of National Veterinary Research Institute, Jos South Local Government Area, Plateau State on Latitude 09°44°N and Longitude 08°45°E, with physical features of rocky granites of old volcanoes.

Seventy-two spent layer hens were assigned to four (4) dietary treatment groups with six (6) birds per replicate and three (3) replicate per treatment in a completely randomized design.

Experimental Materials

Dried ginger was purchased at a local market (Bukuru market). The dried ginger was milled and added as additive to the basal diet of the layers in 0%, 5%, 10% and 15% inclusion levels.. The processing (drying and milling) of the materials was monitored. The feeding trial was carried out for (2) two weeks. The birds were fed once a day, feed intake and left over feed was measured daily. Routine management practices were also carried out.

Parameters measured

Shear force determination: The objective evaluation of tenderness was performed using the modified Warner Bratzler shear force procedure (Bouton and Harris, 1978).

Water holding capacity determination: Water Holding Capacity (WHC) was determined according to Wardlaw *et al.* (1973).

Determination of Extract Release Volume (ERV): This was done according to Jay (1964).

Experimental design

The experimental design was a completely randomised design.

Statistical Analysis

The data was statistically analyzed with the SPSS program for Windows (SPSS version 21.0, SPSS Inc., Chicago, IL, USA). Duncan's multiple-range test was used to compare the difference between means.

RESULTS AND DISCUSSION

The shear force of meat from spent layer hens fed ginger-based diet is showed in Figure 1. A consistent pattern was observed in the shear force of the meat obtained. As the inclusion levels of ginger increased, there was decrease in the shear force values. The shear force values of meat indicate tenderness of meat. High shear force values indicates an increased toughness of meat. . However, when the values obtained are low, it shows that the meat is tender. The results obtained could be attributed to the effect of proteolytic enzyme found in the ginger which may have led to more degradation and availability of dietary protein. Naveena and Mendiratta (2001) also observed that in ginger powder treated samples the shear force values were low when compared with the control. Khanna and Panda (2007) also reported a reduction in shear force values of papain-treated spent hen meat. The shear force value of ginger and papain treated samples were almost closer to that of broiler meat

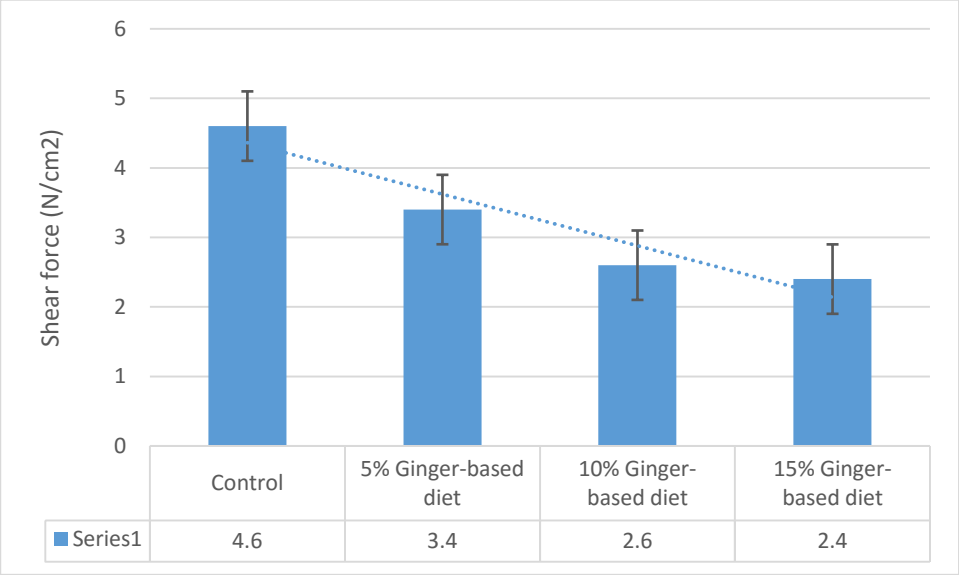


Figure 1: Effect of ginger based diet on shear force value of meat from spent layer hens

Figure 2 shows the water holding capacity and extract release volume of meat from spent layer hens fed ginger-based diet. The water holding capacity (WHC) is the ability of meat to hold on to its water after external pressure was applied. A trend was observed; there was an increase in WHC as the inclusion levels increased. LowerWHC values ranging from 38.70 to 47.00 (%) was reported by Muthulakshmi *et al.* (2018) while higher WHC values than control was in agreement with reports by Naveena and Mendiratta (2001). Khanna and Panda (2007) reported increased WHC of spent hen meat treated with papain and Naveena *et al.* (2004) reported similar results in buffalo meat treated with ginger extract.

Extract release volume (ERV) is a measurement technique that is based on the volume of aqueous extract released by homogenate of meat when allowed to pass through the filter paper for a given period of time By this, meat of good organoleptic and microbial quality release large volume of extract, whereas meat of poor quality releases smaller volume or none. A trend was observed in the result obtained in this study. As the inclusion level increased, the ERV increased. The result obtained shows that as the inclusion level increased the meat organoleptic and microbial quality was improved. This could be due to reported phytochemical substances present in the ginger powder (Mendiratta *et al,*.2000)

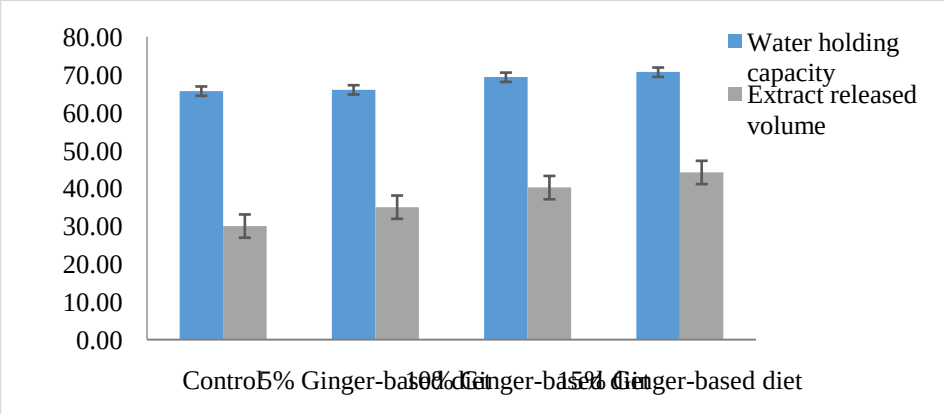


Figure 2: Effect of ginger-based diets on water holding capacity and extract release volume of meat from spen layer hens

CONCLUSION

Addition of 10 to 15% ginger powder into basal diet of spent layer hens is an effective meat tenderizer and the tenderization is achieved through its action on both myofibrillar and connective tissue components of the meat.

REFERENCES

Bailey, A.J., Light. N.D (1985). The role of collagen in the development of muscle and it relationship to eating quality. *Journal of Animal Science* 60:1580 – 1587

Bhaskar, N., Sachindra, N. M., Modi, V. K., Sakhara, P. Z. and Mahendrakar, N. S. (2006). Preparation of proteolytic activity rich ginger powder and evaluation of its tenderizing effect on spent hen muscle. *Journal of Muscle Foods*. 17, 174–184.

Bouton PE, Harris PV (1978). Factors affecting tensile and warner – Bratzler shear values of raw and cooked meat. *Journal of Texture study*., 9: 395 – 413.

Jay (1964), Beef microbial quality determined by extract release volume (ERV) (1964), *Food Technology*. 18: 132-137.

Khanna, N., and Panda, P.C.(2007). Effect of papain on tenderization and functional properties of spent hen meat cuts. *Indian Journal of Animal Research* 41, 55-58.

Lawrie (1991). Meat Science. 5th edition Pergamon Press, New York, NY.

Liu A, Nishimura T. and Takahashi K. (1995). Structural weakening of intramuscular tissue during post-mortem agingof chicken semi-tendinous muscle. *Meat Science* 39:135–142

Mendiratta S.K., Anjaneyulu, A.S.R., Lakshmanan, V., Naveena, B.M., and Bisht, G.S. (2000). Tenderizing and antioxidant effect of ginger extract on sheep meat. *Journal of Food Science and Technology*, 37, 565–570.

Naveena B.M., and Mendiratta S.K. (2001). Tenderization of spent hen meat using ginger extract. *British Poultry Science*, 42,344–350.

Naveena B.M., Mendiratta, S.K., and Anjaneyulu A.S.R. (2004). Tenderization of buffalo meat using plant proteases from *Cucumis trigonus* Roxb (Kachri) and *Zingiber officinale roscoe* (Ginger rhizome). *Meat Science,* 68, 363–369.

Nishimura T, Liu A, Hattori A. and Takahashi K. (1998). Changes in mechanical strength of intramuscular connective tissue during postmortem aging of beef. *Journal of Animal Science* 76:528–532

Stanton C. and Light N. (1990). The effect of condition of meat collagen. Evidence for proteolytic damage to endomysial collagen after conditioning. *Meat Science* 27:41–54.

Wardlaw, F.B., Maccaskill, L.H. and Acton, J.C. (1973) Effect of postmortem muscle changes in poultry meat loaf properties. *Journal of Food Science,* 38, 421–424.

CURRENT INTENSIVE POULTRY PRODUCTION SITUATION IN THE HOT HUMID TROPICAL ENVIRONMENT OF SOUTHERN NIGERIA

Ukwu, P.C. Okere, P.C. Odoemelam, V.I. Obikaonu, H.O. Uchegbu M.C. and Okoli I.C.
Department of Animal Science and Technology, Federal University of Technology, P.M.B 1526 Owerri, Imo State, Nigeria
Corresponding author: P.C. Ukwu; E-mail: chikodiliukwu@gmail.com

ABSTRACT
The hot humid tropical climate of southern Nigeria with its prevailing high ambient temperature and relative humidity imposes a lot of stress on commercial poultry production dominated by small–scale producers who practice mostly mixed farming of broilers and layers in deep litter pens.Many of these poultry farms are however finding it increasingly difficult to survive because of high cost of inputs, such as feeds and feed raw materials. In addition,the hot humid climate exerts continuous heat stress on the high producing imported breeds. However, most small-scale farms still utilize commercially produced feeds in feeding their birds, while the large-scale farms produce their feeds in-house.The major diseases prevalent in the farms are Newcastle, Gomboro, fowl pox, chronic respiratory diseases and coccidiosis.Poultry production remains attractive in the region because birds are able to adapt easily, have low economic value, rapid generation time and high rate of productivity.

Keywords: Poultry, chicken, humid tropics, southern Nigeria

INTRODUCTION
Southern Nigeria is situated in sub-Saharan Africa with coordinates of longitudes 3° and 14^{1} East of the Greenwich Meridian and latitudes 4° and 14^{1} north of the equator. The area is made up of three geo-political zones and seventeen distinct states; the South east (Enugu, Imo, Anambra, Abia and Ebonyi states), South- south (Rivers, AkwaIbom, Cross River, Edo and Bayelsa states) and South west (Oyo, Lagos, Ogun, Ondo, Oshun and Ekiti states). The population of the three southern zones was estimated at 63.813,163 (NPC, 2006). Although there are variations in their socio-cultural characteristics that reflect in observable differences in their languages, culture, religions, food habits and other socio-cultural values, the zones have similar climate which is tropical, wet and humid, while the vegetation consists of dense mangrove/ rain forests (Okeudo, 2004).
This tropical climate has been shown to impose a lot of stress on animals with the high ambient temperature and relative humidity, particularly placing continuous heat stress on high producing imported breeds. These result in reduction in feed intake and growth rate (Okeudo, 2004), especially in intensively reared commercial poultry (Ukwu*et al.*, 2018). The high temperature also increases the rate of ammonia release from poultry dung and in many poultry farms a strong and choking odor fills the air and adversely affect the health of the birds to which the solution is reducing the stocking density and increasing the ventilation (Okoli, 2004).
The objective of this paper is to report the currentintensive poultry production situation in the hot humid tropical environment of southern Nigeria

Types of poultry operations
Small–scale producers dominate the commercial poultry industry in southern Nigeria (Okeudo, 2004). According to the report of a survey on commercial broiler production conducted in the south-east of Nigeria, about 50% of the farms had between 200 and 300 birds, 20% had 400 – 500 birds, 26% had 1000 – 1500 birds and no farm had more than 2700 birds. Specifically, Akandu (2012) reported that the major poultry operations were egg, broilers, feed production and to a lesser extent breeder and turkey productions as well as feed distribution. This study also reported that 48% of broiler farms have 100 - 1000 birds, while another 36% of the farms have 1000 - 5000 birds. The highest percentage of layer farms (34.40%) stocked 1000 - 5000 birds, followed by 21.90% that stocked 100 - 1000 birds and another 15.60% each stocking 5000 - 15000 and 15000 - 30000 birds. These results

show that poultry farmers in Southern Nigeria stock more layers than broilers and are in agreement with the report of USDA (2013) that Nigeria is the leader in Africa with respect to egg production and fourth in broiler production. Ogegbuna (2014) reported that 48% of poultry farmers in south east Nigeria had mixed broiler and layer farms, while 44% reared only broilers. In the south-south, Bassey (2014) reported 40.70, 33.89 and 25.42% for broiler, layer and mixed farming respectively. Oluyemi and Roberts (2000) attributed higher mixed farming activities to the shorter maturing period of broilers and the need for farmers to maximize market opportunities.

Deep litter system is the preferred rearing approach by most of the farmers in the zones (Ugwu, 2009).Akandu (2012) reported a 50.00% adoption of deep litter, 15.60% of cage system and 34.40% of combined approach. This report is however at variance with the results of a focused study on Imo state which showed that most (100%) farmers kept their birds on deep litter probably because of their inability to access battery cages at that time (Okoli*et al.,* 2004). Alimi*et al.* (2006) showed that there has been a steady growth in the Nigerian poultry industry with growth figure standing at 112% during a 14-year period of (1990-2003). It is therefore probable that over the period of eight years from 2004 to 2012 that the farming system in the zone have changed.

Production constraints

According to Okoli*etal*. (2005), many poultry farms are finding it increasingly difficult to survive in the business in southern Nigeria, because of high cost of inputs, particularly high cost of feeds and feed raw materials. For example, in Enugu and Imo states of south eastern Nigeria, high cost of feeds, disease and high cost of day old chicks are considered the key identified constraints to poultry production (Okoli*et al*., 2005). Ugwu (2009), also identified marketing problem as another constraint of the southeast states, which manifests as fluctuations in prices of products and inadequate market outlets, leading to egg glut and spoilage of products during certain periods of the year (Ugwu, 2009). Overall however, poultry keeping has become a practicable livelihood empowerment and poverty reduction venture in the region, just as in other developing countries. Poultry production is attractive in the region because birds are able to adapt easily, have low economic value, rapid generation time and high rate of productivity that results in the production of meat within eight weeks and eggs within eighteen weeks of first chick being hatched.

Chick quality

In southern Nigeria under review, although day old chicks may be considered available, they are relatively expensive (Okoli*et al*., 2005). In a survey conducted by Ugwu (2009), this high cost was attributed to high transportation costs and other contingent expenses. Commercial chicks raised in Southeastern Nigeria are sourced mostlyfrom Ibadan, Abeokuta and Sapele in Southwestern and South-south regions of Nigeria respectively (Akandu, 2012). Because of the distance between the southeast and these centers of day old chick production, Ukwu (2013) reported that there is always a time-lag between the hatching and on-farm feed and water treatment of considerable percentage of chicks being reared in this area. Delay factors such as poor condition of roads and vehicles used in transportation of chicks as well as delays occasioned by corrupt law enforcement agents have been reported. These factors often occasion delays which may lead to the exhaustion of the chicks with various levels of in-transit and post-transit loss of chick condition and mortality. The occasioned early feed and water denial, as well as transportation stress compromises the development of broiler chicks and prevents them from achieving their growth potential (Ukwu, 2013).

Feed and feeding

Feeding is a critical factor in intensive poultry production all over world, including the study area of southern Nigeria (Oluyemi and Roberts, 2000). The cost of producing meat and egg is heavily burdened by the high cost of feed materials, which is estimated to be more than 70% of the production cost of the finished products (Esonu, 2006). Income from poultry production is thus highly dependent on feed utilization for all types of intensive poultry production in the region. Quality feeds of appropriate nutritional value suitable for efficient production are therefore critical inputs in the enterprise (Omede, 2010). Most small-scale farms utilize commercially produced feeds in feeding their birds, while the large-scale farms produce their feeds in-house (Adene and Oguntade, 2006). The nutritive values of the commercial feeds have been shown to vary widely across brands and types

(Omede, 2010). They have been shown to vary due to factors such as age of feed materials, processing methods, seasonal variations in nutrient contents of feedstuffs and method of conservation as well as possible presence of toxic substances and pathogens (Omede,2010). Therefore, there is perhaps no other factor directly or indirectly related to feed quality in impacting performance of poultry and this is ultimately linked to productivity and profitability of the ventures.

The high cost of conventional feedstuffs has made the search for alternative feed materials, imperative. The use of these alternative feed materials has been shown to be relatively cost effective (Esonu, 2009). Among the alternative feedstuffs that have been utilized in the region are cassava tuber products as sources of energy (Okoli and Udedibie, 2017), cassava leaves as source of protein, minerals and xanthophyll andcassava peel meal when processed adequately. Cassava tubers and cocoyam corms flours have been demonstrated to be good maize replacers in poultry diets when given adequate processing treatment (Abdurashid and Agwunobi, 2012). Also, combinations of different alternative feed materials such as palm kernel cake and cassava tuber flour supplemented with appropriate additives to boost their utilization as poultry feed materials have been reported (Okoli and Udedibie, 2017).

Animal health

The increase in intensive poultry production in southern Nigeria provides the optimum conditions for the concentration and transmission of pathogens, specifically because the crowding of birds in enclosed environments is highly conducive for the transmission of pathogenic organisms. The major poultry diseases in the region are Newcastle, Gomboro, fowl pox, chronic respiratory diseases and coccidiosis (Okoli*et al*., 2005). Etuk*et al*. (2004) reported that coccidiosis is a major disease of the area, whileKanu*et al*.(2019) reported incidence levels of 30.85% for coccidiosis, 30.35% for Newcastle disease, 14.93% for Gomboro disease, 14.43% for chronic respiratory disease and 9.45% for fowl typhoid over a period of five years (2013 – 2017).The reports of Okoli*et al*. (2005) for Imo state, Bassey (2014) for AkwaIbom state and Ogegbuna (2014) for Anambra state show that antibiotics, coccidial drugs and vaccines are the most prescribed animal health products, supporting the report of high occurrence of coccidiosis, Gumboro and New castle diseases in farms. There is however limited access to animal health care services, especially among the small-scale farmers. Ogegbuna, (2014) reported that only 48.00% of poultry farmers in Anambra state retained the services of animal health workers, while Bassey (2014) reported a high 72.00% retainership of animal health workers' services in AkwaIbom state. These workers also reported high level of self-medication and poor consultation of animal health workers by farmers in southern Nigeria and attributed this to high cost of veterinary services, small-size of poultry farms and remote rural locations of many poultry farms.

CONCLUSION

Poultry production remains an attractive venture in southern Nigeria because birds are able to adapt easily, have low economic value, rapid generation time and high rate of productivity.

REFERENCES

Abdulrashid, M. and Agwunobi, L.N. (2012). Tannia (*Xanthosomasagittifolium*) cocoyam as dietary substitute for maize in broiler chicken. *Greener Journal of Agricultural Sciences,* 2(5). Pp: 167 – 171.

Adene, D.E. and Oguntade, A.E. (2006). The structure and importance of the commeridcal and village based poultry in Nigeria. *Food and Agricultural Organization*. Rome. Pp: 110.

Akandu, C.U. (2012). The structure of the poultry industry in selected states of southern Nigeria.Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Alimi, T., Oluwasola, S.O. and Adejobi, A.O. (2006). Optimal farm size for achieving enterprise objective and sustainability in poultry meat production in Osun state, Nigeria. World Poultry Science Journal, 62525 - 536.

Bassey, I.O. (2014). Socioeconomic and drug use habits of animal health practitioners and poultry farmers in AkwaIbom State. Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Esonu, B.O. (2009). Unconventional feed resources for livestock development and food security. Paradigms for Nigerian Livestock industry. 14th Inaugural Lecture, Federal University of Technology Owerri, Nigeria.

Etuk, E. B., Okoli, I. C. and Uko, M. U. (2004). Prevalence and management issues associated with poultry coccidiosis in Abak Agricultural zone of AkwaIbom State, Nigeria. *Inter. J. Poult. Sci.*, 3(2): 135 – 139.

Kanu, C.G., Okere, P.C. Chibuike, C.E, Uwakwe, M.N., Achonwa, C.C. and Okoli, I.C. (2019). Incidence of common poultry diseases in selected poultryfarms in Owerri North and Owerri West from 2013 – 2017. Proceedings of 44th Annual Conference of Nigerian Society of Animal Production, Abuja Nigeria. Pp: 64 – 67.

NPC (2006). Nigerian census figure. National Population Commission, Abuja, Nigeria

Obegbuna, O. (2014). Socioeconomic and drug use habits of animal health practitioners and poultry farmers in Anambra State, Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Okeudo, N.J. (2004). Empirical studies of the living condition of domestic animals in Nigeria. Results from Nigeria. In: Amalu, U.C. and Gottwald, F. (eds.). *Studies of sustainable agriculture and Animal science in sub-Saharan Africa.* Peter Lang Publication, Germany.

Okoli, I. C., Anyaegbunam, C. N., Etuk, E. B., Uchegbu, M. C. and Udedibie, A. B. I. (2004). Socio-economic characteristics of poultry business entrepreneurs in Imo state, Nigeria. *Journal of Agriculture and Social Research*, 4(2): 100 - 111.

Okoli, I.C., Anyaegbunam, C.N., Etuk, E.B., Opara, M.N. and Udedibie, A.B.I. (2005). Entrepreneurial characteristics and constraints of poultry enterprises in Imo State, Nigeria. *Journal of Agriculture and Social Research,* 5(1): 25 – 32.

Okoli, I. C. and Udedibie, A.B.I. (Eds.) (2017). The science and technology of cassava utilization in poultry feeding. Proceedings of a NIPOFERD Workshop,June 27 – July 1 2016, Asaba, Nigeria.

Oluyemi, J.A. and Roberts, F.A. (2000). *Poultry production in warm-wet climates, 2rd edition.* Spectrum Books Ltd., Ibadan, Nigeria.

Omede, A.A. (2010). The use of physical characteristics in the quality evaluation of some commercial poultry feeds and feed stuff. M.Sc. Thesis, Federal University of Technology Owerri, Nigeria.

Ugwu, D.S. (2009). Base line study of small and medium-scale poultry production in Enugu and Lagos states of Nigeria. World Journal of Agricultural Sciences, 5(1): 27 – 33.

Ukwu, C.P. (2013). Influence of selected stressors on day old chicks development in the hot humid tropical environment of southeastern Nigeria. MSc Thesis, Federal University of Technology, Owerri, Nigeria.

MORPHOMETRIC, CARCASS MEASUREMENTS AND MUSCLE DISTRIBUTION OF FOUR BREEDS OF RAMS INTENSIVELY FATTENED

Akinleye, S. B., Omojola, A. B. & Adetunji, V. A.
Meat Science Laboratory, Department of Animal Science, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria
Corresponding Author : bamideleakinleye@yahoo.com

ABSTRACT
This study was to investigate breed differences in live weight, carcass traits and muscle distribution of Balami (BA), Uda (UD), Yankasa (YK) and West African Dwarf rams (WAD). fForty-eight rams were randomly assigned into four groups of twelve rams per breed in a completely randomized design. Linear measurements were obtained weekly during the fattening period. At the end of the feeding trial, animals were subjected to a 18-hours fast and slaughtered for carcass measurements and muscle distribution. Results showed that BA and UD had higher values for body length (115.75±4.25 and 110.25±1.89), withers height (70.50±5.57 and 69.00±2.16) and heart girth (92.00±2.94 and 84.00±1.41), than YK (96.50±3.87, 60.75±3.30 and 76.75±0.96), respectively which in turn had higher values than WAD (86.50±5.20, 53.25±5.32 and 75.25±3.30). Carcass length, pistola length, and leg length were 75.75±4.79, 60.75±7.14 and 88.00±2.16; 75.50±4.66, 56.00±5.00 and 80.25±5.80; 59.00±7.79, 56.00±10.62 and 71.50±2.65; 60.50±3.11, 53.75±5.91 and 61.00±2.94cm for BA, UD, YK and WAD rams, respectively. BA and UD had higher proportion of muscle distribution and were generally better than the YK and WAD breeds. This may boost their potential for large scale meat production under fattening conditions.
Keywords Breeds, Meat, Growth . Morphology, Carcass, Muscle distribution

INTRODUCTION
Nigeria livestock industry is small and slow-growing relative to the population relying on it for meat (Agboola and Balcilar, 2012). The use of specialised meat breeds to improve animal productivity is desirable in intensive sheep production. Locally adapted breeds of rams have attributes that can be used in a collective and valuable approach to increase meat production and improving their connections to the market (FAO, 2012). Morphometric measurements have been used to evaluate the characteristics of various breeds of animals and could provide first-hand information on the suitability of animals for selection (Yakubu, 2010). Muscularity indicates the amount of muscle tissue, determined by muscle to bone ratio and fatness describes the external and internal deposition of fat in the carcass. According to Srivastava *et al* (1968), body measurements are indices of skeletal development and indirectly help to determine carcass composition. Another parameter that was used over the years to estimate the amount of meat that could be obtained from slaughtered animals is carcass measurement. De Boer *et al* (1974) identified four types of linear carcass measurements. The objectives of the present study were to compare various measurements of body, carcass and tissue distribution for Balami, Uda, Yankasa and West African Dwarf breeds of ram intensively managed.

MATERIALS AND METHODS
Location and management of experimental animals
The study was conducted at the Sheep and Goat unit of the Teaching and Research Farm, University of Ibadan. Twelve rams each of Balami (BA), Uda (UD), Yankasa (YK) and West African Dwarf (WAD) breeds , weighing 17.00± 0.39–19.38±0.39 (12-18 months of age). At the end of the ninety days, four rams in each group whose weights were the closest to average final weight of the rams of their respective breeds were chosen for subsequent carcass analysis.

LINEAR BODY MEASUREMENTS
The six morphometric traits measured were height at wither, pelvis height, body length, heart girth, chest width and chest depth. Measurement (cm) was done using a graduated measuring stick and tape rule. To achieve this, animals were placed on a flat ground and held by two field assistants. The length measurements were carried out using a tape rule while the width measurements (cm) were taken using a calibrated wooden calliper.

SLAUGHTER PROCEDURE

The selected sixteen rams from the four breeds were transported to the slaughterhouse of the Department of Animal Science, University of Ibadan where pre-slaughter live weight was recorded after 18-hours of fasting with free access to water. Exsanguination was carried out by an incision on the jugular furrow at the occipito-atlantal junction close to the head, severing the carotid arteries, jugular veins, trachea, oesophagus and the spinal cord. The head was removed and the carcass was hung by the hind legs using a pulley and then skinned.

EVISCERATION OF CARCASSES AND CARCASS EVALUATION:

Skinning and evisceration was carried out and hot carcass weight was taken on the slaughter floor within 10min post-motem. The carcass was chilled for twenty-four hours at 3°C-4°C and reweighed to get chilled carcass weight. Dimensional measurements taken on the carcasses were: Carcass Length, Length of Hindleg, Length of Foreleg, Heart Girth and Depth of Chest according to the procedures of De Boer *et al.* (1974). Abdominal, pectoral, Kidney and pelvic fats were removed, weighed and calculated as a percentage of the hot carcass weight. Carcasses were split along the midline. The left sides were separated as outlined by Fisher and De Boer (1994). These included carcass length and depth, and leg length. The length of the pistola was obtained following quartering of the carcass side. After a 24-h chilling period (4°C), the right side of each carcass was cut through the spinal column between the 5th and 6th thoracic vertebrae.

DISSECTION OF MUSCLES

Dissection of the chilled half carcass was carried out by making incision at the point of insertion and origin to harvest the following muscles semimembranosus, semitendinosus, biceps femoris, adductor, gluteus medius, deltoideus, supraspinatus, infraspinatus, subscapularis. The muscles were weighed separately, then their relative proportions to the cold carcass weight (CCW) and recorded. Dissection was carried out using the dissecting set apparatus following the procedures of Sisson and Grossman (1953).

STATISTICAL ANALYSES

Data were statistically analysed using the general linear models procedure of the Statistical Analysis System Institute (SAS, 1996).

RESULTS AND DISCUSSION

Body measurements

Linear measurements in relation to weight are shown in Table1 as objective measure of carcass blockiness. BA (115.75±4.25 and 70.50±5.57) and UD (110.25±1.89 and 69.00±2.16) had significantly higher values than YK (96.50±3.87 and 60.75±3.30) and WAD (86.50±5.20 and 53.25±5.32) for body length and wither height, the values for YK were greater than WAD. BA had a significantly pelvis chest than UD (80.25±5.80) and WAD (61.00±2.94), which were not different (P>0.05). When expressed relative to live weight, BA and WAD differed significantly for all values, where as UD (84.00±1.41 and 80.25±5.80) had significantly higher values for heart girth and pelvis height than WAD (75.25±3.30 and 61.00±2.94). The slaughter weight in the present study reflects commercial practices and maintains good comparability with other breed. The findings indicated that body measurements can be used for estimation of body weight of animals in the field where scales are not readily available. Lavvaf *et al*. (2012) observed that chest depth and rump width were suitable factor for predicting hot carcass weight in each of Afshari and Zandi sheep, respectively. These measurements provide important evidences for the growth of the breed and information about the morphological structure and development ability of the animals.

Table 1: Morphometric Measurements of four breeds of rams intensively fattened

Parameters	BA	UD	YK	WAD
Live weigth (kg)	36.59±1.83	37.00±0.82	36.00±1.83	36.39±2.38
Measurements (cm)				
Body length	115.75±4.25^{a}	110.25±1.89^{a}	96.50±3.87^{b}	86.50±5.20^{c}
Wither heigth	70.50±5.57^{a}	69.00±2.16^{a}	60.75±3.30^{b}	53.25±5.32^{c}
Heart girth	92.00±2.94^{a}	84.00±1.41^{a}	76.75±0.96^{c}	75.25±3.30^{c}
Pelvis heigth	88.00±2.16^{a}	80.25±5.80^{b}	71.50±2.65^{c}	61.00±2.94^{d}
Chest width	18.75±0.50	19.25±0.50	17.75±1.71	17.75±3.30
Chest depth	33.00±2.58^{a}	33.00±3.74^{a}	29.50±2.65^{ab}	25.75±0.96^{b}
Measurements relative to liveweight (cm/100g)				
Body length	3.17±0.16^{a}	2.98±0.11^{ab}	2.77±0.23^{b}	2.76±0.26^{b}
Wither heigth	1.93±0.09^{a}	1.87±0.03^{ab}	1.74±0.16^{ab}	1.70±0.20^{b}
Heart girth	2.52±0.07^{a}	2.27±0.06^{ab}	2.20±0.12^{bc}	2.40±0.17^{c}
Pelvis heigth	2.41±0.09^{a}	2.17±0.15^{b}	2.05±0.17^{bc}	1.94±0.14^{c}
Chest width	0.51±0.04	0.52±0.02	0.51±0.07	0.57±0.11
Chest depth	0.09±0.07	0.89±0.10	0.85±0.09	0.82±0.08

Means in the same along the same row with different superscripts are significantly different (P<0.05). BA: Balami, UD: Uda, YK: Yankasa, WAD: West African Dwarf

Carcass and measurements

Carcass measurements are presented in Table 2. The proportion of hot carcass weight was 18.72 ±1.85, 18.25±0.87, 17.72±0.17 and 17.72±1.26 for BA, UD, YK and WAD, respectively. Carcass and pistola length were significantly greater for BA (75.75±4.79 and 60.75±7.14) and UD (75.50±4.66 and 56.00±5.00) than YK (59.00±7.79 and 56.00± 10.62) and WAD (60.50±3.11). BA (88.00±2.16) had greater (P<0.05) leg length than both UD (80.25±5.80), YK (71.50±2.65) and WAD (61.00±2.94), which did not differ (P>0.05). When expressed relative to hot carcass weight, carcass length, carcass depth and pistola length were not significant between the breeds but were lower (P<0.05) for WAD. All the four breeds differed significantly for leg length relative to carcass weight, which was greatest for BA (0.46±0.04) and least for WAD (0.39±0.02). Breed significantly affected all carcass measurements except carcass depth, with BA having higher values for all traits. Linear carcass measurements and indexes are used as indicators of carcass conformation and size (Sañudo *et al.* , 1998c) . The results of the current study indicate significant effect of breed on carcass measurements and conformation indexes could be explained by breed specific morphologic characteristics of BA breeds.

Table 2. Hot carcass weight and carcass measurements of of four breeds of rams intensively fattened

Parameters	BA	UD	YK	WAD
Cold Carcass Weigth	18.72 ±1.85	18.25±0.87	17.72±0.17	17.72±1.26
Carcass Measurements (cm)				
Carcass Length	75.75±4.79^{a}	75.50±4.66^{a}	59.00±7.79^{b}	60.50±3.11^{b}
Carcass Depth	24.25±0.96	24.50±0.58	24.75±3.30	24.25±4.03
Pistola Length	60.75±7.14^{a}	56.00±5.00^{b}	56.00±10.62^{b}	53.75±5.91^{c}
Leg Length	88.00±2.16^{a}	80.25±5.80^{b}	71.50±2.65^{c}	61.00±2.94^{d}
Carcass Measurements (cm/100g carcass)				
Carcass Length	0.41±0.02^{a}	0.42±0.02^{a}	0.34±0.04^{b}	0.39±0.05^{ab}
Carcass Depth	0.13±0.01	0.14±0.01	0.14±0.02	0.15±0.01
Pistola Length	0.33±0.01	0.25±0.11	0.32±0.06	0.34±0.01
Leg Length	0.46±0.04^{a}	0.44±0.04^{b}	0.40±0.02^{bc}	0.39±0.02^{c}

Means in the same along the same row with different superscripts are significantly different (P<0.05). BA: Balami, UD: Uda, YK: Yankasa, WAD: West African Dwarf

MUSCLE MEASUREMENTS

Distribution of muscles are shown in Table 3. Weigth of SM and ST were significantly higher for BA (0.54±0.02) and UD (0.59±0.10) than YK (0.49±0.01) with WAD (0.47±0.03) being the lowest (P>0.05), whereas weight of the BF was significantly lower for WAD (0.22±0.06) and YK(0.25±0.05) than BA (0.36±0.01) and UD (0.39±0.06), which did not differ (P>0.05), The weigth of GM was

lower for YK (0.15±0.01) and WAD (0.15±0.02) than BA (0.18±0.01) and UD (0.17±0.01), which were similar (P>0.05). The weight of DP was higher for BA (0.63±0.06) than UD (0.42±0.11), YK (0.38±) and WAD (0.42±0.17), which were not significant to one another (P>0.05). The weight of IF (0.23±0.01), SP (0.18±0.05), DT (0.30±0.02) and SS (0.24±0.08) were significantly greater for BA. The relative weight of the SM was significantly higher for UD (0.51±0.08) and YK (0.45±0.01) than for BA (0.39±0.03)FR and WAD (0.38±0.02). The relative weight of the ST (0.40±0.04), ADD (0.38±0.03), GM (0.14±0.01) and BF (0.34±0.04) was significantly greater for UD than the values recorded for both BA and YK. The greater muscle of BA compared to the UD,YK and WAD breeds reflected the greater fleshiness and carcass conformation. The relative small differences in tissue distribution together with the non-significant differences in the proportion of muscle in the weight suggest that carcass conformation score is not a reliable indicator of traits (McGee *et al*., 2005).

Table 3. Hot carcass weight and percentage proportion of muscles of four breeds of rams intensively fattened

Parameters	Balami	Uda	Yankasa	WAD
Hot Carcass Weigth (HCW)	18.72 ±1.85	18.25±0.87	17.72±0.17	16.82±1.26
Muscle Measurements (g)				
Semimembranosus (SM)	0.54±0.02^{ab}	0.59±0.10^{a}	0.49±0.01^{b}	0.47±0.03^{b}
Semitendinosus (ST)	0.49±0.14^{a}	0.46±0.02^{ab}	0.37±0.02^{ab}	0.35±0.06^{b}
Adductor (ADD)	0.47±0.06	0.45±0.03	0.40±0.01	0.40±0.05
Gluteus Medius (GM)	0.18±0.01^{a}	0.17±0.01^{ab}	0.15±0.01^{c}	0.15±0.02^{bc}
Biceps femoris (BF)	0.36±0.01^{a}	0.39±0.06^{a}	0.25±0.05^{b}	0.22±0.06^{b}
Deep pectoralis (DP)	0.63±0.06^{a}	0.42±0.11^{b}	0.38±0.02^{b}	0.42±0.17^{b}
Infraspinatus (IF)	0.23±0.01^{a}	0.19±0.01^{b}	0.18±0.01^{b}	0.18±0.04^{b}
Supraspinatus (SP)	0.18±0.05^{a}	0.14±0.01^{b}	0.14±0.01^{b}	0.13±0.01^{b}
Deltoideus (DT)	0.30±0.02^{a}	0.27±0.01^{ab}	0.28±0.02^{ab}	0.25±0.02^{b}
Subscaplaris (SS)	0.24±0.08^{ab}	0.17±0.09^{b}	0.31±0.01^{a}	0.27±0.10^{ab}
Percentage proportion of muscle to HCW				
Semimembranosus	0.39±0.03^{bc}	0.51±0.08^{a}	0.45±0.01^{ab}	0.38±0.02^{c}
Semitendinosus	0.34±0.06^{ab}	0.40±0.04^{a}	0.34±0.02^{ab}	0.28±0.04^{b}
Adductor	0.33±0.01^{bc}	0.38±0.03^{a}	0.37±0.01^{ab}	0.32±0.04^{c}
Gluteus Medius	0.13±0.01^{bc}	0.14±0.01^{a}	0.13±0.00^{b}	0.12±0.01^{c}
Biceps femoris	0.25±0.01^{b}	0.34±0.04^{a}	0.24±0.05^{bc}	0.18±0.04^{c}
Deep pectoralis	0.45±0.09	0.37±0.11	0.35±0.01	0.34±0.13
Infraspinatus	0.17±0.01	0.16±0.01	0.17±0.01	0.14±0.03
Supraspinatus	0.13±0.04	0.12±0.00	0.13±0.01	0.11±0.01
Deltoideus	0.21±0.01^{bc}	0.23±0.00^{b}	0.26±0.02^{a}	0.20±0.02^{c}
Subscaplaris	0.17±0.04^{b}	0.22±0.06^{ab}	0.28±0.01^{a}	0.27±0.01^{a}

Means in the same along the same row with different superscripts are significantly different (P<0.05). BA: Balami, UD: Uda, YK: Yankasa, WAD: West African Dwarf

CONCLUSIONS

BA and UD breeds have higher values as demonstrated by the results, the use of BA and UD becomes valuable replacement for meat production. Improvements in genetics and husbandry are needed to improve the potential of these animals for efficient large scale meat production.

REFERENCES

Agboola, M. O and Balcilar M. (2012). Impact of Food Security on Urban Poverty: A Case Study of Lagos State, Nigeria. Procedia - Social and Behavioral Sciences. Vol 62 (1995): 1225–1229.

Bee, G, Anderson, A. L, Lonergan, S. M, Huff-Lonergan, E. (2007) Rate and extent of pH decline affect proteolysis of cytoskeletal proteins and water-holding capacity in pork. Meat Science 76, 359–365. doi:10.1016/j.meatsci. 2006.12.004

Hernández-Castellano L. E, Morales-de la Nuez A, Moreno- Indias I, Torres A, Sánchez-Macias D, Capote J, Castro N, Argüello A. (2013). Carcass and meat quality determination as a tool to promote local meat consumption in outermost regions of Europe. J Appl Anim Res. 41:269–276.

Keane, M.G. and Allen, P.(2002). A comparison of Friesian-Holstein, Piemontese × Friesian-Holstein and Romagnola × Friesian-Holstein steers for beef production and carcass traits. Livestock Production Science 78: 143–158.

Lavvaf, A., Noshari A and Farahvash, T. (2012). Evaluation of the relationship between body measurements and carcass traits of finishing afshari and zandi rams. Asian J. Anim. Vet. Adv., 7: 187-192.

McGee, M., Keane, M. G., Neilan, R., Moloney, A. P. and Caffrey, P. J. (2005). Production and carcass traits of high dairy genetic merit Holstein, standard dairy genetic merit Friesian and Charolais × Holstein-Friesian male cattle. Irish Journal of Agricultural and Food Research 44: 215–231.

Sañudo, C., Sanchez, A., and Alfonso, M. (1998c). Small ruminant production systems and factors affecting lamb meat quality. Meat Science, 49(Suppl. 1), 29–64.

Yakubu, A. (2010). Fixing multicollinearity instability in the prediction of body weight from morphometric traits of White Fulani cows. J. Cent. Eur. Agr., 11(4):487-92.

STUDY OF LENGTH-WEIGHT RELATIONSHIPS AND CONDITION FACTORS OF SOME FISH SPECIES

[1]Buba, S.A, [1]Abdulkarim, M. [1]Mancha, Y.P., [2]Yusuf, Z.I. & [1]Mahmood, S.1
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria
[2]Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria
Corresponding Author: email: Salisububa336@gmail.com

ABSTRACT
This review investigated the length-weight relationships (LWR) and condition factors (K) of *Tilapia zilli, Tilapia mariae, Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* from Lower Usuma Reservoir in Abuja. Two thousand four hundred and fifty two (2,452) fish samples were collected for morphometric measurements. The results obtained showed that the growth pattern of the fish species had negatively allometric growth with b values range from 1.4 to 2.3. There was significant difference between LWR (P<0.001). There were strong correlation (0.86 – 0.73) between the length and weight of all the species, except *Tilapia mariae* which was weakly correlated (0.54). The condition factor (K) range from 1.06- 2.02, these were an indication that the fish species were thriving very well in the Reservoir. Futhermore, LWR and K of 5 fish species in Nkoro River Niger delta were reviewed. The exponential equation for the LWR were: *Ethmalosa fimbrata* (Wt= 0.0162 X Tl $^{3.199}$) and *Cynoglossus senegalensis* (Wt = 0.0326 X Tl $^{3.508}$). All species studied exhibited isometric growth pattern with the value of b = 3 except *S. maderensis* and *C. senegalensis* with value of b =3.6 and 3.5 respectively that exhibited positive allometric growth. The value of K ranged from 0.92 to 0.99 for *Ilisha. africana* to *C. senegalensis)*. There was difference in the condition factors for the monthly K for *E. fimbrata* (0.85±0.015) and *I. africana* (0.96±0.061). LWR and K of *Clarias gariepinus*, in Kiri reservoir had a b value of 3.80 which indicated the fish species had allometric growth pattern. Monthly K range from 0.65 - 1.21 with a mean value of 0.78±0.09 and 1.04±0.12. Condition factors of the *C. gariepinus* were not in a good condition of wellbeing.

INTRODUCTION
The condition factor in fish serves as an indicator of physiological state of the fish in relation to its welfare (Le Cren, 1951). Condition factor play an important role in understanding the life cycle of fish species and it contributes to adequate management of these species, hence, maintaining the equilibrium in the ecosystem (Imam *et al,* 2010).
This study reviewed the length and weight relationships (LWR) and condition factors (K) of *Ethmalosa fimbrata, Ilishia africana, Sardinella maderensis, Cynoglossus senegalensis* and *Elops senegalensis* from the Nkoro River and also to assess LWR and K of *Tilapia zilli, Tilapia mariae, Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* from Lower Usuma Reservoir in Abuja as well as *Clarias. gariepinus* in Kiri Reservoir Adamawa State.

STUDY AREA
The Nkoro River is a distributary of the Andoni River in the Niger Delta area of Nigeria. Lower Usuma Reservoir was located in Bwari Area council in Abuja. Kiri reservoir had a coordinates of 9°40′47″N 12°00′51″E on the southern part of Adamawa State, It was situated within Shelleng Local Government Area and Numan Local Government. The Dam is1.2 km long, 20 m high zoned embankment with an internal clay blanket.

FISH SAMPLING TECHNIQUES
Fish species were caught twice a month for a period of twelve months. The fish species were stored in coolers containing ice and transported to the laboratory for further analysis.

DATA COLLECTION
Total Length (TL) of fish species were each measured from the tip of the anterior or part of the month to the caudal fin. The weight of fish species were each measured with digital weighing balance after blot drying with a piece of clean hand towel.

STATISTICAL ANALYSIS

LWR analysis were carried out following the format accepted by FISAT (Gayando and Pauly, 1997). The LWR of the fish species was expressed by equation (Pauly, 1997):

$$W=aLb$$

W=Weight of fish in (g), L=Total Length (TL) of fish in (cm), a=Constant (intercept) and b = The Length exponent (slope)

The condition factor (k) of the experimental fish were estimated from the relationship:

$K = 100/L^3$

K= condition factor, W= weight of fish and L = length of the fish species.

RESULTS AND DISCUSIONS

Table 1: Length-weight Relationships of Fish species in Lower Usuma Reservoir

Fish species	Number of Fish species	Sex	a	b	95% CI for b	r	Significance of r	Pattern
T. zilli	601	M	0.541	2.301	2.279-2.323	0.844	0.001	Negative allometric
	604	F	0.552	2.275	2.251-2.299	0.861	"	Negative allometric
	1205	M+F	0.545	2.291	2.279-2.303	0.857	"	Negative allometric
T. mariae	120	M	0.700	1.570	1.541-1.599	0.536	"	,,
	234	F	0.730	1.442	1.422-1.462	0.543	"	,,
	354	M+F	0.720	1.486	1.470-1.502	0.539	"	,,
O. niloticus	236	M	0.539	2.328	2.295-2.361	0.861	0.001	Negative allometric
	298	F	0.577	2.198	2.165-2.231	0.862	"	"
	534	M+F	0.559	2.259	2.249-2.269	0.866	"	"
B. occidentalis	81	M	0.684	1.945	1.908-1.982	0.700	"	,,
	225	F	0.640	2.168	2.144-2.192	0.740	"	Negative allometric
	306	M+F	0.650	2.11	2.088-2.132	0.731	"	"

* N = Number of sample size; a and b = regression coefficients; CI = confidence interval; r =

correlation coefficient

Source: Dan-kishiya, (2013)

Table 1 shows that LWR of the fish species from lower Usuma Reservoir. The 95% confidence interval values of the exponent 'b' in the LWR varied between 2.2 and 2.3 for *Tilapia zilli*, 1.4 and 1.6 for *Tilapia mariae. Oreochromis niloticus* had values that range between 2.1 to 2.3 while *Barbus occidentalis* and *Barilius loati* had values that range between 1.9 to 2.2 and 2.3 to 2.4, respectively. Analysis of both the males and females separately and combined showed that all the species exhibited negative allometric growth pattern. Similarly, Ibrahim *et al.* (2012) observed allometric growth pattern in Kontagora reservoir in Niger state. There was strong correlation 0.536 between the length and the weight of all the species except *Tilapia mariae* which was weakly correlated. Model equation for *Tilapia zilli*: Weight = 0.541+ 2.301 length. LWR of *C. gariepinus* in River Kiri revealed that b value was 3.18, which exhibited allometric growth and showed linear relationship with significant correlation coefficient of 0.122 ($p<0.05$). King (1991) also reported allometric growth patterns for Tilapia species from Umuoseriche Lake.

Table 2. Mean condition factor (K) of five fish species from Lower Usuma Reservoir

Fish species	Number of fish species	Sex	Mean K	Mean TL(cm)	Mean W(gm)	STD	SE
Tilapia zilli	601	M	2.02	10.397	22.747	0.26	0.011
	604	F	1.96	11.490	29.733	0.29	0.012
	1205	M+F	2.00	10.945	26.249	0.28	0.008
Tilapia mariae	120	M	1.82	7.360	7.215	0.16	0.015
	234	F	1.94	7.465	8.063	0.15	0.010
	354	M+F	1.90	7.429	7.776	0.16	0.009
Oreochromis	236	M	1.93	10.742	23.891	0.25	0.016
niloticus	298	F	1.87	11.944	31.942	0.29	0.017
	534	M+F	1.91	11.413	28.384	0.12	0.005
Barbus	81	M	1.31	10.021	13.233	0.17	0.019
occidentalis	225	F	1.24	10.266	13.406	0.19	0.013
	306	M+F	1.26	10.201	13.361	0.18	0.010
Barilius loati	53	M+F	1.06	12.102	18.759	0.14	0.019

* N = Number of sample size; K= Condition factor; TL= total length; W= weight; STD= standard deviation; SE= standard error
Source: Dan-kishiya, (2013)

There were differences in the condition factors for the males and females as well as combined sexes and the monthly K- factor for each fish species studied. The condition factor for the 5 species recorded ranged from 1.06 to 2.02. *Tilapia zilli* had a range of 1.96 – 2.02 while, *Tilapia mariae* had a range of 1.82 – 1.94 with a monthly range of 1.55-2.85 (fig.2). Others were *Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* with mean K- values of 1.87 – 1.93, 1.24 – 1.31 and 1.06 while there monthly values range from 1.52-2.2 (fig.3), 1.04-1.52 (and 0.82-1.58, respectively. While Ahmed and Saha (1996) recorded a K value that ranged from 0.506 to 3.415 which indicated that the fish species were doing well.

Monthly condition factor for *C. gariepinus* in Kiri reservoir (July) varied between 0.84 and 1.02 with mean value of 0.93 ± 0.07, while in December varied between 0.95 and 1,21 with a mean value of 1.04 ± 0.12. This support the findings of Jafaru (2011) who reported an increase in K during dry season as a result of water clarity during the period. The mean K value obtained in River Nkoro ranged from 0.941 – 0.985 slightly varied with results from others studies. The K value in the study showed the fish species were in good condition. Pauly (1997) reported that data pulling, sex, stages of maturity and stage of stomach affects K value of fish species.

CONCLUSIONS

Growth pattern of the fish species were mostly allometric. However *I. Africana* and *E. senegalensis* had isometric growth pattern. There is direct relationships between the length and weight of *C. gariepinus.* The fish species had moderate condition factors.

REFERENCES

Ahmed, K.K., and Saha, S.B. (1996). Length- weight relationships of major carps in Kaptai Lake. Bangladash. NAGA. ICLARM Q., **19**(2):28.

Dan Kisha, A.S. (2013). Length – weight relationship and condition factor of five fish species from a tropical water supply reservoir in Abuja, Nigeria.**1** (9): 175 – 187.

Gayando, F.C., and Pauly, D. (1997). FOA ICLARM stock assess tools (FISAT): Reference manual, FOA computerized information series (Fisheries) (8): 262p.

Imam, T. S., Bala, U., Balarabe, M. L. and Oyeyi, T. I. (2010). Length-weight relationship and Condition factor of four fish species from Wasai Reservoir in Kano, Nigeria. *African Journal of General Agriculture.* 6(3): 125-130

Jafaru, A. (2011). Length – weight and condition factor of *Sarotherondon galilaeus* from River Benue, Yola, Adamawa State, Nigeria. *Adamawa State University Journal of Scientific Reseach.* **1**(2): 7 -12.

King, R.P. (1991). The biology of *Tilapia mariae* Bovlenger 1899 Perciformes: (Cichilidae) in a Nigeria rain forest stream. Ph.D. thesis department of zoology, University of Port Harcourt, Nigeria.

Le Cren, E.D. (1951). The length-weight relationship and seasonal cycle in gonad weight and Condition in the perch Perca fluviatilis. *J. Anim. Ecol*., 20(2): 201-219.

Pauly, D. (1997). Some Simple methods for the assessment of tropical fish Stock. FAO Fish Tech. Paper No. 234. 52p.

PERFORMANCE CHARACTERISTICS AND RUMEN FLUID PARAMETERS OF WEST AFRICAN DWARF GOATS FED GRADED LEVELS OF PINEAPPLE (*Ananas comosus)* WASTE WITH YEAST (*Saccharomyces cerevisiae)* SUPPLEMENTATION.

[1]A.O. Adekanbi, [2]C.F.I Onwuka, [2]A.O Oni, [3]V.O.A .Ojo, [1]K.B. Jinadu,[1]A.O. Akingbade, [4]Y. A. Adejola, [1]T. A. Olaniyi

[1]Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation
[2]Department of Animal Nutrition, Federal University of Agriculture, Abeokuta
[3]Department of Pasture and Range, Federal University of Agriculture, Abeokuta
[4]Federal College of Agriculture, P.M.B. 5029, Moor Plantation
Correspondence email address: funkedemi@yahoo.com

ABSTRACT

A ninety days feeding trial was conducted to assess the effects of Pineapple waste (PW) with Yeast supplementation (YS) on performance, rumen parameters and microbial counts of West African Dwarf (WAD) goats. Twelve WAD goats were used for the experiment, using *Panicum maximum* as the basal diet. The experiment had four treatments with three animals per treatment. The total body weight gain of the animals were significantly (P<0.05) higher than the control. Average daily feed intake was significantly different (P<0.05) and the highest value was recorded in goats fed 30% inclusion in the diet (3.90kg). The feed conversion (FCR) ratio was also significantly different (P<0.05) and the lowest FCR was recorded in diet containing 30% inclusion level of Pineapple waste with Yeast supplementation. Rumen parameters such as pH, lactic acid, propionic acid, butyric acid were also significantly (P<0.05) different across the treatments. The total bacteria counts, total fungi counts were also significantly (P<0.05) different across the treatment respectively. The use of Pineapple waste (PW) with yeast supplementation at 30% inclusion level of ruminant feed improved the performance characteristics, rumen fermentation parameters and microbial counts of West African Dwarf Goats.

INTRODUCTION

Nutrition is perhaps the most important consideration in Livestock management. Inadequate supply of both quantity and quality of feeds is responsible for the low livestock productivity. Seasonal variability in Nigeria affects the nutritive quality of natural pastures which in turn, affects animals' live-weight (Suilapwa and Simukoko, 2001).However, to alleviate the shortage in feed during the dry season, farmers collect agro-industrial by-products, dry and store them for later use. The completion between man and livestock for conventional feedstuffs has necessitated the need to explore alternatives feed resources that are rarely consumed by man but which can meet the nutritional requirement of goat with little or no processing (Saksathit *et al.*,2011).

Goats in Nigeria suffer several nutritional stress in the dry season as a result of seasonal variability that affects the availability and nutritive quality of pastures which in turn marked decrease in nutrient intake and utilization. Small ruminant feed requirement in the tropics is aggravated by high cost of conventional feeds and lack of alternative source of feeds particularly during dry season when forages are scarce. This has necessitated the need to search for alternative source that are cheaper and readily available. (Okoruwa and Adewumi, 2010)

Pineapple waste is such an example of Agro-industrial by-products that can be explicated to a good advantage for ruminant animal nutrition in Nigeria. Pineapple waste is usually discarded as waste after processing, is also rich a rich source of energy, but low in protein (Fadel *et al.*, 2000).

Yeast products such as *Saccaromyces cerevisiae* appear to be more useful in manipulating the microbial ecosystem of the rumen to improve feed utilization and productive efficiency of the ruminants. This study is designed to evaluate the performance and rumen fermentation parameters of West African Dwarf goats fed diet containing pineapple wastes with yeast supplementation.

MATERIALS AND METHODS

The experiment was carried out at the Small Ruminant Unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Nigeria. Four experimental concentrate diets containing varying levels of pineapple waste at 0%, 10%, 20% and 30% in replacement of maize bran

with yeast supplementation were formulated. Other fixed ingredients in the diets include wheat offal, dried brewers grain, oyster shell, premix and salt. The gross composition of the experimental diets is as presented in Table 1. Twelve WAD goats aged 6-7 months were used for the experiment. The goats were given prophylactic treatments before the commencement of the experiment and randomly allotted to four treatment groups of 3 animals per treatment having balanced them for weight. The experimental design was a completely randomized design and lasted for 3 months. Fresh water was supplied *ad-libitum* while feeding was done at 07.00 hrs and 16.00 hours Daily feed intake and weight gain were monitored and recorded. Rumen fluid was collected by the use of a suction tube. The rumen fluid was collected and taken to laboratory for analysis to know the volatile fatty acids, the lactic acid, the rumen pH, the ammonia nitrogen and microbial counts.

CHEMICAL ANALYSIS

The proximate composition of experimental diet was carried out according to method of (A.O.A.C,1995) while fibre fractions analysis was done according to (Vansoest and Robertson,1985)

STATISTICAL ANALYSIS

Data obtained was subjected to one-way analysis of variance in a completely Design using (SAS,1999). Significant means were separated using Duncan Multiple Range Test (Duncan,1955)

RESULTS AND DISCUSSION

Ingredients composition of experimental concentrate diets are shown in Table 1. The chemical composition of the experimental diets (Table 2) shows that Crude protein (CP) contents ranged between 162.1g/kg DM in 0% inclusion level to 149.2g/kg DM in treatment 4 and was not consistent with the values of 9500 g/kg DM to 1000 g/kg DM obtained by ARC (1990). The performance characteristics (Table 3) shows that total weight gain and growth rate were significantly different ($P<0.05$). The results obtained from the experiment based on weight gain agrees with the earlier findings of (Okoruwa and Adewumi, 2010) which says higher growth rate and lower feed conversion ratio had indicated better performance of the animals. . Also, the inclusion of yeast (*Saccaromyces cerevisiae*) in the concentrate feed had a positive effect on weight gain which is in line with what was reported by Fickers *et al*. (2005) that supplementation of yeast improved feed utilization and productive efficiency of ruminants.

Table 4 shows the rumen parameters and microbial counts of West African Dwarf goats fed pineapple waste with yeast supplementation. There were significant differences ($p> 0.05$) in the Ammonia nitrogen, Acetic acid, Lactic acid, Propionic acid and Butyric acid respectively. Treatment 4 which had the 30% inclusion of pineapple waste with yeast supplementation had the highest pH (6.10) which was in agreement with the findings of Wells and Russels (1993) whose value was (5.5-7.5) which was recommended to be a standard rumen pH values. Bacteria counts of rumen are dependent on rumen ammonia concentration and pH of the rumen fluid and both are factors dependent on the type of diet fed.

CONCLUSION

It can be concluded from this research work that inclusion of pineapple waste with yeast supplementation in the diet of West African Dwarf (WAD) goats did not have any negative influence on performance characteristics, rumen fluid parameters, and microbial counts.

REFERENCES

A.O.A.C, (1995). Official Methods of Analysis Association of Analytical Chemist, 15th edition K Helrick editor) Arlington pp1230

A.R.C (1990): Agricultural Research Council. The nutrient requirements of ruminants livestock. Commonwealth Agriculture Bureaux, Farnham Royal, U.K

Duncan, D.B (1955): Multiple range test and Multiple F- test Biometrics 11:1-42.

Fadel, J.G., E.J. Depeters and A. Arosemena, 2000.Composition and digestibility of beef pulp with and without molasses and dried using three methods. *Journal. Animal*

Fickers, P., Benetli, P.H., Wache, Y., Marty, A., Manersberger, S., Smit, M.S. and Nicaud, J.M. (2005): Hydrophobic Substrate utilization by yeast and Its potential applications Yeast res. 5

(6-7) 527- 543. Fish (*Teleostei silvriformes*) from the upper rio locatins basin, central brazil. *Neotropical Ichthyology* 6 (3): 329 – 338 (30 September, 2008).

Okoruwa, M.I. and Adewumi, M.K. 2010**:** Effect of replacing *Panicum maximum* with dried pineapple pulp on nutrient digestibility and nitrogen balance of West African Dwarf Sheep. *Nigeria Journal of Animal Science,* 32: 108- 115.

SAS (1999). Statistical analysis system , user guide statistical analysis institute, Inc, carry, North Carolina .

Saksathit, S., Wachirapakorn, C. and Opatpanakit, Y. (2011): Effect of levels ensiled pineapple waste and pangola hay fed as roughage on feed intake, nutrient digestibility and microbial fermentation of Southern Thai native cattle, *Journal of Science* and *Technology* 33, 281-289.

Suilapwa, N.J, and Simukoko, H, (2001). Status of crop residues and agro-industrial by-products as supplementary animal feeds in Zambia. Pp 231.

Van Soest, P.J. and Robertson, H.B. (1985). Analysis of forage and fibrous foods. As 613 manual Dept of Animal Science , Cornell University. Itchaca.

Wells, J.E. and Russel, J.B. (1996). The effect of growth and starvation on the analysis of ruminant cellulolytic bacterium, Fibrobacter succinogens gas. *J. Appl. Environ*. Microbial.1342.

Table 1: Percentage (%) Composition of the Experimental Concentrate

Ingredients	**Levels of Inclusion**				
	0%	**10%**	**20%**	**30%**	
Maize bran	50.00	40.00	30.00	20.00	
Pineapple	0.00	10.00	20.00	30.00	
Oyster shell	5.00	5.00	5.00	5.00	
Wheat offal	24.50	24.50	24.50	24.50	
Premix 0.25	0.25	0.25	0.25		
DBG 20.00	20.00	20.00	20.00		
Yeast -	+	+	+		
Total 100	100	100	100		
Calculated analysis (%)					
Crude protein	14.37	14.97	14.24	14.01	
Crude fibre	8.98	10.89	12.11	13.00	
M.E. (MJ/KgDM)		8.17	8.93	8.99	9.10

Positive sing (+) indicates with yeast supplementation of the rate of 1g on daily basis. Negative signs (-) indicates without yeast supplementation.

Table 2: Chemical Composition of Experimental Concentrate Diet

Parameters	T_1 0%	T_2 10%	T_3 20%	T_4 30%	
Dry matter	89.84	90.03	89.89	89.91	
Crude Fibre	11.37	14.67	15.59	15.75	
Crude Protein	16.21	15.28	14.92	15.97	
Crude Fat	3.74	3.61	3.57	3.55	
Ash	7.59	7.14	6.88	7.21	
Nitrogen free extract		50.93	49.33	48.93	48.25
NDF	41.69	42.93	49.87	48.95	
ADF	21.08	31.79	38.79	39.05	
ADL	9.79	10.78	11.06	10.76	
Hemicellulose	20.61	11.14	11.08	9.90	
Cellulose	11.29	21.01	27.73	28.29	

NDF = Neutral Detergent Fibre
ADF = Acid Detergent Fibre
ADL = Acid Detergent Lignin
HEMICELLULOSE = NDF – ADF
CELLULOSE = ADF – ADL

Table 3: Performance Characteristic of West African Dwarf Goat Fed Pineapple Waste with Yeast Supplementation

	Treatments				
Parameters	**0%**	**10%**	**20%**	**30%**	**SEM±**
Initial body weight (kg)	7.30	7.83	7.50	7.00	0.14
Final body weight (kg)	10.13^{b}	11.26^{a}	10.65^{ab}	10.90^{a}	0.38
Total weight gain (kg)	2.96^{c}	3.43^{ab}	$3.16b^{c}$	3.90^{a}	0.13
Growth rate (g/d)	34.90^{c}	42.74^{ab}	37.25^{bc}	45.87^{a}	1.61
Average daily intake (g/d)	414.00	460.86	437.52	422.88	13.22
FCR	11.91^{a}	10.84^{a}	11.71^{a}	9.19^{b}	0.36

^{abc} means on the same row having different superscripts are significantly ($P<0.05$) different
SEM – Standard Error of Mean

Table 4: Effect of Feeding Graded Levels of Pineapple Waste with Yeast Supplementation on Rumen Parameters at the Start of the Experiment

Rumen Fluid Parameters	T1 0%	T2 10%	T3 20%	T4 30%	SEM±
Rumen pH	5.73	5.90	5.90	6.10	0.06
NH3-N (%)	9.17^{c}	10.30^{ab}	9.92^{b}	10.62^{a}	0.18
Lactic Acid (%)	5.11^{b}	8.87^{ab}	5.56^{b}	10.04^{a}	0.77
Acetic Acid (%)		3.65^{b}	5.39^{ab}	4.32^{b}	7.51^{a} 0.57
Propionic Acid (%)		2.49^{b}	3.95^{b}	2.92^{b}	4.47^{a} 0.33
Butyric Acid (%)		3.82^{b}	6.02^{ab}	4.44^{ab}	6.81^{a} 0.50
Total bacteria count (cfum1-1x10^{6})	11.80^{a}	7.60^{c}	8.67^{b}	8.87^{b}	0.48
Total fungi count (cfum1-1x10^{6})	0.40^{b}	0.27^{c}	0.47^{b}	0.73^{a}	0.05
Total coliform (cfum1-1x10^{6})	1.07^{c}	1.47^{b}	1.90^{a}	0.73^{d}	0.14

^{abc} = value in the same row with different superscripts are significantly (P<0.05) different
SEM – Standard Error of Mean

CHEMICAL COMPOSITION OF MILLET PANICLE WASTE ENSILED WITH POULTRY MANURE AT GRADED LEVELS

N. Kadi[2], Muftau,M. A[1]
Department of animal science, KSUSTA, Kebbi State

ABSTRACT
Millet panicle waste was ensiled with poultry dropping at graded levels; 90:10, 80:20, 70:30, 60:40 (millet panicle waste/poultry dropping) representing B, C, D and E respectively, and 100:00 (control) treatment A. The material ensiled were put in polythene bags replicated three times, the sample were sealed and allow fermentation to take place for a period of 21 days. The resultant silage was analyzed for pH, Crude protein (CP), Crude fiber (CF), Either Extract (EE), ash and Nitrogen Free Extract (NFE). There were significant differences ($p<0.05$) in all the parameters measured except that of Dry matter (DM). Ensiling millet panicle waste increased pH, CP, ash, EE, and NFE, but reduced CF with increased proportion of poultry dropping. Treatment C has the highest CP (4.38) and DM (93.50), with lower CF (1652) compared with control treatment with (33.73). The result suggested that ensiling millet panicle waste with poultry dropping improve its feeding value.

INTRODUCTION
Proper nutrition is necessary for optimum livestock production; unfortunately, there is shortage of forage supply during dry season for ruminant animal especially in the northern part of Nigeria. (Ruthender, 1980). There are many agricultural crop residues with great potential for ruminant feeding. One of such is millet by product known as millet panicle waste.
Presently, the consumption of millet is becoming more pronounced in the most of the northern region especially in villages and semi urban areas where there is availability of millet panicle waste especially during dry season in northern part of Nigeria when people engage in processing of millet. The panicle waste are thrown everywhere during this period of processing. Millet panicle waste is obtainable from processing of millet which is not use for any purpose. The waste are dumped in the water ways causing environmental havoc by blocking drainages or burnt by local people which causes additional environmental pollution by increasing the global warming effect.

Silage making is considered as a technology that increase livestock productivity and minimizes resource degradation and viable option for conserving succulent feeds (Muhammad et *al.,* 2008).

In view of this, the utilization of millet panicle waste as feed for ruminants will drastically reduce the above mentioned problems as well as solving the problem of feed scarcity especially in the dry season. The aim of this study is to find out the chemical composition of millet panicle waste ensiled with poultry droppings at different graded levels

MATERIALS AND METHODS
The experiment was conducted within the Animal Science laboratory of Kebbi State University of science and Technology,

COLLECTION AND PREPARATION OF EXPERIMENTAL MATERIALS

Millet panicle waste was collected from processing points identified within and around Aliero LGA. All foreign materials (stones, irons, polythene) were removed. Poultry manure was obtained from Labana poultry farm Aliero. The collected millet panicle waste and poultry manure were sun dried to a constant weight by spreading on a concrete floor.

ENSILING PROCEDURE

The dried millet panicle waste used for silage was packed in a polythene bags to make compaction easier. (Ogunlolu *et al*; (2010). Millet panicle waste was ensiled with poultry manure in proportions, 100:00, 90:10, 80:20, 70:30 and 60:40, representing treatment A, C, D, and E respectively. Fifteen Polythene bags were used as laboratory silos (Ogunlolu *et al*; 2010). The samples were ensiled for 21 days in triplicates; masking tape was used to further seal the polythene bags after filling with weighed materials and compressed.

At the expiration of the ensiling period, the polythene bags were opened and top most materials was scooped off to avoid contamination with partially ensiled materials. The samples were taken using forceps from each ensiled polythene bag for pH determination and chemical analysis.

EXPERIMENTAL DESIGN AND DATA ANALYSIS

A complete Randomized design (CRD) was used as outlined by Steel and Torrie (1980). There were five treatments designated as A, B, C, D and E with three replicates each.

PROXIMATE ANALYSIS

Crude protein (CP) where measured using kjeldhl method (Nx6.25) while other proximate constituents, Either extract (EE), Ash, Crude fiber (CF) and Nitrogen Free Extract (NFE) were measured according to procedure described by AOAC (2005).

DATA ANALYSIS

Data were analyzed using the general linear model procedures of the (SPSS 2007), and mean separation was done using Duncan multiple range test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

Table 1: pH properties of ensiled millet panicle waste

Treatments		**pH**
A	100:00	5.45^{c}
B	90:10	5.71^{c}
C	80:20	6.11^{bc}
D	70:30	7.69^{ab}
E	60:40	8.45^{a}
SEM		9.39

abc: means on the same row with different super scripts are significantly ($p<0.05$) different

Table 1: present the pH reading of the silage. Significant differences ($p<0.05$) were observed among the treatments. The highest pH was recorded in treatment E(8.45) with the least in treatment in treatment A. (4.45). This is in accordance with the findings of Rasool *et el*. (1998) Who reported an increase in initial and subsequent pH in sudax grass ensiled with 30% broiler litter and 9%molasses.

Table 2: Proximate analysis millet panicle waste

	Treatments					
Parameters	A (0%)	B (10 %)	C (20 %)	D (30%)	E (40%)	SEM
DM	94.00	92.50	93.50	92.00	91.75	12.27
CP	3.15^{d}	3.68^{c}	4.38^{a}	3.99^{b}	3.98^{b}	0.069
CF	33.73^{d}	22.46^{c}	19.30^{b}	21.06^{bc}	16.52^{a}	7.89
EE	4.25^{ab}	4.05^{ab}	4.95^{ab}	3.25^{c}	5.51^{a}	7.89
ASH	4.25^{d}	6.75c	8.25^{b}	12.25a	11.75a	8.74
NFE	20.47^{d}	75.32^{b}	77.63^{a}	972.02^{c}	72.77^{c}	10.39

abcd: means on the same row with different superscripts are significant ($p<0.05$) different.

Table 2: shows the proximate composition of millet panicle waste. There is no significant ($p<0.05$) difference in the dry matter among the treatments. However, the highest value was obtained in treatment A (94:00) and the least was recorded in treatment E (91.75). This contradicts with Al Rokayan *et al*. (1998) who reported an increase in the dry matter when broiler litter was ensiled with sorghum forage in the proportions of 0:100, 25:75, 35:65, and 45:55.

The values of CP of the resultant silage was observed to have increased ($p<0.05$) with increase proportion of poultry droppings. The CP was highest in treatment C (4.38) than B, D, and E although the increase was not steady across the treatments. This is in line with Ngele *et al*. (2006) who reported an increase in the CP when rice straw was treated with broiler litter at different ratios.

There was significant difference ($p<0.05$) in CF composition of the silage among the treatments. CF of all treatments is lower than the control, the CF was observed to decrease with increased proportion of poultry dropping from (22.46) in treatment B to (16.52) in treatment E. This is in accordance with the findings of Rasool *et al,* (1998) who observed decreased in CF when sudax grass was with broiler litter and molasses.

The EE components of the treatments were significantly ($p<0.05$) affected, the highest EE was recorded in treatment E (5.51) and the least was recorded in treatment D (3.25). The result of this study agreed with that of Mthiyan *et al*. (2001) who observed an increase in EE composition of sugar cane top ensiled with broiler litter and that of Ngele *et al* (2006).

Ensiling millet panicle waste with poultry dropping increases ($p<0.05$) ash content of the resultant silage. Treatment D has highest value (12.25) compared with treatment E, C, B and the control which has least value of (4.25). This is in agreement with the findings of Al Rokayan *et al*. (1998) and that of flachowsky and Hennig (1990) who observed a linear increase in ash content with increased proportion of broiler litter.

Nitrogen Free Extract of the millet panicle waste ensiled with poultry dropping increases ($p<0.05$) with the increase in the level of poultry dropping with treatment C having the highest value (77.63)

and the least was recorded in treatment A (20.47). This observation agreed with the findings of Baba *et al*. (2010).

CONCLUSION

Poultry dropping improved the nutritive value by increasing the CP and lowering the CF of the waste.

REFERENCES

A.O.A.C. (2007). Official Methods of Analysis. Association of Analytical chemists, 18th edit. Gaithersburg, M.D.

Al Rokayan, S.A., Z. Naseer and S. M. Chaudlary. 1998. Nutritional quality and digestibility of sorghum broiler litter silage. Animal Feed.Sc. Tech. 75: 65– 73

Baba, M., T. Uba and A. R. Halim. 2010. Nutritional value of Kyasuwa Hay (Penniharac and chemically treated animal excreta for ruminants– A review Biol. Waste, 31: 17–36

Mthiyane . D.M.N., I. V. Nsahlai and M. L. K. Bonsi. 2001. The nutritional composition, fermentation characteristics, in Sacco degradation and fungal pathogen dynamics of sugar cane tops ensiled with broiler litter with or without water.Anim. Feed. Sci. Tech> 94 : 171–185

Muhammad, I. R., Abdu, M. L.L,. Iyegbe-Erakpotobo, G. T and Sulaiman, K. A. 2009. Ensiling quqlity of Gamba grass fortified with tropical legumes and its preference by Rabbits. *Res. J. of. Appl. Sci*. 4(1) : 20-23

Ngele, M. A., T.A Adebola and S.E.S. Bogoro, (2006). Nutritive value of rice straw treated with poultry litter. Proceedings of the 31st Annual conference of Nigerian society for Animal production, March 12-15. BayeroUniversityKano, pp:18-21

Ogunlolu, B. T. Jolaosho, A. O. Akintola, T. O. and Aniwe, P. O. (2010). Effects of Length of Storage and Moisture of Cassava Peel, Pineapple Residues and Guinea Grass On Mineral content of Silage Proceddings of the 35th Annual Conference of the Nigeria Society of Animal Production 14th -17th March, 2010, University of Ibadan. Pp 489-490.

Rasool, S., M. A. sail, Ahsan–ul–Haq and A. Jamil 1998. Chemical changes during ensilingof Sudax fodder with broiler. Anim. Feed. Sci. Tech. 72: 347-352.

SPSS. 2007. Statistical package for Social Sciences. Inc. Chicago, IL

Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of Statistics. A Biometrical Approach, 2nd Edition. McGraw – Hill, New York.

EFFECT OF FEEDING ENSILED SUGARCANE WASTE ON RUMEN FLUID CHARACTERISTICS OF YANKASA RAMS

[*]Dan Abba, Y. U., [#]Ashiru, R. M., [+]Ubayi, K. M & [$]Ibrahim, J

[*]*Department of Animal Science, Federal University Dutsin-ma, Katsina, Nigeria*
[#]*Department of Animal Science, Kano University of Science and Technology, Wudil, Nigeria*
[+]*Bilyaminu Usman Polytechnic, Hadejia, Jigawa State Nigeria*
[$]*Umar Suleiman College of Education, Gashuwa, Yobe State, Nigeria*
*(*yusufdanabba07@gmail.com)*

ABSTRACT
A feeding trial was conducted to assess the effect of inclusion of ensiled sugarcane waste (ESCW) with poultry litter on rumen fluid characteristics of Yankasa rams in a completely randomized design (CRD) for twelve weeks (84 days). Sugarcane waste was mixed with poultry litter in 3:1 and ensiled for 21 days. The ESCW was used as partial replacement in complete diet. Sixteen Yankasa rams (mean body weight 21.87±2kg and aged 12 to 18 month) were allotted to the four groups on the of body weights into control without ESCW (CG) or control diets partially replaced with ESCW 15% (T1), 30% (T2) or 45% (T3) as treatment groups (TG). Diets were offered *ad-libitum,* along with clean drinking water and mineral salt lick at will. Ten (10mls) of rumen liquor was drawn individually from all experimental animals using rubber stomach tube before feeding (0 hours), at 3 hours and 6 hours after morning feeding for pH and microbial counts determination. The results showed that there were significant ($P<0.05$) differences in bacteria counts at 3 and 6 hours sampling periods while fungi counts were significant ($P<0.05$) different at 0 and 3 hours sampling periods. In conclusion, feeding of ESCW maintained the pH of the rumen fluid at optimum for fibre digestion. The results further indicated that the number of bacteria and fungi in solution were adequate for fibre degradation. Therefore, inclusion of up to 45% ESCW could be done to improve its utilization by Yankasa rams.

Key words: Ensilage rumen pH bacteria fungi

INTRODUCTION
The major constraint to livestock production in developing countries is the scarcity and fluctuation in quantity and quality of year round forage supply. During the dry season, the available forages are very low in protein, energy and minerals leading to a marked decrease in the voluntary feed intake and digestibility (Akinwande *et al.,* 2011). With increasing demand for livestock products as a result of rapid growth in the world economic and shrinking land area, future hope of feeding the ever increasing population will depend on the better utilization of non-conventional feed resources. Any factor affecting rumen microorganism populations directly or indirectly affects yield and feed efficiency ratio (Hobson and Stewart, 1997). Sugarcane (*Saccharum officinarum*) is a typical or sub-tropical perennial grass. Sugarcane waste is obtained when the cane is being processed for chewing (Ashiru *et al*., 2016), it comprises of the top, peels, and bagasse. Sugarcane waste has not gain much attention in ruminant feeding, it is dumped on the street and water ways which often constitute nuisance in the environment by blocking drainage. Although a number of non-conventional feeds are traditionally used in livestock feeding little or no information is known on their effects on the rumen environment.

OBJECTIVES
This study therefore aims at evaluating the effect of ensiled sugarcane waste on rumen fluid characteristics of yankasa rams.

MATERIALS AND METHODS
The study was conducted at the Research Farm, Department of Animal Science, Kano University of Science and Technology, Wudil, Kano State, located in the Sudan Savannah Region of Nigeria. The site is situated between longitude $8^0$25'E and latitude $12^0$58'N. The area has an average annual rainfall of 890mm with a peak in August with an average annual temperature of 38 to 43^0C and relative humidity of 40 to 51% (Olofin *et al*., 2008). There are three distinct seasons recognized in the area viz: dry cold (October to January), dry hot (February to May) and wet (June to September).

ENSILING PROCEDURE AND EXPERIMENTAL MATERIALS

Sugarcane waste (SCW) was collected within and around Kano State, cleaned for extraneous materials like stones, iron and polyethene. Poultry litter (PL) was obtained from a deep litter poultry production system. The collected SCW and PL were sun dried for a period of 3 days during dry season by thinly spreading on a concrete floor. The dried SCW used for the silage were chopped into about 2-3cm length using forage chopper for better compaction (Ogunlolu *et al*., 2010). SCW was ensiled with PL (ESCW) in the ratio 75: 25, for 21 days after wetting with water at the rate of 15 l/25kg mix in a 300 liter capacity plastic water reservoir as silo. Silo filled with weighed materials was covered with polyethene and compressed by human trampling. Five hundred kilograms (500kg) of the ESCW with PL was produced and used to formulate four diets (Table 1). Other concentrate feed ingredients included in the diets were maize, wheat offal, full fat soybean meal, cowpea husk and salt. The diets were fed *ad-libitum* as complete diet to all the experimental rams.

EXPERIMENTAL ANIMALS AND MANAGEMENT

Sixteen male Yankasa rams (Mean body weight 21.87±2kg; aged 12 to 18 months) were purchased from the market and quarantined for two weeks. The rams were treated for internal and external parasites with Ivomec® – super at 200µg/kg body weight subcutaneously before the start of the experiment. Rams were divided into 4 groups of 4 animals each in CRD based on live weight (Steel and Torrie, 1980). Control group (CG) was fed diet without ESCW while other 3 treatment groups (TGs) were fed 15, 30, and 45% of ESCW, respectively replacing the concentrate feedstuffs (Table 1). Rams were housed in individual pens measuring 2m x 1m. The pens were cleaned and disinfected using Omo® detergent and Moriguard®. Water and salt lick were provided *ad libitum*.

DATA COLLECTION

Ten (10mls) of rumen liquor was drawn individually from the all experimental animals using rubber stomach tube before feeding (0 hours), at 3 hours and 6 hours after morning feeding. The collected samples were strained through two layers of cheese cloth (Prigge *et al.*, 1984), the pH was measured immediately using a digital pH meter. Strained rumen fluids were stored in glass bottles and immediately transferred to laboratory for analysis.

CHEMICAL ANALYSIS

Thoroughly mixed representative samples of the experimental diets and faeces were analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE) according to AOAC (2005) procedures. The bacteria, protozoa and fungi, in the rumen fluid were estimated at 0, 3, and 6 hours after morning feeding by the method described by Broudiscou *et al*. (1997).

STATISTICAL ANALYSIS

Data were subjected to analysis of variance (ANOVA) using CRD and significant differences between the means were tested by least significant difference (Steel and Torrie, 1980). Differences between the means were considered significant at 5% probability level ($P<0.05$). The data were analyzed using SAS Statistical package (SAS, 1989). The tools of the study were generally linear model(GLM) package of SAS. Where means was separated using the least significant difference (LSD).

RESULTS AND DISCUSSION

Chemical composition (%) of the experimental diets

The results of the chemical composition of experimental diets are presented in Table 2. It can be seen that dry matter varied from 90.78% in CG to 94.80% in TG3. Percent DM values obtained in the present study were comparable and differed slightly from the DM values 94.00 to 95.00% reported by Sirajo *et al*. (2010) for diets containing graded levels of PL waste. Crude protein content of the TGs varied from 14.39 to 14.87% while that of CG was 13.89%. The CP values obtained in the present study were higher than the range of 10 to 12% recommended by Gatenby (2002).

RUMEN FLUID CHARACTERISTICS

The resultS for rumen fluid characteristic of Yankasa rams fed graded levels of ESCW ensiled with PL are shown in Table 3. There were significant (P<0.05) differences among different means of diets at different sampling times for pH, bacteria and fungi, except for 0 hours (before feeding). There were no significant (P>0.05) differences in pH values at all the sampling periods. Rumen pH is an important factor affecting fermentation in the rumen and influences its function. The CG and the TGs had neutral pH values at 0 hours, the pH tended to be more acidic after 3 hours post feeding, but showed less neutral pH at 6 hours of post feeding. According to Campbell *et al*. (1988), changes in pH could be due to plane of feeding. Intake of feed has a major effect on rumen pH which generally declines after feeding (Maekawa *et al*., 2002a). At 3 hours post feeding bacteria counts in TG2 were significantly (P>0.05) higher than those of CG, while at 6 hours, bacteria the CG had significantly (P<0.05) higher bacterial counts. Bacterial count was observed to be the same statistically at 0 hours sampling time for all the treatments, this might be due to the starvation since all animals were not given any feed. The observed increased in bacterial count at 3 hours might be due to bacterial activities in the rumen after feeding which resulted in the conversion of feeds to VFAS. The decrease in bacterial count at 6 hours sampling time might be due to the fact that microorganisms themselves are digested to free up nutrient for the ruminants use (Ensminger, 2002). Similarly fungi counts were significantly (P<0.05) different at 0 and 3 hours sampling. At 0 hours, the CG had significantly (P< 0.05) higher fungal counts while at 3 hours sampling period the CG is comparable to TG3. Fungi appears to be the first organisms to invade and commence digesting the structural plant components, beginning from the inside, they reduce the tensile strength of these particles (Akin *et al*., 1989) and thus increase particle breakdown in rumination. This might be attributable to the fungi's efficient enzymes system which can degrade structural elements of the plant cell wall.

CONCLUSION AND RECOMMENDATION

In conclusion, feeding of ESCW maintained the pH of the rumen fluid at optimum for fibre digestion. The results further indicated that the number of bacteria and fungi in solution were adequate for fibre degradation. Therefore, inclusion of up to 45% ESCW could be done to improve its utilization by Yankasa rams.

REFERENCES

Akin, D. E. (1989). Histological and physical factors affecting digestibility of forages. *Agronomy Journal* **81:** 17 -25.

Akinwande, V. O., Mako, A. A. and Babayemi, O. J. (2011). Silage quality, voluntary feed intake (VFI), nutrient digestibility and nitrogen balance in West African Dwarf sheep fed ensiled Water Hyacinth (WH) in Nigeria. *In:* A. A. Adeniji, E. A. Olatunji and E. S. Gana (eds.) *Value Re – Orientation in Animal Production: A Key to National Food Security and Stable Economy*. Proceedings of the 36th Annual Conference of the Nigerian Society for Animal Production (NSAP), 13th – 16th March, held at Merit House/Raw Materials Research and Development Council, Abuja. Pp 509 – 512.

AOAC (2005). **Association of Official Analytical Chemists. Official Methods of Analysis** 18th Edition AOAC Inc, Arlingon, Virginia USA. 1094pp.

Ashiru, R. M.**,** S. A. Maigandi, I. R. Muhammad, Muktar, I. S. (2016). Chemical Properties of Ensiled Sugarcane Waste Treated With Non-Protein Nitrogen Sources and Soybean Residue. *Techno Science Africana Journal* 13 (2), 224 - 231. ISSN 2006-2273

Broudiscou, L. P., Papon, Y., Fabre, M. and Broudiscou, A. F. (1997). Maintenance of rumen protozoa populations in a dual outflow continuous fermenter. *Journal of Science Food and Agriculture*, **75**: 273-280.

Ensminger, M. E. (2002). **Sheep and goat science**. 6th ed. Danville, IL: Interstate Publisher, Inc.

Hobson, P. N. and Stewart, S. S. (1997). **The Rumen Microbial Ecosystem**, 2nd Edition. New York: Springer.

Maekawa, M., Beauchemin, K. A. and Christensen, D. A. (2002a). Effect of concentrate level and feeding management on chewing activities, saliva production, and ruminal pH of lactating dairy cows. *Journal of Dairy Science* **85:** 1165-1175.

Ogunlolu, B. T., Jolaosho, A. O., Akinola, T. O. and Aniwe, P. O. (2010). Effects of length of storage and mixture of cassava peel, pineapple residues and guinea grass on mineral content of silage. *In:* O. J. Babayemi, O. A. Abu and E. O. Ewuola (eds.) *Fast – Tracking Animal Agriculture in a Challenged Economy*. Proceedings of the 35th Annual Conference of the Nigerian Society for Animal Production (NSAP) 14th - 17th March, held at University Ibadan, Nigeria. Pp 489-490.

Olofin, E. A. (1985). Human responses to the Natural environments in Kano Region *In:* Barkindo, A. A. (ed.) **Kano and its Neighbours.** Ahmadu Bello University Press, Zaria.

Prigge, E. C., Baker, M. J. and Varga, G. A. (1984). Comparative Digestion, Rumen Fermentation and Kinetics of Forage Diets by Steers and Wethers. *Journal of Animal Science,* **59**:237-245.

SAS. (1989). Statistical Analysis System SAS/STAT. Guided for Personal Computers. Version 6 Edition, Cary N.C. USA 967 – 978pp.

Sirajo, A., Maigandi S. A., Malami, B. S. and Daneji, A. I. (2010). Nutritional evaluation of poultry litter waste fed to growing Uda sheep. *In:* O. J. Ifut, U. A. Inyang, I. P. Akpan and I. E. Ebeso (eds.) *Diversifying Nigeria's Economy: Animal Production Option*. Proceedings of the 15th Annual Conference of the Animal Science Association of Nigeria (ASAN), 13th – 16th September held at University of Uyo, Akwa Ibom State, Nigeria. Pp 592 – 593.

Steel, R. G. D. and Torrie, J. H. (1980). **Principles and Procedures of Statistics.** A Biometrical Approach, 2nd Edition. McGraw – Hill, New York.

Table 1: Composition (%) of Complete Experimental Diets Fed to Yankasa Rams

		Treatment Groups (TGs)		
Ingredients	**CG (0%)**	**TG1 (15%)**	**TG2 (30%)**	**TG3 (45%)**
Ensiled SCW with PL (3:1)	0	15	30	45
Groundnut haulms	20	15	15	10
Wheat bran	20	20	15	15
Cowpea husk	20	20	15	15
Maize	19	14	9	9
Soybean meal	5	5	5	5
Rice milling waste	15	10	10	0
Salt	1	1	1	1
Total	100	100	100	100
CP (%)	13.66	13.64	13.51	13.74

Table 2: Chemical composition (%) of experimental diets

Parameters		**Treatment Groups (TGs)**		
	CG (0%)	**TG1 (15%)**	**TG2 (30%)**	**TG3 (45%)**
DM	90.78	92.21	94.80	93.33
CP	13.89	14.87	14.39	14.50
CF	26.09	25.29	22.88	20.60
EE	4.05	3.98	3.71	3.27
Ash	11.68	11.08	8.13	8.19
NFE	43.31	45.35	51.39	53.44

Table 3: Rumen fluid characteristics of Yankasa rams fed ESCW

Parameters	Sampling Time (hrs)	Treatment Groups (TGs)				LSD
		CG (0%)	TG1 (15%)	TG2 (30%)	TG3 (45%)	
pH	0	7.46	7.61	7.71	7.67	0.908
	3	5.53	5.58	5.63	5.90	0.783
	6	6.95	6.55	6.52	6.94	0.886
Bacteria $\times 10^6$cfu/ml	0	7.30	7.28	7.60	7.32	1.001
	3	8.17^{b}	8.80^{ab}	8.97^{a}	8.87^{ab}	0.724
	6	7.24^{a}	6.73^{ab}	6.35^{bc}	5.98^{c}	0.654
Fungi $\times 10^6$cfu/ml	0	6.88^{b}	6.67^{b}	8.85^{a}	6.68^{b}	1.106
	3	7.38^{a}	6.31^{b}	6.20^{b}	7.25^{a}	0.850
	6	6.71	6.68	6.73	6.83	1.128

NUTRITIVE VALUE AND ANTIOXIDANT PROPERTIES OF SOME CROP RESIDUES USED IN RUMINANT FEEDING

✸Yusuf, H. K. & ◆Garba, Y.
✸Department of Agricultural Science Eductaion, Sa'adatu Rimi College of Education, Kano
◆Centre for Dryland Agriculture, Bayero University, Kano

ABSTRACT
The study was carried out to evaluate the nutritive value and anti-nutritive properties of five common crop residues used in ruminant feeding. The crop residues used were, millet bran, groundnut hay, rice mill waste, cowpea husk and maize cobs. The treatments were laid in a completely randomized design. The samples were shade dried, pulverized and analyzed for nutritive value (proximate constituents) and antioxidant properties which were replicated thrice. Data collected were analyzed using SAS (2000) and means were separated using Tukey's test at P<0.05. The results obtained showed that there was significant (p<0.05) difference among the treatments in all variable evaluated. Cowpea husk had the highest crude protein contents (13.77%) and nitrogen free extract (80.33%) while ash content was found to be highest in groundnut hay (7.15%) and maize cobs had the least dry matter content (90.14%). Alkaloids and saponins levels were highest in groundnut hay (0.70%) and millet bran (2.58%) respectively. Groundnut hay had the least radical scavenging activity (0.29µg/ml) and (0.31µg/ml) at 0.8mg/ml and 1.0mg/l respectively while maize cobs had the highest at both concentrations. The ferric reducing power effect was recorded highest in rice mill waste (0.65µg/ml) at 0.4ml/l and least in maize cobs (0.48µg/ml) at 0.2mg/ml concentrations. It is concluded that in terms of crude protein and nitrogen free extract, cowpea husk proved to be superior. However, groundnut hay had superior ash content. Similarly, cowpea husk had the highest total antioxidant activity.
Key words: crop residues, nutritive value, antioxidant

INTRODUCTION
Human population explosion is a source of worry globally. Food shortages and famine are becoming endemic in many places. To address these problems, scientists are investigating alternative feed sources, evaluating and utilization of food. Thus, feeding grains to ruminants is questioned because Man, a monogastric can utilize grains directly. On the other hand, ruminants are characterized by their ability to convert low quality roughages to meat, milk, natural fibres, leather and manure and other products that are useful to Man (Gertenbach, 2013). Hence, the use of crop residues in ruminant feeding has been advocated. The nutritive value of crop residues is influenced by several factors depending on the type of the crop. It is generally determined by feed composition, intake and utilization efficiency of digested matter (ACP, 2002). Various crop residues have diverse nutritional values and are used by different animal species.
An antioxidant is a molecule that inhibits the oxidation of other molecules or a substance that in small amount will inhibit the oxidation of other compounds (Prakash *et. al.*, nd). Oxidation is a chemical reaction that can produce free radicals, leading to chain reactions that may damage cells. The main characteristic of an antioxidant is its ability to trap free radicals. The aim of this study was to evaluate the nutritive value and anti-nutritive profile of common crop residues used in ruminant feeding.

MATERIALS AND METHODS
SAMPLE COLLECTION:
The crop residues evaluated were millet bran, rice mill waste, groundnut hay, cowpea husk and maize cobs. Maize cobs, cowpea husk and rice mill waste were obtained from the Faculty of Agriculture Farm, Bayero University Kano while groundnut hay and millet bran were obtained from farms in Kibiya Local Government Area.

SAMPLE PREPARATION:
The crop residues were shade-dried, pulverized using a grinder and stored in airtight containers as stated by Seal (2011). Proximate composition and antioxidant concentration as well as its activities were evaluated in the Biochemistry laboratory Bayero University Kano.

PROXIMATE ANALYSIS:
The nutritive value (proximate contents) of the samples comprising moisture, ash, ether extract, crude protein, crude fibre and Nitrogen Free Extract (NFE) were determined according to the standard methods outlined by AOAC (2000).

ANTIOXIDANT TESTS
The antioxidant analysis for the presence of saponins, tannins, alkaloids, and flavonoids were carried out according to the methods described by Ejikeme *et. al,* (2014) and Hassan *et. al,* (2015). Each analysis was carried out in triplicate.

EXTRACTION OF PLANT MATERIAL FOR ANTIOXIDANT ANALYSIS:
One gram of each plant material was soaked in 20ml aqueous methanol (20%) for 18 hours at room temperature. The extracts were filtered and diluted to 50 ml and aliquot were analyzed for their total phenolic content and their free radical scavenging capacity (Seal, 2011).

QUALITATIVE ANALYSES OF ANTIOXIDANT:
Two grams of each sample was measured and poured into a conical flask, 50ml of distilled water was added to the Sample and the mixture was shaken vigorously and allowed to stop for 30 minutes. The mixture was then filtered using Whatman filter paper and few drops of different indicators were added to the filtrate depending on the compound of concern.

ESTIMATION OF ALKALOID CONTENT:
Two and a half grams of each plant sample was weighed into a 250 cm^3 beaker and 200 cm^3 of 10 % acetic acid in ethanol was added to each plant powder and allowed to stand for 4 hours. This was filtered and the extract was concentrated on a water bath to one - quarter of the original volume followed by addition of 15 drops of concentrated ammonium hydroxide drop wise to the extract until the precipitation was complete. The whole mixture was allowed to settle for 3 hours, the supernatant was discarded and the precipitates washed with 20cm^3 of 0.1M of ammonium hydroxide and then filtered using Whatman filter paper. The residue was dried in an oven and weighed using electronic weighing balance (Ejikeme *et. al,* 2014**).**

ESTIMATION OF TOTAL FLAVONOID CONTENT:
The total flavonoid content of crude extract was determined by the aluminium chloride colorimetric method. Fifty microliter of crude extract (1 mg/ml ethanol) were made up to 1 ml with methanol, mixed with 4 ml of distilled water and then 0.3 ml of 5% $NaNO_2$ solution; 0.3 ml of 10% $AlCl_3$ solution was added after 5 min of incubation, and the mixture was allowed to stand for 6 minutes. Then, 2 ml of 1 mol/L NaOH solution were added, and the final volume of the mixture was brought to 10 ml with double-distilled water. The mixture was allowed to stand for 15 min, and absorbance was measured at 510 nm. The total flavonoid content was calculated from a calibration curve, and the result was expressed as mg rutin equivalent per g dry weight (Baba and Malik, 2015)**.**

ESTIMATION OF TOTAL SAPONIN CONTENT:

Fifty microliter of plant extract was added to 250 µL of distilled water. To this, 250 µL of vanillin reagent (800 mg of vanillin in 10 mL of 99.5% ethanol) was added. Then 2.5 mL of 72% sulphuric acid was added and it was mixed very well. This solution was kept in a water bath at 60 °C for 10 min. After 10 min, it was cooled in ice cold water and the absorbance was read at 544 nm. The values were expressed as diosgenin equivalents (mg DE/g extract) derived from a standard curve (Makkar *et. al*, 2007).

DETERMINATION OF TOTAL ANTIOXIDANT ACTIVITY

The antioxidant activity of the extracts was evaluated by the phosphomolybdenum method according to the procedure of Prieto *et al.* (1999). Three mililiter of reagent solution (0.6mM sulfuric acid, 28mM sodium phosphate and 4mM ammonium molybdate) was added to 0.3 ml of the plant extracts. The tubes containing reaction solution were incubated at 95°C for 90 minutes. Then the absorbance of the solution was measured at 695nm using spectrometer against blank after cooling to room temperature.

DETERMINATION OF FREE RADICAL SCAVENGING ACTIVITY (FRSA) USING DPPH METHOD

The free radical scavenging activity of the extract was measured using DPPH by the method of Blios (1958). A 0.1 mM solution of DPPH in methanol was prepared and 1 ml of this solution was added to 3 ml of various concentrations (0.2 to 1.0 mg/l) of sample dissolved in methanol to be tested. After 30 min, absorbance was measured at 517 nm. Ascorbic acid was used as a reference material. The scavenging activity was calculated as follows:

DPPH radical scavenging activity (%) = [(Absorbance of control – Absorbance of sample)/Absorbance of control] × 100 (Babu *et. al*, 2013).

DETERMINATION OF ANTIOXIDANT ACTIVITY USING FERRIC REDUCING ANTIOXIDANT POWER (FRAP)

The reducing power of the extract was determined according to the method of Oyaizu (1986). The mixture was incubated in a water bath at 50°C for 20 minutes. Afterwards, 2.5ml of a 10% (w/v) trichloroacetic acid solution was added and the mixture was then centrifuged at 3000 rpm for 10 minutes. A 2.5ml aliquot of the upper layer was combined with 2.5ml of distilled water and 0.5 ml of a 0.1% (w/v) solution of ferric chloride, and absorbance was measured at 700nm (Babu *et. al*, 2013)

Data Analysis*:*

The data collected were subjected to analysis of variance (ANOVA) using SAS 2000 and means were separated using Tukey's test at ($p<0.05$)

RESULTS AND DISCUSSION

Table 1: Proximate Composition of Some Crop Residues used in Ruminant Feeding

CROP RESIDUES	PARAMETERS (%)					
	Ash	Dry Matter	Crude protein	Crude fibre	Ether extract	Nitrogen free extract
Millet bran	4.98^{b}	94.13	9.42^{b}	6.48^{d}	4.04^{a}	75.07^{b}
Groundnut hay	7.15^{a}	91.98	12.53^{a}	11.50^{c}	1.02^{d}	67.81^{c}
Rice mill waste	4.30^{bc}	93.22	9.15^{b}	40.33^{a}	1.53^{c}	44.69^{e}
Cowpea husk	2.55^{d}	92.26	13.77^{a}	2.79^{e}	0.57^{e}	80.33^{a}
Maize cobs	3.18^{cd}	90.14	6.59^{c}	31.83^{b}	3.43^{b}	54.96^{d}

a,b,c,d and e means with different superscripts across column are significantly ($p<0.05$) different.

Table 2: Antioxidant Concentration of Common Crop Residues used in Ruminant Feeding

VARIABLES	CROP RESIDUES				
(%)	Millet Bran	Groundnut hay	Rice mill waste	Cowpea husk	Maize cobs
Alkaloids	0.46[b]	0.70[a]	0.25[c]	0.46[b]	0.66[a]
Saponins	2.58[a]	2.34[abc]	2.47[ab]	2.04[bc]	1.94[c]

Means with different superscripts across rows are significantly ($p<0.05$) different

Table 3: Free Radicals Scavenging Activity of some Crop Residues used in Ruminant Feeding.

CONCENTRATION	CROP RESIDUES				
(mg/l)	Millet bran	Groundnut hay	Rice mill waste	Cowpea husk	Maize cobs
0.2	0.39[b]	0.40[ab]	0.38[b]	0.45[a]	0.39[ab]
0.4	0.39[ab]	0.32[b]	0.43[a]	0.45[a]	0.40[a]
0.6	0.36[b]	0.33[b]	0.43[a]	0.34[b]	0.35[b]
0.8	0.33[b]	0.29[c]	0.47[a]	0.32[bc]	0.48[a]
1.0	0.34[b]	0.31[b]	0.50[a]	0.34[b]	0.51[a]

a,b,c means in the same rows with different superscript are different significantly ($p<0.05$)

Table 4: Ferric Reducing Antioxidant Power of some crop residues used in Ruminant Feeding

CONCENTRATION	CROP RESIDUES				
(mg/l)	Millet bran	Groundnut hay	Rice mill waste	Cowpea husk	Maize cobs
0.2	0.53[c]	0.52[d]	0.54[b]	0.60[a]	0.48[e]
0.4	0.53[d]	0.57[c]	0.65[a]	0.61[b]	0.52[d]
0.6	0.56	0.59	0.62	0.62	0.53
0.8	0.57[cd]	0.60[b]	0.59[bc]	0.63[a]	0.55[d]
1.0	0.58[bc]	0.63[a]	0.60[b]	0.65[a]	0.57[c]

Means with different superscripts across rows are significantly different ($p<0.05$)

Table 5: Total Antioxidant Activity of Some Crop Residues used in Ruminant Feeding

VARIABLES	CROP RESIDUES				
	Millet bran	Groundnut hay	Rice mill waste	Cowpea husk	Maize cobs
Antioxidant activity (µg/ml)	1.46[d]	2.04[b]	1.28[e]	2.62[a]	1.83[c]

a,b,c,d and e means with different superscripts across rows are significantly different ($p<0.05$)

All the crop residues analyzed in this study had crude protein (CP) content higher than the critical level 7% required for optimum microbial function of the rumen (Van Soest 1982) except maize cobs which has a value (6.59%) closer to that reported by Bogale *et.al* (2008) who treated pea straw. This indicates that there is no need for protein supplementation in the diets of ruminants when these crop

residues are utilized. However, the CP content of groundnut hay was not in line with literary report by Ayoade *et. al,* (1983). These differences may be due to plant varieties, methods of processing and handling of the plant material.

The values of the dry matter (DM) content obtained from this study were comparable where the value obtained for millet bran (94.13%) was similar to 94.2% reported for wheat straw by Bogale *et. al,* (2008). However, DM content of maize cobs (90.14%) obtained in this study differed from report of Olagunju *et .al,* (2013). This result was also not in agreement with reports by Tonamo *et. al,* (2015).

The ash content obtained was in agreement with report by Aregheore and Ikhatua (1999).

The alkaloid levels of crop residues were considerably higher than those reported by Onyeonagu and Njoku (2010).

Tilley and Terry (1963) reported that most crop residues contain saponin but the quantities of saponin produced by the crop residues are too low to pose major animal health problem. The saponin levels obtained in this study (1.94% to 2.58%) are within the range (0.03% - 5.18%) reported for crop residues and agro industrial by products by Onyeonagu and Njoku (2010).

Results with respect to free radical scavenging activity of some common crop residues, where the scavenging effect of rice mill waste increases with an increase in the concentration of the sample from 0.2mg/l to 1.0mg/l is supported with the findings of Senguttuvan *et. al,* (2014) who treated medicinal plants at different concentration of the plant extracts (50µg/ml to 250µg/ml). At 1.0mg/l concentration, rice mill waste and maize cobs showed strong radical scavenging activity of 0.50µg/ml and 0.51µg/ml respectively while ground hay showed relatively poor free radical scavenging activity of 0.31µg/ml. This variation might be due to the phenolic content of the plant extracts (Zahin *et. al,* 2009).

The result obtained from the present study revealed that the ferric reducing antioxidant power of some common crop residues increased with an increase in the concentration of the extracts which is in agreement with reports by Senguttuvan *et. al,* (2014) when medicinal herbs were evaluated.

REFERENCES

A.O.A.C. (2000). Association of Official Analytical Chemists. *Official Methods of Analysis of the Association of Analytical Chemists International*, 17th ed. Gathersburg, MD Association of Official Analytical Chemists.

Agriculture and consumer protection (2002). Animal production based on crop residues. Retrieved from www.fao.org/dorcep/005/y1936e06.html. on 15/04/2016

Ayoade, J. A., Makhambera, P. E. and Bodzalekani, M. Z., (1983). Evaluation of crop residues as feeds for goats. Voluntary intakes, digestibility and nitrogen utilization of groundnut and bean haulms. *South Afr. J. Anim. Sci.*, 13(1): 12-13

Baba, A. S. and Malik, S. A. (2015). Determination of total phenolic and flavonoid content, antimicrobial and antioxidant activity of a root extract of *Arisaema jacquemontii* Blume. *Journal of Taibah University for Science* 9:449-454. Retrieved on 28/05/2016 from http://www.sciencedirect.com/science/article/pii/S1658365514001046

Babu, D., Gurumurthy, P., Borra, S.K. and Cherian, K.M (2013). Antioxidant and free radical scavenging activity of triphala determined by using different in vitro models. *Journal of Medicinal Plant Research.* Vol. 7(39):2898-2905.

Blios M. S. (1958). Antioxidant determinations by the use of a stable free radical. Nature.26:1199-1200.

Bogale, S., Melaku, S. and Yami, A. (2008). Potential Use of Crop Residues as Livestock Feed Resources Under Smallholder Farmers Conditions in Bale Highlands of Ethiopia. *Tropical and Subtropical Agroecosystems* 8: 107 – 114.

Ejikeme, C. M., Ezeonu, C. S. and Eboatu, A. N. (2014). Determination of physical and phytochemical constituents of some tropical timbers indigenous to niger delta area of Nigeria. *European Scientific Journal* 10(18):247-270.

Gertenbach,W.D. and Dugmore, T.J. (2004). Crop residues for animal feeding. *SA-ANIM SCI* 5:49-. Retrieved from http://www.sasas.co.za/Popular/Popular.html

Hassan, A., Achakzai, P. and Nangyal, H. (2015). Detection and Estimation of Alkaloids, Saponins and Tannins of Quetta Baluchista. *American-Eurasian J. Agric. & Environ. Sci.*. 15 (6): 985-990

Makkar, H.P, Siddhuraju P., Becker K. (2007). **Methods in Molecular Biology**: Plant Secondary Metabolites. Totowa: Human Press; 93-100pp.

Olagunju, A., Onyike, E., Muhammad A., Aliyu S. and Abdullahi, A. S. (2013). Effects of fungal *(Lachnocladium spp.)* pretreatment on nutrient and antinutrient composition of corn cobs. *African Journal of Biochemistry Research* 7(11): 210-214.

Onyeonagu, C.C. and Njoku, O.L. (2010). Crop residues and Agro-industrial by-products used in traditional sheep and goat production in rural communities of Markudi L.G.A. *Journal of Tropical Agriculture, Food, Environment and Extension* 9(3):161 -169

Prakash, A., Regelhof, F. and Miller, E. (nd). Antioxidant activity. Retrieved from https://en.wikipedia.org/wiki/**Antioxidant.** On 25/03/2016

Prieto, P., Pineda, M. and Aguilar M (1999). "Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphomolybdenum complex: specific application to the determination of vitamin E." *Anal. Biochem.* 269(2):337-341.

Seal, T. (2011). Determination of Nutritive value, Mineral content and Antioxidant activity of some wild edible plants from Meghalaya State, India. *Journal of Applied Sciences* 4(3):238-246. Retrieved from http://knowledgiascientif.com. on 15/5/2016

Senguttuvan, J., Paulsamy, S. and Karthika, K. (2014). Phytochemical analysis and evaluation of leaf and root parts of the medicinal herb, *Hypochaeris radicata* L. for *in vitro* antioxidant activities. *Asian Pac J Trop Biomed.* (1): 359-367.

Smith, O. B. (1993). Feed resources for intensive smallholder systems in the tropics: the role of crop residues: Proceedings of the XVII International Grassland Congress. Rockhampton, Australia: 1969-1976

Tilley, J.M.A. and Terry, R.A. (1963). A two stage technique form vitro digestion of forage. *Journal of the British Grassland Society* 18:104 -111

Tonamo, A., Tamir, B. and Goshu, G. (2015). Assessment of Cattle Feed Resources; Chemical Composition and Digestibility of Major Feeds in Essera District, Southern Ethiopia. *Science, Technology and Arts Research Journal* 4(2):89-98. retrieved from http://www.starjournal.org/ on 03/11/2016

Zahin, M., Aqil, F. and Iqbal Ahmad, I. (2009). The *in vitro* Antioxidant Activity And Total Phenolic Content Of Four Indian Medicinal Plants. *International Journal of Pharmacy and Pharmaceutical sciences* 1(1):88-95.

IN SITTU NUTRIENTS DISAPPEARANCE OF SWEET POTATO VINE CULTIVARS BY GOATS

Jinjiri, A[1*], Garba Y[2] & Nasiru, A[3]
[1]*RMK College of Advanced and Remedial Studies, Tudun Wada*
[2]*Centre for Dryland Agriculture, Bayero University, Kano*
[3]*Department of Animal Science, Bayero University, Kano*
**Corresponding author Email: jinjiri.aminu001@gmail.com +23408064980565*

ABSTRACT
The objective of the study was to determine the effect of sweet potato vine cultivars on *in sacco* nutrients disappearance. Three bucks were cannulated and assigned to switch over design. Samples were incubated for 0, 8, 12, 18, 24, 32 and 48 hours. The result revealed that sweet potato vine cultivars have no significant effect (P>0.05) on dry matter disappearance (76.74 vs 80.41%) for *Danchina* and *King J* respectively. However, the dry matter disappearance of Cowpea (66.05%) was lower. Acid detergent fibre and neutral detergent fibre follows similar pattern with dry matter disappearance. Sweet potato vine cultivars have significant (P<0.05) effect on Crude Protein (CP) disappearance for *Danchina* and King J (80.08 and 90.14%) respectively. It was concluded that *King J* and *Danchina* sweet potato vine cultivars can be fed to animals as a replacement of Cowpea hay as they were proven to be nutritionally good in term of disappearance.
Keywords: disappearance; bucks; cannulated; and vines

INTRODUCTION
Among the livestock that makes up the farm animals in Nigeria, ruminants comprising sheep, goats and cattle, constitute the farm animals largely reared by families in the country's agricultural system. The larger proportion of these animals' are concentrated in the Northern region of the country than the Southern region (Adebowale, 2012). The most difficult problem in ruminant production in the tropics is the scarcity of energy and protein feedstuffs during the dry season (Odeyinka *et al*, 2009). This led to the search for cheap sources of energy and protein feed stuffs to supplement the low quality forages of the dry season (Nworgu, 2006). One of the alternative feed resources during the seasonal nutritional stress is the use of sweet potato vines which has been limited far and it principally consists of vines being fed to livestock as energy and protein supplements. The vines make good feed for ruminant without restriction, which can be fed for milking and fattening animals, and no need to give any supplement as the vines alone can supply all the protein needed by these animals. It also contains nutrients that would sustain acceptable growth in heifers (Sankaran *et al.,* 2012). The aim of the study was to determine the effect of *in sittu* nutrients disappearance by goat bucks fed sweet potato vines.

MATERIALS AND METHODS
Experimental location: The study was conducted at livestock and research farm, faculty of Agriculture Bayero University Kano.
Experimental design: Switch over experimental design was used in the study where two varieties of sweet potato vines (Danchina and King J) and Cowpea hay (Control diets) were fed to the bucks in three different cycles.
Experimental animals and their management: Three bucks with an average initial body weight of 19.43kg were used for the study. The experimental animals were cannulated and allowed to recover for about two weeks. They were offered Danchina vine (Local variety), King J vine (Improved variety) and Cowpea hay (Control diet) as basal feed in the morning hours while the concentrates were also formulated and offered to the animals as a supplements in the evening hours. The ratio of forage to concentrate offered were 60:40.
In sittu procedure was carried out in accordance with Orskov *et al.* (1980). Dried samples of the vines were milled to pass through a 2 mm sieve. Four (4) grams of the vine samples were transferred into the bags and incubated in the rumen of each breed of buck with a permanent cannula in triplicate for 8, 12, 18, 24, 32 and 48 hours.

Dry matter disappearance was estimated as described by Osuji *et al.*, 1993:

$$DMD = \frac{(SWa - BW) \times DMa - (SWb - BW) \times DMb}{(SWa - BW) \times DMa}$$

Where: SWa= weight of original sample + nylon bag
BW = weight of empty nylon bag
SWb=weight of the sample + nylon bag after incubation
DMa = dry matter of feed sample
DMb = dry matter of residue sample

The measure of fraction of the DM, CP, ADF and NDF was expressed as the differences between the amount of the original samples and the remaining in the nylon bags after the incubation. Nutrients disappearance was calculated as the difference between the fractions of nutrients lost during the washing and the truly water soluble fraction (Woods *et al.* 2002).

Chemical analysis: The feed samples which include both the concentrate and the forage were analyzed for proximate composition in accordance with AOAC (2005). The ADF and NDF were analyzed according to Van Soest *et al.*, (1991).

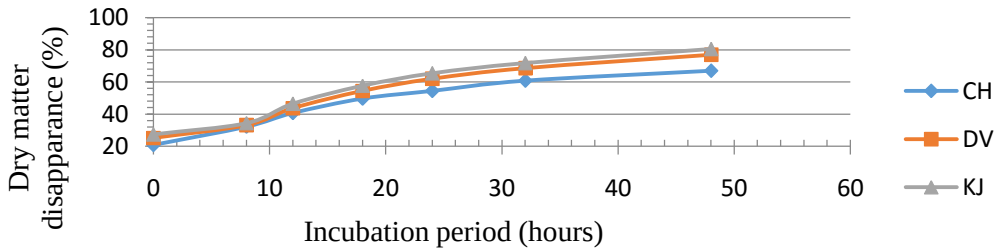
Table 1: Composition of the experimental diets (%)

Item	T1	T2	T3	Cowpea hay	Danchina	King J
Maize	03	24	09			
Wheat offal	30	14	22			
Cowpea husk	20	07	15			
Groundnut Cake	07	28	21			
Rice bran	12	10	10			
Rice Milling Waste	26	15	21			
Salt	02	02	02			
			Chemical Composition			
DM	91.24	90.97	90.00	86.98	92.12	91.26
CP	16.01	16.05	16.08	13.01	13.74	14.71
CF	22.47	21.17	20.73	20.40	19.08	18.00
EE	4.15	4.75	4.60	4.38	4.26	3.95
ASH	12.93	13.55	12.38	8.33	7.46	9.23
NFE	41.86	42.47	45.33	40.86	47.58	45.37
ADF	29.28	29.13	29.10	25.95	27.53	27.16
NDF	36.85	35.59	32.10	33.06	35.09	35.27

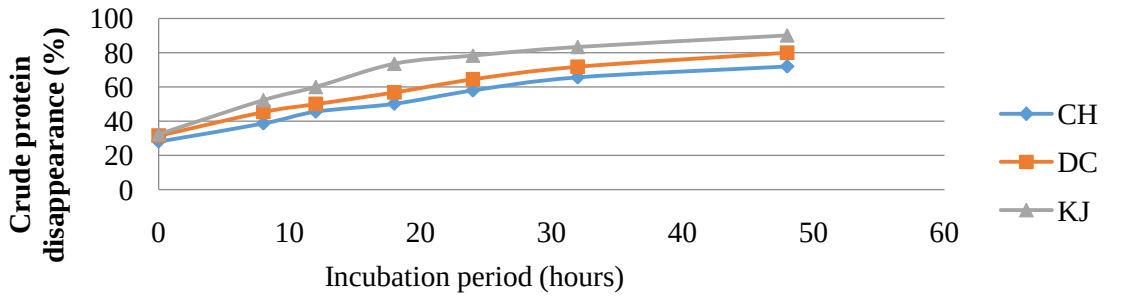
DM: Dry matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, NFE: Nitrogen Free Extract, ADF: Acid detergent fibre, NDF: Neutral detergent fiber, T1: Concentrate diets to the goats fed cowpea hay, T2: Concentrate diets to the goats fed danchina vine, T3: Concentrate diets to the goats fed king j vine

RESULTS AND DISCUSSION

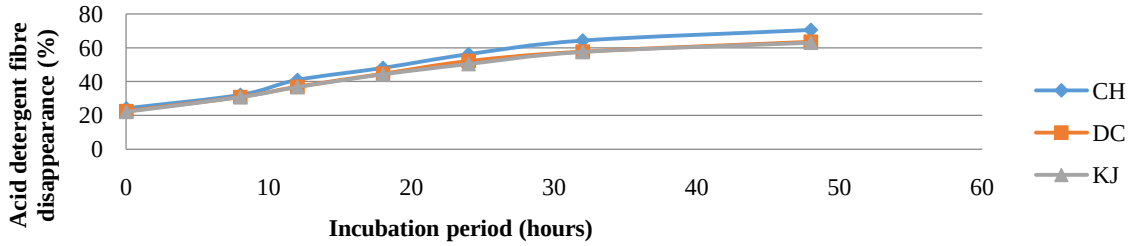
Nutrients disappearance of sweet potato vines revealed the possible degradation of nutrients incubated *in sacc*o after certain period of time. Sweet potato vines cultivars have no effect ($p>0.05$) on DM disappearance (76.74 vs 80.41 %) for *Danchina* and *King J* respectively. However, *in sacco* DM disappearance of cowpea (66.05%) was lower ($p<0.05$) when compared with the two potato cultivars. The disappearance of *in sacco* CP did not follow the same pattern with the *in sacco* rumen DM disappearance (Figure 1a). There was significant effect ($p<0.05$) between *in sacco* rumen CP disappearance for sweet potato vines (80.08 and 90.14%) for *Danchina* and *King J* respectively) and Cowpea hay (72.10%). Sweet potato vines had increased ($p<0.05$) CP *in sacco* rumen disappearance than Cowpea hay. Figure 1c revealed the disappearance pattern of acid detergent fiber (ADF). Sweet potato vine cultivars have no effect ($p>0.05$) on *in sacco* rumen ADF disappearance. Moreover, there is no significant difference ($p>0.05$) on *in sacco* rumen ADF disappearance between the cowpea hay and the two sweet potato vine cultivars (68.50, 65.39 and 64.38 for cowpea, *Danchina* and *King J* respectively). The disappearance of *In sacco* rumen NDF disappearance follows similar pattern with *In sacco* ADF disappearance (Figure 1d) Based on the findings, sweet potato vine cultivars had more than 50% dry matter disappearance at 48 hours of incubation. This indicated that all the cultivars could be used as feed for livestock due to the forage quality that meet the requirements for feeding livestock as observed by Larbi *et al.*, (2007). The *in sacco* nutrients disappearance indicated that the disappearance features of *Cowpea*, *Danchina* and *King J* vines differed slightly among themselves. This is similar to the report of Chumpawadee *et al.*, (2005). Results of dry matter disappearance observed values are in accordance with the values reported by Chumpawadee *et al.* (2005) but higher than those reported by Fadel *et al.*, (2007). The CP disappearance values obtained were comparable to those obtained by Chumpawadee *et al.* (2005). Greater CP disappearance was reported by Bayourthe *et al.*, (2000) for Pea (*Pisum sativum*) flour. Lower CP disappearance value was obtained by Danesh *et al.*, (2005). The result for the CP disappearance of sweet potato vines in this study showed that nutrient disappearance was comparatively higher. The CP nutrients of *King J* and *Danchina* vines disappeared faster in the rumen than that of the Cowpea. This could be due to greater proteolytic activities of the ruminal microflora there by evoking a higher disappearance Antwi *et al.*, (2014). The Acid detergent fibre and neutral detergent fibre disappearance obtained in this study were comparable to the values reported by Pawelek *et al.*, (2008). The disappearance parameters measured in this study are of paramount importance as they influence rumen fill and hence feed intake (Van Soest, 1987).



b



c



d

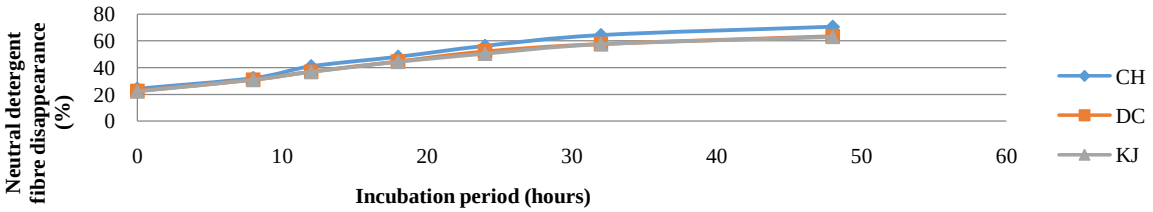


Figure 1: Pattern of disappearance of a) dry matter b) crude protein c) acid detergent fibre d) neutral detergent fibre from CH: cowpea hay, DC: danchina sweet potato vine cultivar, KJ: king j sweet potato vine cultivar during rumen incubation for various times in goat.

CONCLUSION AND RECOMMENDATION

It was concluded that *King J* and *Danchina* sweet potato vine cultivars can be fed to animals as a replacement of Cowpea hay as they were proven to be nutritionally good in term of disappearance. More research should be conducted further with a view to ascertaining the nutritive value of sweet potato vines.

ACKNOWLEDGEMENT

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REFERENCES

Adebowale, L. O. A. (2012). Dynamics of Ruminant Livestock Management in the Context of Nigerian Agricultural System. http://dx.doi.org/10.5772/52923.retrieved on 29/09/18

Antwi,C. I., Osafo, E. L. K., Donkoh, A. and Adu-Dapaah, H. (2014). Chemical composition, gas production and degradation characteristics of haulms of improved dual purpose Cowpea (*Vigna unguiculata*) cultivars. *Livestock Research for Rural Development* 26 (11)

AOAC (2005). *Official Methods of Analysis of AOAC International*. Maryland USA

Bayourthe, C., Moncoulon, R and Enjalbert, F. (2000). Effect of particle size on *In sittu* ruminal disappearances of Pea (*Pisum sativum*) Organic matter, protein and starch in dairy cows. *Canadian Journal of Animal Science* 80: 203-206

Chuwpawadee, S., Sommart, K., Vongpralub, T. and Pattarajinda, V. (2005). In sacco degradation characteristics of energy feed souces in Brahman – Thai native cross bred steers. *Journal of Agricultural Techology* I (2):192 – 206.

Danesh, M. M. and Stern, M. D. (2005). Ruminal and post ruminal protein disappearance of various feeds originating from Iranian plant varieties determined by the *In sittu* mobile bag and alternative methods. *Animal Feed Science Technology,* 118: 31 – 46

Fadel, A. M. A., Nietmat, I. and Amasaib, E. O. (2007). Chemical composition and In sittu dry matter degradability of stover fractions of five sorghum varieties. *Journal of Applied Sciences Research* 3 (10): 1141-1146

Larbi, A. Etela l. Nwokocha, H.N., Orji U.I Anyanwu, N.J, Gbaranch, L.D, Anioke, S.C., Balogun, R.O. and Muhammad, I.R. (2007). Fodder and tuber yields and fodder quality of sweet potato cultivars at different maturity stages in the west African Humid forest and Savannah Zones. *Animal feed Science and Technology* 35 (1 – 2), 126 – 138.

Odeyinka, S. M, Ogunyebi O. O. and Oyedele O. J. (2009). Peri-urban small ruminant feeding in Ekiti State. *Nigerian Journal of Animal Production.36(1):96-101*

Orskov, E. R., Horvell, D. and Mould, F.L. (1980). The use of nylon bag techniques for the evaluation of feedstuffs. *Tropical Animal Production* 5:195-213.

Osuji, P.O., Nsahlai, I. V. and Khalili, H. (1993). Feed evaluation. ILCAManual, Addis Ababa, Ethiopia.40 PP

Pawalek, D. L., Muir, J. P., Lambert, B. D. and Wittie, R. D. (2008). *In sacco* rumen disappearance of condensed tannins, fibre and nitrogen from herbaceous native Texas legumes in goats. *Animal Feed Science and Technology* 142 (1-2): 1 – 16.

Sankaran, M., Suresh, K. P. and Maniyam, N. (2012). Sweet potato as animal feed. *Journal of fodder, fruit, vegetable, cereal science and biotechnology* (2)1:109-114

Van Soest, P. J. (1987). *Nutritional Ecology of the Ruminant.* Comstock publishing Associate, A division of Cornell University press, Ithaca, New York. Pp305

Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and non starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74:3583-359

Woods,V.B.O., O'Mara, F.P. and Moloney, A. P. (2003). The nutritive value of concentrate feedstuffs for ruminant animals. Part 1: *In situ* ruminal degradability of Dry matter and Organic matter. *Animal Feed Science Technology* 110:111-130

UTILIZATION OF CATTLE FORE-STOMACH DIGESTA ENSILED WITH AFRICAN LOCUST BEAN PULP AND NON PROTEIN NITROGEN SOURCES BY GROWING UDA RAMS

[1]Inuwa, M., [1]Abubakar, M. M., & [1]Bello, K. M.,
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi,
Corresponding author email: musainuwa211@gmail.com
+ 2340836970701

ABSTRACT
Sixteen growing Uda rams weighing between 20 and 25kg were used to determine the utilization of cattle fore-stomach digesta ensiled with African locust bean pulp (ALBP) and non-protein nitrogen (NPN) sources. The study was conducted in Katagum, Zaki Local Government Area, Bauchi State. The animals were randomly allocated to four dietary treatment groups in a completely randomized design (CRD). The research lasted for eighty four (84) days of feeding and seven (7) days digestibility trials. Data were taken on feed intake and body weight changes. Blood samples were also collected and analyzed for haematological indices. The results showed that feed intake and dry matter intake (%body weight) were significantly (p<0.001) different. The weight gain, ADWG, total feed intake, feed conversion ratio, haemoglobin, park cell volume, red blood cell, white blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration were not significantly different. There was no significant difference in terms of digestibility of DM, CP, CF, EE, and Ash across the treatments. The cost of production showed no significant differences across the treatments means, but treatment A with 40% fore-stomach digesta and 60% African locust bean pulp was recorded the least cost of ₦332.51 and is recommended to farmers for feeding ruminant animals.

Keyword: Rumen Content, African Locust Bean Pulp, Poultry Litter, Non Protein Nitrogen Sources, Growing, Uda Rams

Introduction
Ruminant animals play active role in converting feedstuffs of no human dietary value to meat and milk. Efforts have been on using such feeds to reduce cost of feeds and subsequently cost of animal production. In recent years, several authors (Garba and Maigandi, 2008; Fawolu and Fajemisin, 2011) investigated the use of cheap agro-industrial by-products and waste materials; such as slaughter/abattoir waste and poultry droppings and cassava peels at various levels of inclusions in small ruminant diets to determine their efficiency of utilization in term of growth and production. Also with a view to identifying the most suitable one in terms of nutrition, cost effectiveness and year round availability.
The findings will further buttress the need for the populace in the developing world's to turn to these cheaper sources of protein to combat the problem of malnutrition.

Materials and Methods
Experimental Site
The study was conducted at Katagum, Zaki Local Government Area, Bauchi State.Zaki is a Local Government Area in Bauchi State, Nigeria, and its coordinates are 12º08'N and 10º17'EIt has an area of 1,436km^2 and a population of 191,457 as at 2006 census.The postal code of the area is 752. The predominant ethnic groups in the area are the Hausa with some Kanuri and Kare-Kare in the east of the area. Zaki Local Government Area has two main seasons, the dry season, which last from October to May/June and the rainy season that last from June/July to September. Zaki Local Government Area as part of the sahel region of Nigeria is blessed with abundant livestock resources because of its climate which is more suitable for livestock production, due to absence of Tse-tse fly on the open grassland. The experiment was conducted between the months of July-October 2019.
Experimental Materials

Rumen contents (RC), Africa locust bean powder, poultry litter, Urea, water mixing bowl, masking tape, marker and weighing scale.

Experimental Animals and their Management

Sixteen (16) growing Uda rams weighing between 20 and 25kg and 6-7 months of age were purchased from Gamawa town of Bauchi State for the experiment. The rams were transported to Zaki Local Government Area. On arrival, the rams were quarantined, dewormed and sprayed against ecto parasites (using permethrin). The experimental rams were allocated to four different dietary treatment groups and water was provided *ad-libitum.* The feeding trial lasted for eighty four (84) days.

Experimental Design and Feeding Procedure

The experimental design used was complete randomized design (CRD). A total of 16 growing Uda rams were used, such that each treatment contained four replicates. Each group of four animals was assigned to one of the experimental diets for 84 days feeding trial. Each ram was fed individually at the rateof 2kg/ram body weight. Apart from the experimental diets (Table 1), each animal was fed the concentrate diet with the formulation shown in Table 2 at the rate of 1kg.

RESULTS AND DISCUSSIONS

Chemical Composition of the Experimental Diets

Chemical compositions of the experimental diets are present in table 5.Crude protein content was higher in treatment A (16.43%) which was higher than the 6-8% CP recommended by Norton (2003) for growing sheep and goat. Gatenby (2002) indicated 10-12% CP as moderate level for ruminant production.

The higher CP content in this study could be due to the ensiling effect like rapid increase in soluble component of crude protein due to proteolysis and deamination. The DM value (89.61%) obtained in this study was similar with the values of (87.61-87.71%) observed by ochepo *et al*. (2012) in diets containing sugarcane peels. The higher DM value might be attributed to the types of materials used which were all dried. Higher DM suggest a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen.

The crude fibre value (10.11-9.63%) in the present study were lower than the value (31.30-33.60%) obtained by Ahmed *et al*. (2007) when sugarcane baggase was ensiled with chicken manure. This may be as a result of the experimental materials present in the ensiled mass. Ether extract values (8.14 – 6.93%) obtained from this trial was higher than those reported by Tukur and Maigandi (2010). These are authors obtained EE values ranged of (4.3-5.5%) when fattening rams was fed varying levels of fore-stomach digesta (FSD). The higher ether extract (EE) in diets indicate fats content which give rise to high concentration of volatile fatty acid (VFA).

The Ash values 6.52-7,69% in the present study was lower than (12.91-19.54%) reported by Garba *et al*. (2010) when *Guirera Senegalensis* was fed to yankasa rams as complete diets.

GROWTH PERFORMANCE

Growth performance of the experimental animals higher in feed intake is a good indication of proper utilization of the experimental diets (ensiled FSD with ALBP NPN) by the animals, which could also be attributed to the aroma and palatability of the ensiled diets. Initial, final body weight (BW), daily feed intake (DF1) weight gain, average daily weight gain (ADWG), total feed intake, feed conversion ratio and dry matter intake percentage body weight (DMI%BW) of growing uda rams fed graded levels of the experimental diets were shown in table 2.. Statistical analysis revealed that, there was no significant different ($p>0.05$) effects among the experimental diets across the various treatments on the life weight gain and average daily weight gain. The results of voluntary feed intake were varied statistically ($p<0.001$) among the treatments. Treatment D and C had the higher feed intake. Variation in feed intake between treatments could be as a result of better quality of the materials (urea and poultry litter) used to treat fore-stomach digesta (FSD) and African locust bean pulp (ALBP) which might have aided better intake and improved palatability of the diets.

These results are in line reported by Mondal *et al*. (2013) who found that inclusion of Dry rumen contents (DRC) in diets at O, 5 and 10% DRC did not affect final live weight and average daily gain (ADG) in kids and lambs.

Dry matter intake as percentage body weight was significantly different ($p<0.001$) between the treatments. DMI% BW indicates the nutritional quality of the feed with minimal wastage. The DMI% BW generally indicates that the animals on the various diets showed positively DM status by

consuming more than (2) percent of their body weight. The values obtained in this study fail within the range of 2.18-3.78% reported by Olorunnisomo (2010) for sheep fed maize and amaranth fodder.

NUTRIENT DIGESTIBILITY

The result of nutrient digestibility is present in table 3. The result showed that nutrient in the experimental diets was well utilized. The digestibility of the nutrients obtained in this present study was comparably high. Muhammad *et al*. (2016b) observed similar trend when uda rams were fed graded levels of *Parkia biglobosa* yellow fruit pulp. Wada *et al*. (2014) observed medium digestibility (40-60%).

Generally, the entire nutrients digestibility in this study was higher and the high digestibility could the attributed to the inclusion level of urea and poultry litter in the experimental diets as sourec of protein. This agreed with the report of Garba and Maigandi (2008) that adequate nitrogen in diets enhanced the activities of rumen microbes which eventually improved the overall nutrient digestibility.

The dry matter (DM), Crude fibre (CF), Crude protein (CP) Ether extract (EE), and ASH digestibility in present trial were comparable to the finding of Muhammed *et al*. (2016b) and higher than the report of Wada *et al*. (2014a). DM values in this study ranges from 75.63-83.44% and that of Muhammad *et al*. 2016b) ranged from 77.22-78.02%.

CP values obtained in the present research ranges from 78.74-84.58% which is higher than the values 24.48-32.27% reported by Wada *et al*. (2014a).

CONCLUSIONS AND RECOMMENDATION

The result showed that daily feed intake was significantly higher in treatments C (1.21kg) and D (1.22kg) than in treatment A (1.08kg) and B (1.09kg).Dry matter intake as % BW was significantly higher in treatments C and D than in treatment A (1.08kg) and B (1.09kg).

Therefore treatment D was recommended due to the high DFI, weight gain and low in FCR.

Table 1: Chemical Composition of the Experimental Diets and Concentrate Mixture

	Treatments				
	A	B	C	D	Concentrates
Parameters (%)					
Dry matter	89.61	89.11	88.60	89.59	98.10
Crude protein	16.43	15.96	16.11	16.19	14.93
Crude fibre	9.63	10.11	9.72	9.65	28.00
Ether extract	8.14	6.93	7.29	7.39	4.50
Ash	7.69	6.52	6.86	6.93	6.00

Table 2: Performance Characteristics of Uda Rams Fed Experimental Diets

	Treatments					
	A	B	C	D	SEM	LOS
Parameters						
Initial BW(kg)	20.25	20.50	21.75	19.50	0.35	NS
Final BW (kg)	26.50	26.00	28.25	26.75	0.39	NS
DFI (kg)	1.08[b]	1.09[b]	1.21[a]	1.22[a]	0.01	***
Weight gain (kg)	6.25	5.50	6.50	7.25	0.28	NS
ADWG (g/day)	74.40	65.48	77.38	86.31	3.38	NS
TFI(kg)	90.72	91.56	101.64	102.48	4.78	NS
FCR	14.52	16.65	15.64	14.14	0.78	NS
DMI % BW	4.32[b]	4.36[b]	4.84[a]	4.88[a]	0.03	***

TFI = Total Feed IntakeDMI(% BW) = Dry Matter Intake as % Body Weight LOS = Level of significance NS = Not Significant FCR= Feed Conversion Ratio DFI = Daily Feed Intake ***= $p<0.001$ abc, means within the same row with different superscript are significantly different ($p<0.001$).

Table 3: Nutrients Digestibility of Experimental Rams

	Treatment					
	A	B	C	D	SEM	
Parameters (%)						
DM	82.70	82.88	78.14	84.20	0.55	NS
CP	84.58	78.74	83.67	80.45	1.06	NS
CF	82.68	82.54	81.64	76.03	0.93	NS
EE	78.45	79.47	80.78	79.86	0.88	NS
ASH	66.13	64.16	70.65	71.48	1.04	NS

DM = Dry Matter CP = Crude Protein CF = Crude Fibre EE = Ether Extract ASH = Ash

REFERENCE

Ahmed, G. M., Salih, A. B. and Nagwa, E. G. (2007).Improvement of Digestibility of surgarcane baggase by fermentation with chicken manure.*Resources Journal of Agriculture and Biological Sciences,* 3(2): 115-118.

Fawolu, T. S and Fajemisin, A. N. (2011). Performance and micro-mineral utilization by West African Dwarf rams fed rumen content- poultry droppings mixed based diets. In: A. A. Adeniji, E. A Olatunji and E. S. Gana (eds.J *Value Re-Orientation in Animal Production: A key to National Food Security and Stable Economy.* Proceedings of the 36th Annual Conference of the Nigrian Society for Animal Production (NSAP), 13th -16th march, held at Merit House/Raw Materials Research and Development Council, Abuja. Pp533-535.

Garba, Y., and. Maigandi, S. A. (2008). Nutrient digestibility and utilization by growing lambs fed ensiled fore-stomach digesta (FSD) with poultry litter waste (PLW). In Repositioning Animal Agriculture for the Realization of National Vision 2020. Pp 222-225.

Garba,Y., Mohammed, A. S., Muhammad I. R, and Nasiru, A. (2010). Intake and Nutrientdigestibility by Yankasa rams fed graded levels of *Guira senegalensi as a complete diet.* In: O. J, Babayemi, O. A. Abu and E. O Ewuola (eds) Fast-tracking Animal Agriculture in a Challenged Economy. *Proceedings of the 35th Annual Conference of the Nigerian Society for Animal production* (NSAP) 14th-17th March, held at University Ibadan, Nigeria. Pp514-517.

Gatenby, R.M. (2002). *The Tropical Agricultural series.* In: A. J. Smith (ed). Macmillan Publishers Ltd. Between Town Roads, CTA, Post Bus 380,6700 A.J Wageningen, Netherland. Pp 32-33.

Mondal, S., Haldar, S., Samanta, I., Samanta, G. and Ghosh, T.K. (2013).Exploring nutritive potential of undigested rumen contents as an ingredient in feeding of goats.*Anim. Nutr. Feed Technol.*, 13:79-88.

Mohammed, Y. S., Mustafa MW, Bashir N and Mokhtar AS. 2013. Renewable energy resources for distributed power generation in Nigeria: A review of the potential. Renewable and Sustainable Energy Reviews. Vol 22: 257–268.

Norton, B. W. (2003). The nutritive value of tree *legumes In: Gutteridge, R. C., Shelton, H. M. (eds). Forage Tree Legumes in Tropical Agriculture. Tropical Grassland Society of Australia Inc., Stlucia Queensland. CAB International Pp 192-201.*

Ochepo, C. O., Ochepo, G. O and Ayoade, J. A (2012). The utilization of complete diet containing sugarcane peels by Goats. In *I. I. Bitto, F. G. Kaankuka and S. Attah (Eds) Sustainable Animal Production for National Food Security and poverty Alleviation.* Proceedings of the 37th Annual conference of the Nigerian Society for Animal Production (NSAP), 18th -21st March, held at the collage of Animal Science, University of Agriculture, Makurdi, Nigeria. Pp 507-511.

Olorunnisomo, O. A. (2010). Nutritive Value of Conserved Maize amaranth or Maize amaranth mixture as dry season fodder for growing West African Dwarf Sheep. *Livestock Research for rural development.* 22: 191-194.

Tukur, H. M., & Maigandi, S. A. (2010). Performance of fattening Rams fed varying levels of fore-stomach digesta. *Journal of Agriculture and Environment*,<5(1 and 2), 51-61.

Wada, N. I., Njidda, A. A., Olafadehan, O. A., & Bello, B. (2014). Effect of Graded Levels of *Parkia Biglobosa* in a Concentrate Diet on Growth Performance, Digestibility and Nitrogen Utilization of Yankasa Rams. *Global Journal of Biology), Agriculture and Health Sciences,* 3(4), 65-70.

Muhammad, N.B.M. Miana, K.M, Aljameel, S.A Maigandi and Buhari (2016b). Nutrient intake and Digestibility of uda rams fed Graded levels of parkia bigblobosa Int.J. of Livestock research **6**(5): 33-42.

GROWTH RESPONSE OF WEST AFRICAN DWARF GOATS FED *Chromolaena odorata* LEAF MEAL

J. A. Odedire & G. A. Olusegun-Bakare
Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, 220005, Nigeria
Corresponding author: oadeolu1@gmail.com

ABSTRACT
This study investigated the performance of West African Dwarf (WAD) goats offered *Chromolaena odorata* leaf meal (COLM) as supplement to a guinea grass – based diet. Sun –dried *Chromolaena odorata* leaves were milled and incorporated into a compounded ruminant concentrate diet. Twenty growing WAD goats, aged 5 - 7 months of both sexes, were randomly allotted to four concentrate diets containing graded levels of sun –dried processed COLM at 0, 10, 20 and 30% to make Diets 1, 2, 3 and 4 respectively. Results obtained indicate that goats on Diet 1 gave the best performance in terms of average daily gain (35.95 g/day) and feed conversion ratio (6.93), which was closely followed by goats on Diet 2 (25.0 g/day and 9.12 respectively). The study showed that COLM at 10 % level of inclusion possesses adequate nutritive value to support good growth of West African Dwarf goats without any deleterious effect.

Keywords: COLM, guinea grass, performance, WAD Goats

INTRODUCTION
Diets of small ruminants, such as goats and sheep, in the tropical regions of Africa have been reported to be deficient in protein (Becholie *et al.*, 2005), especially during the periods of drought and as such period, leguminous trees and shrubs provide a suitable source to offset the observed deficit. The recurrent world food crisis has been reported to inform the need to improve the use of local feed resources such as leguminous fodder trees and shrubs for animal nutrition (Alonso-Díaz *et al*., 2010). As such, Animal nutritionists are now focusing on the development of cost effective ways to maximize available feeds and innovatively broaden feed resource base through identification, evaluation and utilization of the many potential wild forages (Lanyasunya *et al*., 2005). *Chromolaena odorata*, a fast growing and invasive multipurpose wild shrub, has the potential of filling the nutritional gap for this class of ruminants. Recent researches on *Chromolaena odorata* has shifted from its eradication as an unwanted plant, to its utilization as a feed resource for livestock (Bamikole *et al*.,2004; Aro *et al.*, 2009; Igboh *et al.*, 2009). However, the use of *Chromolaena odorata* leaf meal in livestock production has been largely constrained by its unpalatable nature when fed fresh to farm animals. Hence, the need for processing the leaves into a more receptive and palatable form, in order to enhance its use in livestock feeding. The aim of this study therefore, was to assess the growth response of WAD goats fed sun – dried *Chromolaena odorata*.

MATERIALS AND METHODS
The experiment was conducted at the Sheep and Goat unit of the Obafemi Awolowo University Teaching and Research Farm, between March and July, 2016. Fresh leaves of *Chromolaena odorata* were harvested and processed into leaf meal by sun – drying. This was done by exposing the freshly harvested *C. odorata* leaves to the radiation effect of the sun, on a clean dry concrete slab for 72 hours. Preliminary investigations about processing methods (air – drying, oven – drying and sun – drying) had revealed sun – drying as the best, as the radiation effect significantly reduced the anti – nutritive contents of *C. odorata*, compared to the other two processing methods. The sun – dried C. odorata was subsequently ground using a hammer mill, to become *Chromolaena odorata* leaf meal (COLM). The COLM was incorporated into a typical ruminant concentrate diet in graded levels of 10, 20 and 30%, with 0% serving as the control, as contained in Table 1. Twenty growing West African Dwarf (WAD) goats of mixed sexes, aged 5 to 7 months were randomly allotted to four experimental diets comprising COLM at 0, 10, 20 and 30% inclusion level, which were fed to the WAD goats at 2% body weight with a basal ration of *Panicum maximum* at 3% of their body weight, in a completely randomized design. The growth trial lasted 98 days, including initial feed adaptation of 14 days. Goats

were weighed weekly throughout the duration of the experiment. Parameters measured include daily feed intake, average daily gain, total weight gain and feed conversion ratio. Laboratory analysis of diets was carried out using the procedure of AOAC (2000). Data collected were subjected to a one-way analysis of variance using the General Linear Model (GLM) procedures of SAS (2003) while differences between means were separated using the Duncan's Multiple Range Test of the same package.

Table 1: Gross composition of experimental diets for WAD goats

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
COLM	-	10.00	20.00	30.00
Corn bran	45.00	45.00	45.00	45.00
BDG	35.00	25.00	15.00	5.00
Palm Kernel Cake	17.50	17.50	17.50	17.50
Bone meal	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50
Vitamin	0.50	0.50	0.50	0.50
Total	100	100	100	100

RESULTS AND DISCUSSION

The chemical composition of the compounded concentrate diets fed to the WAD goats is shown in Table 2. The dry matter, crude protein, crude fibre, ether extract, ash, neutral detergent fibre, acid detergent fibre and acid detergent lignin contents of the diets increased with increasing level of *Chromolaena odorata* leaf Meal (COLM) inclusion. The CP contents, which is about the most critical nutrient, in all the diets were far above the 8% needed to provide the minimum ammonia levels required for microbial activities in the rumen (Norton, 1994).

Table 2: The chemical composition of experimental diets offered to WAD goats

Parameter(g/100g)	Diet 1	Diet 2	Diet 3	Diet 4
Dry Matter	92.82	93.11	93.22	93.45
Crude protein	16.90	18.50	18.76	19.53
Crude fibre	14.52	15.15	15.27	16.32
Ether Extract	8.55	8.60	10.19	11.12
Ash	7.52	8.18	9.62	9.05
Nitrogen free Extract	52.51	49.57	46.16	43.98
Fibre Analysis				
Neutral detergent fibre	51.87	54.33	58.10	66.53
Acid detergent fibre	30.05	30.99	32.24	34.04
Acid detergent lignin	15.51	17.88	18.54	19.25
Hemicellulose	21.82	23.34	25.87	32.49
Cellulose	12.54	13.11	13.70	17.79

Diet 1 (Control): 0% COLM inclusion; Diet 2: 10% COLM inclusion; Diet 3: 20% COLM inclusion; Diet 4: 30% COLM inclusion

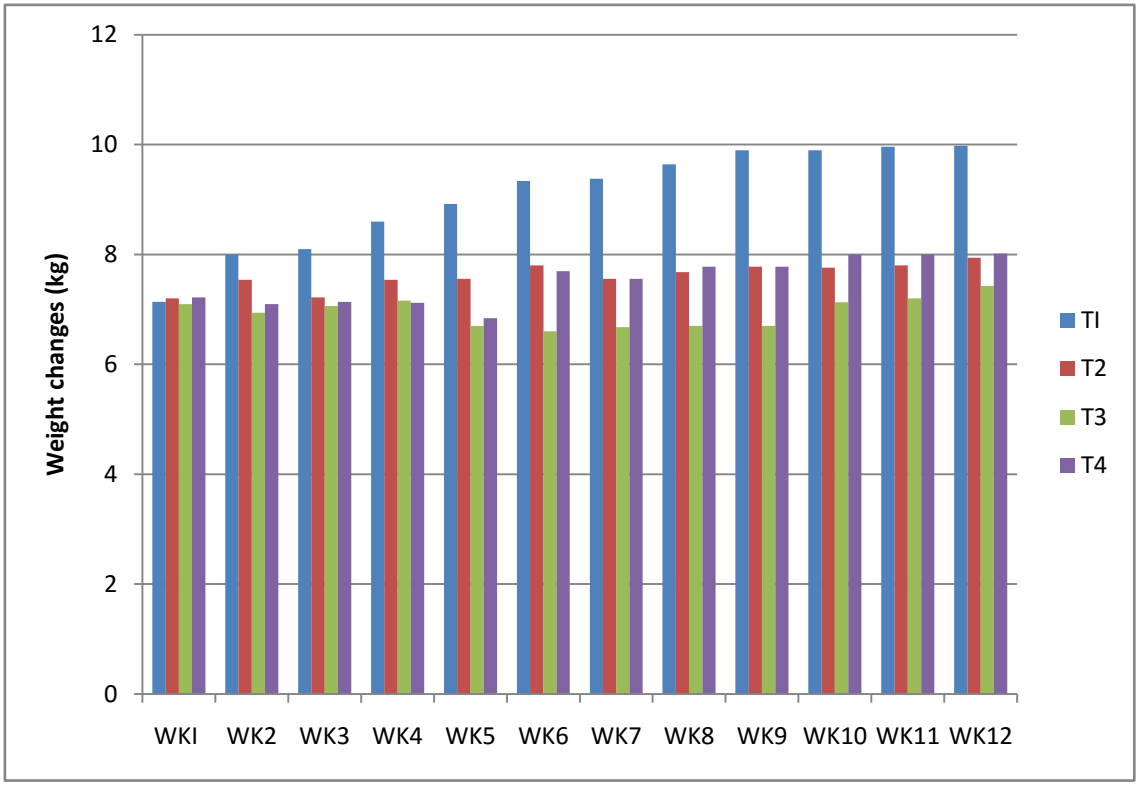
Table 3 shows the Performance characteristics of the WAD goats fed the experimental diets. Average daily intake decreased with increasing content of COLM inclusion in the diet (Table 3). This can be attributed to the bitter taste of *C. odorata,* which is a reflection of its saponin and tannin contents (Igboh *et al*., 2009). Sun –drying method has been reported to reduce the anti– nutrient contents of *C. odorata* and improve acceptance and palatability (Fasuyi *et al.,* 2005). The observed decreased feed intake is in agreement with previous reports on *C. odorata* when fed to birds (Aro *et al*., 1990) and albino rats (Akinmutimi and Akufo, 2006). Average daily gain decreased with increasing COLM content in the diets. Highest ($P<0.05$) daily gain (35.95 g/day) was observed for goats on Diet 1 and the least (15.71 g/day) recorded for goats on Diet 4. The decreasing weight gain could also be attributed to the effect of the reduced feed intake, as well as poor nutrient utilization, although the goats were all in positive weight balance. In terms of efficiency of feed utilization, the WAD goats recorded better performance with decreasing COLM content in the diets, as reflected by the Feed

Table 3: Performance characteristics of WAD goats fed experimental diets

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM (±)	PROB
ADFI (g/day)	249.04[a]	227.99[b]	217.94[c]	220.97[bc]	4.64	0.001
Initial weight (kg)	7.14	7.20	7.23	7.22	0.24	0.99
Final weight (kg)	10.16	9.30	9.37	8.54	0.32	0.34
Total weight gain (kg)	3.02[a]	2.10[ab]	1.70[b]	1.32[b]	0.22	0.01
Ave. daily gain (g/day)	35.95[a]	25.00[ab]	20.24[b]	15.71[b]	2.59	0.01
FCR	6.93[b]	9.12[ab]	10.77[ab]	14.07[a]	1.42	0.03

[a,b,c] means with different superscript differ significantly (P<0.05);Diet 1 (Control): 0% COLM inclusion; Diet 2: 10% COLM inclusion; Diet 3: 20% COLM inclusion; Diet 4: 30% COLM inclusion; ADFI: Average daily feed intake; FCR: Feed conversion ratio.

conversion ratio which increased with increasing content of COLM although the differences in the FCR values of Diets 1, 2 and 3 were not significant (P >0.05). The implication of this is that the WAD goats could tolerate COLM in their diets up to 20% inclusion level without any negative performance.



T1 = Diet 1(0% COLM); T2 = Diet 2 (10% COLM); T3 = Diet 3 (20% COLM); T4 = Diet 4 (30% COLM)
Figure 1: Growth response of WAD goats to the experimental diets

Figure 1 shows the growth response of the WAD goats on the COLM diets. Goats on Diet 1, which is the control diet, without COLM inclusion maintained a consistent daily weight gain throughout the period of the study while for the goats on Diets 2, 3 and 4, a clearly demarcated three growth phases played out. Phase one (Week 1 – 4) recorded a fairly steady increase in body weight gain across the treatment diets while in Phase 2 (Week 5 – 8), a negative growth response was observed. Phase 3

(Week 9 – 12) depicted a period of physiological adaptation to the COLM diets, where the goats exhibited compensatory growth response after the phase of growth depression.

CONCLUSION AND RECOMMENDATIONS

The study concluded that WAD goats can tolerate *Chromolaena odorata* leaf meal (COLM) in their diets up till 30% inclusion level, but best response is obtained at 10% level of inclusion. It is recommended that for optimum performance, COLM should not be fed to goats for more than 4 weeks at a stretch.

REFERENCES

Akinmutimi, A.H. and Akufo, A. (2006). The Effect of Graded Levels of Dietary Inclusion of Siam Weed (*Chromolaena odorata*) Leaf Meal in Grower Rabbits Diet in a Tropical Environment. *Journal of Animal and Veterinary Advances* 5(8): 707 – 711.

Alonso-Díaz, M. A., Torres-Acosta, J. F. J., Sandoval-Castro, C. A. and Hoste, H. (2010). Tannins in tropical tree fodders fed to small ruminants: a friendly foe? *Small Ruminant Research, 89*(2), 164-173.

A.O.A.C. (2000). Official Methods of Analysis. 16th edition. Association of Official Analytical Chemists.
Washington, DC., USA.

Aro, S., Osho, I., Aletor, V. and Tewe, O. (2009). *Chromolaena odorata* in livestock nutrition. *Journal of Medicinal Plants Research, 3*(13), 1253-1257.

Bamikole, M. A., Ikhatua, U. J. and Osemwenkhae, A. E. (2004). Converting bush to meat: a case of *Chromolaena odorata* feeding to rabbits. *Pakistan Journal of Nutrition*, 3(4), 258-261.

Becholie, D., Tamir, B., Terrill, T., Singh, B., & Kassa, H. (2005). Suitability of tagasaste (*Chamaecytisus palmensis* L.) as a source of protein supplement to a tropical grass hay fed to lambs. *Small Ruminant Research*, 56(1), 55-64.

Fasuyi, A.O., Fajemilehin, S. O. K. and Aro, S.O. (2005). Nutritional potentials of Siam weed (Chromolaena odorata) leaf meal (SWLM) on laying hens: Biochemical and haematological implications. *Pakistan Journal of Nutrition* 4(5): 336-341.
https://eprints.kfupm.edu.sa/95121/1/95121_1.pdf

Igboh, M.N., Ikewuchi, C.J. and Catherine, C. (2009). Chemical Profile of *Chromolaena odorata* L. (King and Robinson) Leaves. *Pakistan Journal of Nutrition* 8: 521-524.
https://scialert.net/abstract/?doi=pjn.2009.521.524

Lanyasunya,T.P., Musa, H.H., Yang, Z.P., Mekki, D.M. and Mukisira, E.A. (2005). Effects of Poor Nutrition on Reproduction of Dairy Stock on Smallholder Farms in the Tropics. *Pakistan Journal of Nutrition* 4: 117-122.

Norton, B. W. (1994). Nutritive value of tree legumes. In: Gutteridge, R. C. and H. M. Shelton (Eds). Forage tree legumes in tropical Agriculture. CAB International, Oxford. 389 pp

SAS (2003). Statistical Analytical System Institute. SAS/STAT User's guide. SAS Institute, Cary, North Carolina, USA.

EFFECT OF SUBSTITUTING MAIZE GRAIN WITH COBS TREATED WITH COMBINATIONS OF UREA AND WOOD ASH ON CHEMICAL COMPOSITION AND *IN SACCO* DEGRADABILITY

[1]Abdulazeez, A., [2]Tsopito, C.M. and [2]Madibela, O.R.
[1]Federal College of Education (Technical) Gusau, Zamfara State, Nigeria.[2]Botswana University of Agriculture and Natural Resources.
Corresponding author:azeezrazaq70@gmail.com, +2348028502373

ABSTRACT

An experiment was conducted to determine the effect of substituting maize grain with maize cobs treated with 25% urea plus 75% wood ash (WA) on chemical composition and *in sacco* degradability. Maize grain was substituted with graded levels of 25U75WA in the dietary ingredients and the treatments were: 100M = 100% maize grain, 66M34C = 66% maize grain plus 34% treated maize cobs, 34M66C = 34% maize grain plus 66% treated maize cobs and 100C = 100% treated maize cobs. Samples were analyzed for dry matter (DM), organic matter (OM), ash, crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL); they were incubated *in sacco* for 6, 12, 24, 48 and 72 hrs and their DM degradation kinetics described using the equation $y = a + b (1- e^{-ct})$. Results indicated that as maize grain is substituted with treated maize cobs, NDF, ADF and ADL also increased, however only the neutral detergent soluble (NDS) for treatment 100C was reduced. At 72 hrs of incubation, treatment 34M66C had the highest DM degradation, rapidly soluble fraction 'a' and potential degradability 'a+b'. It was concluded that maize cobs treated with combinations of urea and WA could substitute 66% of maize grain in ruminant diets.
Key word: Maize cob, maize grain, in sacco, urea, wood ash.

INTRODUCTION

Domestic ash left after burning of wood for cooking is alkaline, can improve the digestibility of crop residues the same way as urea and is available at household level at no cost to the farmer. Most researches have centered investigations on use of either urea (Sundstol and Coxworth, 1984; Preston, 1985; Chenost, 1995) or wood ash (Adebowale *et al*., 1991; Ramirez *et al.,* 1992., Solomon *et al*., 2012) as source of crop residue treatments but not their combinations. The combination is expected to reduce cost of treatment, improve digestibility at the same time incorporating both nitrogen present in urea and minerals from ash into the crop residue. After maize harvest and shelling of the grains, the cobs are left in the homestead as waste and in some cases burnt. Meanwhile livestock compete with man for grain, therefore there is need to conserve grains for human consumption by either partially or completely replacing it with urea-wood ash treated maize cobs which are rich in energy, nitrogen and minerals (Chenost, 1995; Solomon *et al.,*2012). The objectives of this study was to determine the effect of substituting maize grain with cobs treated with combinations of urea and wood ash on chemical composition and *in sacco* degradability.

MATERIAL AND METHODS

Location of Study, Sample Collection and Treatment

The study was conducted at the Botswana University of Agriculture and Natural Resources, Content Farm located 10 Km north of Gaborone in South Eastern Botswana. Maize cobs treated with a combination of 25% urea and 75% WA were used to substitute graded level of maize grain in a complete diet as shown in Table 1.

Laboratory Analysis

Dry matter (DM, ID number 930.15) for all samples were determined by drying in forced air oven at 60° C for 24 hr. Organic matter (OM, ID number 942.05) and ash were obtained by difference in weight after ignition at 550° C in a muffle furnace (Muffle Furnace Size 3, Gallenkamp, UK). The

NDF, ADF and ADL were determined with ANKOM fiber analyzer (Ankom Technology Corporation, Fairport, NY, USA) according to the procedure of Van Soest *et al*, (1991). In the analysis of NDF, sodium sulphite and alpha amylase were also added. Nitrogen was determined by the Kjeldahl method (ID number 955.04) according to AOAC (1999) and CP determined as N*6.25 (ID number 954.01).

IN SACCO DEGRADABILITY

The *in sacco* DM degradability analysis for the various treatments was carried out according to the procedure of Mehrez and Orskov (1977). Various samples were milled through a 3mm sieve and 2g weighed into nylon bags (pore size 20µ) in duplicates. These were then incubated for 6, 12, 24, 48 and 72 hours in two fistulated steers (5 treatments × 5 time periods × 2 fistulated steers). The procedure was repeated three times and means for each incubation used as replicates. The steers were fed commercial concentrate combined with crushed maize cobs for 5 days to get rumen microbes adapted to the feed. After removal, the nylon bags were thoroughly washed with cold running water until no further coloured liquid could be extruded, followed by drying at 60 ^{0}C for 48 hours. The dry matter losses for each incubation time were then determined according to the formula proposed by Osuji *et al.* (1993)

The DM degradation data were then fitted to the exponential equation $\mathbf{P= a + b (1 –e^{-ct})}$ (Orskov and McDonald, 1979): where P = DM disappearance in rumen at time't', a = the rapidly soluble fraction, b = the insoluble but fermentable fraction, c = the constant rate of degradation of 'b' (% per hour), a + b = Potential degradability. ed = a + bc/ (c + k) where k = the ruminal passage rate assumed at 3%$^-$h.

STATISTICAL ANALYSIS

I*n sacco* degradability constants were generated with Non Linear Model (NLIN) SAS programme using the code of Osuji *et al*. (1993) and effects of treatment carried out using GLM procedure of SAS (2002) and means separated using Duncan's multiple range test (Steel and Torrie, 1984).

Results

Table 1: Ingredients and chemical composition (g/kg) of experimental diet

	Types of treatment				
Ingredients (%)	100M	66M34C	34M66C	100C	
Maize cob	0	15	30	45	
Maize grain	45	30	15	0	
Lucerne	39	36	32.5	29.5	
Wheat bran	10	10	10	10	
Sun Flower Cake	5	8	11.5	14.5	
Salt	0.5	0.5	0.5	0.5	
DCP	0.5	0.5	0.5	0.5	
Chemical composition (g/kg)					SD±
DM	945.0	950.0	950.0	955.0	4.630
ASH	82.01	100.0	107.9	175.4	38.68
OM	918.0	900.0	892.1	824.6	38.68
CP	134.3	131.0	133.5	133.5	3.740
NDF	470.0	470.0	480.0	570.0	54.97
ADF	160.0	220.0	250.0	360.0	78.51
ADL	53.20	63.20	85.20	114.4	28.61
HC	310.0	250.0	230.0	210.0	53.45
NDS	530.0	530.0	520.0	430.0	54.97
ME MJ/kg	18.94	19.19	19.28	17.24	0.938

DM= dry matter, OM=organic matter, CP=crude protein, NDF=neutral detergent fibre, ADF=acid detergent fibre, ADL=acid detergent lignin, HC=hemicellulose, NDS=neutral detergent soluble, ME=metabolizable energy, DCP= Di calcium phosphate. 100M= 100% maize, 66M34C=66% maize 34% treated maize cobs, 34M66C=34% maize

66% treated maize cobs, 100= 100% treated maize cobs.

Ingredients and chemical composition of experimental diet are shown in Table 1. It was observed that the NDF, ADF and ADL of the experimental diets increased as the maize was substituted with urea-wood ash treated maize cobs; however, treatment 100C had the lowest NDS. The result indicated that treatment 33M66C had the highest DM degradation at all the time intervals (Table 2), while the highest 'a', 'a+b' and 'ed' were also recorded for treatment 33M66C (Table 3)

Table 2: *In sacco* degradation (%) characteristics of experimental diets

Time of incubation (hr)	Types of treatment					
	100M	66M34C	34M66C	100C	SE	P value
6	27.21[b]	27.85[b]	32.59[a]	26.16[b]	0.9723	0.0124
12	30.15[b]	31.17[b]	35.91[a]	29.49[b]	0.9725	0.0126
24	37.67[b]	39.01[b]	41.96[a]	36.53[b]	0.8064	0.0161
48	41.25[c]	42.51[b]	46.31[a]	40.26[c]	0.8778	0.0004
72	61.96[b]	60.72[b]	67.35[a]	55.50[c]	1.633	0.0045

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100= 100% treated maize cobs

Table 3: *In sacco* degradation (%) parameters of experimental diets

Parameters	Types of treatment					
	100M	66M34C	34M66C	100C	SE	P value
a	27.72[b]	27.50[b]	30.76[a]	26.14[b]	0.7015	0.0523
b	52.86[ab]	52.35[ab]	55.06[a]	51.47[b]	0.6015	0.1597
c	0.0093	0.0097	0.0094	0.0079	0.0005	0.6605
a+b	80.58[b]	79.85[b]	85.82[a]	77.61[b]	1.172	0.0064
ed	40.23[b]	40.31[b]	43.88[a]	36.91[c]	0.9586	0.0083

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100= 100% treated maize cobs, a= rapidly soluble fraction, b= insoluble but fermentable fraction, c= degradation rate/h, a+b= potential degradability, ed= effective degradability.

DISCUSSION

It was observed that the more the substitutions of maize grain with treated maize cobs, the more the ash content of the feed. The high amount of ash in the feed may supply more minerals to the animals and rumen microbes (Imbeah, 1999). However the substitution also led to increase in NDF, ADF and ADL and reduction in NDS of treatment 100C. The higher NDS content of treatments 100M, 66M34C and 34M66C could be attributed to their maize contents that were mostly cell soluble compared to treatment 100C that was characterized by higher contents of NDF, ADF and ADL which can negatively affect digestibility. Various authors have also reported increases in NDF, ADF and ADL contents of feeds when energy source is substituted with maize cobs (Khan *et al*., 2006; Wanapat *et al*., 2012). The reason for the high NDF and ADF contents of treatment 100C based diet was because of its high crude fibre content.

At 72 hours of *in sacco* degradability, treatment 34M66C had the highest percent degradability probably because it had better colonization and attachment by rumen microbes due to its low maize grain contents compared to treatments 100M and 34M66C. When diets have high grain contents, they are fermented rapidly by rumen microbes to VFAs which leads to a drop in rumen pH. A drop in rumen pH depresses the activities of rumen microbes thereby impacting negatively on digestibility of fibrous materials. However, the impact of low pH may not be significant under *in sacco* condition due to dilution resulting from entry and exit of other particles surrounding the nylon bags. The fact that treatment 34M66C had the highest degradation (%) after 72 hours of incubation and highest potential degradability 'a+b,' implied that it was superior to the other treatments in terms of digestibility. Carro *et al*. (1991) reported that the fraction that would be degraded when samples were incubated indefinitely in the rumen was the potential degradability and did not indicate the *in vivo* condition. Khazaal *et al.* (1995) reported that potential degradability of feed pointed to the quality of feed because it was associated with the degradability of feed. Therefore, feeds with higher 'a+b' fractions may degrade faster than those with lower 'a+b' fractions.

CONCLUSION

It was therefore concluded that 66% of maize cobs could replace maize grain in ruminants' diets.

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REFERENCES

Adebowale, E.A., Orskov, E.R. and Shand, W.J. (1991). Use of ash of cocoa pod husk as source of alkali for upgrading agricultural residues with or without hydrogen peroxide. *Trop. Agric*. 68: 27-32.

AOAC, (1999). Official Methods of Analysis, 16th ed. Official Methods of Analysis of AOAC International, Gaithersburg, MD, USA.

Carro, M.D., Lopez, S., Gonzalez, J.S. and Ovejero, F.J. (1991). The use of the rumen degradation characteristics of hay as predictors of its voluntary intake by sheep. *Animal Production* 52: 133-139.

Chenost, M. (1995). Optimizing the Use of Poor Quality Roughage through Treatments and Supplementation in Warm Climate Countries with Particular EmpHasis on Urea Treatment. First Electronic Conference on Tropical Feeds with Particular EmpHasis on Urea Treatment FAO, Rome.

Imbeah, M. (1999). Wood ash as mineral supplement for growing lambs under village conditions in the tropics *Small Ruminant Research* 32: 191-194.

Khan, M.A., Iqbal, Z., Sarwar, M., Nisa, M., Khan, M. S., Lee, W.S. and Kim, H.S. (2006). Urea treated maize cobs ensiled with or without additives for buffaloes: Ruminal characteristics, digestibility and nitrogen metabolism *Asian-Aust. J. Anim. Sci*. 5: 705- 712.

Khazaal, K., Dentinho, M.T., Robeiro, J.M. and Orskov, E.R. (1995). Prediction of apparent digestibility and voluntary intake of hays fed to sheep: comparison between using fibre components, *in vitro* digestibility or characteristics of gas production or nylon bag degradation. *Animal Science* 61: 527-538.

Mehrez, A.Z. and Orskov, E.R. (1977). A study of the artificial fibre bag technique for determining the digestibility of feeds in the rumen. *J. Agric. Sci.*, 88: 645-650.

Orskov, E.R. and McDonald, L.M. (1979). The estimation of protein degradability in the rumen from incubation measurement weighted according to rate of passage. *J. Agric. Sci.Camb.* 92: 499-503.

Osuji, P.O., Nsahlai, I.V. and Khalili, H. (1993). Feed evaluation. ILCA Manual 5 ILCA (international Livestock Centre for Africa), Addis Ababa, Ethiopia. pp40.

Preston, T.R. (1985). Strategies for Optimizing the Utilization of Crop Residues and Agro industrial Byproducts for Livestock Feeding in Tropics. Towards Optimal of Agricultural By-products to Livestock in Africa 17pp. Proceedings of a Workshop held at the University of Alexandria. International Livestock Center for Africa (ILCA), Egypt.

Ramirez, R.G., Cruz, F. and Gonzalez, C.C. (1992). Effect of treating corn stover with wood ash and sodium hydroxide on nutrient digestibility by sheep and goats *Small Ruminant Research* 7: (3) 225-233.

SAS, (2002). Statistical Analysis System. SAS user's guide: Statistics, SAS Inst. Inc., Carry, NC.

Solomon, A. K., Ulfina, G.G. and Gemeda, D. J. (2012). The potential of treatment with ash solution in improving degradability of fibrous feeds in Ethiopia *Agric. Sci. Res. Journal* 3:100- 105.

Sundstol, F. and Coxworth, E.M. (1984). Ammonia treatment In: Sundstol, F. and Owen, E. (Eds.), Straw and other fibrous by-products as feed, Elsevier, Amesterdam, pp 196-247.

Steel, R.G.D. and Torrie, J.H. (1984). Principles and Procedures of Statistics. A Biometrical Approach (2nd Ed). McGraw Hill Book Co. Inc. New York. USA.

Van Soest, P.J., Robertson, H.B. and Lewis, B.A. (1991). Methods of dietary fibre, NDF and non-starch polysaccharides in relation to animal material. *J. Dairy Sci.* 74: 3583-3595.

Wanapat, M., Pilajun, R., Kang, S., Satyaningsih, K. and Setyawan, A.R. (2012). Effect of ground maize cobs replacement for cassava chip on feed intake, rumen fermentation and urinary derivatives in swamp buffaloes. *Asian-Aust. J. Anim. Sci*. 8: 1124-1131.

PROBIOTICS USE IN RUMINANT NUTRITION

Aruwayo A.

Federal Universirty Dutsin-Ma
Faculty of Agriculture and Agricultural Technology
Department of Animal Science
Email:aaruwayo@fudutsinma.edu.ng
Phone: +234-8035813377

ABSTRACT
Ruminant production in very prominent in livestock production. They are available all over Nigeria where pasture constitute their major source of feed. However, utilization of the available pasture depends on the microbes in the rumen which then determines the overall wellbeing of these animals and their productive capacity. Additives have been used to improve the ability of these microbes to productively utilize the feedstuff and consequently, the digestibility. The additives in use previously have been demonstrated to impact negatively on the health of the animals. Probiotics then became prominent as an additives because of the ability to improve the productive capacity of the microbes in the rumen without any known negative effect on the health of the animals. The study then reviewed probiotics use in ruminants and concluded that it improves the productivity of ruminants due to improved microbial activities.

Keywords: Probiotics, ruminant, feed, microorganism, Nigeria

INTRODUCTION
Due to its multi-purpose functions, small ruminant production has been given a pride of place in animal production in Nigeria. This contributes greatly to Nigeria's animal protein potential (Aruwayo , 2018). It constitutes a profitable business for rural families and the success depends mainly on the feeding and feeding stuffs available and the efficiency with which the microbes in these animals ' digestive systems are mobilized and used to improve the digestibility and feed utilization. Abd El-Tawab *et al*. (2016) documented feed to be major a component of livestock production and that exemplary attention has been paid to improving animal output in its utilization capacity. Efforts being made to boost the use of feed which necessitated use of additives has proved to be one of the successful among other methods of improving feed utilization. This research paper dwelt on the effect of probiotics as a class of feed additives on productivity and health condition of ruminant livestock.

FEED ADDITIVES
McDonald *et al*. (2010) reported that feed additives are materials used to improve the usefulness of nutrients and to exert their effects on the animal intestines or on the gut wall cells. Fanelli (2012) has documented his intention to promote animal growth by increasing the quality and palatability of feed Chahal et al. (2008) reported that feed additives in feed for ruminants lead to improved production of animal protein for human consumption, thus reducing the cost of animal products. Feed additives used in feeds include antibiotics, probiotics, oligosaccharides, enzymes and organic acids. Antibiotics was one of the prominent additives used to improve the consumption of feed and increase production. Nevertheless, because of the recorded residue impact on livestock items, it gradually lost prominence because of the residue effect recorded on livestock products. Morril *et al.* (1977) stated that in the past, antibiotic growth promoters were commonly used as animal feed additives to improve feed intake, increase production, and prevent infections. Nevertheless, the use of antibiotics was banned which brought probiotics into the limelight and accepted that they were healthy for the animals. The term ‘ probiotics' was used by Lilly and Stillwell (1965) to identify growth enhancing substances generated by a ciliate protozoan which enhanced the growth of any other ciliate. Now, probiotics encompasses a far wider category of species. Probiotics was described as "species and compounds that promote intestinal microbial stability which include live and non living organisms (Parker, 1974).
The United Nations Joint Food and Agriculture Organization (FAO) and World Health Organization (

WHO) Working Group classified probiotics as ' live micro-organisms which endow advantages in health on the host when administered in sufficient quantities ' (FAO / WHO, 2001).

PROBIOTICS USE

Probiotics constitute viable microorganisms and, when used in large numbers (Rook and Burnet 2005), the microflora can transform the digestive system of ruminants, resulting in improved health and growth. They are living microbes and are feed supplements that are beneficial to the host through improvement of its microbial bowel balance. Such species are genetically robust, capable of producing antimicrobials and altering the colonic flora in favor of a healthy configuration and thus cause luminous or systemic effects that are useful for the health of the host (Kaur et al., 2002; Parvez *et al*., 2006). Bacteria and yeasts are significant probiotics used in the ruminant development. Probiotics have been used in ruminant diets for the improvement of the health, productivity and health of the animals.

It has also been documented that probiotics regulate rumen pH, increase the production of volatile fatty acids and promote protozoan use for lactic acid, resulting in highly efficient rumen work. Despite not being non-pathogenic to animals, microbes that are employed as probiotics are chosen considering their longevity in the gastro intestine along with their capacity to resist low pH and high levels of the bile acids. Furthermore, those selected strain can withstand processes of production, transport, storing and application, preserving the viability and desired features (Collins *et al*., 1998). The ability by the prospective probiotic micro-organisms geared towards resisting the digestive tract may be verified in vitro with low pH challenges (H) (Hood and Zoitola, 1988; Collado and Sanz, 2006). Their capacity to condone acidic environment and bile differs among strains (Mishra and Prasad, 2005). Additional attractive trait is the capacity to bind to the epithelium of the intestines facilitating colonization of the intestine by the probiotic strain(s) (Guarner and Schaafsma, 1998). Furthermore, the capacity of growing fast on cheap media becomes a necessary requirement (Collins, Thornton and Sullivan, 1998) in profitable production.

Probiotics can enhance the amount of helpful microbes plus lactobacilli and bifidobacteria, inhibiting the growth of deleterious microbes through the production of constraining substances like bacteria or/and organic acids. As a result, probiotic characteristics lead to improved animal health, increased productivity (Isolauri *et al*. 2004), and improved the immunity of the host (Patel *et al*., 2015).

Yeast feeding makes the rumen pH stable, raises total volatile fatty acids (VFAs) and decreases ammonia (Erasmus *et al*. 1992, Newbold *et al*. 1996, Abd El-Tawab 2007, Bakr *et al*. 2015). In addition, the probiotics use have been demonstrated to possess capacity to boost production of milk and may decrease those risk of neonatal diarrhea and mortality. Yeast utilization in the feed of rumen lowers the redox capacity which results in better situations for the growth of stringent anaerobic microorganisms, produces specific factors such as vitamin B12 or branched chain fatty acids, thus arousing microbial biomass production in the rumen (Jouany, 2006; Chaucheyras — Durand *et al*., 2008). In addition, rumen acidosis is decreased by yeast supplementation, promoting growth and operation of the lactic acid-using rumen bacterium Selenomonas ruminantium (Nisbet and Martin, 1991). Yeast operations also results in rumen fermentation stimulation and leads to enhanced digestibility and feed use. The enhanced bacterial population is fundamental to the yeast's operation in enhancing the productive capacity of ruminants (Wallace and Newbold 1992). Yeasts can promote cellulolytic bacteria's growing and enzymatic activity, and increase microbial protein production and fiber digestibility (Bomba *et al.* 2002).

Use of probiotic strains, both individual and combined, could have considerable effect on absorption and utilisation of feed, daily increase of body weight and total body weight of various animals, including sheep, goats (Chiofalo, 2004), cattle, and horses (de Rezende, 2012). An addition of probiotic microorganisms to feed results in improved quantity and quality of milk, meat and eggs. The efficacy of probiotics in combating diarrhea has been well studied. Recombined probiotics constitutes one of the most novel biomedical applications of genetically modified organisms (GMO) (Musa,2009). The absence of clinical side effects is an important benefit of probiotics. However,

despite the fact that the micro-organisms used as probiotics in the feed of ruminants, there should be precaution in their use because some might be dangerous to animals, human beings and the environment.

CONCLUSION:

From this study, it was clearly shown that probiotics use in ruminants' has improved their utilization of feed. This is because probiotics enhance the capacity of the rumen microbes to utilize feed better in the rumen.

REFERENCE

Abd El-Tawab M. M. (2007). Linico-laboratory evaluation of probiotics applications in buffalo calves. M.V.Sc. Thesis, Fac Vet Med, Beni-Suef University, Egypt and health of small ruminants Polish Journal of Veterinary Sciences Vol. 19: 4 , pp 893–906
Article

Aruwayo A. (2018). Use of Urea Treated Crop Residue in Ruminant Feed . International Journal of Advances in Scientific Research and Engineering (ijasre). Vol. 4: 7, pp 55-67.

Bakr H. A., Hassan M. S., Giadinis N. D., Panousis N., Ostojić Andrić D., Abd El-Tawab M. M., Bojkovski J. (2015). Effect of Saccharomyces cerevisiae supplementation on health and performance of dairy cows during transition and early lactation period. Biotechnol Anim Husb vol 31: 349- 364.

Bomba A, Nemcova R, Gancarcikova S, Herich R, Guba P, Mudronova D (2002). Improvement of the probiotic effect of micro-organisms by their combination with maltodextrins, fructo-oligosacharides and polyunsaturated fatty acids. Br J Nutr 88: 95-99.

Chaucheyras-Durand F., Walker N. D., Bach A. (2008). Effects of active dry yeasts on the rumen microbial ecosystem: past, present and future. Anim Feed Sci Techn vol 145: 5-26.

Chiofalo V., Liotta L, Chiofalo B.. (2004). Effects of the administration of Lactobacilli on body growth and on the metabolic profile in growing Maltese goat kids. Reprod Nutr Dev. Vol 44:449–57.

Collins, J., Thornton, G. & Sullivan, G. (1998). Selection of probiotic strains for human applications. International Dairy Journal, 8(5-6): 487–490.

de Rezende A. S.C., Trigo P., Lana A. M. Q., Santiago J. M., Silva V. P., Montijano F. C. (2012). East as a feed additive for training horses. Cienc Agrotecnol, 36:354–62.

Erasmus L. J., Botha P. M., Kistner A. (1992) Effect of yeast culture supplement on production, rumen fermentation and duodenal nitrogen flow in dairy cows. J Dairy Sci 75: 3056-3065.

Fanelli A. (2012) Direct-Fed Microbials (DFMs) in horses and poultry: e؛ects on digestibility, nutritional value of animal products and animal health. Graduate School of Veterinary Sciences for Animal Health and Food Safety. Doctoral Program in Animal Nutrition and Food Safety.Università degli Studi di Milano.

FAO/WHO. 2001. Guidelines for the evaluation of probiotics in food. http://www.fda.gov/ohrms/dockets/dockets/95s0316/95s-0316-rpt0282-tab-03-ref-19-joint-faowho-vol219.pdf Accessed 15 April 2014.

Isolauri E., Salminen S., Ouwehand A. C. (2004). Probiotics. Best Pract Res Clin Gastroenterol. 18:299–313.

Jouany J. P. (2006) Optimizing rumen functions in the close-up transition period and early lactation to drive dry matter intake and energy balance in cows. Anim Reprod Sci 96: 250-264.

Kaur IP, Chopra K, Saini A (2002) Probiotics: potential pharmaceutical applications. Eur J Pharm Sci 15: 1-9.

Lilly, D. M. & Stillwell, R. H. (1965). Probiotics: growth-promoting factors produced by micro-organisms. Science, 147(3659): 747–748.

McDonald P., Edwards R. A., Greenhalgh J. F. D., Morgan C. A., Sinclair L. A. (2010), Animal Nutrition (7 th edn.) Pearson Books

Morrill J. L., Dayton A. D., Mickelsen R (1977). Cultured milk and antibiotics for young calves. J Dairy Sci

Musa H. H., Wu S. L., Zhu C. H. (2009). The potential benefits of probiotics in animal production and health. J Anim Vet Adv. 2009; 8(2):313–21.

Nisbet D. J., Martin S. A. (1991). Effect of a *Saccharomyces cerevisiae* culture on lactate utilization by the ruminal bacterium *Selenomonas ruminantium*. J Anim Sci 69: 4628-4633.

Parker, R. 1974. Probiotics, the other half of the antibiotic story. Animal Nutrition and Health, 29(4): 8.

Parvez S., Malik K. A., Ah Kang S., Kim H. Y. (2006). Probiotics and their fermented food products are beneficial for health. J Appl Microbiol 100: 1171-1185.

Patel S., Shukla R., Goyal A. (2015). Probiotics in valorization of innate immunity across various animal models. J

Wallace R. J., Newbold C. J. (1992). Probiotic for ruminant. In: Probiotics: the scientific basis. Champman and Hall publisher, London, pp 317-353.

RESULTS AND DISCUSSIONS

Figure 1 shows the shear force of spent layers' meat tendered with turmeric extract. As the levels of inclusions increased, the shear force value decreases. 15% of turmeric extract had the lowest shear force value while control without turmeric extract had the highest shear force values. The shear force values indicate tenderness of meat. When the value obtained is higher, it denotes that the meat will be tough but when the values obtained was lower, it shows that the meat will be tender. In this study a trend was observed in the shear force value of the meat. As the inclusion levels of turmeric extract increased, there was decrease in the shear forces. These results might be attributed to the effect of proteolytic enzyme found in the turmeric which may lead to more degradation and availability of dietary protein. Shear force values in our experiment are in agreement with Naveena *et al.,* 2004 reported significant reduction of shear force value in all enzyme treated samples compared to control. Similar result was also obtained in the work of Verma, *et al*. (2018).

The water holding capacity of meat from spent layer tendered with turmeric extract results was showed in Table 1. A consistent value was observed for water holding capacity. As the inclusion level increased, the water holding capacity increases. More so, the extract released volume result shows that the control had the lowest value of (17.50%) without turmeric extract while spent layer meat tendered

with turmeric extract at 5% had the highest value of (43.75%). The water holding capacity (WHC) is the ability of meat to hold water after external pressure was applied. Turmeric treated sample had higher WHC than control which are in agreement with Naveena and Mendiratta (2001).

Extract released volume is a technique that is based on the volume of aqueous extract released by homogenate of meat when allow to pass through the filter paper for a given period of time, by this meat of good organoleptic and microbial quality release large volume of extract, whereas meat of poor quality releases smaller volume or none. The result obtained shows that as the inclusion level increased the meat organoleptic and microbial quality was improved. This could be due to phytochemical substances present in the turmeric extract.

The mean pH value was higher in meat from 15% turmeric extract while the control meat had the lowest pH value. The result obtained from pH.

CONCLUSION

In conclusion, spent layers meat can be marinated in turmeric extract up to 10 – 15% /L due to improvement of tenderness.

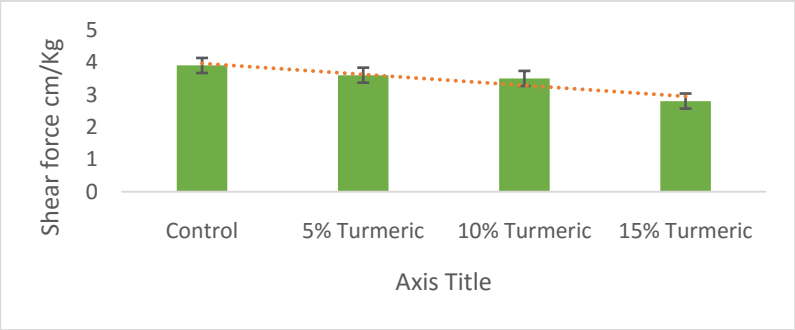


Figure 1: Shear force of the spent layer's meat tendered with turmeric extract

Table 1: Physical evaluation of spent layers meat tender with turmeric extract

Parameters	Control	5% Turmeric/L	10% Turmeric/L	15% Turmeric/L	SEM
Water holding capacity	33.33^{c}	68.33^{b}	70.00^{b}	85.83^{a}	5.8
Extract released volume	17.50^{c}	43.75^{a}	23.75^{b}	28.75^{b}	3.28
Ph	6.55^{b}	6.65^{ab}	6.65^{ab}	6.70^{a}	0.02

^{abc} Means on the same row with different superscripts are significantly different ($p<0.05$)

SEM= Standard Error mean

REFERENCES

AOAC (2000). Association of Official Analytical Chemistry Official Methods of Analysis of AOAC international (17th ed.). MD, USA.

Bouton P.E and Harris P. V (1978). Factors affecting tensile and Warner- Bratzler shear values of raw and cooked meat. *J. Texture Stud*., 9: 395-413.

Jay (1964), Release of aqueous extract by beef homogenates and factors. Food Technol. 18:129-132.

Mennecke, B. E., Townsend, A. M., Hayes, D. J., & Lonergan, S. M. (2007).A study of the factors that influence consumer attitudes toward beefproducts using the conjoint market analysis tool.Journal of Animal Science,85, 2639–2659.

Naveena B. M. and Mendiratta S. K (2001).Tenderisation of spent hen meat using ginger extract. *British Poultry Science* 42:344-349

Naveena, B.M., S.K. Mendiratta and A.S.R. Anjaneyulu, 2004. Tenderization of buffalo meat using plant proteases from *Cucumis trigonus roxb* (Kachri) and *Zingiber officinale roscoe* (Ginger rhizome). Meat Sci., 68: 363-369.

Verma S.P., Salamone E., Goldin B. Curcumin and genistein, plant natural products, show synergistic inhibitory effects on the growth of human breast cancer MCF-7 cells induced by estrogenic pesticides. *Biochem. Biophys. Res. Commun*. 2018;233:692–696. doi: 10.1006/bbrc.1997.6527

Wada, M., Suzuki, T., Yaguti, Y., & Hasegawa, T. (2002). The effects of pressure treatments with kiwi fruit protease on adult cattle semitendinosus muscle. *Food Chemistry, 78(2), 167–171*. doi:10.1016/s0308-8146(01)00395-8

Wardlaw, F. B., McCaskill, L. H and Acton J. C. (1973). Effects of postmortem muscle changes on poultry meat loaf properties. *J. Food Sci*. 38:421-423.

DETERMINATION OF MINERALS COMPOSITION OF RAW MEAT AND *BALANGU* OFFERED FOR SALE AT RETAIL OUTLETS IN HADEJIA LOCAL GOVERNMENT AREA OF JIGAWA STATE, NIGERIA

Umar, A. M.
Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State.
Corresponding author: auw.umar@gmail.com +2348164727548 and +2348027374654

ABSTRACT
The study was carried out to assess the minerals composition of raw meat and *Balangu* offered for sale at retail outlets in Hadejia Local Government Area of Jigawa State. Triplicate raw meat and *Balangu* samples sold in three different locations namely: Atafi (T1), Yayari (T2) and Yan-Koli (T3) were purchased using simple random sampling method. The samples were collected fortnightly from 3rd to 17th April, 2018 given a total of fifty four samples. The samples were immediately packaged in Ziploc bags and transported to Soil Science Laboratory, Bayero University, Kano for minerals analysis. Data obtained on Calcium (Ca), Magnesium (Mg), Copper (Cu) Iron (Fe) and Zinc (Zn) using Atomic Absorption Spectrophotometer (Buck Scientific Model 210 VGP), and Sodium (Na) and Potassium (K) using Flame Photometer were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability. Results showed that *Balangu* obtained from T2 has highest values for Mg (2.50 mg/kg), Cu (20.47 mg/kg), Fe (4.88 mg/kg) and K (1.16 mg/kg) while lowest values for Ca (2.71 mg/kg), Mg (0.83 mg/kg), Na (1.58 mg/kg) and K (0.78 mg/kg) were reported from T3. It was concluded that higher values of Mg and Fe were reported at T2 for both raw and processed meat.

Key words: Raw Meat, Minerals, *Balangu*, Outlet and Hadejia

INTRODUCTION
Meat is an animal flesh that is eaten as food. Humans have hunted and killed animals for meat since prehistoric time (FAO, 2006). The advance of civilization allowed the domestication of animals such as cattle, goats, sheep and chickens and eventually their use in meat production at industrial scale (Abubakar *et al.*, 2016). Meat is mainly composed of protein, fat, minerals and water. It is normally eaten after cooked and mixed with spices for better taste. Unprocessed meat is easy to spoilage within hours or days as a result of infection with or decomposition by some microbes such as bacteria and fungi (Singh *et al.*, 2014). Meat can be broadly classified as red meat such as beef, mutton and chevon while that from chicken, turkey, duck and goose are considered as white meat (Williams *et al.*, 2006).
In the content of nutrition, a mineral is chemical element required as an essential nutrient by organisms to perform functions necessary for life (Wilcox, 2005). Mineral is one of the six groups of essential nutrients, the others are carbohydrates, fat, protein, vitamin, and water (Yasmine, 2009). Minerals are classified into two groups which are major or macro minerals (Wan Zabri and Wahid, 1985) such as Calcium (Ca), Phosphorous (P), Potassium (K), Sodium (Na), Magnesium (Mg) and Sulphur (S), while the second group is micro or trace minerals such as Iron (Fe), Manganese (Mn), Copper (Cu), Iodine (I), Zinc (Zn), Cobalt (Co), Fluorine (F) and Selenium (Se). The body needs large amount of macro minerals and small amount of micro minerals (Yasmine, 2009).
Meat is produced by killing an animal and cutting flesh out of it, these procedures are called slaughtering and butchering, respectively. Meat is cooked and processed into difference ways such as *Balangu*, *Kilishi*, *Tsire*, and *Dambun-Nama*. The aim of the research is to determine the minerals contents of *Balangu* offered for sale at Hadejia Metropolis.

MATERIALS AND METHODS
The research was conducted at Hadejia Local Government Area of Jigawa State. Hadejia is one of the oldest Local Government Areas created since 1975, from the then Kano State (now Jigawa State) of the northern Nigeria. Hadejia Emirate comprises of Hadejia, Mallam-Madori, Kafin-Hausa, Birniwa, Guri, Kaugama, KiriKasamma and Auyo Local Government Areas. It is 6,880 square kilometer and

located in the Northern Sudan Savannah Zone of Nigeria. It lies approximately between longitude 10.00 ^{0} E and latitude 12.25^0 N. The population of the study area was 47,400 (NPC, 2006). The major tribes of the town are Hausa, Fulani and Kanuri. The town is served by Federal Truck linking it to Nguru in the East, Kano in the North, Katagum in the South and Dutse (capital of the state) in the South-West. It is bounded on the immediate south by Hadejia River. The railway line from Kano to Nguru passes through the Kaugama, Mallam-Madori and Birniwa at the Northern sector of the town.

The area is covered by palatable grasses, shrubs and legumes which gave a quality land for good grazing. It has an annual rainfall ranging from 100-110mm which is accompanied by heavy wind. The temperature ranged from 31 to 40^0 C. There are two seasons in a year, it has about 6-8 months of dry season and the rainy season lasts for about 4 months.

Balangu is prepared basically from boneless meat of animal which may be cattle, sheep, goat or camel. The flesh meat from hind limbs (*Longissimus dorsi*) is commonly used (Abubakar *et al.*, 2014). The flesh meat is washed with clean water and sliced into thin sheets of not less than 1 cm in thickness, then placed over fire on a wire mesh and continuously turned over until it was well roasted. Groundnut oil, salt and spices were sprinkled during roasting to bring out the taste.

Triplicate raw meat and *Balangu* samples sold in three different locations namely Atafi (T1), Yayari (T2) and Yan-Koli (T3) in Hadejia metropolis were purchased using simple random sampling method. Three samples from each outlet were collected fortnightly from 3rd to 17th April, 2018. A total of fifty four meat samples as shown in Table 1 were collected. The samples were immediately packaged in Ziploc bags and transported to Soil Science Laboratory, Bayero University, Kano for minerals analysis.

One (1g) gram from both raw and processed meat products (*Balangu*) were collected from the three different treatments for minerals determination. The minerals determined were Ca, Mg, Cu, Fe and Zn using Atomic Absorption Spectrophotometer (Buck Scientific Model 210 VGP), and Na and K using Flame Photometer. The experiment was laid in a Completely Randomized Design (CRD). Each location serves as a treatment. Data obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability.

Table 1: Total Number of Samples Collected for Minerals Assessment

S/No.	Type of meat	Number of Samples
1	Raw	27
2	*Balangu*	27
	Total	54

RESULTS

The result of the minerals composition of raw meat (mg/kg) offered for sale at Hadejia Metropolis is presented in Table 2. There was significant difference (P<0.05) in Ca, Mg,Cu, Fe, Zn, Na and K between the three treatments. Highest values for Ca (3.54 mg/kg), Na (8.53 mg/kg) and K (3.57 mg/kg) were observed in T3 while lowest values for Ca (2.29 mg/kg) and Zn (8.16 mg/kg) were determined from T2.

Table 3 presents the minerals composition of *Balangu* (mg/kg) offered for sale at Hadejia Metropolis. There was significant difference (P<0.05) in Ca, Mg, Cu, Fe, Zn, Na and K between the three treatments. Highest values for Mg (2.50 mg/kg), Cu (20.47 mg/kg), Fe (4.88 mg/kg) and K (1.16 mg/kg) were realized in T2 while lowest values for Ca (2.71 mg/kg), Mg (0.83 mg/kg), Na (1.58 mg/kg) and K (0.78 mg/kg) were reported in T3.

Table 2: Minerals Composition of Raw Meat (mg /kg) Offered for Sale at Hadejia Metropolis

Mineral	Treatment			
	T1	T2	T3	SE(±)
Ca	2.71[b]	2.29[c]	3.54[a]	0.005
Mg	1.25[b]	1.27[a]	1.25[b]	0.003
Cu	1.57[a]	1.42[b]	1.27[c]	0.011
Fe	0.64[b]	0.93[a]	0.54[c]	0.012
Zn	13.46[a]	8.16[c]	10.20[b]	0.005
Na	3.66[c]	6.10[b]	8.53[a]	0.004
K	7.14[a]	1.79[b]	3.57[a]	0.004

[a, b and c] means on the same row having different superscripts are significantly different at P<0.05

Table 3: Minerals Composition of *Balangu* (mg/kg) offered for sale at Hadejia metropolis

Mineral	Treatment			
	T1	T2	T3	SE(±)
Ca	3.96[a]	3.33[b]	2.71[c]	0.000
Mg	1.67[b]	2.50[a]	0.83[c]	0.001
Cu	13.63[c]	20.47[a]	17.53[b]	0.000
Fe	1.79[b]	4.88[a]	4.88[a]	0.001
Zn	1.79[c]	3.57[b]	5.36[a]	0.001
Na	1.87[a]	1.72[b]	1.58[c]	0.001
K	1.09[b]	1.16[a]	0.78[c]	0.001

[a, b and c] means on the same row having different superscripts are significantly different at P<0.05

DISCUSSIONS

Zapata *et al.* (1988) reported Ca values of 4.71 and 5.69 mg/100g in broiler chicken light meat and dark meat, respectively. These means values are slightly higher than those found in this study. Lower level of Ca in chicken meat compared to this was found by Hamm and Searcy (1981). Similar to the studies of Grzeskowiak *et al.* (2011) and Polawska *et al*. (2011) P and K content are lower.

Calcium is responsible for strong bones and teeth. It also helps in the transmission of nerves impulses, contractions of muscle, blood clothing, activation of enzyme reactions and secretion of hormone. The Recommended Daily Allowance (RDA) value for Calcium is 50 mg, this indicates that *Balangu* is rich in calcium and should be consumed by both young and old people.

The iron content as reported by Asibey (1974) in the meat of Wild Grass-cutter (4.36 mg/kg), Domesticated Grass-cutter (3.75 mg/kg), Mutton (3.10 mg/kg) and pork (3.10 mg/kg) were similar to the values obtained in this work.

CONCLUSION

Higher values of Mg and Fe were reported at T2 for both raw and processed meat.

REFERENCES

Asibey, E.O.A. (1974). Present Status, Wildlife Conservation in West Africa. A Haploid Published by International Union for Conservation and Natural Resources Morgue, Switzerland.

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2014). Assessment of Four Meat Products (*Kilishi*, *Tsire*, *Dambu* and *Balangu*) in Bauchi Metropolis. *ACT-Biotechnology Research Communications,* 1:140-148.

Abubakar, M., Adamu, A.K., Abdullahi, S.A., … and Shika, S.T. (2016). Proximate Composition of Raw and Steamed Chicken Intestine. In: Proceedings of the 40th Conference and Annual General Meeting of the Nigerian Institute of Food Science and Technology held at Coronation Hall, Government House, Kano, Nigeria.

FAO (2006). Food and Agriculture Organisation.Corporate Ducoment Repository, Meat and Meat Products in Human Nutrition in Developing Countries. Rome.

Grzeskowiak , E., Magda, F. and Lisiak, D. (2011). Ocena zawartosci Fosforu oraz jakosci miesa I przetworow miesnych dostepnych na rynku krajowym (Assessment of Phosphorus Content and Quality of Meat and Processed meat Products available in Polish Maket) In Polish, Summary in English. ***Zywnosc. Nauka. Technologia. Jakosc.***2(75):160-170.

Hamm, D. and Searcy, G.K. (1981). Minerals content of Commercial Samples of Mechanically Deboned Poultry meat. *Poultry Science*. 60:686-688.

NPC (2006). National Population Commission Census. Nigerian Population Census. Abuja, Nigeria.

Polawska, E., Marchewka, J. Cooper, R.G., Sartowska, K. Pomianowski, J., Joswik, A., Strzalkowska, N. and Horbanczuk, J.O. (2011). The Ostrich Meat, an updated Review ii. Nutritive Value. **Animal Science Papers and Reports**. 29(2):89-97.

Singh, V. K ., Udit, J., Yadav, J.K. and Basanti, B. (2014). Assessment of Bacterial Quality of Raw Meat Samples (Carabeef, Chevon, Pork and Poultry) from Retail Meat Outlets and Local Slaughter Houses of Agra Region, India. *Journal of Foodborne and Zoonotic Diseases,* 2(1):15-18.

Wilcox, B.F. (2005). Fundamental of Food Chemistry**.** 5th edition, New York, USA.

Williams, P., Droulez, K. and Levy, G. (2006). Nutrients Composition of Australian Red Meat. Gross Composition Data. *Food Ausralia*, 58: 173-181.

Yasmine, P.D. (2009). Nutrients Composition of Chicken Meat. National Centre of Excellence in Functional Foods, University of Wollongong. Pub. No:8/210. Pp 2-35.

Zapata, J.F.F., Moreira, R.S., Fuentes, M., Sampaio, E.M. and Morgano, M. (1988). Meat Mineral Content in Broilers fed Diet without Mineral and Vitamin Supplements. **Pesquisa Agropecuaria Brasileira.** 33(11):1815-1820.

QUALITY ATTRIBUTES OF BREAKFAST SAUSAGE AS AFFECTED BY DIFFERENT TYPES OF ANIMAL FATS

V. A Adetunji and S. B. Akinleye

Meat Science Laboratory, Department of Animal Science, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria

Corresponding Author : bamideleakinleye@yahoo.com

ABSTRACT

Fat is one of the main components of meat sausages, along with muscle tissue and water, therefore, it has a substantial effect on emulsion stability in meat products. It is traditionally produced from pork and lard, but there is insufficient knowledge on the yield and nutritive qualities of breakfast sausage prepared with other animal fats. Investigations were carried out in a completely randomized design to study the effect of different fats on various physical, chemical and sensory properties of breakfast sausage. Three treatments were evaluated to test the effect of different animal fats on sausage production: sausage produced with lard (LS), sausage produced with tallow (TS) and sausage produced with sheep fat (SFS). The results obtained showed the yield from the three fat types when used for production of breakfast sausage were 83.85%, 78.52%, and 76.45% for lard, tallow and sheepfat, respectively. The mean pH value of breakfast sausage were ($P<0.05$) 6.46, 6.25 and 6.51 for LS, TS and SFS, respectively. Water Holding Capacity of LS (84.78%) and TS (84.82%) were similar and significantly ($P<0.05$) higher than SFS (82.69%), Crude protein (31.77 %) and ashes (4.83%) of sausages with lard were higher (LS)while the SFS had (25.47%) and (3.39%) for crude protein and ashes, respectively. The aim of this study was to evaluate the influence of different types of animal fats on the physical, chemical composition and sensory evaluation of breakfast sausages.

Key Words: Physical, Chemical, Sensory evaluation, Breakfast sausages, Animal fats.

INTRODUCTION

Sausage is a food that contains an amount of protein with a widespread consumption. Other than protein, it has a high content of fats. Sausage industries need to select a number of various ingredients in the appropriate amount to manufacture and obtain the desired quality and safe product [Savadkoohi, *et al*., 2014]. Fat is one of the main components of meat sausages, along with muscle tissue and water, therefore, it has a substantial effect on emulsion stability in meat products. Hence, it is important to obtain reliable, practical, technological and scientific information about the type of fat used. Fat in the diets serves not only as nutrient in the human body, but also as source of essential fatty acids and essential components of cell membrane [Pearson, 1987]. Sausages contain fat which is important in the processing, textural, and sensory characteristics of sausage products. It interacts with other components present within a meat system and helps to develop what can be a more consumer acceptable product. There is limited research available, regarding the effects of fat on processing, textural, and sensory characteristics in sausage products. Thus, the objectives of this study were to evaluate the physico-chemical, textural and sensory properties of cooked sausages as affected by tallow, lard and sheep fat.

MATERIALS AND METHODS

Preparation/processing of breakfast sausages

Semitendonisus muscle (6kg) tallow, lard and sheep fat used for this project were purchased from carcass of animals' slaughtered one hour postmortem at Bodija market in Ibadan. The formulation of breakfast sausages and composition of non-meat ingredients are presented in Table 1. The meat was chopped and minced using a 5mm sieve in a tabletop mincer (Breville, Model UTP141, United Kingdom).The minced meat was apportioned into three groups of 2 kg. Group one contained 20% lard as emulsifier (LS) while groups 2 (TS) and 3 (SFS) contained tallow and sheep fat each at 20% inclusion level. Each treatment was replicated four times in a completely randomized design. Slurry of salt (NaCl), sodium nitrite, phosphate and sugar was prepared in the proportion shown in Table 1. All other ingredients were added in equal amounts (g/100g) as shown in Table 1. The minced meat and the other ingredients were mixed thoroughly in a mixer (Oster 8-Speed Blender Model, MG—MB

E103TI -Mexico) for 5 minutes. The thoroughly mixed meat samples were stuffed into natural casing (conditioned pig intestine) of about 2 cm diameter. The stuffed casings were twisted at 10cm intervals to obtain shorter linked units.

Table 1: Sausage formulation of different animal fats types

Ingredients	LS	TS	SFS
Beef	65.00	65.00	65.00
Fat	20.00	20.00	20.00
Soybean flour	4.00	4.00	4.00
Common salt	2.00	2.00	2.00
Sugar	1.00	1.00	1.00
SodiumNitrate	0.01	0.01	0.01
Phosphate	0.30	0.30	0.30
Icewater	3.00	3.00	3.00
Dry spices	2.00	2.00	2.00
Onion	1.31	1.31	1.31
Garlic	0.69	0.69	0.69
Ginger	0.69	0.69	0.69
Total	100	100	100

Determination of physical properties of the product

Cooking loss:

Samples were taken from the prepared sausage for analysis. Sausages from the different treatments were weighed using an electronic scale (Cuisinart KML-K03BV36246-China) before cooking into an internal temperature of 75°C and after cooking.

PRODUCT YIELD (PY)

The cooked and uncooked sausages were weighed, and the product yield was calculated as follows: the weight of the cooked sausage sample divided by the weight of the uncooked sausage sample multiplied by 100 [Yang *et al*., 2007].

WATER HOLDING CAPACITY:

This was determined following a slightly modified method [Suzuki et al., 1991]. The amount of water released from the samples was measure indirectly by measuring the area of the filter paper wetted relative to the area of pressed sample. The water holding capacity (WHC) of the meat was then calculated as follows [Suzuki *et al*., 199]

CHEMICAL ANALYSIS:

Moisture content, crude protein, ether extract and ash of sausage using different animal fats were determined using the analytical methods [AOAC, 2000].

SENSORY EVALUATION

Sensory evaluation was conducted on freshly prepared sausage (day 0). A total of twenty panelists (60% male and 40% female) with age ranging between 22 and 40 years were trained according to the British Standard Institution [BSI, 1993] guidelines to evaluate the product.

STATISTICAL ANALYSIS

All data obtained were subjected to analysis of variance and the means were compared using the Duncan‘s Multiple Range Test (DMRT). The SAS computer soft ware package [SAS, 1991] was used for all statistical analysis.

RESULTS AND DISCUSSION

Cooking Characteristics

Cooking characteristics of breakfast sausage as affected by different animal fats such as product yield, cooking loss, cold shortening and WHC was investigated, and the obtained results are presented in Table 2. The use of different animal fats showed a significant effect ($P<0.05$) on the PY of the

sausages. LS had the highest PY (83.85%) value, while TS and SFS had 78.52% and 76.45%,respectively for PY (Table 2The highest product yield percentage recorded in LS might be due to the fact that LS had the highest water holding capacity and water holding capacity and yield are directly proportional. The cooking loss (10.00%) of beef sausage prepared from lard in this study was lower than the cooking loss of (19.88%) obtained for comparison of textural properties of low-fat chevon, beef, pork and mixed-meat sausages [Gadiyaram and G. Kannan]. Similar results were reported for fermented sausages in which 10 and 20% of the total pork backfat was replaced by olive oil [Bloukas *et al*.,1997]. The inclusion of different types of fat in the processing may change the fatty acids of the meat products [Lima *et al*., 2004]. Cooking loss is an important variable to predict the juiciness and tenderness of the meat and its derivatives, because the dryness of meat affects the sensory characteristics [Guerrero *et al*., 2013]. WHC was influenced (P<0.05) by different animal fats; LS (84.78%) and TS (84.82%) had the highest WHC, and SFS (82.69%) had the lowest; these results showed that different types of fats improve the water holding capacity. WHC of some fibers is related to the type and amount of their polysaccharides; large particles are associated with open structures that improve the properties of hydration and fat absorption capacity.

Table 2: pH, Product yield and physical characteristics of sausage produced using three different fats

Parameter (%)	LS	TS	SFS	SEM
Product Yield	83.85[a]	78.52[b]	76.45[c]	2.23
Cooking Loss	10.10[b]	10.26[b]	12.20[a]	3.36
Cold Shortening	17.74[c]	18.73[b]	19.63[a]	0.69
Water Holdig Capacity	84.78[a]	84.82[a]	82.69[b]	3.36
pH	6..46[b]	6.25[c]	6.51[a]	0.07

[abc]:Means with the same superscript on the same row are not significantly(P> 0.05) different

PROXIMATE COMPOSITION

Table 3 showed the chemical composition values obtained from the three treatments. Results showed that there was a significant difference for moisture content, crude protein, ether extract and ash. The moisture of TS (76.10%) was higher than that of LS (71.47%), and TS (76.33%) had the highest value. Lipids are highly efficient sources of energy and they contain more than twice the energy of carbohydrate and protein [Okazumi *et al*., 2000]. In the present study lipid content varies from 5.20% to 7.27% and shows a significance difference between the three treatments (P<0.05). Highest lipid content was found in LS (7.27%) and the lowest was found in TL (5.20%). High lipid LS have less water and more protein than TL and SFS. There is also concern that low levels of fat will lead to products that is perceived as dry and less tasty. The minimum requirement for an acceptable level of consumer satisfaction for meat products is 3–4% ether–extract on a fresh uncooked basis [Savell and Cross, 1986]. The mean level of protein determined from the sausage was high. However our determinations showed that SFS had a remarkably lowest protein content than LS (31.77%) and TS (28.35%), respectively. The highest crude protein contents of the LS products can be explained by the differences in fat content from the carcasses of different species of farm animals, therefore, its addition to meat products has the advantage of increasing the crude protein contents of the final product. [FAO, 1991] indicated that the most valuable component of meat, from the nutritional and processing points of view is protein, also indicates their biological value, thus meat with higher protein levels are graded higher in terms of quality, than those with lower crude protein levels [Lawrie and Ledward, 2006].

Table 3: Proximate composition of sausage prepared using three different animal fats

Parameters	LS	TS	SFS	SEM
Moisture Content	71.47[c]	76.10[b]	76.33[a]	1.78
Crude Protein	31.77[a]	28.35[b]	25.47[c]	1.59
Ether Extract	7.27[a]	5.60[c]	6.83[b]	0.58
Ash	4.83[a]	4.40[b]	3.39[c]	0.33

[abc]:Means with the same superscript on the same row are not significantly($P > 0.05$) different

SENSORY EVALUATION

Mean scores that the panelists gave for the three treatmens of products are shown in Table 4. Colour, flavour, juiciness, tenderness and overall acceptability were significantly different with respect to different sources of fats, whereas no significant differences in aroma were found among the three treatments. In meat products, fat contributes to the flavour, texture, juiciness, and overall acceptability of lubricity of the product [Mugueza *et al*., 2002]. Juiciness also has an important role in overall quality of meat products [Chambers and Bowers, 1993]. LS sausages obtained the highest score for colour (5.43), flavour (5.83), juiciness (5.63), tenderness (6.13) and overall acceptability (6.38). These results indicate that the higher acceptability of LS sausages may be related only to appearance traits and fat content because differences in fat content improved texture attributes.

Table 4: Sensory evaluation of sausage prepared using three different fats

Parameter (%)	LS	TS	SFS	SEM
Aroma	5.50	5.57	5.71	0.28
Colour	5.43[a]	4.50[c]	4.77[b]	0.22
Flavour	5.83[a]	4.90[b]	4.47[c]	0.29
Juiciness	5.63[a]	5.37[b]	4.83[c]	0.20
Tenderness	6.13[a]	5.10[ab]	4.87[b]	0.25
Overall Aceeptability	6.83[a]	5.03[b]	5.73[ab]	0.31

[abc]:Means with the same superscript on the same row are not significantly($P>0.05$) different

CONCLUSION

This study was conducted to evaluate the effect of various types of animal fats on the physico-chemical and sensory characteristics of the final products. The moisture and fat contents of breakfast sausages varied from 71.47%-76.33% and 5.60-7.26%, respectively, whereas, the protein content ranged from 25.47 to 31.77%. Sensory evaluation results indicated that the most appropriate fat content (%) to have better sensory properties was LS. Further research should be performed to analyze the proportion of lard fat require for the production of breakfast sausages.

REFERENCES

Savadkoohi, S., Hoogenkamp, H., Shamsi K and A. Farahnaky A. (2014) Color, sensory and textural attributes of beef frankfurter, beef ham and meat-free sausage containing tomato pomace. *Journal of Meat Science*, Vol. 97, Issue 4, pp 410-418.

Pearson, A. M. Asghar, A GrayJ. I. and Booren, A. M. (1987). Impact of fat reduction on palatability and consumer accepatance of processed meat. Proceedings of the 1987 International Conference Paper on Recipe of Meat Confeference, Vol. 40, pp105-114, 1987.

B. Nowak, B., Von Mueffling, T. Grotheer, J., Klein, G and Watkinson, B. M. Energy content, sensory properties, and microbiological shelf life of German Bologna-type sausages produced with citrate or phosphate and with inulin as fat replacer'', Journal of Food Science, Vol. 72, Issue 9, pp 629-638, 2007.

Yang, H. S. Choi, S. G., Jeon, J. T. Park G. B and Joo, S. T. (2007). Textural and sensory properties of low fat pork sausages with added hydrated oatmeal and tofu as texture-modifying agents'', Journal of Meat Science, Vol. 75 Issue2, pp 283-289.

Savell, J. W. and Cross, H.R. (1986). The role of fat in the palatability of beef, pork and lamb. Meat Research Update 1, Department of Animal Science, Texas A&M University System, Texas, USA, Vol. (4), pp. 1– 10. 1986.

Lawrie R. A. and Ledward, D. A. (2006). Lawrie's meat science'' (7th ed), Woodhead Publishing Ltd., Cambridge, England and CRC Press Boca RATON, UK, pp75-155.

Choi, Y. S., Kim, H. W. Hwang, K. E. Song, D. H. Choi, J. H. J., Lee, . H. Chung J. H. and Kim C. J. (2014) Physicochemical properties and sensory characteristics of reduced-fat frankfurters with pork back fat replaced by dietary fiber extracted from makgeolli lees. *Journal of Meat Science* Vol. 96, Issue 2, pp 892-900 2014 .

Muguerza, E. G. Fista, I. Ansorena, D., Astiasarán, J., and Bloukas J. G. (2002) Effect of fat level and partial replacement of pork backfat with olive oil on processing and quality characteristics of fermented sausages. Journal of Meat Science, Vol. 61 pp 397–404.

EFFECT OF AGING DURATION ON THE QUALITY PARAMETERS OF GRILLED LOCAL CHICKENS

Zakka G. C., Gandi B.R., Musa J. and Kachong Y.K.
Department of Animal Science, Kaduna State University.
Corresponding Authors mail: zakkaxtian@gmail.com.

ABSTRACT
This study evaluated the effect of aging duration on the sensory attributes of grilled local chickens. Sixteen roasters (24 weeks old) of the Fulani ecotype were conventionally slaughtered, dressed and randomly allotted into four treatments with four replicates per treatment in a completely randomized design. Carcass from birds were aged at 4°C for 0, 24, 48 and 72 hours corresponding to the various treatments (T1, T2, T3 and T4 respectively). Meat samples from each treatment were grilled and evaluated for their sensory and physical parameters. Results obtained for sensory evaluation on a 9 point hedonic scale was statistically significant (P<0.05), with T4 having the highest values in terms of tenderness (8.90), juiciness (8.45), aroma (8.55) and overall acceptability (8.75), while T1 had the least mean values. A decline in pH was recorded for T2, T3 and T4 (5.86%, 5.60% and 5.36% respectively). Treatment four had the highest thermal shortening (22.5%) statistically significant (P<0.05), while T1 was the lowest (6.75%). Percent cooking was highest in T1 (31.3%) and T4 recorded the lowest value (12.5%) which was statistically significant (P<0.05). Treatment one was significantly the highest (88.3%) in water holding capacity while T4 was the lowest (52%). From these observations, it was concluded that local chickens aged for 72 hours before grilling possess the best physical and sensory qualities.

Key words: Aging, Grilled, Local, Chickens, Sensory.

INTRODUCTION
In Nigeria, local Chickens are grown for their meat as well as their eggs. These chickens are grown in their natural environments without much interference from farmers. The population of the Nigerian local chickens is estimated to be about 149.4 million (FLD, 2015) with the vast majority being raised by farmers living in rural areas. The population outstrips that of the exotic which accounts for only 11.8%. The local chickens account for about 69% and 12% of poultry meat and total egg production respectively (FLD, 2015).

Grilled chicken is one of the world's most popular grilled dishes, it consists of chicken parts or entire chickens that are barbecued or smoked (Campbell *et al*., 2016). Grilled chicken is often seasoned or coated in a spice rub, barbecue rub, or both then coated with tomato based barbecue sauce and grilled.

Aging is a process of preparing meat for consumption, mainly by breaking down the connective tissue, it involves storing meat without protective packaging at refrigeration temperatures for few hours to five weeks to allow the natural enzymatic and biochemical processes that result in improved tenderness and the development of the unique flavor. The key effect of aging is the concentration and saturation of the natural flavor, as well as the tenderization of the meat texture (Stenstrom *et al*., 2014).

In Nigeria, many people love the flavor of grilled local Chickens compared to the exotic broiler birds, but meat from these birds are often associated with problem of toughness, local poultry meat can therefore benefit from conditioning or aging which is known to improve meat quality especially the textural characteristics.

This study was necessitated by the limited availability of information and research on the aspect of value addition to meat products obtained from our own indigenous breeds of chicken. Addressing factors that affect meat quality from these chickens will enhance formulation of grading standards and increase acceptability of meat produced from local chickens in various niche market segments such as tourist hotels and supermarkets.

The objectives of this study was to determine the effects of varying aging durations on the sensory qualities of grilled local chickens, determine the physical properties of grilled chickens aged at different durations and to determine the effect of aging on nutrient profile of chickens.

MATERIALS AND METHOD

The study was conducted in Department of animal science Kaduna State University (KASU) located at Kafanchan Jama'a Local Government Kaduna state, latitude 9.58° N, longitude 8.29° E and situated at an elevation of 733m above sea level (world atlas, 2018). Sixteen rosters (24 weeks old) from the Fulani ecotype breeds were conventionally slaughtered and randomly allotted into four treatments (T1, T2, T3 and T4). Treatment one was grilled immediately after slaughter, while T2, T3 and T4 were held at 4°C for 24, 48 and 72hours respectively before grilling, after which meat samples from each treatment were collected for sensory evaluation using 20 semi-trained sensory panelists, a 9 point hedonic scale was used with a score of 9 indicating "like extremely", 5 "neither like nor dislike" and 1 "dislike extremely". Physical parameters such as percent cooking loss, water holding capacity and thermal shortening were evaluated alongside proximate compositions of the meat samples.

Proximate analyses was carried out at the Food Science Departmental Laboratory of Kaduna State Polytechnique using AOAC (2011) methods which include protein determination using Kjeldahl, fat extraction via Soxhlet, crude fiber determination using digestion with sulphuric acid, moisture determination by drying the sample for 16-18 hours at 100-102°C in an oven and mineral, by ashing the sample at 550°C for 9 hours in a furnace oven. Percentage cooking loss was determined using the formula; $\%\ cooking\ loss = \frac{initial\ sample\ weight - grilled\ sample\ weight}{initial\ sample\ weight} \times 100$

(Petracci and Baéza, 2009).

Thermal shortening determined according to the procedure described by Mahendraker *et al.*, (1998) which is; $(initial\ length - final\ length) \times 100$. Water holding capacity (WHC) was calculated using the formulae developed by Suzuki *et al.*, (1997) which is; $WHC = \frac{100-(Ar-Am)\times 9.47}{Wm \times Mc} \times 100$. Where Ar = Area of water released from meat (cm^2), Am = Area of meat sample (cm^2), Wm = Weight of meat in mg, Mc = Moisture content of meat % and 9.47 is a constant factor. Data obtained from sensory evaluation and that of physical parameters of chickens were analyzed by one way ANOVA using IBM SPSS statistics software (21) and Tukey HSD was used for mean comparisons, test of significance and standard error.

RESULTS AND DISCUSSION

Proximate composition of grilled local chickens aged at different durations is shown in table 1. There was an increase in moisture content for T2, T3 and T4 (67.5, 67.6 and 67.8%, respectively). Studies conducted by Dashmaa *et al.*, (2016) explained that during aging process, the juices are absorbed back into the meat, this may account for the increase in moisture content. There was a decrease in dry matter content for T2, T3 and T4 (32.5, 32.4 and 32.2% respectively). Studies conducted by Dashmaa *et al*, (2016) revealed that during aging of meat, there is natural breakdown of protein, connective tissues and fat components of the meat by enzymes contained in the meat. A decline in pH was observed for T2, T3 and T4 (5.86, 5.60 and 5.36% respectively). The decline in pH was due to anaerobic metabolism of glucose leading to the production of lactic acid which in turn lowers the meat pH (Mbaga *et al*., 2016).

Table 1: Proximate Composition of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**
Moisture (%)	67.2	67.5	67.6	67.8
Dry matter (%)	32.8	32.5	32.4	32.2
Protein (%)	22.1	22.0	21.8	21.5
Fat (%)	2.14	2.12	2.10	2.00
Ash (%)	0.85	0.83	0.825	0.82
Crude fiber (%)	3.01	2.9	2.84	2.60
Carbohydrate (%)	4.71	4.65	4.835	5.28
pH (%)	5.90	5.86	5.60	5.36

KEY: **T1**: chickens aged for 0hours. **T2**: chickens aged for 24hours.
T3: chickens aged for 48hours **T4**: chickens aged for 72hours.

Physical Composition of Grilled Local Chickens Aged at Different Durations

Mean values for physical properties of grilled local chickens aged at different durations is presented in table 3. The highest value for percent cooking loss was recorded in T1 (31.3%) and the lowest was T4 (12.5%) which was statistically ($P<0.05$) significant. Mushi *et al*. (2009) explained that cooking loss in meat depends on ultimate pH. From table 1, there was a decline in pH for T2, T3 and T4 (5.86%, 5.60% and 5.36% respectively) this may account for the decrease in cooking loss. The highest value for water holding capacity (WHC) was recorded at T1 (88.3%) and the lowest was T4 (52.0%) which was statistically ($P<0.05$) significant. Bendall (1979) explained that pH influences the color and WHC of meat, and in table 2, a decline in pH was observed, this could be the reason for the decrease in WHC.

Table 3: Mean Values for Physical Properties of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Cooking loss (%)	31.3^{a}	22.5^{b}	17.5^{bc}	12.5^{c}	2.3783
Water holding capacity (%)	88.3^{a}	74.3^{b}	64.8^{c}	52.0^{d}	1.6646
Thermal shortening (%)	6.75^{c}	13.8^{b}	19.0^{ab}	22.5^{a}	1.8085

Means on the same column with different superscripts are significantly ($P<0.05$) different.

SENSORY QUALITIES OF GRILLED LOCAL CHICKENS AGED AT DIFFERENT DURATIONS

Table 4 shows the mean values for the sensory qualities of grilled local chickens aged at different durations. Mean scores for aroma obtained at T2, T3 and T4 (8.10, 8.40 and 8.55 respectively) were statistically the same ($P>0.05$) while T1 had the lowest score (7.45) which was statistically significant ($P<0.05$). When aged meat is being cooked, flavor precursors react with each other to form new molecules or volatile compounds that enrich the aroma further (Kemp *et al*., 2009). Mean values for taste obtained from T1, T2, T3 and T4 (7.95, 8.05, 8.15 and 8.25 respectively were statistically ($P>0.05$) the same. Mean scores for color obtained from T1, T2, T3 and T4 (8.40, 8.05, 7.95 and 7.65 respectively) were statically ($P<0.05$) different, with T1 having the highest score, while T4 had the lowest score, reason being that meat samples appeared darker with successive increase in aging

duration. Mean scores for tenderness obtained from T1, T2, T3 and T4 (7.20, 8.10, 8.45 and 8.90 respectively) were statistically (P<0.05) different with T4 recording the highest tenderness, while T1 was the lowest. Tenderness during aging is brought about by natural breakdown of fat, proteins and connective tissues by enzymes contained in the meat (John *et al*., 2007).The highest mean value for juiciness was recorded in T4 (8.4500) and the lowest was T1 (7.25) which was significantly (P<0.05) different. Mean scores for T2 and T3 (7.65 and 7.85 respectively) were statistically the same (P>0.05). Studies conducted by Dashmaa *et al*, (2016) showed that beef steaks were significantly juicier 21days after aging than 14days, and steaks aged for 14days were statistically juicier than those aged for 7days. Overall acceptability recorded for T1, T2, T3 and T4 (7.90, 8.20, 8.45 and 8.75 respectively) was statistically significant (P<0.05) with T4 having the highest mean value (8.75), and T1 having the lowest score of 7.90. This result is similar to that given by Smith *et al*. (2012), which showed that broiler chickens aged for 8-12hours significantly recorded the best overall acceptability.

Table 4: Mean Scores for Sensory Qualities of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**	**S.E.M**
Aroma	7.45^{b}	8.10^{a}	8.40^{a}	8.55^{a}	0.33
Taste	7.95^{a}	8.05^{a}	8.15^{a}	8.25^{a}	0.30
Color	8.40^{a}	8.05^{b}	7.95^{c}	7.65^{d}	0.28
Tenderness	7.20^{d}	8.10^{c}	8.45^{b}	8.90^{a}	0.34
Juiciness	7.25^{c}	7.65^{b}	7.85^{b}	8.45^{a}	0.33
Overall	7.90^{d}	8.20^{c}	8.45^{b}	8.75^{a}	0.25

Means in the same Colum with different superscript are significantly (P<0.05) different. *Rated on a nine-point hedonic scale, higher value indicates higher preference.

CONCLUSION AND RECOMMENDATION

Results obtained from this study shows that 72hours is the best duration to age local chickens before grilling because it recorded the highest value for tenderness, juiciness, aroma and overall acceptability as well as having no notable change in crude protein, minerals, and carbohydrate contents. Aging of local chickens for 72hours is again commendable because it recorded favorable changes in physical parameters such as thermal shortening, percent cooking loss and water holding capacity although further research could be carried out using longer durations of time and other different processing techniques e.g. boiling.

REFERENCES

AOAC. (2011). Official Methods of Analysis. Association of Official Analytical Chemists, (18th ed.). Washington, DC.

Bendall, J. R. (1979). Relations between meat pH and important biochemical parameters during the postmortem changes in mammalian meat. *J. Meat Sci.*, 3, 143–157.

Campbell, R. E., Hunt, M. C. and Chambers, L. P. (2001). EIV Dry-aging effects on palatability of beef *longissimus* muscle. *J. Food. Sci.*, 66, 196–205.

Dashmaa, D., Vinay, K. T., Soohyun, C., Younghoon, K., and Inho, H. (2016). Dry aging of beef; a review. *J. Ani. Sci. Tech.*, 58, 20-33.

Federal Livestock Department (FLD) (2015). Second National Poultry Survey. Federal Ministry of Agriculture Water Resources and Rural Development Lagos, pp. 10-65.

IBM SPSS Statistics software, V21-EQUiNOX full. Developer(s): IBM Corporation. (2017).

John, J. A., Sendra-Nadal, E., Sanchez-Zapata, E. J. and Viuda-Martos, M. (2007). Poultry flavour: General aspects and applications, in: GUERRERO-LEGARRETA, I. & HUI, Y.H. (Eds)

Handbook of Poultry Science and Technology: Secondary Processing, Vol. 2, pp. 339-357 (New Jersey, John Wiley & Sons).

Kemp, C. M., Sensky, P. L., Bardsley, R. G., Buttery, P. J. and Parr, T. (2010). Tenderness–An enzymatic view. *J. Meat. Sci.*, 84, 24–56.

Mbaga, S.H., Sanka, Y.D., Katule, A.M. and Mushi, D. (2016). Effects of Storage Time on the Quality of Local Chicken Meat. *Tanz. J. Agric. Sci.*, 13(1), *48-54.*

Mahendraker, N. S., Khabade, V. S. and Dani, N. B. (1988). Studies on the effects of fattening on carcass characteristics and quality of meat from Bannu-lamb. *J. Food. Sci. Tech.*, 25, 228-230.

Mushi, T., Rhue, M. R., Okitani, A. and Kato, H. (2009). Components contributing to the improvement of meat taste during storage. Agricultural and Biological Chemistry, 52, 2323-2330.

Petracci, P. O., and Baeza, A. E. (2013). Processing and Preparation of Meat and Formation of Carcinogens. AICR‟S Annual Research Conference on Food, Nutrition, Physical Activity and Cancer, 7(8), 29-38

Smith, R. D., Nicholson, K. L., Nicholson, J. D., Harris, K. B., Miller, R. K., Griffin, D. B. and Savell, J. W. (2008). Dry versus wet aging of beef: Retail cutting yields and consumer palatability evaluations of steaks from US choice and US select short loins. *J. Meat. Sci.*, 79, 6–9.

Stenström, H., Li, X., Hunt, M. C. and Lundström, K. (2014). Consumer preference and effect of correct or misleading information after aging beef *longissimus* muscle using vacuum, dry aging, or a dry aging bag. *J. Meat Sci.*, 96, 661–670.

World atlas (2018). Retrieved from https://academic.oup.com/worldmap/search91/6/1489/1548662 on 08 August 2018

MINERALS EVALUATION OF *TSIRE* OFFERED FOR SALE AT RETAIL OUTLETS IN HADEJIA LOCAL GOVERNMENT AREA OF JIGAWA STATE, NIGERIA

[β]Umar, A.M., [β]Muhammad, Y., [μ]Mohammed, A., [α]Bello, B., [©]Mati, I.U., [β]Salisu, N., [£]Madobi I. S., [β]Abdullahi, H.I., [β]Muhammad, A.S. and [£]Sulaiman, S.L.

[β]Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State. [α]Department of Animal Science, Bayero University, Kano. [μ]Department of Animal Health and Production, Federal Polytechnic Bauchi. [£]Department of Animal Health and Production, Audu Bako College of Agriculture, Dambatta, Kano. ©Department of Agricultural Education, School of Vocational Studies, Jigawa State College of Education, Gumel

Corresponding author: auw.umar@gmail.com +2348164727548 and +2348027374654

ABSTRACT

The study was carried out to assess the minerals composition of *Tsire* offered for sale at retail outlets in Hadejia Local Government Area of Jigawa State. Triplicate raw meat and *Tsire* samples sold in three different locations namely: Gagulmari (T1), Dubantu (T2) and Matsaro (T3) were purchased using simple random sampling method. Three samples from each outlet were collected fortnightly from 3rd to 17th April, 2018. Each location serves as a treatment; treatments were replicated three (3) times making a total of fifty four samples. The samples were immediately packaged in Ziploc bags and transported to Soil Science Laboratory, Bayero University, Kano for minerals analysis. The minerals determined were Calcium (Ca), Magnesium, Copper (Cu) and Iron (Fe) using Atomic Absorption Spectrophotometer (Buck Scientific Model 210 VGP), and Sodium (Na) and Potassium (K) using Flame Photometer. The experiment was laid in a Completely Randomized Design (CRD). Data obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability. Results showed that there were significant differences ($P< 0.05$) in Calcium and Potassium between the treatments in both raw meat and *Tsire*. It was concluded that higher values of calcium and copper were reported at TI for both raw and processed meat.

Key words: Minerals, *Tsire*, Outlet, Hadejia and Jigawa

INTRODUCTION

Meat is an animal's flesh that is eaten as food; human has hunted and killed animals for meat since prehistoric time. The advance of civilization allowed the domestication of animals such as chickens, sheep, goats, pigs and cattle and eventually their uses in meat production at an industrial scale (Muhammad *et al*., 2012). Meat is mainly composed of proteins, fats and water. It is normally eaten after it has been cooked and seasoned or processed in variety of ways (Lawrie *et al*., 2006).

Most often, meat refers to the skeletal muscles, associated fat and other tissues and offal. Meat is sometimes also used in a more restrictive sense as the flesh of mammalian species such as cattle, sheep, goats, camels, pigs and dogs raised and prepared for human consumption. Meat obtained from poultry, cattle, sheep and goat are called chicken, beef mutton and chevon, respectively (FAO, 2007).

Poultry is raised for the production of meat and eggs; cattle for meat, milk and hide; sheep and goats for meat, milk and skin; pigs for meat: and camel for meat, milk and hide (Purchas *et al*., 2005). Poultry are now found in almost all parts of the world, regardless of the climatic condition. There is an estimated one domestic chicken for every human being in the world (FAO, 2007).

Muscle tissues is very rich in protein containing all the essential amino acids; it is also a good source of Zinc, Selenium, Phosphorous, Iron, Niacin, Chloride, Riboflavin, Vitamin B6, B12 and Vitamin K (Jokanovic *et al.*, 2014). The fat contain of meat can vary widely depending on species and breed of animals, the way the animals were raised, including what it was fed, the anatomical part of the body and the methods of butchering and cooking (Prasanna *et al.*, 2014).

Meat contains quality protein, vitamins, fatty acids and minerals. Meat has an alluring aroma, social value, is prestigious and yield income (Amanda *et al.*, 2007). In many parts of the world, meat makes

up a considerable portion of a typical diet. It contributes protein, minerals, vitamin and fat and these nutrients are important for their beneficial effect on well being. Understanding the nutrients composition of meat can help to make positive choice when selecting food for daily diet (FAO/WHO, 1997).

Meat is cooked and processed into difference ways such as *Tsire, Balangu, Kilishi and Dambun-Nama*.

The aim of the research is to examine the minerals contents of *Tsire* offered for sale at Hadejia Metropolis.

MATERIALS AND METHODS

The research was conducted at Hadejia Local Government Area of Jigawa State. Hadejia is one of the oldest Local Government Areas created since 1975, from the then Kano State (now Jigawa State) of the northern Nigeria. Hadejia Emirate comprises of Hadejia, Mallam -Madori, Kafin-Hausa, Birniwa, Guri, Kaugama, KiriKasamma and Auyo Local Government areas. It is 6,880 square kilometer and located in the Northern Savannah Zone of Nigeria.

Hadejia town is the capital of Hadejia Emirate and is located at the central part of the emirate. It lies approximately between longitude 10.00 ^{0} E and latitude 12.25^0 N. The population of the area was 47,400 (NPC, 2006). The major tribes of the town are Hausa, Fulani and Kanuri. The town is served by Federal Truck linking it to Nguru in the East, Kano in the North, Katagum in the South and Dutse (capital of the state) in the South-West.

The area has an annual rainfall ranging from 100-110mm which is accompanied by heavy wind. The temperature ranged from 31 to 40^0 C. There are two seasons in a year, it has about 6-8 months of dry season and the rainy season lasts for about 4 months.

Tsire is a boneless lean meat which is cut into pieces and sliced with a sharp knife, staked on a wooden/iron stick and heavily dusted with a mixture of spices made up of groundnut cake paste, red pepper, seasoning, salt, ground ginger, garlic, ground nut oil and other aromatic spices. The staked meat is roasted around a glowing charcoal fire as described by Abubakar *et al.* (2014).

Triplicate raw meat and *Tsire* samples sold in three different locations namely Atafi (T1), Yayari (T2) and Yan-Koli (T3) in Hadejia metropolis were purchased using simple random sampling method. Three samples from each outlet were collected fortnightly from 3rd to 17th April, 2018. A total of fifty four meat samples (Table 1) were collected. The samples were immediately packaged in Ziploc bags and transported to Soil Science Laboratory, Bayero University, Kano for minerals analysis.

Table 1: Total Number of Samples Collected for Minerals Assessment

S/No.	Type of meat	Number of Samples
1	Raw	27
2	*Tsire*	27
	Total	54

One (1g) gram from both raw and processed meat products (*Tsire*) were collected from the three different treatments and inoculated in a vacuum plastic container which were immediately transported to the laboratory for analysis. The minerals determined were Calcium (Ca), Magnesium (Mg), Copper (Cu) and Iron (Fe) using Atomic Absorption Spectrophotometer (Buck Scientific Model 210 VGP), and Sodium (Na) and Potassium (K) using Flame Photometer.

The experiment was laid in a Completely Randomized Design (CRD). Data obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability.

RESULTS AND DISCUSSIONS

The minerals composition of raw meat (mg/kg) offered for sale at Hadejia Metropolis is presented at Table 2. There was significant difference ($P< 0.05$) in Ca, Mg and K between the treatments. Highest values (mg/kg) for Cu (6.10), Fe (5.36) and K (1.29) were reported at T3 while lowest values (mg/kg) for Ca (3.13) and K (1.24) were reported at T 2.

Table 2: Minerals Composition of Raw Meat (mg/kg) Offered for Sale at Hadejia Metropolis

Minerals	Treatment			
	T1	T2	T3	SE(±)
Ca	4.17[a]	3.13[c]	3.33[b]	0.003
Mg	2.09[b]	2.50[a]	0.83[c]	0.005
Cu	6.10[a]	3.66[b]	6.10[a]	0.005
Fe	3.57[b]	3.57[b]	5.36[a]	0.004
Na	2.01[b]	2.29[a]	2.01[b]	0.005
K	1.27[b]	1.24[c]	1.29[a]	0.107

[a, b and c] means on the same row having different superscripts are statistically different

Table 3 showed the results of the minerals composition of *Tsire* (mg/kg) offered for sale at Hadejia metropolis. There was significant difference (P<0.05) in Ca, Cu, Fe and K between three treatments. Highest values (mg/kg) for Ca (3.75), Mg (1.67), Cu (29.59), Fe (8.54) and Na (2.15) were reported for T1 while lowest values (mg/kg) for Ca (2.50), Cu (19.39), Fe (4.75) and K (1.17) were reported from T3.

Table 3: Minerals Composition of *Tsire* (mg/kg) Offered for Sale at Hadejia Metropolis

Minerals)	Treatment			
	T1	T2	T3	SE(±)
Ca	3.75[a]	2.92[b]	2.50[c]	0.001
Mg	1.67[a]	1.33[b]	1.25[b]	0.047
Cu	29.59[a]	24.49[b]	19.39[c]	0.001
Fe	8.54[b]	7.32[b]	4.75[c]	0.079
Na	2.15[a]	1.70[b]	1.48[b]	0.125
K	1.40[a]	1.24[b]	1.17[c]	0.002

[a, b and c] means on the same raw having different superscripts are statistically different

Abulude (2004) reported higher Cu (10.23 mg 100 g^{-1}) and lower Ca, Mg and Na contents which is similar to this finding. Dietary Cu is not toxic to humans because its intake is usually low and body can usually regulate its storage through binary excretion. Meat is a good source of K, Mg, Ca, Na and Fe. The amount of Zn obtained in this report suggests that the sample could provide a significant portion of Zn. Meat is the richest source of Zn in the diet and supplies one third to one half of the total Zn intake for meat eaters. Similar Fe (5.20 mg 100 g^{-1}) in millipede content obtained by Abulude and Folorunso (2003) is comparably with the current results. Fe in meat is well absorbs (20-30%). It also enhances the absorption of Fe from other sources. Inadequate Fe in the diet is associated with poorer learning and decrease cognitive development (FAO/WHO, 1997). The differences in the minerals contents of the samples could be due to soil, water, plant nutrient content and the rate of mineral uptake by animal.

REFERENCES

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2014). Assessment of Four Meat Products (*Kilishi*, *Tsire*, *Dambu* and *Balangu*) in Bauchi Metropolis. *ACT-Biotechnology Research Communications,* 1:140-148.

Abulude, F.O. (2004). Proximate Composition, Mineral Contents and Functional Properties of Cricket (*Acheta spp*.). *Pak. J. Sci. Ind. Rea.* 47:212-213.

Abulude, F.O. and Folorunso, R.A. (2003). Preliminary studies on millipede, Proximate Composition, Nutritionally Valuable Minerals and Phytate Content. *Global J. Agric. Sci*. 2:68-71.

Amanda, C., Leizman, F.G., Gail, M.H., Hollenbeck, A.R., Shicitzkin, A. and Sinha, R. (2007). A Prospective Study of Feed and Processed Meat Intake in Relation to Cancer Risk. Public Library of Science. 4(12):325-336.

FAO/WHO (1997). Food and Agricultural Organisation/World Health Organization. Protein Quality Evaluation. Report of a Joint FAO/WHO Export Consultation held in M.D. Bathesda, USA.

FAO (2007). Food and Agricultural Organisation. Meat and Meat Products in Human Nutrition in Developing Countries, Rome. 97pp.

Jokanovic, M.R.,Tomic, V.M., Jovic, M.T., Skaljak, S.B., Sojic, B.V., Ikonic, P.M. and Tasic, T.A. (2014). Proximate and Minerals Composition of Chicken Giblets from Vojvodina (Northern Serbia). *International Journal of Biological, Biomolecular, Agricultural Food and Biotechnological Engineering,* 8(9):973-976.

Lawrie, R.A., Ledward, D.A. and Thakur, K. (2006). Lawrie's Meat Science. 7th Edition Cambridge: Woodhead publishing Limited.

Muhammad, B.F., Ibrahim, S.L, Salisu, A.A. and Inusa, S.K. (2012). Carcass Characteristics and Organoleptic Properties of Japanese Quail (*Corturnix cortunix japonica*) and Pigeon (*Columba livia*) meat processed into *Dambu*. **In**: *Proceedings of the 46th Annual Conference of the Agricultural Society of Nigeria* held at Faculty of Agriculture, Bayero University, Kano, Nigeria.

NPC (2006). National Population Commission Census. Nigerian Population Census. Abuja, Nigeria.

Purchas, R., Rutherfurd, S. and Pearce, M.O. (2005). Concentration in Beef and Lamb of Taurine, Carnosine, Coenzyme Q10 and Creatine. *Meat Science,* 66: 629-637.

Prasanna, R.K. and Sahitya, R.M. (2014). Chemical Composition of Chicken of Various Commercial Brands Available in Market. *Journal of Agriculture and Veterinary Science*. 7(7): 22-26.

CHEMICAL COMPOSITION OF BROILER CHICKEN MEAT FLOSS FED DIETS CONTAINING VARYING ENERGY LEVELS

[β]Umar, A.M., [μ]Mohammed, A., [β]Muhammad, Y., [β]Shehu, B., [β]Kazaure, L.A., [£]Madigawa, I.L., [β]Dahiru, M., [β]Faruq, A.U., [β]Idris, M. and [β]Abdul'aziz, A.

[β]Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State. [μ]Department of Animal Health and Production, Federal Polytechnic Bauchi. [£]Department of Animal Health and Production, Audu Bako College of Agriculture, Dambatta, Kano.

Corresponding author: auw.umar@gmail.com +2348164727548 and +2348027374654

ABSTRACT

This study was designed to investigate the chemical composition of meat floss prepared from broiler chickens fed diets containing varying energy levels. A total of 270 day old broiler chicks were weighed and randomly allocated to three treatments (A, B and C) of ninety birds per treatment, each treatment having three replications of thirty birds. Three experimental diets comprising three energy levels of 2, 400 (A); 2, 600 (B) and 2, 800 ME Kcal/Kg (C) were formulated and fed to the chickens. The crude protein of the starter and finisher diets were fixed at 24 and 20%, respectively. At the end of 8th weeks, 3 birds were randomly taken from each replication which were used for the preparation of meat floss. Triplicate samples of the raw and chicken meat floss were analysed for moisture, crude protein, ash and ether extract. Data obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability. Results showed that the raw meat of broiler chickens fed diet containing 2, 800 Kcal/kg has the highest values of ash and crude protein while that fed diet containing 2, 400 Kcal/kg has the highest ether extract value. Meat floss of birds fed diet containing 2, 400 Kcal/kg has the highest mean values of ash and moisture. In conclusion there was noticeable increase in the nutrient profile of the chicken meat floss over their raw counterparts.

Key words: Broiler Chicken, Meat Floss, Diets, Energy Levels and Chemical Composition

INTRODUCTION

Meat is defined by the *Codex Alimentarius* as all parts of an animal that are intended for use and have been judged as safe and suitable for human consumption (FAO, 2006). It is the term used for the flesh of the animals used for food, especially that of cattle, sheep, goat and swine, as distinct from game, poultry and fish: sometimes it is inclusive of all animal flesh (Muhammad *et al*., 2012). FAO (2007) reported that meat and meat products contain significant levels of protein, vitamins and minerals which are essential for human growth and development.

Dambun-Nama (Meat Floss) is a Nigerian traditionally spiced, cooked, pounded, shredded and dried meat product which is commonly prepared using chicken meat, beef, chevon, mutton or camel meat and is popularly consumed in the Northern parts of Nigeria. The product was developed as a means of preserving meat in the absence of facilities for refrigerated storage by the early Fulani and Hausa herdsmen (Sanwo *et al*., 2011). The aim of the research is to examine the minerals contents of *Tsire* offered for sale at Hadejia Metropolis.

MATERIALS AND METHODS

The research was conducted at the Poultry Demonstration Farm of the Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State. A total of 270 day old broiler chicks of Zartech strain were purchased from an accredited distributor. The chicks on arrival were weighed and randomly allocated to three treatments (A, B and C) of ninety birds per treatment, each treatment having three replications of thirty birds. The birds were managed under deep litter system with wood shaving as litter materials.Three experimental diets comprising three energy levels of 2, 400 (A), 2, 600 (B) and 2, 800 MEKcal/Kg (C) were formulated and fed to the chickens. The crude protein of the starter and finisher diets were fixed at 24 and 20%, respectively.

The floss was prepared following the method described by Eke *et* a*l*. (2012) as showed in Figure 1.

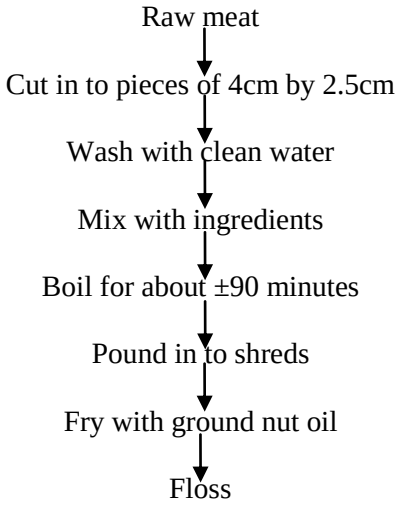


Figure 1**:** Chicken meat floss preparation. Source: Eke *et* a*l*., 2012

Triplicate samples of the raw and chicken meat floss were taken to Biochemistry Laboratory of Bayero University, Kano for the proximate analysis The meat floss samples produced from broiler chickens fed different energy levels were assessed for moisture, crude protein, ash and ether extract according to the procedure of AOAC (2007). Moisture content was determined gravimetrically (Oluwatosin *et al*., 2007) by drying 6 g of meat at 105°C. Crude protein was determined by Kjeldahl method according to the NF V 04-407 norm and using a Kjeltec Auto Sampler System 1035 Analyzer. The total ash content was determined according to the NF V 04-404 French standard method, about 6 g of samples were ashed in an oven maintained at 550°C to determine ash content. The fat content was determined by Soxhlet method according to the NF V 04-402 standard ISO 1443: 1973, using petroleum ether at 40-60 °C. Each analysis was repeated twice.
Data obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model Univariate Procedure of SPSS 17.0 and significant differences of means were compared using LSD at 5% level of probability.

RESULTS AND DISCUSSIONS

The chemical composition of raw meat prepared from broiler chickens fed diets containing varying energy levels is presented in Table 1. Results showed that the raw meat of broiler chickens fed diet containing 2, 800 Kcal/kg has the highest values of ash and crude protein. The raw meat of broiler chickens fed diet containing 2, 400 Kcal/kg has the highest ether extract value. There is significant ($P<0.05$) differences in all the parameters (ash, moisture, crude protein and ether extract) measured across the three treatments.
Table 2 shows the chemical composition of meat floss prepared from broiler chicken fed diets containing varying energy levels. Results showed that there were significant ($P< 0.05$) differences across treatments. Chicken meat floss of birds fed diet containing 2, 400 Kcal/kg has the highest mean values of ash and moisture.

Table 1: Chemical Composition (%) of Raw Broiler chicken Meat Fed Diets Containing Varying Energy Levels (Kcal/kg)

Parameter (%)	Energy Level (Kcal/kg)			
	2 400	2 600	2 800	SE (±)
Ash	3.05[c]	3.53[b]	4.30[a]	0.02
Moisture	69.02[a]	68.82 [b]	68.90[b]	0.05
Crude Protein	11.29[c]	12.07[b]	12.97[a]	0.01
Ether Extract	16.47[a]	15.58[b]	13.79[c]	0.01

Means along the same row having different superscripts (P<0.05) differ

Table 2: Chemical Composition (%) of Meat Floss Prepared from Broiler Chickens Fed Diets Containing Varying Energy Levels

Parameter (%)	Energy Level (Kcal/kg)			
	2 400	2 600	2 800	SE (±)
Ash	7.47[a]	7.75[a]	6.00[b]	0.00
Moisture	9.03[a]	8.75[c]	8.88[b]	0.05
Crude Protein	58.57[b]	59.40[a]	58.75[b]	0.00
Ether Extract	24.92[b]	24.10[c]	26.37[a]	0.00

Means along the same row having different superscripts (P<0.05) differ

Abubakar *et al*. (2016) reported crude protein value of raw meat as 15.68 ±0.01 which agrees with the findings (11.29 to 12.97%) of this work. Huss (1988) observed that the chemical composition of animals varies from species to species as well as from individual animals depending on age, sex, environment and season. Proteins are powerful compounds that build and repair tissues; it also helps to maintain the body's structure. Protein speeds up chemical reaction in the body, serves as chemical messenger, fight infection and transport oxygen from the lungs to the body tissue. Poultry broiler chickens have recently been shown to fall into a group of high-protein foods that can help keep post-meal insulin levels within a desirable range (Nwosu *et al.*, 1980). There was noticeable increase in the nutrient profile of the chicken meat floss over their raw counterparts (Tables 1 and 2).

Prasanna and Sahitya (2014) reported fat values of raw meat from 13.74 ± 18 to 22.39 ± 91, which is similar to that reported in this work. Valsta *et al*. (2005) documented that appropriate manipulation with broiler chicken diet could modify fatty acid profile in meat and increase its nutritional value, which is in agreement with the work of Castellini *et al*. (2012), who stated that chemical composition of meat depended on type of the diet. The crude fat determined was 16.27% for birds fed diet containing 2, 400 Kcal/kg, 15.58% for birds fed 2, 600 Kcal/kg and 13.79% for birds fed diet containing 2, 800 Kcal/kg, which were within the range (3.70 to 18.06%) reported by Ogunmola *et al*. (2013). Birds fed diet containing 2, 800 Kcal/kg has the least crude fat percentage followed by those fed diet containing 2, 6000 Kcal/kg and the highest value was determined in birds fed diets containing 2, 400 Kcal/kg, thus, there was progressive increase in fat content as the energy level decreases. Possible reason for the high fat content from broiler chickens fed diet containing 2, 400 Kcal/kg may be as a result of high feed intake at both starter and finisher stages. Fats play an important role in building the membranes that surround our cells, in helping blood to clot. Also, presence of fat in the right proportion in the body helps the body to absorb certain vitamins and also to prevent the body from extreme cold and heat.

Ash value ranged (6.00 to 7.75%) for chicken meat floss of this study is in conformity with the work of Abubakar *et al.* (2014) who reported 6.2, 6.3 and 7.1% for shredded meat prepared from beef,

mutton and chevon, respectively. Similar results (4.87±0.11 to 5.60±0.14) were reported by Bulus and Ibe (2016). Eke *et al.* (2012) reported ash values of 5.76 ± 0.02 (Laboratory *Dambun- Nama*) and 4.90 ± 0.04 (Traditional *Dambun-Nama*) which were within the range obtained in this study. The same authors reported crude protein values of 46.51 ±0.03 (Laboratory *Dambun-Nama*) and 39.19 ± 0.03 (Traditional *Dambun-Nama*) which were similar with the result of this findings. Ash in food determines largely the extent to which the dietary minerals would be available in a particular food sample. It also determines the rate at which food substances would make available the amount of energy locked in it (Nwosu, 1979).

The moisture content of the chicken meat floss obtained in this study was within the range values of intermediate moisture products reported by Ogunsola and Omojola (2008). Differences in moisture content may be related to water holding capacity and lipid content of the samples.

REFERENCES

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2014). Assessment of Four Meat Products (*Kilishi*, *Tsire*, *Dambu* and *Balangu*) in Bauchi Metropolis. *ACT-Biotechnology Research Communications*, 1:140-148.

Abubakar, M., Adamu, A.K., Abdullahi, S.A. and Shika, S.T. (2016). Proximate Composition of Raw and Steamed Chicken Intestine. In: Proceedings of the 40th Conference and Annual General Meeting of the Nigerian Institute of Food Science and Technology held at Coronation Hall, Government House, Kano, Nigeria.

AOAC (2007). Association of Officials Analytical Chemist. Official Methods of Analysis. 18th Edition Benjamin Franklin Station, Washington DC, USA.

Bulus, D. and Ibe, U.O. (2016). Quantity Assessment of *DanbuNama* Produced from Different Meat Sources. In: Proceedings of the 40th Conference and Annual General Meeting of the Nigerian Institute of Food Science and Technology held at Coronation Hall, Government House, Kano, Nigeria.

Castellini, C., Mugnai, C. and Dal Bosco, A. (2012). Effect of Organic Production System on Broiler chicken Carcass and Meat Quality. *South African Journal of Animal Science*, 42(4): 2319-2380.

Eke, M.O., Ariahu, C.C. and Okonkwo, T.M. (2012). Production and Quality Evaluation of *Dambun-Nama*- A Nigerian Dried Meat Product. *African Journals Online*, 2(30):57-66.

FAO (2006). Food and Agriculture Organisation.Corporate Ducoment Repository, Meat and Meat Products in Human Nutrition in Developing Countries. Rome.

FAO (2007). Food and Agricultural Organisation. Meat and Meat Products in Human Nutrition in Developing Countries, Rome. 97pp.

Huss, H.H. (1988). Fresh Fish Quality and Quality Changes. FAO Fisheries Series No. 29, Rome, Italy. 276pp.

Muhammad, B.F., Ibrahim, S.L, Salisu, A.A. and Inusa, S.K. (2012). Carcass Characteristics and Organoleptic Properties of Japanese Quai (*Corturnix cortunix japonica*) and Pigeon (*Columba livia*) meat processed into *Dambu*. **In**: Proceedings of the 46th Annual Conference of the Agricultural Society of Nigeria held at Faculty of Agriculture, Bayero University, Kano, Nigeria.

Nwosu, C.C. (1979). Characterization of the Local Chicken in Nigeria and its Potential for Egg and Meat Production. Proceedings of the 1st National Seminar on Poultry Production, Ahmadu Bello University, Zaria, Nigeria. pp: 187-210.

Nwosu, C.C., Obioha, F.C., Fred, G., Belonwu, T. C., Onuora, G.I. and Omeje, S.S.I. (1980). A Study of the Growth Pattern of Local and Exotic Chickens. *Nigerian Journal of Animal Production*, 7:38-48.

Ogunmola, O. O., Taiwo, O., F. and Ayankoso, A. S. (2013). The Nutritive Value of the Meat Quality of Locally Breed Chicken, Exotic Chicken and Turkey. *Journal of Applied Chemistry*,3 (6): 46-50.

Ogunsola, O. O. and Omojola, A. B. (2008). Qualitative Evaluation of *Kilishi* Prepared from Beef and Pork. *African Journal of Biotechnology*, 7(11):1753-58.

Oluwatosin, O., Olawoyin, E., Agiang, A., De Neji, C. and Iso, E. (2007). Nutritional Evaluation of the thigh and breast muscles of four cockerel strains. *African Journal of Animal and Biomedical Sciences,* 2(2): 26-31.

Prasanna, R.K. and Sahitya, R.M. (2014). Chemical Composition of Chicken of Various Commercial Brands Available in Market. *Journal of Agriculture and Veterinary Science*. 7(7): 22-26.

Sanwo, K.A., Olayiwola, J.A., Iposu, S.O. and Adegbite, J.A. (2011). Effects of Different Boiling Temperatures on Meat Quality of Beef and Turkey Meat. In: Proceedings of the 36th Annual Conference of the Nigerian Society for Animal Production held at University of Abuja, Nigeria.

Valsta, L. M., Tapanainen, H. and Mannisto, S. (2005). Meat Fats in Nutrition, In. Meat Science. (70): 525-530.

MICROBIOLOGICAL ATTRIBUTES AND QUALITY OF AVIAN BASED GRINDED MEAT (*DAMBUN NAMA*)

[+]Inusa, S. K., [+]Maigari, S. K. and *[++]Maigari, A. K.

[+]Department of Animal Science, Faculty of Agriculture, Bayero University, Kano. PMB, 3011, Kano State, Nigeria.

[++]Nigerian Institute for Trypanosomiasis (and Onchocerciasis) Research, Kano Liaison Office, Infectious Diseases Hospital, France Road, Kano State, Nigeria.

Corresponding Author: akabirum@gmail.com; 08036028452

ABSTRACT

Contamination of ready-to-eat meat products has been reported by many researchers. It is an established fact that, meat and meat products provide an excellent growth medium for bacteria, yeasts, moulds and protozoans. Therefore, this study was aimed at evaluating the microbiological attributes of Avian Based grinded meat (*Dambun Nama*) prepared from chickens, ducks, guinea fowls and quails. Aerobic Mesophilic Plate Count (APC), Total Coliform Count (TCC) and fungal species were evaluated using standard techniques. The result shows that, the product prepared from chickens had the highest APC (2.54×10^3 cfu/g). However, the product prepared from chickens, ducks and guinea fowls recorded the same values for TCC (3 MPN/g), while that of quails had the lowest TCC (< 3 MPN/g). *Escherichia coli* and *Staphylococcus* were present in all the samples while the presence of *Enterobacter* and *Klebsiella* was found in the product prepared from chickens. *Salmonella* was only present in the product prepared from ducks. *Candida*, *Penicillium* and *Rhizoctonia* were detected in the product prepared from chickens while *Aspergillus* and *Rhizoctonia* were detected in that of guinea fowls and quails, respectively. It can be concluded that, the avian based grinded meat had satisfactory microbial quality. Therefore, the study recommends maintenance of personal hygiene while processing, handling and selling the products, alongside proper storage to improve its safety and shelf life.

Key words: Microbial, Contamination, Avian, Grinded meat

INTRODUCTION

Meat contains important nutrients such as amino acids, vitamins, minerals and fatty acids which are essential for human growth and development (Campbell *et al*., 2003). However, the handling and processing methods by the local manufacturers as well as the hawking system of meat and meat products exposes it to both pre – and post – processing contamination, and thus may pose danger to public health. Hence, the need to improve its processing, handling, storage, distribution and overall quality. Umar (2015) reasoned that meat and meat products provide an excellent growth medium for microbes including bacteria, fungi and protozoans. Microbial growth can lead to slime formation, structural components degradation, off odor and appearance (Russell *et al*., 1996). Therefore, unless dried, cured, smoked, or fermented in some way, meat has a tendency to spoil rapidly (Robert, 1994). Poor sanitary practices increase microbial damage resulting in reduced color, flavor and product safety (Umar, 2015). Numerous studies have reported that meat products sold in Nigeria are contaminated with various species of bacteria and fungi (Ologhobo *et al*., 2010, Salihu *et al*., 2010, Umar, 2015, Dahiru and Maigari, 2019). *Staphylococus aureus*, *Escherichia coli* and *Corynebacterium* spp, isolated in meat products are potentially pathogenic (Abubakar *et al*., 2010). Similarly, fungal species such as *Aspergillus niger*, *Aspergillus fumigatus*, *Rhizophus nigricans* and *Hansenula anomala* could affect meat products on storage and could be dangerous (Abubakar *et al*., 2010, Umar, 2015). Most food poisoning results from mishandling foodstuffs, inappropriate temperature of storage, cross contamination and incorrect reheating (Umar, 2015). Considering the high demand of ready to eat meat products and their economic values, coupled with the fact that, grinded meat (*Dambun Nama*) is highly relished by people and incessantly hawked in Kano State, the present study is justified.

MATERIALS AND METHODS

Experimental Design and Preparation of *Dambun Nama*

Chickens, ducks, guinea fowls, quails and the ingredients (onions, ginger, salt, seasonings, sweet pepper, hot pepper, garlic and vegetable oil) were purchased from Rimi market, located in Kano metropolis, Kano State, Nigeria. The *Dambun Nama* was prepared at the Department of Animal Science, Faculty of Agriculture, Bayero University, Kano. The samples were aseptically placed in clean, sterile plastic containers immediately after collection and subsequently transported to the Post Graduate laboratory of the Department of Microbiology, Bayero University, Kano, for analysis.

MICROBIOLOGICAL EVALUATIONS

Samples of *Dambun Nama* were stored at room temperature in sterile plastic containers for 2 weeks. The sample preparation was carried out according to the method described by Food and Agricultural Organization, FAO (2010). Aerobic mesophilic bacterial count was carried out according to Abdullahi *et al*. (2004), and the colonies obtained were counted, averaged and multiplied by the dilution factor to give the number of colony forming units per gram of a sample (cfu/g). The detection and enumeration of coliforms was carried out according to the method described by Atlas (1997). The number of gas positive tubes was compared with the most probable number (MPN) table to estimate the most probable number of coliforms per gram of sample. Three different microbial culture media (nutrient agar and MacConkey agar for bacterial analysis and potato dextrose agar for fungal evaluation) were prepared, and were aseptically distributed into sterile Petri plates. One gram of the meat product was thoroughly agitated in 9 ml of sterile water, serially diluted to 10 - 3 and plated. Following incubation (at 37^0C for 24 hours and 25^0C for 3-5 days for bacteria and fungi, respectively), plate counts and possible identification of the isolates was carried out. The characteristics of the isolates was referred to Bergey‟s Manual of Determinative Bacteriology for identification. Gram staining and other biochemical tests such as IMVIC (Indole, methyl red, Voges-Proskauer Tests and citrate utilization), Catalase, Coagulase, and Triple Sugar Iron Agar Test (TSI) were conducted according to procedure for the identification of bacterial colonies as described by Atlas (1997). Members of the enterobacteriacea family were further confirmed using API 20E identification kit, while yeast and mold counts was carried out according to the method of Atlas (1997), and identified using a color guide and microscopy.

RESULTS AND DISCUSSION

The Aerobic Plate Counts (APC) and Total Coliform Count (TCC) of the avian based *Dambun Nama* is presented in Table 1. Chickens had the highest APC while quails had the least APC. *Dambun Nama* prepared from chickens, ducks and guinea fowls recorded the same values for TCC, while that of quails had the lowest TCC values. The occurrence of bacteria in the experimental *Dambun Nama* indicated that *E. coli* and *Staphylococcus* were detected in all the samples. The presence of *Enterobacter* and *Klebsiella* was confirmed in *Dambun Nama* prepared from chicken meat while *Salmonella* was only detected in the product made from duck meat (Table 2). The occurrence of fungal species is presented in Table 3 where *Candida, Penicillium* mould and *Rhizoctonia* spp. were detected in *Dambun Nama* prepared from chickens. *Aspergillus niger, Penicillium* mould and *Rhizoctonia* species were detected in the product made from ducks. However, *A. niger* was the only fungal species detected in the product prepared from guinea fowl meat, while *Rhizoctonia* spp. was the only fungal species detected from the product obtained from quails.

The low bacterial counts from the products in this study is generally attributed to the clean environment, good personal hygiene of the processor, and the use of clean utensils during processing and packaging. Thus possible cross contamination of the finished product from adjacent raw meat through unclean hands of the handlers and/or flies was minimized. This is in agreement with Shamsuddeen (2009), Fonkem *et al*. (2010) and Inusa and Sa'id (2017). The degree of meat spoilage is usually influenced in part by the microbial load at the beginning of production, packaging and handling of the finished product (Inusa and Sa'id, 2017). The International Commission on

Microbiological Specifications for Foods (ICMSF, 1996) reported the limits for total aerobic bacterial and fungal counts to be in the order of ≤ 103 as acceptable and 104 to 105 tolerable for ready to eat foods. Similarly, London Health Protection Agency, (LHPA, 2009) put <106cfu/g as satisfactory limit, and 106 to <107cfu/g as acceptable range. Thus, the levels of microbiological contamination in the present study, although very low, might portend public health concern as conditions favoring growth and proliferation of microbes prevails in most of the retail outlets. Okonko *et al*. (2013) isolated *Bacillus* species, *Staphylococcus aureus* and *Escherichia coli* in *Dambun Nama* samples from Port Harcourt, Rivers State. Moreover, in addition to *Bacillus cereus*, Edema *et al*. (2008) isolated, *Staphylococcus aureus* and *Salmonella* spp from a study on *Dambun Nama* samples retailed at some selected cities in Southwestern Nigeria. In another study, Fonkem *et al*. (2010) isolated *E. coli* and *Staphylococcus aureus* from Cameroonian *Dambun Nama* while Shamsuddeen (2009) reported the presence of *E. coli*, *Salmonella* species, *Staphylococci* and *Clostridium perfringens* in spices used in the production of *Dambun Nama*.

Abdullahi *et al*. (2004) reasoned that, differences in meat handling practices, ingredients, processing methods and variation in environmental factors may influence the microbial load of meat products. The findings of this study agrees with the work of Badau *et al*. (2001) who reported the presence of *Aspergillus* and *Penicillium mould* in *Dambun Nama* among hawkers in Maiduguri, Borno State. The study also, is in agreement with the report of Abolama and Egbebi (2007) in Ado Ekiti, Ekiti State where *Aspregillus niger*, *Penicillium* and *Rhyzoctonia* were reported. Similarly, Umar (2015) reported the presence of *Aspregillus niger*, *Penicillium*, *Rhyzoctonia* and *Trichophyton* in a study of *Dambun Nama* sold in Kano Metropolis, Kano State. In a more recent study of *Dambun Nama* prepared from goat meat, Garba (2017) reported the presence of *Aspregillus niger*, *Penicillium* and *Candida*. The presence of variety of mould species are points of great concern. This is because, mould like *Aspergillus niger* has the ability to produce extracellular metabolites called mycotoxins (Umar, 2015). One popular example is the aflatoxins which are a group of highly toxic metabolites produced by the fungi of the genus *Aspergillus*.

Table 1: Microbiological Quality of Avian based Grinded Meat

	Microbial count	
Avian Species	APC (cfu/g)	TCC (MPN/g)
Chickens	2.54×10^3	3
Ducks	2.39×10^3	3
Guinea Fowls	2.08×10^3	3
Quails	1.71×10^3	<3

APC: Aerobic Plate Count
TCC: Total Coliform Count

Table 2: Occurrence of Bacteria in Avian Based Grinded Meat

Avian Species	*Escherichia coli*	*Enterobacter*	*Klebsiella*	*Salmonella*	*Staphylococcus*
Chickens	+	+	+	-	+
Ducks	+	-	-	+	+
Guinea Fowls	+	-	-	-	+
Quails	+	-	-	-	+

+ indicates presence; - indicates absence

Table 3: Occurrence of Fungal Species in Avian Based Grinded Meat

Avian Species	*Aspergillus niger*	*Candida*	*Penicillium*	*Rhizoctonia spp*
Chickens	-	+	+	+
Ducks	+	-	+	+
Guinea Fowls	+	-	-	-
Quails	-	-	-	+

+ indicates presence; - indicates absence

CONCLUSION AND RECOMMENDATIONS

It can be concluded that, the avian based grinded meat had satisfactory microbial quality. Therefore, the study recommends maintenance of personal hygiene while processing, handling and selling the products, alongside proper storage to improve its safety and shelf life.

REFERENCES

Abdullahi, I. O., Umoh, V. J. and Galadima, M. (2004). Hazards Associated with Kilishi Preparations in Zaria. *Nigerian Journal of Microbiology*, **18** (1-2): 339 – 345.

Aboloma, R. I. and Egbebi, A. O. (2007). Microbiological Quality of some Dried Meat and Fish Samples Sold in Ado Ekiti, Ekiti State, Nigeria. *BEST Journal*, **4** (2): 158 – 161.

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2010). Processing and Evaluation of Dambu, Tsire and Balangu from Non-ruminant Animals. *ACT-Biotechnology Research Communications* **1** (1): 49-55.

Atlas, R. M. (1997). Principles of Microbiology, 2nd edition C. Brown Publishers, Pp 802– 803.

Badau, M. H., Adeniran, A. M. and Nkama, I. (2001). Fungi Associated with Various Fresh Meat Sold in Maiduguri Market, Nigeria. *Science Forum*: *Journal of Pure and Applied Science*s, **4** (2): 255-262.

Campbell, J. R., Kenealy, M. D., Campbell, K. L. (2003). Animal Sciences. The Biology, Care, and Production of Domestic Animals, fourth ed., McGraw-Hill, New York.

Dahiru, A. T. and Maigari, A. K. (2019). Bacteriological Quality Assessment of Kilishi Produced in Kunchi Local Government Area, Kano State, Nigeria. *UJMR*, **4** (1): 12 – 18.

Edema M. O., Osho A. T. and Diala C. I. (2008). Evaluation of Microbial Hazards Associated with the Processing of Suya (a grilled meat product). *Scientific Research and Essays*, **3** (12): 621-626.

Food and Agriculture Organization, FAO (2010). Meat and meat Products, Animal Production and Health Division, Agriculture and Consumer Protection Department. Accessed online from www.fao.org/meat.meatproduction.

Fonkem, D.N., Tanya, V.N. and Ebangi, A.L. (2010). Effects of Season on the Microbiological Quality of Kilishi, a Traditional Cameroonian Dried Beef Product. *Tropicultura*, **28** (1): 10-15.

Garba, A. I. (2017). Effects of Breed on the Microbiological and Sensory Properties of Meat Floss (Dambun Nama) Prepared from Goat Meat. An Undergraduate Project Submitted to the Department of Animal Science, Faculty of Agriculture, Bayero University, Kano.

International Commission on Microbiological Specifications for Foods, ICMSF (1996). Microorganisms in Foods 5: Microbiological Specifications of Pathogens. p.89.

Inusa, S. K. and Said, I. S. (2017). Evaluation of the Chemical and Microbiological Properties of Kilishi Sold in Kano Metropolis. *Journal of Dry Land Agriculture*, **3** (1): 59 – 69.

Okonko, I.O., Odu, N.N. and Igboh, I.E. (2013). Microbiological Analysis of *Kilish*i Sold in Port Harcourt, Nigeria. *New York Science Journal*, **6** (7):37-43.

Ologhobo, A. D., Omojola, A. B., Ofongo, S. T., Moiforay, S. and Jibir, M. (2010). Safety of Street Vended Meat Products - Chicken and Beef Suya. *Afr. J. Biotech.* **9**: 4091-4095.

Robert, W. B. (1994). Microbiology. Benjamin Cummings Publishers, Pp 748 – 753.

Russell, S. M., Flecher, D. L. and Cox, N. A. (1996). Spoilage Bacteria of Fresh Broiler Chicken Carcasses. *Poultry Science*, **74**: 20 – 24.

Salihu, M. D., Junaidu ,A.U., Magaji A. A., Aliyu, R. M., Yakubu, Y., Shittu A. and Ibrahim, M.A. (2010). Bacteriological Quality of Traditionally Prepared Fried Ground Beef (Dambun Nama) in Sokoto, Nigeria. *Advance Journal of Food Science and Technology*, **2** (3):145-147.

Shamsuddeen, U. (2009). Microbiological Quality of Spice used in the Production of *Kilishi* a Traditionally Dried and Grilled Meat Product. *Bayero Journal of Pure and Applied Sciences,* **2** (2): 66 – 69.

Umar, S. (2015). HACCP during the Production of Traditional Meat Snacks. Microbiological Hazard and Critical Control Point Analysis of Dried and Minced Meat Snacks Produced in Kano, Nigeria. Lambart Academic Publishing, OmniScriptum GmbH & Co. KG, Germany, Pp. 67.

CHEMICAL AND SENSORY EVALUATION OF AVIAN BASED GRINDED MEAT

[+]Inusa, S. K., [+]Maigari, S. K., [++]Yangora, Y. M. and *[+++]Maigari, A. K.

[+]Department of Animal Science, Faculty of Agriculture, Bayero University, Kano. PMB, 3011, Kano State, Nigeria.

[++]Department of Forestry, Audu Bako College of Agriculture, Dambatta, Kano State.

[+++]Nigerian Institute for Trypanosomiasis (and Onchocerciasis) Research, Kano Liaison Office, Infectious Diseases Hospital, France Road, Kano State, Nigeria.

**Corresponding Author: akabirum@gmail.com; 08036028452*

ABSTRACT

This study was conducted to evaluate the sensory and chemical properties of grinded meat, locally called *Dambun Nama*, prepared from chickens, ducks, guinea fowls and quails. Fifteen (15) semi-trained panelists were used to determine the sensory properties of the Avian Based *Dambun Nama* (ABDN) using a 7 – point hedonic scale. The ash content, moisture, crude protein, ether extract and mineral concentrations of ABDN were evaluated using standard procedures. The result revealed that ABDN prepared from quails had significantly ($p < 0.05$) higher ash contents (2.67%), while that of ducks had significantly ($p < 0.05$) higher moisture (12.17%). Overall, ABDN prepared from quails had the highest acceptability (6.80 ± 0.41), although not significantly different ($p > 0.05$). However, the product prepared from ducks had significantly ($p < 0.05$) higher crude protein (23.70%) and ether extracts (53.73%), while that from chickens had higher concentrations of Ca (225.4 mg/kg), K (22.09 mg/kg), Mg (8.19 mg/kg) and Zn (0.09mg/kg). ABDN prepared from quails recorded higher value of Na (67.90mg/kg), whereas, that of ducks and guinea fowls had higher concentrations of Cu (0.06 mg/kg) and Fe (0.07mg/kg), respectively. Conclusively, the avian based *Dambun Nama* was highly nutritious, palatable and generally accepted. Thus, highly nutritious foods such as *Dambun Nama* are particularly required for malnourished people especially children and women.

Key words: Chemical, Sensory, Avian, *Dambun Nama*

INTRODUCTION

The provision of adequate food to the ever increasing teeming population of the world is one of the greatest challenge to mankind (Abubakar *et al*., 2011). In 2010, the World Population Data Sheet (WPDS), estimated 6.892 billion people that may reach 7 billion in 2011 and 8 billion in 2024. Thus, the feeding of almost 7 billion people is an enormous task that must be taken seriously. According to the Food and Agricultural Organization, FAO (2010a), global per capita output of meat consumption, which at present averages 41.9 kg per year, varies greatly not only between developed countries (80.7 kg) and developing countries (31.6 kg) of the world, but even within communities in a country. Speedy (2003) had shown that while some countries consume more than 100 kg meat per annum, others consume less than 10 kg, which is insufficient and often leads to under-nourishment and malnutrition (FAO, 2010b). The high cost of meat is enough to make developing countries, including Nigeria, have limited access to meat and meat products. This is due to the fact that production and rearing of animals is far below demand and the preservative technology is grossly inadequate, resulting in high perishability of meat and meat products (Eke *et al*., 2012). Fresh meat is highly perishable, and to prevent its spoilage, meat is usually processed into products using many techniques such as grounded meat, locally called *Dambun Nama* (Abubakar *et al.*, 2011).

Dambun Nama is a significant portion of the diet of a large active population in Northern Nigeria (Salihu *et al*., 2010). In Kano State, it is usually sold as ready to eat meat products, which could be prepared locally for travelers and, especially during festivities. It is an indisputable fact that, reduction of protein malnutrition in the sub-Saharan African countries requires evaluation of simple, appropriate and affordable technologies applicable to local environment. As such, all avenues of meat preservation should be exploited so as to meet the animal protein requirement of the increasing world

population. Therefore, the purpose of this study is to evaluate the sensory and chemical properties of grinded meat, prepared under standard laboratory conditions, from some common avian species.

MATERIALS AND METHODS

Experimental Animals and Design: The avian species used for the experiment include; chickens, ducks, guinea fowls and quails. The birds were approximately of the same age and were purchased from Rimi market, located in Kano metropolis, Kano State, Nigeria. The ingredients (onions, ginger, salt, seasonings, sweet pepper, hot pepper, garlic and vegetable oil) were equally purchased from Rimi market. Completely randomized design (CRD) was employed where four treatments representing the four different avian species were used with each treatment replicated three times.

Preparation of *Dambun Nama*: Preparation of *Dambun Nama* was conducted at the Department of Animal Science, Faculty of Agriculture, Bayero University, Kano. The meat was cut into pieces of approximately 4cm by 2.5 cm dimension, washed with water, mixed with spices, boiled and pounded into shreds. It was then shallow- fried using vegetable oil in a stainless steel pot to obtain a brownish product known as *Dambun Nama*. The product was cooled and packaged in low density plastic containers, from where samples was drawn for subsequent analysis.

Determination of Organoleptic Properties: The organoleptic quality assessment of *Dambun Nama* was undertaken using a 7-point hedonic scale (7 = Very much liked, 6 = Liked a lot, 5 = Liked, 4 = neither liked nor disliked, 3 = Disliked, 2 = Much disliked, 1 = Very much disliked) as reported by Beinner *et al*. (2010), where 15 semi-trained panelists were used. The evaluation was based on aroma, tenderness, color, flavor, texture, juiciness and general acceptability of the product.

Determination of Chemical Properties: The ash, moisture, crude protein, ether extract contents and some selected mineral constituents (Ca, Mg, K, Na, Fe, Cu, Zn) of the samples were determined according to the methods described by the Association of Analytical Chemists, AOAC (2007).

RESULTS AND DISCUSSION

Sensory Evaluation of Avian Based *Dambun Nama*

The mean sensory scores for the experimental *Dambun Nama* is presented in Table 1. All the parameters examined were not significantly ($p = 0.1645$) affected by meat type. The range of values (6.00 – 6.80) obtained are higher than those reported by Ogunsola and Omojola (2008) which ranges between 2.33 and 4.47 in their study on quantitative evaluation of *Dambun Nama* prepared from beef and pork. They are also higher than the values obtained by Onwuka and Nwosuagwu (2005) with a range between 1.90 and 6.00 in a study on the effect of four local vegetable leaves on the protein and microbial content of smoked and dried beef. In terms of flavor, the product prepared from quails was rated highest, also products prepared from chickens, ducks and guinea fowls were rated same. This may be due to the standardization of ingredient mix (Omojola, 2008). However, the contributions of each of the ingredients to the overall *Dambun Nama* flavor and quality was not clearly ascertained. A similar view had been reported by Eke *et al*. (2012) in their preliminary studies on the production and quality evaluation of *Dambun Nama*. Flavor, texture and appearance are perhaps the most important characteristics of food because they are the attribute the consumers can readily assessed. Consumers often base their meat purchasing decisions on appearance, but usually make rapid purchases based on product flavor and texture (Schilling *et al*., 2009). Murano (2005) noted that two types of senses are involved in sensory perception: chemical (taste and odor) and physical (sight, sound and touch). Food flavor is an overall impression combining taste, odor, mouth-feel factors and trigeminal perception. Guinea fowl products are rated highest in aroma, texture and juiciness, but least preferred in terms of color, whereby panelists preferred the color of the product prepared from Chickens. Although *Dambun Nama* prepared from ducks had lower acceptability compared to other products, it was rated highest in terms of tenderness, which reflects consumers less familiarity and acceptability of the product in the study area. Miller *et al*. (1995) reported that mode of processing especially shredding and pounding had a significant effect on meat tenderness. Tenderness in meat is one of the important desires of the consumer, considering the amount of time and resources expended in an attempt to improve it (Farouk *et al*., 1992). Eke *et al*. (2012) reasoned that, the traditionally processed *Dambun Nama* delicacy is highly acceptable to consumers because of its soft and tender taste compared to the hard, non-soft products.

CHEMICAL COMPOSITION OF AVIAN BASED *DAMBUN NAMA*

The result of the chemical composition of avian based *Dambun Nama* is presented in Table 2 and 3. *Dambun Nama* prepared from quails had the highest ash content while *Dambun Nama* prepared from ducks had the least ash content. The ash content had an inverse relation to the moisture content. The higher the ash content the lower the moisture content (Umar, 2015), and hence the higher the shelf life. This implies that, the product obtained from ducks may have shorter shelf life. High moisture content favors the growth of many spoilage and pathogenic microbes and this is one of the reasons why meat is considered as an excellent medium to support microbial growth (Adams and Moss, 1995). Therefore, the product obtained from ducks would be more prone to spoilage since it has the highest moisture content. However, the result shows that *Dambun Nama* prepared from ducks had the highest crude protein and ether extract, while that prepared from guinea fowls and chickens had the least crude protein and ether extract, respectively. Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Cupper (Cu) and Zinc (Zn) were the predominant minerals found in Avian Based *Dambun Nama*. Ca is an important component of bones, thus if the ratio of Ca/P is above one, the food is considered good. K and Na are required for maintaining the osmotic balance of body fluids, pH of the body, regulation of muscle and nerve irritability, control glucose absorption and enhance normal retention of protein during growth (Fasasi *et al*., 2010; NRC, 1989). Na/K ratio in the body is of great importance for prevention of high blood pressure. On the other hand, Zn keeps the immune system strong, promotes healthy skin, growth, development and reproductive health. Thus, the present study shows that the product could be incorporated in the daily balanced diet.

CONCLUSION AND RECOMMENDATIONS

It can be concluded that, the Avian Based *Dambun Nama* was highly nutritious, palatable and generally accepted, which could be useful for malnourished communities or especially among children and women Further studies to determine the hazards associated with the products and also to evaluate all critical control points during processing and packaging of the product is recommended.

Table 1: Mean Sensory Scores for Avian Based *Dambun Nama*

	Samples (Mean ± Standard Deviation)				
Parameters	Chickens	Ducks	Guinea fowls	Quails	LSD
Aroma	5.73 ± 1.43	5.8 ± 1.082	6.200 ± 0.941	6.133 ± 1.125	1.64
Tenderness	5.46 ± 1.060	6.067± 1.279	5.933 ± 1.334	6.000 ± 1.000	0.499
Colour	6.200 ± 1.014	6.133 ± 1.356	5.667 ± 1.234	5.933 ± 1.032	1.07
Flavour	5.933 ± 0.884	5.933 ± 1.163	5.933 ± 1.099	6.467 ± 0.990	1.64
Texture	6.000 ± 0.845	5.600 ± 1.639	6.067 ± 1.033	6.000 ± 1.000	0.57
Juiciness	5.733 ± 1.335	5.533 ± 1.187	6.200 ± 1.082	5.733 ± 1.487	2.139
General Acceptability	6.467 ± 0.831	6.00 ± 1.309	6.533 ± 0.743	6.800 ± 0.414	1.569

Table 2: Chemical Composition (%) of Avian Based *Dambun Nama*

	Samples Mean ± Standard Deviation				
Parameters	Chickens		Ducks	Guinea Fowls	LSD
	Quails				
Ash	2.23 ± 0.104	2.17 ± 0.23	2.28 ± 0.32	2.67 ± 0.60	2.82
Moisture	10. 95 ± 0.44	12.17 ± 0.68	10.95 ± 0.68	10.73 ± 0.61	3.31
Crude Protein	20.42 ± 0.63	23.69 ± 0.63	20.02 ± 0.66	22.24 ± 0.63	6.13
Ether extract	34.13 ± 0.25	53.73 ± 0.68	50.93 ± 0.49	47.93 ± 0.91	7.99

Table 3: Mineral Concentration (mg/kg) of Avian Based *Dambun Nama*

Parameters	Samples			
	Chickens	Ducks	Guinea Fowls	Quails
	225.40	222.22	218.87	212.93
Mg	8.19	5.48	6.57	7.49
Na	51.51	48.94	37.69	67.90
K	22.09	8.70	17.90	14.23
Cu	0.02	0.06	0.04	0.04
Zn	0.09	0.08	0.08	0.05

REFERENCES

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2011). Assessment of four meat products (*Kilishi, Tsire, Dambu* and *Balangu*) in Bauchi metropolis. *ACT Biotechnology Research Communications*, **1**(1): 40-48.

Adam, M. R. and Moss, M. O. (1995). Food Microbiology. Royal Soc. of Chem. Publishers. Pp 115-116.

Association of Official Analytical Chemists, AOAC (2007). Official Methods of Analysis. 18th Ed., Benjamin Franklin Station, Washington, D.C., USA.

Beinner, M. A., Soarres, A. D. N., Barros, A. I. A. and Monteiro M. A. M. (2010). Sensory Evaluation of Food: *Food Science and Technology*, **2**: 211 – 217.

Eke, M. O., Ariahu, C. C. and Abu, J. O. (2013). Sensory and Chemical Evaluation of Beef Based *Dambun Nama* (BBDN). *Advanced Journal of Food Science and Technology*, **5** (10): 1271 – 1274.

Food and Agriculture Organization, FAO (2010a). Food and Agriculture Organization of the United Nations. Meat and meat Products, Animal Production and Health Division, Agriculture and Consumer Protection Department. Accessed online from www.fao.org/meat.meatproduction.

FAO (2010b). Food and Agriculture Organization of the United Nations, Food Outlook, Global Market Analysis, Food and Agriculture Organization of the United Nations, Rome, Italy, June.

Farouk, M. M., Price, J. F., Salih, A. M. and Burnett, R. J. (1992). The Effect of Post ExsanguinationInfusion of Beef on Composition, Tenderness, & Functional Properties, *J. Anim. Sci*.70:2773-2778.

Miller, F. M., Hower I. C., Cook, K. D., Guerra, A. L. and Huffman, L. (1995). Consumer Acceptability of Beef Steak Tenderness in the Home and Restaurant, *J. Food Sci*., 60:963-965.

Murano, P. S. (2005). Understanding Food Science and Technology, 1st ed., Thomson/Wadsworth, Belmont, Cal., USA.

Ogunsola, O. O. and Omojola, A. A. B. (2008), Quantitative evaluation of *Dambu* prepared from beef and pork. *Afr. J. Biotech*. **7**: 1753-1758**.**

Omojola, A. A. B. (2008). Yield and organoleptic characteristics of Suya (an intermediate moisture meat) prepared from 3 different muscles of a matured bull. *Afr. J. Biotech*. **7** 2254-2257.

Onwuka, U. N. and Nwosuagwu, U. N. (2005). Effect of four local Vegetable Leaves on the Protein and Microbial Content of Smoked and Dried Beef, *Nig. Food J*. 23: 74-84.

Salihu, M. D., Junaidu, A.U., Magaji A. A., Aliyu, R. M., Yakubu, Y., Shittu, A. and Ibrahim, M. A. (2010). Bacteriological Quality of Traditionally Prepared Fried Ground Beef (Dambun Nama) in Sokoto, Nigeria. *Advance Journal of Food Science and Technology***, 2** (3):145-147.

Schilling, M.W., Behrends, J. M., Williams, J. B. and Jackson, V. (2009). Flavour Challenges of Sodium Reduction, *Meat Int*. **19** (5/6): 8-10.

Speedy, A. W. (2003). Global production and consumption of animal source foods, *J. Nutr*.133

Umar, S. (2015). HACCP during the Production of Traditional Meat Snacks. Microbiological Hazard and Critical Control Point Analysis of Dried and Minced Meat Snacks Produced in Kano, Nigeria.Lambart Academic Publishing, OmniScriptum GmbH & Co. KG, Germany, Pp. 67.

World Population Data Sheet, WPDS (2010). Population Reference Bureau, Washington D.C. Accessed online from www.world.population.data.sheet.pop.ref.b.. On 7th March, 2018.

ANTIOXIDANT EFFECT OF SPRING ONION (*Allium fistolusom*) ON FRESHLY PREPARED CHEVON SUYA (TSIRE)

Luka J. S.[1*], Oshibanjo D.O.[1], Adeshola Ayobami [2], Njam R. L[3] and Johnson Mfon[1]

[1*] *Animal Production Department, Faculty of Agriculture, University of Jos, Jos Plateau state, Nigeria.*
[2]*Animal Science Department, Faculty of Agriculture, University of Ibadan, Ibadan Oyo state, Nigeria*
[3]*Poultry Division, National Veterinary Research Institute, Vom Plateau State, Nigeria*
Jsaboluka2013@gmail.com
+2348069662059

ABSTRACT

This study was carried out to assess the quality of Chevon Suya (tsire) as affected by the addition of varied levels of Spring Onion (*Allium fistulosum*) leaf powder. Spring Onion powder (SOP) was added to suya spices at 5% and 10% inclusion levels (Treatment 1: Control, 2: 5% SOP and 3: 10% SOP). in a completely randomized design. Products yield (%), pH, oxidative rancidity (mg/g) and microbial load (cfu/g) were assessed on prepared Chevon Suya. Data were analysed using descriptive statistics and ANOVA at $\alpha_{0.05.}$ Reduction in PY, OR, and ML was observed as the SOP inclusion level increased while pH increased with increasing SOP inclusion. Product yield was 94.8% in control Suya and 73.54% in 10% SOP Suya while Oxidative rancidity was 8.56mg/g in control Suya and 7.29mg/g in 10% SOP Suya. Microbial load decreased from 5.19cfu/g in control to 4.28cfu/g in 10% SOP Suya. The pH increased from 6.47 to 6.92. The result obtained shows that SOP has acceptable antioxidant and antimicrobial activities. SOP could be used up to 10% in spices for Chevon Suya production.

Keywords: Chevon, Suya, Spring Onion (*Allium fistulosum*), Antioxidant

INTRODUCTION

Plants contain different bioactive compounds such as carotenoids, phenolic compounds, tocopherols, carotenoids most of which have been reported to have a variety of biological effects such as antioxidant, anti-carcinogenic, anti-inflammatory, and anti-microbial activities (Ehsani *et al.*, 2017). The Allium group is one of the world's most widely cultivated vegetable groups, with their culinary and medicinal uses. Their antimicrobial activity, long recognised in folk remedies has also been validated (Malairajan *et al.*, 2006).

Suya is an intermediate moisture meat product that is easy to prepare and is highly relished. It is a traditional spicy, ready-to-eat, barbecued, smoked or roasted meat product prepared from beef, mutton or chevon (Oshibanjo *et al.*, 2019). Spring onion is a promising source of bioactive compounds such as quercetin and flavonoids that exhibit various biological activities (Ding *et al.*, 2015) which can be harnessed in meat and meat product preservation.

This study therefore assessed the quality of cheron suya (tsire) as affected by the addition of varied levels of Spring Onion (*Allium fistulosum*) leaf powder..

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was conducted at the Animal Products and Processing laboratory, Faculty of Agriculture, University of Jos , Plateau state, Nigeria.

PREPARATION OF SPRING ONION LEAF POWDER

Fresh Spring Onion Leaves was purchased from the Farin-Gada Market Jos, thoroughly washed with clean distilled water and dried under shade for four days to maintain their greenish colour and nutritive potency. The leaves were thereafter ground and sieved with 0.2mm fine mesh to obtain the Spring Onions leaves powder which were then stored in air tight containers and properly labelled.

MEAT PREPARATION

A mature buck was purchased, rested, stunned using physical method then slaughtered. It was hoisted, skinned and eviscerated. Carcass was cut into its primal parts and refrigerated overnight. The meat was deboned and trimmed of all connective tissues. It was cut into pieces and sliced in the same direction of the muscle fiber. Meat was staked on already tagged slender wooden sticks, meat sheets were weighed and randomly assigned into three treatments with ten replicates per treatment.

PREPARATION OF SUYA INGREDIENTS

Spices were purchased at the Jos Farin-Gada Market, Jos, Plateau State and were thoroughly mixed based on the composition stated below.

Table 1. Composition of suya ingredients with different levels of leek leaf powder

Ingredients	Control	5% SOP	10% SOP
Groundnut cake	52.00	47.00	42.00
Leaf powder	0.00	5.00	10.00
Ginger	6.00	6.00	6.00
Garlic powder	6.00	6.00	6.00
Red dried pepper	12.00	12.00	12.00
Salt	8.50	8.50	8.50
Turmeric	6.00	6.00	6.00
Maggi	7.50	7.50	7.50
Groundnut oil	2.00	2.00	2.00
TOTAL	100.00	100.00	100.00

*SOP: Spring onion powder

PREPARATION OF SUYA

The already staked meat was properly coated with the formulated ingredients (Table 1) and each treatment were labeled using a masking tape at the bottom of the sticks. The weight of each suya was determined after roasting and this was used in calculating the percentage loss and the product yield.

PARAMETERS MEASURED

pH determination

The pH was determined using a digital pH meter model PHS-25 Microfield England according to the method described by AOAC (2010)

PRODUCT YIELD

The meat was cut, weighed and roasted on a fire from wood to an internal temperature of about 72°C. Each roasted sample was cooled to room temperature, blotted dry and weighed.

$$\text{Product yield} = \frac{\text{Weight before roasting} - \text{Weight after roasting}}{\text{Weight before roasting}} \times 100$$

OXIDATIVE RANCIDITY DETERMINATION

Thiobarbituric acid value (TBA) was estimated by modified methods of Buege and Aust, (1976)

MICROBIAL LOAD DETERMINATION

Microbial count was done using pour plate method according to Harrigan W. F and McCanee M. E. (1976).

EXPERIMENTAL DESIGN

The experimental design was a completely randomized design

STATISTICAL ANALYSIS

Data collected were analyzed using General Linear Model of SAS (2019) with storage days and method as fixed factors. Statistical variations were observed and means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSION

Product yield of Suya prepared with spring onion powder-based spices is presented in table 1. The control has the highest product yield of 94.8%. The product yield decreased from 84.38 to 73.54% in the Suya with the Spring onion powder as its inclusion level increased. This agrees with reports by Omojola (2008) on the yield and organoleptic characteristics of Suya prepared from three different muscles of matured bulls.. The result obtained in this study could be due to low water holding capacity of the test ingredient.

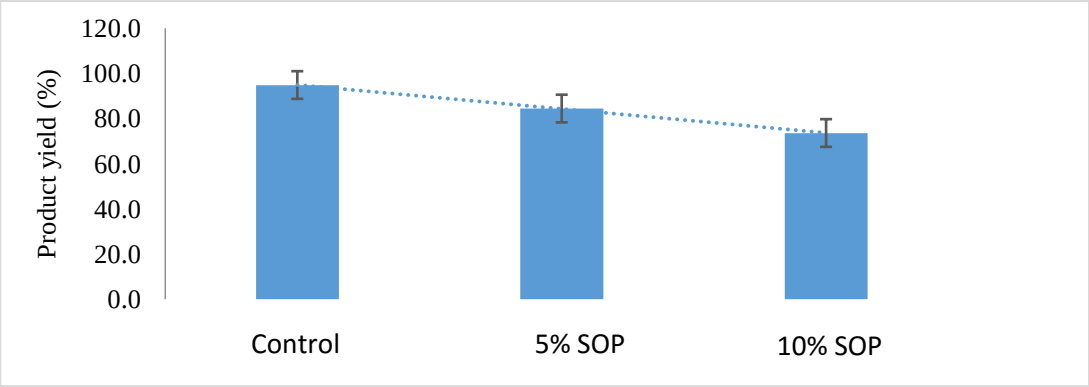


Figure 1: Product yield of Suya prepared with spring onion powder-based spices

*SOP: Spring onion powder

Figure 2 shows the physicochemical properties and microbial count of chevon Suya prepared with spring onion powder. The pH value of chevon Suya was significantly higher in 10% spring onions with least pH in the control treatment. The oxidative rancidity ranged from 7.29 to 8.56 mg/g. This result shows that as the inclusion level of Spring Onion increased, the oxidative rancidity values decreased. This could be due to the antioxidant activity and phytochemical substance presence in the spring onion.

Oxidative rancidity value determines the extent of lipid oxidation. Results on oxidative rancidity of this study is similar to reports by Magra *et al*. (2006) and Zaki *et al.*, (2018). There was significant difference ($p<0.05$) in Aerobic bacteria count (CFU/g) among the treatment with the control having the highest value (5.19 CFU/g) and 10% spring onion having the least value (4.28 CFU/g). Total aerobic plate counts for chevon suya treated with spring onion powder are acceptable when compared to suggested range of 2.5×10^5- 1.0×10^8 CFU/g by Pearson (1996) as cited by Fakolade (2012). The result obtained in this study could be due to the antimicrobial activity and the phenols presence in the tested ingredient.

CONCLUSION

Spring onion powder could be added to spices used in Suya production up to 10% because of its high antioxidant and antimicrobial properties

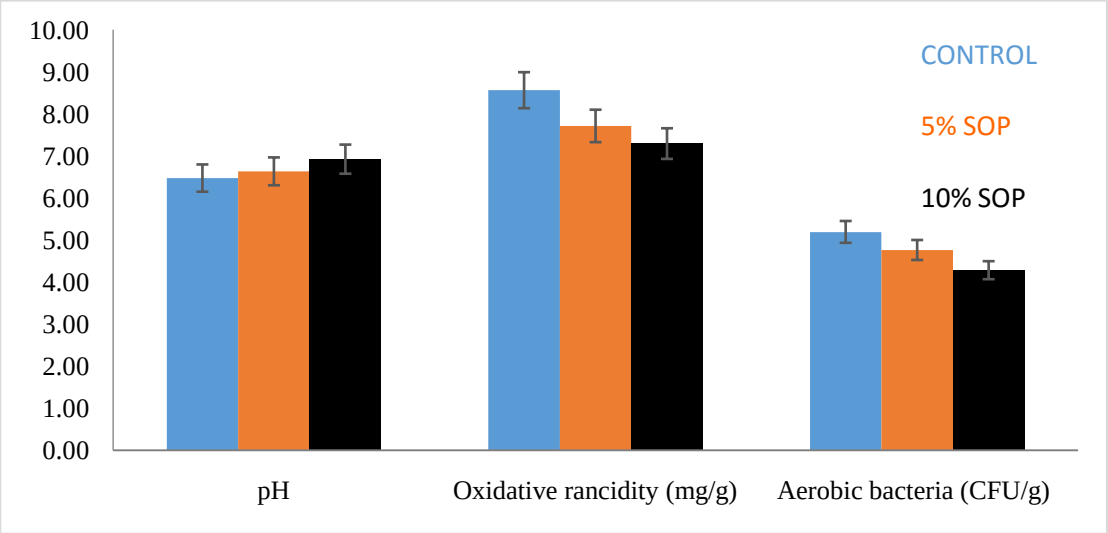


Figure 2: physciochemical and microbial count of chevon Suya prepared with natural antioxidant
*SOP: Spring onion powder

REFERENCES

AOAC(2010) Official methods of analysis. 15th ed., Assoc.Offic. Anal. Chem., Washington DC, USA.

Buege, J.A. and S.D. Aust (1978). Microsomal Lipid, Peroxidation. In: Methods in Enzymology, Vol. 52,Flesicher, S. and L. Packer (Eds.).,Academic Press, New York, pp: 302-310

Ding, Y., Wang S.Y., Yang, D.J., Chang, M.H., Chen, Y.C (2015). Alleviate effects of Litchi (*litchi chinensis sonn.*) Flower On Lipid Peroxidation And Protein Degradation In Emulsified Pork Meatballs. *Journal of Food Drug Analysis*. 23:501-508. https://doi.org/10.106/j.jfda.2015.02.004

Ehsani, A. and Mahmoudi, R. (2017). Phytochemical properties and hygienic effects of Allium ascalonicum and pimpinellaanisum essential oils in lranian white brined cheese. *Journal of ssential Oilbearing Plants*15(6):1013-1020. https://doi.org/10.1080/097206

Fakolade, P.O., (2012). Quality Characteristics and Microbiology Status in Kundi, an Intermediate Moisture Meat (IMM) Product. *Journal of Agricultural Science and Technology*. 2(7b):841-847

Harrigan W. F and McCanee M. E. (1976). Laboratory methods in food and dairy microbiology, Academic Press, London, pp 17-68

Magra TI, Bloukas JG, Fista GA. Effect of frozen and dried leek on processing and quality characteristics of Greek traditional sausages. *Meat Science*. 2006;72:280–287

Malairajan, P., Geetha, G., Narasimhan, S. and Jessi, K. (2006). Analgesic Activity of Some Indian Medicinal Plants. *Journal of Ethnopharmacol*. 19:425-428.

Omojola A.B. (2008) Yield and organoleptic characteristics of Suya (an intermediate moisture meat) prepared from 3 different muscles of a matured bull. *African Journal of Biotechnology* 7 2254-2257

Oshibanjo, D.O., Olusola, O. and Adepoju, G. (2019). Quality Assesement of Suya (Tsire) as affected by Moringa Leaf Powder. International *Journal of Meat Science*, 9: 1-6

Pearson, D. (1996). Application of Chemical Methods for assessment of beef quality. *Journal of Food Science*. 19: 364-366

SAS (2019). SAS/STAT User's Guide: Version 9.2. SAS Institute Inc., Cary. NC., USA.

Zaki, E.F. and Khallaf, M.E. (2012). Effect of Adding Leek As A Natural Source Of Nitrite On The Processing And Quality Properties Of Camel Sausage During Frozen Storage. *Journal of Advances in Food Science & Technology* 5(1): 27-33

COMPARATIVE STUDY OF THE SENSORY QUALITIES OF *TSIRE* (AN INTERMEDIATE MOISTURE MEAT) PREPARED WITH BAOBAB SEED POWDER AND GROUNDNUT CAKE POWDER

[*]Ahmad Y.[1], Abdu S.B.[2], Bello S. S[2], Yaqoob R.[1], Sadiq A. A.[3], and Umar M. M.[4]

[1] National Agricultural Extension and Research Liaison Services ABU Zaria
[2] Department of Animal Science Ahmadu Bello University, Zaria
[3]FCT College of Education Zuba - Abuja
[4]Department of Animal Science Federal University Kashere
[*]Corresponding Author: u09ag1106@gmail.com, 07036660666

ABSTRACT

A comparative study of the sensory qualities of *tsire* prepared with baobab seed powder and groundnut cake powder was conducted in this study. Spiced (Baobab/Kulikuli + spices) and unspiced (Baobab/Kulikuli + no added spices) *tsire* samples were prepared to determine their proximate and organoleptic/sensory quality attributes which included: colour, flavour, texture, juiciness, tenderness, firmness fatness and overall acceptability. Thirty Semi-trained panelists were used to assess the meat samples based on a nine-point hedonic scale. The results were subjected to analysis of variance in a complete randomized design. Results from the study indicated that, there was no significant difference ($P>0.05$) in the general acceptability of the *tsire* prepared from spiced or unspiced ingredients. The *tsire* prepared from spiced baobab seed powder showed significantly ($P<0.05$) higher organoleptic qualities compared to that produced from groundnut cake powder. From the result of this study, it has shown that baobab seed powder could be used to process *tsire*.

Key words: Tsire, Baobab Seed Powder, Groundnut Cake Powder, Acceptability

INTRODUCTION

Meat is the flesh and tissues or organs of animals with a highly nutritive value used as a food ingredient that is consumed by human beings, which provides quality protein (essential amino acids), minerals like iron and essential vitamins (Sebibe, 2014). There are different types of meat depending on the specie of animal from which they are obtained, for example, mutton from sheep, chevon from goat, beef from cattle, pork from pig and chicken from poultry (Soniran and Okunbanjo, 2002). In various parts of Nigeria meat is widely processed into different forms such as *Tsire, Balangu, Kilishi, Dambun-nama* (meat floss), *Banda* and *Kundi* (Ribah *et al.*, 2013; Inyang *et al*., 2005), according to culture and availability and consumed as a delicacy or source of protein (Olaoye and Onilude, 2010). However, other reasons for meat preference and consumption besides nutritional value or protein are: socio cultural, income level, religion, age, sex, individual differences, enjoyment, affluence, prestige and sensory properties.

The consumption of meat and its products like *tsire, balango, ganda, kundi, dambunnama (*meat floss) and *kilishi* has increased both from northern to southern part of Nigeria as well as other African countries (Igene and Mohammed, 1983; Inyang *et al*., 2004; Inyang *et al.*, 2005; Igene, 2008 and Omojola, 2008). These meat products vary in their quality attributes due in part to the ingredients used which might help to avoid associated spoilage, and thus increasing their shelf life as well as sensory properties.

Tsire is a roasted Nigerian spicy snack meat product that is popularly consumed and relished cosmopolitantly.

There is high demand for the utilization of groundnut and its products for both humans and animals as indicated by (Boli et al., 2014; and Ademola *et al*., 2015). *Kulikuli* is produced through roasting groundnut, grinding it, extracting its oil and then frying it to obtain the final product (Adjou *et al.*, 2012). *Kulikuli* powder is one of the major ingredients in the production of *Tsire.* However due to cost effect, variety and possible toxic issues (aflatoxin) associated to *Kulikuli* other ingredients could be used. Therefore, a cheaper and nutritiously similar ingredient such as baobab seed powder may be used as either supplement, replacement and value addition in the production of *Tsire*.

Food and agricultural scientists undergo series of research to discover wild and under-exploited native plants for possible potential value chain sources of food and value addition for increase food production (Vietmeyer and Janick 1996; Oelke *et al*., 1997). Several reports have also indicated that lots of lesser-known native crop species are high in nutrients and could possibly relieve critical food shortages if given adequate promotion and research attention (Murray *et al*., 2001). Baobab is good in nutrients like protein, vitamins, minerals, fibre and believed to have less microbial invasion. Processed baobab seeds are used as flavouring for soups, and also as a side dish, substituting peanut. (Addy and Eteshola, 1984). The seeds are also pressed for oil but the by-product, baobab seed cake is typically underutilized (Osman 2004) making baobab powder an amazing ingredient for this experiment.

MATERIALS AND METHODOLOGY

Experimental site

The study was conducted in the Animal Products and Processing Laboratory of the Department of Animal Science Faculty of Agriculture, Ahmadu Bello University Zaria, which is located between latitude 11°and 12° on an altitude of 646m above the see level (GPS, 2018). The area falls within the Northern-Guinea Savannah of Nigeria, with an average annual rainfall of 1100mm and varying temperature from 26°C to 35°C depending on the season. The mean relative humidity during the harmattan period and the wet season were 21% and 72% respectively (IAR, 2018).

EXPERIMENTAL MATERIALS

Chevon (goat meat), skewers (*geza*), 20kg weighing balance, 2kg sensitive kitchen scale, knife, ground nut cake powder, baobab seed powder, curry, common salt, seasoning cube, vegetable oil, dry pepper, sieve, trays, buckets, wire mesh, charcoal, paper tape, rubber containers, foil paper, tissue paper.

SAMPLE PREPARATION

Raw chevon of about 5kg was obtained from the Animal Products and Processing Laboratory of the Department of Animal Science Ahmadu Bello University Zaria. The meat (chevon) was deboned and cut into strips then further sliced into thin sheets using knife as outlined by Oyadeyi *et al*.,(2014).

INGREDIENT PREPARATION AND SKEWERING PROCESS

The ingredients were sourced from Tudun Wada Zaria market. The baobab seed was roasted for about 30 minutes, then dried and grinded finely into powder. Both baobab and *kulikuli* powder and other ingredients were mixed in a specific ratio of 100% as shown in table 4.

A total of fourty pieces of wooden skewers were used for four treatments 1,2,3,4, as plain *kulikuli*, plain baobab seed powder, spiced *kulikuli* and spiced baobab seed powder (ten each). The meat was skewered by piercing it at the center of the skewers with four slices of meat per skewer and then pressed and coated properly with the spice mix that was spread on a tray. The coated meat was then grilled on a smokeless fire made from charcoal that was medium hot at around 140°C for about 35 minutes with regular turning. The distance of the sticks from the center of the fire was about 25-30cm with regular turning of the product and intermittent addition of vegetable oil of about 2-3ml as described by (Igene and Mohammed 1983; Omojola, 2008) .

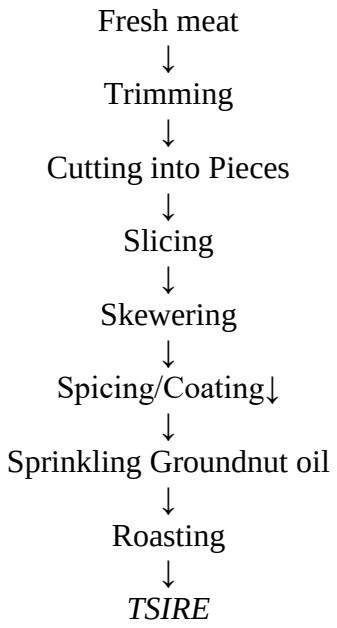


Figure 1: *Tsire* processing

SENSORY EVALUATION

A total of thirty semi-trained panelists (male and female) were used for the sensory evaluation of the meat samples using a 9-point hedonic scale; 1=like extremely; 2=like very much; 3=like moderately; 4=like slightly; 5=neither like nor dislike; 6=dislike slightly; 7=dislike moderately; 8=dislike very much; 9=dislike extremely for meat eating quality attributes (colour, texture, tenderness, aroma, juiciness, and overall acceptability). A blind coding and two equal order of arrangement were used for the meat samples as shown in Appendix I. During the evaluation, crackers biscuits and sachet water were provided for all the panelists.

STATISTICAL ANALYSIS

The data collected was subjected to analysis of variance (ANOVA) using (SAS 2004), the treatment means were separated using Duncan Mean Range Test (DMRT).

RESULTS AND DISCUSSION

PROXIMATE COMPOSITION

The Proximate compositions of baobab and *kulikuli* were presented in Table 1. The protein content of baobab seed 26.71% which is compared though lower by that obtained by Ajayi *et al.* (2006) 36.00% and was higher than 13.40% of *kulikuli*. Baobab seed 35.48% had higher lipid content than 23.21% of *kulikuli.* The lipid content is within the range obtained by Ajayi *et al.* (2006) which was 33.00%. The NFE content of *kulikuli* was 52.19% which was higher than that of baobab seed of 15.55%. Ajayi *et*

al. (2006) reported 39.90% of carbohydrate. The fibre content (2.35 %) of baobab was higher than 0.26% that of *kulikuli* but lower than that obtained by Ajayi *et al.* (2006) which was 6.71%. the ash content of 14.51% of the baobab seed powder was higher than that of *kulikuli* (4.63%) and that obtained by Ajayi *et al.* (2006) 7.50%. These differences might be dew to sources of the seeds, moisture content of 7.76% which was higher than that 5.02% of (Ajayi *et al.* 2006).

SENSORY SCORES OF *TSIRE* PRODUCED FROM BAOBAB AND *KULIKULI*

The result of the sensory evaluation was presented in table 2 showed that there was no significant difference (P>0.05) in the general acceptability between the *tsire* that was produced from plain baobab and plain *kulikuli* from the mean values. There was significant difference (P>0.05) in the mean values of *tsire* produced from the spiced baobab compared to spiced *kulikuli*. However, since the cost of production affected the profitability of any production the result on Table 3, showed that, the use of *kulikuli* was more costlier than the use of baobab seeds.

CONCLUSION

It can be concluded from the study that, baobab seed has high protein and fibre contents as compared to *kulikuli*. Baobab seed could be used as a supplement or replacement of *kulikuli* in the production of *tsire*. The use of baobab seed powder is more cost effective than using *kulikuli*.

RECOMMENDATIONS

It can be recommended that;

Baobab should be used as a supplement or replacement for *kulikuli* in the production of *tsire*. More research on the availability, acceptability and utilization of baobab and other related food materials could be conducted for value addition.

Table 1: Proximate Analysis of Baobab seed powder and Kulikuli powder

Sample	% Moisture	% Ash	% Protein	% Lipid	% Fibre	% NFE
Baobab seed powder	**7.76**	**14.51**	**26.71**	**35.48**	**2.35**	**15.55**
Kulikuli powder	**6.31**	**4.63**	**13.40**	**23.21**	**0.26**	**52.19**

Source: Emelike and Akusu 2018

Table 2: Sensory Scores of *Tsire*

Treatment	Color	Texture	Tenderness	Aroma	Juiceness	Acceptability
1	1.86^{d}	2.83^{ab}	3.31^{a}	2.76^{bc}	3.03^{bc}	3.03^{bcd}
2	2.59^{cd}	2.83^{ab}	3.41^{a}	2.52^{c}	3.52^{abc}	3.03^{bcd}
3	2.37^{cd}	2.80^{ab}	3.10^{a}	2.70^{bc}	2.50^{c}	2.13^{d}
4	2.80^{bcd}	3.20^{ab}	3.03^{a}	2.73^{bc}	2.93^{bc}	2.50^{cd}
SEM	0.54	0.49	0.45	0.50	0.47	0.44

Table 3: Cost Analysis

Baobab seed Powder				***Kulikuli* Powder**			
Ingredients	%/kg meat	Proportion	Price/kg meat	Ingredients	%/kg meat	Proportion	Price
Baobab	71.7	358.5	100	*Kulikuli*	71.7	358.5	250
salt	4.1	20.5	10	Salt	4.1	20.5	10
Pepper	4.9	24.5	50	Pepper	4.9	24.5	50
Ginger	2.0	10	50	Ginger	2.0	10	50
Curry	1.3	6.5	50	Curry	1.3	6.5	50
Seasoning	8.1	40.5	50	Seasoning	8.1	40.5	50
Oil	7.8	39	100	Oil	7.8	39	100
Total	100	499.5	410	Total	100	499.5	560

REFERENCES

Addy, E. O. and Eteshola, E. (1984) Nutritive value of a mixture of Tiger nut tubers (*Cyperus esculentus L.*) and baobab seeds (*Adansonia digitaria L.*) *J. Sci. Food Agric.* 35: 437 – 440

Ademola, S. G., Shittu, M. D., Osanyande, M. O., Omidiji, O. E. (2015). *Effects of Mycotoxin Detoxifier Supplementation to Contaminated Groundnut Cake on the Growth Performance*, Organs and *Serum Enzymes of Two Broiler Strains*. *International Journal of Agriculture Innovations and Research* Volume 4, Issue 2, ISSN 2319-1473 *https://pdfs.semanticscholar.org*

Adjou, E. S., Yehouenou, B., Sossou, C. M. (2012). Occurrence of mycotoxins and associated mycoflora in peanut cake product (*kulikuli*) marketed in Benin. *African Journal of Biotechnology*, 11(78): 14354. DOI:

Ajayi, I.A., Oderinde, R.A., Kalogbola, D.O. & Ukponi, J.U. (2006). Oil of Under utilized Legumes from Nigeria. J. Food Chem. 99(**1**): 115-120.

Boli, Z. A., Zoue, L. T, Alloue-Boraud, W. M., Kakou, C. A., Koffi-Nevry, R. (2014).*Proximate composition and* mycological characterization of peanutbutter sold in retail markets of Abidjan(Côte d'Ivoire). *Journal of AppliedBiosciences*, 72(1): 5822-5829.

GPS. (2018). Government Policy Statement on Land Transport - Ministry of Transportation. *Government Policy Statement on Land Transport*

www.transport.govt.nz › assets › Our-Work › Documents

IAR, (2018). Meteorological Services Unit, I. A. R. Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Igene, J.O., Mohammed I.D., Consumer preferences and attitudes to *Suya*, an indigenous meat product, *Annals of Borno* 1. (1983) 169-178.

Igene, J.O. (2008). *Traditional African meat Products for food security and agroindustrialization: development challenges.* Lambert Academic Publishing, Germany, PP. 1 –210.

Inyang, C. U., Igyor, M. A., Uma, E.N. (2004).Bacterial quality of a smoked meat product (*Suya*).*Nigeria Food Journal 23: 239 –242.*

Murray, S.S. (2001). Nutritional Composition of some wild Plant Foods and Honey used by Hadza Forages of Tanzania. *Journal of Food Composition and Analysis*.**14**:3-13

Oeike,E.A., R.A. Porter, R.A.W. Grombache and P.B Addis, 1997. Wild rice new interest in an old crop Cereal Foods World, 42: 234-247

Olaoye, O. A. and Onilude, A. A. (2008). Microbiological, proximate analysis and sensory evaluation of baked products from blends of wheat-breadfruit flours. *African Journal of Food Agriculture, Nutrition and Development*. 8/ 2 : 1684 – 5384, http://www.bioline.org.br/pdf?nd08017:

Omojola, A.B. (2008). Yield, Organoleptic characteristics of *suya* (an Intermediate Moisture Meat) prepared from three different muscles of a matured bull. *African Journal of Biotechnology* 7 (13): 2254 – 2257. Available online at: http://www.academicjournals.org/AJB

Osman, M.A. (2004). Chemical and Nutrient Analysis of Baobab (*Adansonia digitata*) fruit and seed protein solubility. *J. of plant foods for human nutrition* **(59)**:29-33 Available at www.springerlink.com/content/101424514455215 Accessed 21st Jan. 2011.

Oyadeyi, O.S., Olusola, O. O. and Adebisi T.T. (2014). Organoleptic and Chemical Evaluation of Suya. (An Intermediate Moisture Meat) Cured with *Ocimum gratissimum* Extract. *Nova Journal of Engineering and Applied Sciences,* Online ISSN:2292-7921.

mycological characterization of peanutbutter sold in retail markets of Abidjan(Côte d'Ivoire). *Journal of AppliedBiosciences*, 72(1): 5822-5829.

SAS. (2004). Statistical Analysis System. SAS User's Guide Statistical, Release 6.12 Educations. SAS Inst. Cary, NC, USA.

Sebibe, A. (2014), Sheep and Goat characteristics and Quality, Chapter 12. Ethiopian Sheep and Goat Productivity improvement programme. Assessed from www.esgpip.orgon.

Soniran, O.G. and Okubanjo, A. O. (2002). Physico-chemical and sensory characteristics of pork loin roast cooked to three internal *Nig. Journal of Animal Production* Vol 29, No 1 (2002)

Vietmeyer, N. and J. Janick, 1996. New crops Pagfes 2-8 In: Proceedings of the Third National Symposium of AmericanSociety of Horticultural Scientist, Alexandria, USA, 22-25

ACCEPTANCE OF YOGHURT PRODUCTION AS EMPOWERMENT BY WOMEN GROUPS IN RANO LOCAL GOVERNMENT AREA OF KANO STATE

A.U. Daninna[1], Y. Garba[2] and A.M.Umar[3]

5. School of Rural Technology and Entrepreneurship Development, Kano State Polytechnic, Kano, Nigeria.
6. Centre for Dryland Agriculture, Bayero University, Kano.
7. Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

ABSTRACT

This Supervised Enterprise Project (SEP) was conducted in order to create awareness, empower and impart the skills and knowledge of sustainable techniques of milk processing by converting it to yoghurt. The project empowered thirty rural women leaders in Rano town, Rano LGA of Kano State on how to make yoghurt from fermented cows' milk (nono), thus helping them economically. One hundred questionnaires were distributed to one hundred households in order to assess socio-economic aspects of milk producers in Rano LGA. Chi-square and simple descriptive statistics were used to analyse and describe the data collected. Majority of the farmers had poor knowledge of improved yoghurt processing prior to this project. However, all the farmers reported to have improved their yoghurt processing skills after the project. Furthermore, majority of the farmers indicated willingness to adopt the technology acquired. Chi-square analysis showed that there was a significant ($p<0.05$) difference in willingness to adopt the yoghurt technology between owners of large and small herds, which indicates that, farmers with large number of animals in their herd were more willing to adopt yoghurt technologies than those with fewer animals.

Keywords: Yoghurt, women, empowerment

Corresponding author: sazeeq@yahoo.com Phone no: 08032801005

INTRODUCTION

Fresh Milk is highly perishable, as such, it should be immediately consumed in its fresh form (Yahuza, 2000). Fresh Milk can also be processed into fermented products which could improve the quality and nutritive value (Cashman, 2002).

The problem of low milk yield and of low quality in dairy cattle under tropical environment is held as one of the most important limiting factor to the rapid growth of the dairy industry in Nigeria, and the problem is attributed to a number of factors, which included climate, genetic potential of breeds, inadequate nutrition, diseases and poor management (National Livestock Project Division, 1992). In recent time under nutrition and low protein caloric intake has been recognized in developing countries of the world. The measures to be adopted to correct the nutritional deficiencies in both child and adult population in these countries are still subject to widely differing opinions.

On one hand, loss of milk quality largely due to lack of techniques for improving preservation and lifespan of fermented cow's milk (nono) was identified as a major challenge that requires intervention. Furthermore, improved milk processing techniques can increase output and quality of the milk and hence invariably increase sales and consumption. When there is an increase in sales, the women's income will increase, thus their livelihoods and that of their families will be improved. Milk processing into yoghurt may be of immense help to curb the problem of milk spoilage which leads to immeasurable losses to farmers. The project will also improve the storability of milk for the producers to target better markets and prices. More so, an increased consumption of milk and yoghurt by the people will increase their protein intake and thus increase their health (Barr *et al*., 2000).

PROJECT CONTEXT

The project was conducted as a Supervised Enterprise Project which is an organizational component of Sasakawa Africa Fund for Extension Education (SAFE). The project empowered rural women on how to make yoghurt from fermented cows' milk (nono), thus helping them economically.

MATERIALS AND METHODS

THE STUDY AREA

The training was conducted in Rano town, Rano Local Government Area (LGA) of Kano State. Kano is located in the North-Western part of Nigeria at latitude 12°3'N and longitude 8°32'E with an average temperature of 26.2 °C with warmest temperature being 38 °C in April and the coolest temperature being 13 °C in January and December. The state also receives an average of 873 mm of precipitation annually. The months with the driest weather are January and December. Mean relative humidity was recorded as 31.1% (KNARDA, 2008). On the other hand, Rano has an area of 520Km^2 and a tropical climate. The temperature and rainfall averages are 25.8 °C and 865 mm respectively (Climate-Data.org, 2015). Inhabitants are mostly Fulani cattle rearers and, therefore milk production is one of the major economic activities in the area.

PRELIMINARY ACTIVITIES

A need assessment exercise was carried out at Unguwar Dam, Rano Local Government area, Kano State. The inhabitants were mostly farmers engaging in both crops and animal husbandry. They cultivate crops in both raining and dry seasons. A stakeholders meeting was conducted to identify the areas of priority which people of the study area will mostly benefit from. Both the first and the second stakeholders meetings employed the use of focus group discussion. The first community meeting was conducted on 20th May, 2016 including various stakeholders of the projects. The target farmers were women cooperative societies to assess their various needs.

The project began by introducing the research student to women groups in the LGA and a convenient location was selected for a one-day training. Thirty women leaders were selected after they have obtained proper recommendations from their district heads and Local Government supervisors. Materials required for the training were purchased in Singer market in Kano and a date was set and communicated to all the participants via short message service (SMS).

SAMPLING

One hundred questionnaires were distributed to one hundred households to assess socio-economic aspects of milk production in Rano LGA. The questionnaires were distributed in all the ten (10) wards of the LGA. Ten questionnaires were distributed in each of the wards and the ten households selected within each ward were randomly selected.

INPUTS USED

The materials to use include water, Potassium sorbate powder ($C_6H_7KO_2$ _ preservative), Sodium Benzoate powder ($C_7H_5NaO_2$ _to hinder sourness), evaporated milk, powdered coconut flavour, sugar, cow milk (nono) and custard powder (predominantly made of starch). Equipment includes hand gloves, fine wire mesh sieve, 25 litres plastic containers, spatula, and spoon.

YOGHURT PREPARATION METHODS

On the day of the training, the participants were seated and provided with sample materials that they will practice with. The participants were told the importance of the training and the objectives. The need to train them, so that they train their group members was then emphasized. The student trainer led the training and demonstrated the step-by-step procedures of making yoghurt from cow milk (nono) while each participant used the equipment and materials provided to practically do what the trainer did. Each participant wore hand gloves and was lectured on the importance of hygiene. Furthermore, the training was video recorded to the participants in case they wish to refer to the procedures later.

Participants were guided on how to make a sample of 20 litres of yoghurt from cow milk (nono) as a group. One kilogramme of custard powder was put in a 25 litre plastic container. Five litres of cold water were poured onto the custard and smoothly mixed into paste. Ten litres of previously boiled (100°C) water was then poured to form a thick liquid paste, which was continuously stirred to avoid lumps. Five litres of finely churned cow milk (nono) was then added to the mixture and then thoroughly mixed. After a fine mixture was obtained, a fine sieve was then used to pass the liquid and

to ensure no lumps were left in the liquid. Thereafter, two tins of evaporated milk (410g, 380ml) were also added.

Ten grammes of Potassium sorbate powder (as a preservative), and ten grammes of Sodium benzoate powder (to hinder sourness) together with thirty grammes of coconut flavour were mixed with half cup of cold water and added to the mixture. Three hundred grammes of sugar was then added to taste. The diagrammatic representation of the procedure is shown in figure 1 below:

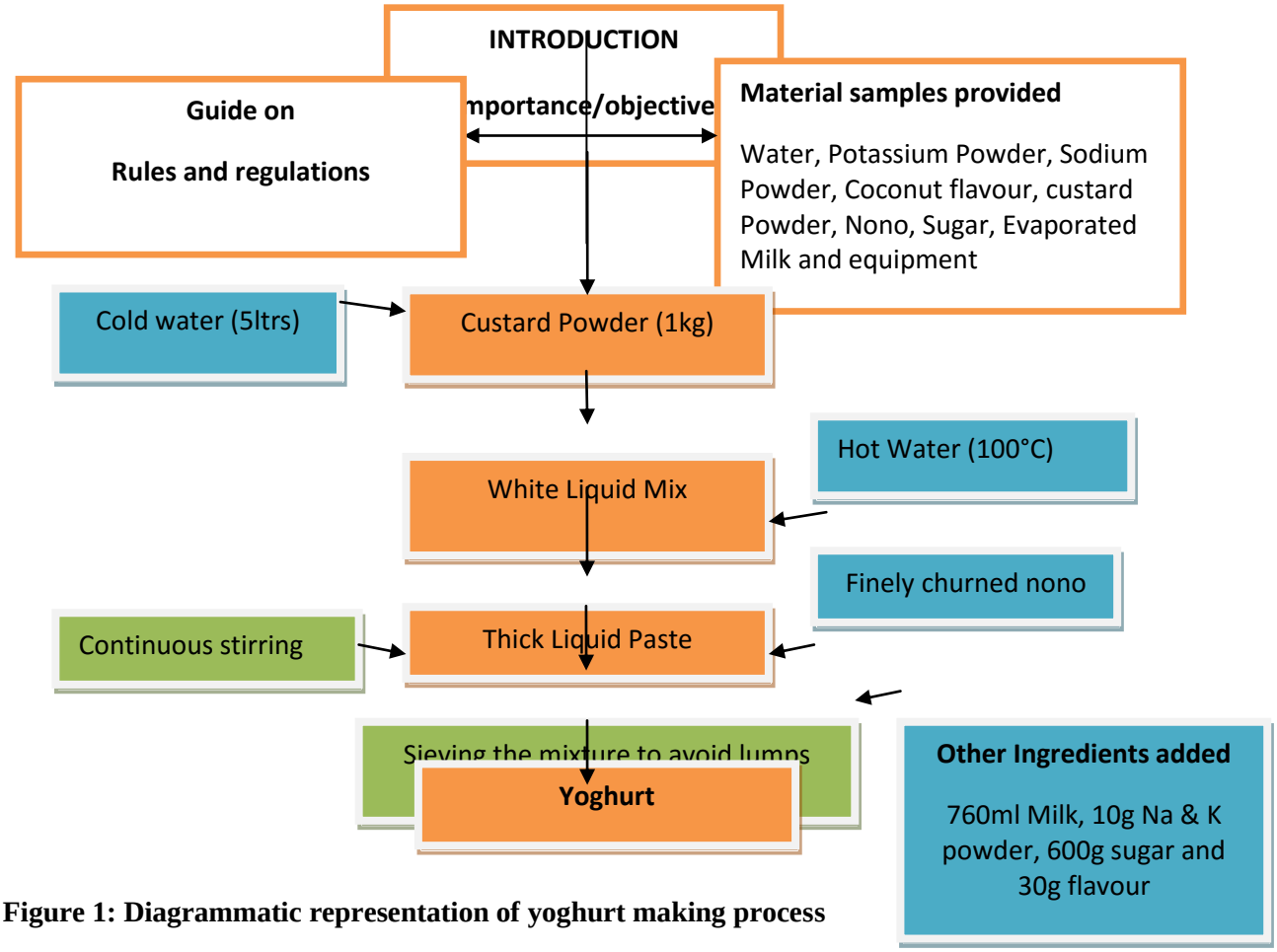


Figure 1: Diagrammatic representation of yoghurt making process

PACKAGING

An optional way of packaging and branding the yoghurt was taught to the participants. Participants were shown how to keep yoghurt by simply pouring it in used water bottles and then sold. A second option was to buy new empty bottles with sealing caps. Yoghurt should be filled up in the bottles and sold. Additionally, a trade name could be obtained and printed slips could then be attached to the bottles to further enhance the brand. However, license and approval must be sought for from relevant agencies.

TOOLS OF DATA COLLECTION

Questionnaire/interview schedule were used to collect primary data from the respondents. Secondary data was also collected from journals, textbooks and relevant websites.

DATA ANALYSIS

Simple descriptive statistics were used to describe the socioeconomic data of the respondents. Chi-square analysis was used to establish relationship between herd size and willingness to adopt yoghurt processing technology by the farmers with the aid of MAXSTAT©, VERSION 3.06 Statistical Package. Cost benefit analysis was used to ascertain the profitability of yoghurt production.

RESULTS AND DISCUSSION

Attempt was made to measure the impact of the yoghurt processing project on the participant farmers' experience, interest and willingness to adopt the new skills taught.

From table 1 below, majority (61.4%) of the participant farmers had poor experience of improved yoghurt processing before this project. This was followed by those with good experience level that were around 22.8%, excellent level 10.5% and fair level with 5.3%.

Also, after the training, majority (54.4%) of the participants reported to have gained improvement in their yoghurt processing skills. The fact that majority of the participants' skills were improved could be attributed to the techniques involved which ensured learning by doing through participatory action research as opined by Attah-Krah and Francis (1987). However, 45.6% of them reported no improvement in their skills. This non-improvement in skills as reported by the minority might be connected with the fact that, some participants did not fully participate in the training or some were naturally laggards.

Table 1: Impact Assessment of Yoghurt Processing amongst farmers in Rano town, Rano LGA, Kano State

Variable	Frequency	Percentage (%)
Experience before Training		
Excellent	6	10.5
Good	13	22.8
Fair	3	5.3
Poor	35	61.4
Total	57	100
Skills Improvement after the Training		
Yes	31	54.4
No	26	45.6
Total	57	100
Intention to Adopt the Technologies		
Yes	30	52.6
No	27	47.4
Total	57	100

Reasons for adoption		
Improve income	20	35.1
Reduce spoilage	24	42.1
Better Market	9	15.8
Others	4	7.0
Total	57	100

Source: Field Survey (2017)

From Table 1 above, 30 farmers (52.6%) showed willingness to adopt the new yoghurt technology they were taught during this project. This was probably due to simplicity of the procedures employed, availability and affordability of the ingredients and the practical and participatory approach used in the training sessions. Those who showed no interest to adopt the technology formed the minority (47.4%). Most of those willing to adopt the yoghurt technology mentioned that their reason was to improve income (35.1%) which was slightly lower than those who wanted to reduce spoilage (42.1%). A fraction of the farmers, i.e. 15.8% and 7.0% were willing to adopt the technology for a better market and other reasons respectively.

Table 2: Chi-Square Analysis of Willingness to adopt Yoghurt Technology between Small and Large Herd Owners amongst farmers in Rano town, Rano LGA, Kano State.

Response	Expected Frequencies	
	Small Herd Owners	Large Herd Owners
Yes	14.74	15.26
No	13.26	13.74

Chi square value = 14.75; Critical Chi square value= 3.84*; P value= 0.0001

The Chi-square analysis (Table 2) shows that, there was a significant ($p<0.05$) difference in the willingness to adopt the yoghurt technology between small herd and large herd owners in the study area. Thus, Number of cows owned by a farmer determines farmers' willingness to adopt milk processing technologies in the area. Those possessing large number of animals (above ten) were more willing to adopt the technology than those with fewer animals (below ten). It could be concluded that, farmers with large herd size were willing to put in their efforts to commercialize their venture as against the small herd owners who might be keeping the animals for subsistence and farm labour.

CONCLUSION

The thirty women trained were technically and economically empowered with the technical-know-how of yoghurt production that increased their potentials which resulted into more sources of

household income and subsequent betterment of living standards. Furthermore, estimates of cost and return of yoghurt production indicated that the venture was profitable and worth adopting by farmers. Additionally, farmers who had larger herds were more willing to commercialize their yoghurt production venture as against the small herd owners who might be keeping the animals for subsistence and farm labour.

RECOMMENDATIONS

The following recommendations were made with regards to the project:

4) The accessibility of yoghurt production materials should be increased, such that the people living in rural communities can purchase the materials and get involved in the production.
5) Furthermore, government intervention is necessary in all aspects of production to provide support to yoghurt producers in terms of materials of production, storage and marketing.
6) The marketing chain needs to be organised such that cooperatives and associations will be created to regulate production and pricing.

REFERNCES

Attah-Krah, A. N., & Francis, P. A. (1987). The role of on-farm trials in the evaluation of composite technologies. *Agricultural Systems*, **15**: 133-152.

Barr, S.I., Mccarron, D.A., Heaney, R.P., Dawson-Hughes, B., Berga, S.L., Stern,J.S. and Oparil, S. (2000). Effects of Increased Consumption of Fluid Milk on Energy and Nutrient Intake, Body Weight, and Cardiovascular Risk Factors in Healthy Older Adults. *Journal of the Academy of Nutrition and Dietetics*, **100**(7): 810–817.

Cashman, K. D. (2002). Calcium intake, calcium bioavailability and bone health, *British Journal of Nutrition*, **87**(2):69-77.

Climate-data.org. (2015). Rano. (Retrieved 28th August,2016) from: http://en.climate-data.org/location/382057/

KNARDA. (2008). Kano State Agricultural and Rural Development Authority, Danbatta Station Meteorological Report.

NLPD (National Livestock Project Division). (1992). National diary survey . NLDP, Kaduna, Nigeria.

Yahuza, M.I. (2000). Small Holder Day Production and Marketing Constraints in Nigeria National Livestock Project Division (WLPD); Yakubu Gowon Way Kaduna Nigeria.

TEACHING ANIMAL PRODUCTS IN NIGERIA: FROM MEAT SCIENCE TO TROPICAL ANIMAL PRODUCTS INDUSTRY

E.B. Sonaiya
Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Osun State.

ABSTRACT
At the introduction of courses in animal products (AP) in Nigeria, meat science was the main focus of the training. In response to graduate unemployment and the paradigm shift to entrepreneurship, self-employment and job creation for university graduates the curriculum was expanded to include topics in economics and marketing and to emphasize the business dimension of AP. For the curriculum review to be successful, there was the need to generate greater passion on the part of the teacher and the student to teach and learn, respectively, all the technical, as well as the business aspects of courses in AP. One well-tested way to generate student interest is to make textbooks available online in Open Access format that can be downloaded onto the smart phone. An Open Access e-book on the tropical animal products industry in Nigeria developed in compliance with instructional design directives evoked a higher student performance.
Key words: Teaching, Products, Course, e-book, Open-access

INTRODUCTION
In the early 1970s and 1980s, the first lecturers in animal products in Nigeria were trained in meat science (mostly in the US); for example: Professors Okubanjo (UI), Igene (UniMaid and UniBen), Sonaiya (OAU) and Aduku (ABU). Typical textbooks used and recommended were: Judkins and Keener, 1961, *Milk Production and Processing*; Lawrie, 1966, *Meat Science;* Zottola, 1972, *Introduction to Meat Microbiology*; Kramlich, et.al., 1973, *Processed Meats;* Forrest et al., 1975, *Principles of Meat Science*; Mountney, 1976, *Poultry Products Technology*; Price and Schweigert, 1978, *The Science of Meat and Meat Products*; and Frazier and Westhoff, 1978, *Food Microbiology*. By the middle to late 1980s, efforts were made to produce original textbooks that would accommodate the peculiarities of handling animal products in Nigeria. Three such texts were: Sonaiya, 1984, *Animal Products*; Ikeme, 1990, *Meat Science and Technology – A comprehensive Approach*; and Aduku and Olukosi, 1991, *Animal Products - Processing & Handling in the Tropics*. It was clear that the curriculum needed to be expanded to include topics in economics and marketing of animal products. In the same period, Taylor and Kauffman (1983) reported that the challenges facing the teaching of animal science included increased need for computer integration, improved communication skills, integration of business and economics into the livestock management systems and the approaches that will motivate students to learn and think. In Nigeria, the value chain approach to AP opens up investment opportunities in the AP industry (Sonaiya, 1998).
A hypothesis of this paper is that making textbooks available online in an Open Access format with lots of illustrations and downloadable onto the smart phone will lead to improved student performance.

MATERIALS AND METHODS
The response to changing needs for course content and student orientation must be accompanied by textbooks / instructional materials that are available online as electronic books in an Open Access format that makes access via the Internet as easy for the student as Facebook. To prepare adequate AP instructional materials requires the author to be familiar with curriculum and instructional design. In curriculum design, a course like Animal Products, as a segment of a B.Sc. / B. Agric. Animal Science (which can be visualized thus: Programme ← Courses ← Modules ← Study Units ← Sections ←

Sub-Sections), must contain at least 3 modules. A module is a number of logically and thematically related study units. A study unit is the smallest segment of a course material that treats a topic which should adequately engage a learner for 3–4 hours of study. Each study unit can be viewed as an individual lecture and, depending on the topic, can be up to 25 pages (Times Roman,13-point size, single spacing) or as brief as 7 pages. The content of a typical study unit (NOUN, 2012) is shown in Table 1.

Table 1. Content of a typical study unit.

Study Unit Title:
1.0 Introduction
2.0 Objectives
3.0 Main Content
- 3.1
- 3.2
  - 3.2.1
  - 3.2.2
  - 3.2.3
- 3.3
- 3.4

4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Readings

Table 2. Content of "Tropical Animal Products Industry in Nigeria".

Module 1. Introduction to animal products, animal by-products and animal products industry
Units
17. Introduction to animal products and by-products
18. Introduction to the animal products industry
19. Products of captured, hunted and harvested free-living animals
20. Products of domesticated food animals
21. Products from other domesticated ruminants and herbivores
22. Products from insects and special animals
23. Animal fibres and inedible animal products

Module 2. Meat production and primary processing
24. Animal growth and development
25. Animal body composition
26. Primary processing systems
27. Slaughter and conversion of muscle to meat
28. Meat processing, preservation and storage

Module 3. Secondary processing, product hygiene and safety
29. Secondary processing of meat animal products
30. Processing of egg and milk
31. Animal products hygiene and inspection

Module 4. Technical and economic aspects of animal products industry
32. Distribution and sale of animals and animal products
17. Economic and social value of animal products
18. Animal products science &technology

The textbook author's role is to analyse the course description and break it into appropriate study units, write appropriate learning objectives for each unit, select relevant content to attain these objectives and design relevant questions / activities to assess learners' attainment of stated objectives. Course learning materials are to be self-instructional; i.e. to "replicate what the teacher does in the classroom". The materials must be interactive and must stimulate independent learning; should be self-explanatory, self-contained, self-directing, self-motivating and self-evaluating. Self-assessment exercises (SAE) use questions, exercises and activities to enable learners review what they have learnt and assess/evaluate themselves. Tutor-marked assignments (TMA) are needed at the end of every study unit and at the end of every module. These are short answer or essay questions, projects or practicals for students to carry out which can serve the purpose of continuous assessment (CA). Summative assessment (SA) is the end of semester examination. The content of "Tropical Animal Products Industry in Nigeria" (Sonaiya et. al. 2019), an Open Access e-book that was developed in line with instructional design directive, is shown in Table 2. The material was made available to the class via Google drive and class performance without (in the 2017/2018 session) and with the drive (in the 2018/2019 session) was recorded and charted.

RESULT

The class performance without and with The Tropical Animal Products Industry in Nigeria (TAPIN) drive is shown on Figures 1 and 2. With an enrolment of 43 students in Figure 1, 54% of the class scored less than 50% and only 2% scored 70% of the 50 marks obtainable. In Figure 2, enrolment was 51 and 0% of the class scored less than 50% while 23% scored 70% and above of the 72 marks obtainable.

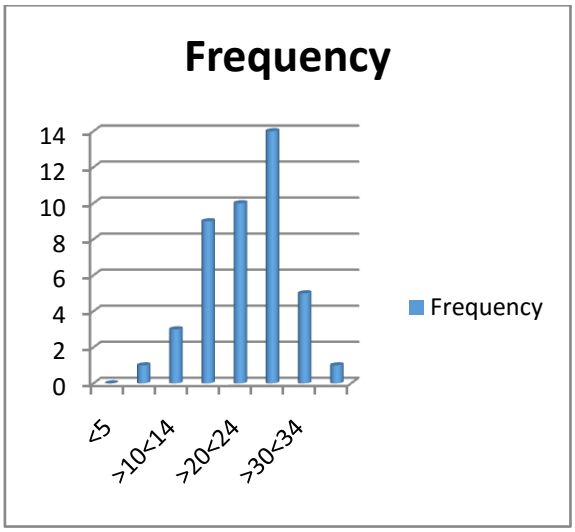


Figure 1. Class score without use of TAPIN

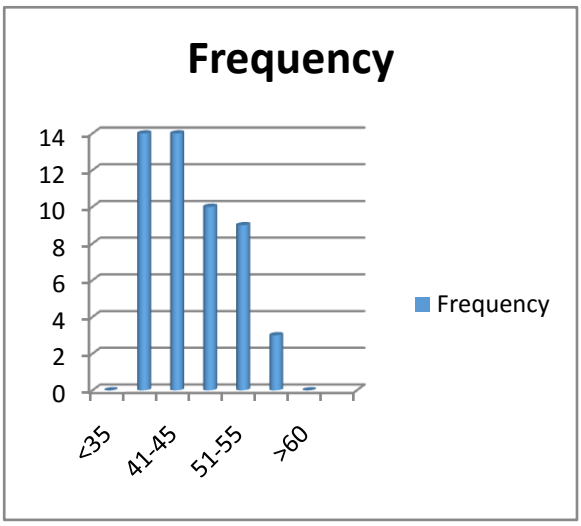


Figure 2. Class score with use of TAPIN

DISCUSSION

Animal products – meat, egg and milk – have great potential for balanced human nutrition, physical and mental development in the tropical countries of the third world. The next generation of Nigerians needs animal production scientists that are well trained and knowledgeable about the science, business, economics and politics of animal products and can leverage their knowledge to create viable businesses in "Animal Agriculture [which is] the goldmine of Nigeria's agro-revolution".

CONCLUSION AND RECOMMENDATION

In order to promote entrepreneurship in the AP industry, animal product scientists must apply the value chain approach in teaching about meat, milk and egg. To achieve this, Open Access e-books on the tropical animal products industry in Nigeria are needed. For the entire animal production science profession, a redesign of the curriculum is also recommended.

REFERENCES

Aduku, A.O. and Olukosi, J.O. (1991). *Animal Products Processing and Handling in the Tropics*. Living Books Series, GU Publications, Abuja. ISBN 978-2022-35-7.

Forrest, J.C., Aberle, E.D., Hendrick, H.B., Judge, M.D. and Merkel, R.A. (1975). *Principles of Meat Science*, W. H. Freeman & Co. San Francisco.

Frazier, W.C. and Westhoff, D.C. (1978). *Food Microbiology*, McGraw-Hill Inc., New York.

Ikeme A. I. (1990). *Meat Science and Technology: A Comprehensive Approach.* African-Fep. Publishers Limited. ISBN 978-175-259-9.

Judkins, H.F. and Keener, H.A. (1961). *Milk Production and Processing*, John Wiley & Sons, New York.

Kramlich, W.E. Pearson A.M. and Tauber, F.W. (1973). *Processed Meats*, AVI Publ. Co. Westport, Connecticut.

Lawrie, R.A. (1966). *Meat Science*, 1st Edition. Pergamon Press, Oxford.

Mountney, G.J. (1976). *Poultry Products Technology*. The AVI Publishing Co. Inc., Westport, Connecticut.

NOUN. (2011). NOUN Course Writer's Directives. Report of the implementation team for the establishment of School of Agricultural Sciences in the National Open University of Nigeria (NOUN), Victoria Island, Lagos.

Price, J.F and Schweigert, B.S. (1971). *The Science of Meat and Meat Products*. 2nd Edition, W.H. Freeman & Co. San Fransisco.

Sonaiya, E. B. (1984). *Animal Products*. Thelia House Publishers, Ile-Ife.

Sonaiya, E.B. (1998). *Energy Flux and Animal Products*. Inaugural Lecture 125, Obafemi Awolowo University, Ile-Ife, Nigeria. https://ir.oauife.edu.ng/bitstream/handle/123456789/4113/Emmanuel%20Babafunso%20Sonaiya.pdf?sequence=1&isAllowed=y

Sonaiya, E.B., Makinde, O.A. and Oyebanji, B.O. (2019). *The Tropical Animal Products Industry in Nigeria.* Reviewed by Springer Animal Sciences Editorial, Heidelberg, and Open Access publication by Syl Multimedia Ltd, Yaba, Lagos.

Taylor, R.E and Kauffman, R.G. (1983). Teaching Animal Science: Changes and Challenges. *Journal of Animal Science* Vol. 57, Suppl 2: 171-196. https://doi.org/10.2527/animalsci1983.57Supplement_2171x.

Zottola, E.A. (1972). *Introduction to Meat Microbiology*. American Meat Institute, Chicago.

NUTRIENT COMPOSITION AND VALUE OF SELECTED GAME MEAT: A REVIEW

Waba, Y.E.[1] and Saidu, I.[2]

1.Department of Animal Health and Production, Federal Polytechnic Bali, Taraba State
2.Department of Animal Health and Production, Bauchi State College of Agriculture Bauchi

ABSTRACT
Now days people consider game meat to be healthier and safe products, and therefore associate to healthier and tasty meat arising from game animals. Because of this an overview is presented on the global human usage of unconventional animal species (ungulates, lagomorphs, other landed wild mammals and birds) that are hunted for human consumptions. The nutritional values of these species is discussed, focusing on their potentials for food security**.** One of the most valuable foods is meat, due to its nutritional value, largely determined by the essential amino acids, fatty acids, vitamins, minerals, etc. The importance of wildlife to local communities is now globally recognized in community-based. The results presented in this review are mostly on the proximate and biochemical composition of some selected species of game animals. Warthog and domestic pig meat was compared**,** where warthog presented a higher (74.04,1.69, 22.14 and 1.29, for moisture, total lipids, proteins and ash respectively) values (Table 2). Likewise, macro and micronutrient in domestic pigs and wild boars was also reviewed (Tables 8&9). The results showed that K and Ca values (11239.00[a] and 208[a]) in wild boars was significantly (P<0.05)higher than in domestic pigs. Micronutrient in wild boars shows significant (P<0.05) differences, with levels of Fe, Zn and Cu higher (136, 91 and 90.3% respectively) above that of domestic pigs. Chemical composition of Hartebeest was also compared in different regions and among sex (Table 3), where values for nutrient compositions did not differ except ash content for sex, where females exhibit higher (1,3±0.18) value than in males(1.2±0.20).Chemical compositions in ostrich was found to be higher than in beef and chicken particularly for fat content (0.90-1.34%)(Table 10).It was also observed among all the animals species studied that cholesterol levels ranges between 64.41-95.01 mg/100g in both fat and muscles (Table 13).The review therefore highlights not only the economic importance of wildlife, through consumptive and non-consumptive uses, but also present the potentials of nutritional value.
Key Words; Nutrients, composition, Game, meat,

Introduction
In a global sense, game refers to wild animal and birds, with the term game being used for culinary purpose to describe all birds and animals that are hunted for food (Costa *at al.,* 2016). In the European union (EU), wild game is defined as being, wild ungulates and lagomorphs, as well as other land mammals that are hunted for human consumption and are considered to be wild game under the applicable law in the member state concerned. These includes mammals living in enclosed territory under conditions of freedom similar to those of wild game and wild birds that are hunted for human consumption, (Costa *et al*., 2016). Around the world, a vast number of wild animals are harvested for several reasons, including for food purpose and sport hunting, with the type and range of animals hunted, depending on climate, animal diversity, tradition, local taste, legislations and local perception on what can or cannot be legitimately hunted. Red meat is an important source of minerals (mainly Zn, Fe, and Mn) in human diet, as provides highly bioavailable elements required for normal development and health (Nikolic *et al*., 2015), Tomovic *et al.,* 2015). Macro and micro nutrients, serve many functions in the human organism. They are the building material of bones, teeth, skin and hair and are fundamental components for metabolic processes, maintenance of acid base equilibrium and regulation of water and electrolyte metabolism (Soetan *et al*., 2010; Ustymowicz-Farbiszewska *et al*., 2014).
According to Onyongo *et al*. (1998), the decrease in the per capita supply of high quality protein and the increase in the world's population have intensified the need to search for other sources of protein. Although there is an increase in the demand for game, and tendency for the meat to be sold under the generic name of game meat or venison with no specific indication of species. Therefore, the objectives of the review is to present the analyzed data on the nutrient composition and food values of must wild animals which may not be readily available for use by institutions and individual needs

particularly in the health institutions and to give an insight on the comparative analysis of selected elements in some carcass parts of wild or game meat.

Chemical composition of meat and nutritional considerations

Now days, consumers are increasingly demanding for healthy and safe products as they are concerned about the food they eat. In general, consumers associate game to a healthier, thinner, and tasty meat arising from animal that supposed to be free of hormones and generally be considered to be highly nutritious (Costa *et al*., 2016).

Table1: Proximate composition of meats from different game species (g/100g; mean values are given).

Animal species		**Proximate composition(g/100g)**			
		Moisture	**protein**	**Fat**	**Ash**
Ungulates					
Kudu	*Tragelaphus strepsiceros*	74.14-74.49	23.60-24.30	1.56-1,58	1.23-1.29
Impala	*Aepyceros melampus*	70.2-74.0	18.9-20.0	1.2-4.3	4.4-4.6
Springbok	*Antidorcas marsupialis*	70.4-75.3	17.4-18.4	2.5-5.3	4.2-4.3
Blesbok	*Damaliscus dorcas phillipsi*	68.20-75.33	19.30-22.43	0.21-6.8	1.24-4.2
Com. duiker	*Sylvicapra grimmia*	71.41	25.71	2.12	1.29
Red deer	*Cervus elaphus*	76.90	21.70	0.60	1.11
Fallow deer	*Dama dama*	74.90	22.0	2.50	1.08
Roe deer	*Capreolus capreolus*	68.20	22.82-25.35	1.0-2.12	1.29
Elk	*Alces akces*	---	22.72	1.33	--
Mouflon	*Ovis ammon*	74.52-75.30	21.88-22.35	0.61-0.99	1.03-1.12
Wild boar	*Sus scrofa*	72.8-75.0	21.4-23.23.6	1.1-4.4	--
Leporidae					
Wild rabbit	*Oryctolagus cuniculus*	74.86	23.71	0.20	1.18
Hare	*Lepus europaeus*	72.83	24.7	1.48	--
Game birds					
Wild duck	*Anas platyrhynchos*	73.95-74.9	19.6	3.39	1.27
Quail	*Coturnix japani*	73.60-73.65	22.94-22.96	2.31-3.32	1.56-1,57
Pheasant	*Phasianus colchicus*	73.09-75.14	22.22-25.37	0.13-0.40	1.26-1.35
Pigeon	*Columbia livia*	66.52-70.59	20.56-23.61	0.98-1.48	0.98-1.48

Source: Costa *et al*. (2016)

Table I shows a results on the proximate Composition of different game meat. The values presented shows that evaluated animal proteins content are generally higher than 20% with some species presenting levels around 25% protein. On the contrary, total fat content can be considered as being low, as it is generally inferior to 5%, with some species including different ungulates, lagomorphs, and game birds presenting levels less than 0.5% fat. Currently it is a general agreement that total fat intake is certainly related to health risks, however it is also accepted that both quantities and qualitative aspects are important. Thus the type of consumed fat or fatty acids is of critical importance.

Table 2: Mean mineral concentration per 100g of edible raw tissue of Reindeer meat

Element	Mean ±SD					
	Meat (n=29)	Liver (n=29)	Tallow (n=15)	Bone marrow (n=9)	RDA Male	Female
Zn(mg)	6.8±0.2	3.5±1.7	0.2±1.0*	0.1±0.1*	7mg	9mg
Ca(mg)	5.4±10	6.4±1.1	5.1±2.1	339.7±277.3*	1g	1g
Fe(mg)	3.3±0.7	41.1±21.7	4.1±1.5	3.1±1.30	16mg	9mg
Se(mg)	3.0±3.2	48.7±48.9	0.8±1.6	0.2±0.5	40mg	50mg

Source: Ammar *et al*. (2012)

Mean mineral concentrations (mg/100g) of edible raw tissue for Ca, Fe and Zn was reported by Ammar *et al*. (2012**)** (Table 2). The highest concentration of 339.70±277.30mg/100g was found in bone marrow (P<0.01). The Ca concentration in meat and tallow were higher (5.40±1.0 iron and 5. 10±2.10mg/100g), when compared to iron of 3.3±0.7 and 4.1±1.5mg/100g respectively). Liver appeared to be the best source of Fe in terms of mean concentration at 41.10+±21.70 mg/100g (P<0.01). There were no differences in Fe concentration of meat, tallow and bone marrow (P>0.05), with the following concentration 3.3± 0.70, 4.10±1.50 and 3.1±1. 30mg/100g. Liver also had the highest Se content of 48.70±48.90mg/100g(p<0.01). The Se concentrations in meat, liver, tallow and bone marrow (Table 2) were characterized by variations among districts and from animals within the same districts (result not shown), with one animal demonstrating a remarkable high Se concentration (data not show). These variations have resulted in standard deviations similar or higher than the mean concentration. The Zn in liver was the only mineral that was significantly correlated with meat (r= 0.77, P<0.01). As expected the result from Table 2 revealed considerable differences in nutrient levels between the meat and the rest of the studied tissues. These differences were statistically significant (P<0.05), except for Se and Fe in tallow and bone marrow.

Table 3: Biochemical Composition of Game Meat

Group	N	Protein%	Fat%	Cholesterol(Mg100g-1)
Elk	8	22.72	1.33	64.41
Deer	18	22.36	1.90	70.57
Roe deer	16	22.82	1.59	67.92
Wild boar	12	22.92	2.82	95.07
Beef	15	19.61	1.48	76.31
Pork	15	21.32	2.77	57.85

Source: Vita *et al*. (2013)

Cholesterol found in muscles is free cholesterol and it is not related to that in animal blood, i.e. "good" or "bad" cholesterol. It is found in both fat and muscle in the range 64.41 to 95.07 mg 100 g-1 among animal species (Table 3). From a nutritional point of view, in terms of cholesterol, none of ruminant meats is superior (preferred) over others. The exception is wild boar meat, in which higher cholesterol levels can be explained by the high level of adrenaline under stress during the hunting season. The cholesterol levels statistically differed between animals ($F = 2.55$, $P < 0.05$) (Vita *et al*. ,2013). The human body requires the essential amino acids lysine, isoleucine, phenylalanine, tryptophan, leucine, methionine, threonine, and valine. Each of these amino acids have a role in the human body. Game muscle protein contains all essential necessary amino acids. Wild deer, roe deer and elk meat samples are similar in the summed concentrations of essential amino acids. Wild boar and pork samples, differed most in the summed concentrations of essential amino acids: 24.14 and 12.35 g 100 g-1, indicating the relatively higher biological protein value of wild boar over pork (Vita *et al*.,2013).

References

Ammar Ali Hassan1*, Torkjel M. Sandanger1,2 and Magritt Brustad (2012) Level of selected nutrients in meat, liver, tallow and bone marrow from semi-domesticated reindeer (Rangifer t. tarandus L.).Int.J.Circumpolar Health.71:17997

Costa H., Mafra I., Oliveira M.B.P.P. and Amaral J.S. (2016) Game: Types and Composition. In: Caballero, B., Finglas, P., and Toldrá, F. (eds.) The Encyclopedia of Food and Health vol. 3, pp. 177-183. Oxford: Academic Press

Nikolic D, Djinovic-Stojanovic J, Jankovic S, Stefanovic S, Radicevic T, Petrovic Z, Lausevic M. (2015). Comparison of essential metals in different pork meat cuts from the Serbian market. Proc Food Sci. 5:211–214.

Onyango, C.A., Izumimoto, M. & Kutima, P.M., (1998). Comparison of some physical and chemical properties of selected game meats. Meat Sci. 49, 117-125.

Tomovic VM, Jokanovic M, Sojic B, Skaljac S, Tasic T, IkonicP.(2015).Minerals in pork meat and edible offal. Proc Food Sci. 5:293–295.

Ustymowicz-Farbiszewska J, Fiłon J, G_orski J, Karczewski J,SwieRcka J. (2014). Comparative analysis of the trace element content in daily food rations of postsecondary school students in Bialystok and Warsaw. Probl Hig Epidemiol.95:107–114. (Article in Polish)

Vita S, Aleksandrs J, and Vita Đ (2013). Nutrition Value of Wild Animal Meat. *Proceedings of the Latvian Academy of Sciences.* Section B, Vol. 67 No.

ASSESSMENT OF CONSTRAINTS AFFECTING GOAT PRODUCTION AND MARKETING PRACTICES IN MAKODA AND UNGOGO LOCAL GOVERNMENT AREAS, KANO STATE, NIGERIA.

***Danguguwa, D.D.[1], Ibrahim, U. S.[2,] Sulaiman, L. S.[1], Abdu, A[2].**

[1]*Department of Animal Health and Husbandry, Audu Bako College of Agriculture, Dambatta, Kano State.*

[2]*Department of Agricultural Extension and Management, Audu Bako College of Agriculture, Dambatta, Kano State.*

EMAIL: danazumidanbabadanguguwa@gmail.com

ABSTRACT

The study was conducted to assess constraints affecting goat production and marketing practices in Makoda and Ungogo Local Governments Areas of Kano State, Nigeria. The study describe socioeconomic characteristics of goat rearers, as well as major constraints affecting goat production in the study area. A multistage sampling technique was used to select 130 farmers used for the study. Data were collected through the use of structured questionnaires which was later analyzed using descriptive statistics, (frequencies and percentages). Findings revealed average age of 44 (43.65) years among the respondents. Majority 56.92% of them were males, 83.85% were married and have average household size of 8 people among the respondents. Majority 56.92% of the farmers were found to be literate. The result further shows 60.77% of them as mixed farmers and 68.46% of them have average 13 years of farming experience with average flock size of 6 goats among the farmers. Diseases, inadequacy of feeds, poor markets and lack of promising breeds were identified from the study as major constraints affecting goats' production and their prices in the area. It is concluded from the study that farmers could obtain better goat prices and income to solve a lot of their economic, social and domestic needs if necessary veterinary extension personnel and facilities as well as means of making feeds more adequate year – round, introducing more promising breeds together with mass enlighten campaigns are made available at the reach of the farmers in the study area.

Key words: Assessment, Constraints. Goat, Marketing, and Production

INTRODUCTION

Small ruminants (sheep and goats) contribute significantly to meat (and sometimes milk) production in Africa and hence, in meeting the current short fall created by the fast rising human population (Mukasa-Mugerwa, 1996). Gall (1981) reported that goat is numerous and widely distributed (scattered) in the tropics. In Nigeria, as at 2010, it was reported to have population of 34.5 million and 56 million sheep and goats respectively (FAO, 2010). Goats are small ruminant widely distributed throughout the geographical and climatic region of Nigeria. Goats adapt quickly and can be productive under almost any condition if they are properly managed (Jasen and Burg, 2004). Goat farming is not a new enterprise. Rearing goats is a profitable business. Goat production over the years in Nigeria has resulted in poverty alleviation and supply of high quality animal protein in order to meet the demand of animal protein for the country's teeming population (Anaeto *et al*, 2011). Goat farming can be suited with production of other livestock such as, sheep and cattle on low-quality grazing land. In tropical Africa and indeed in Nigeria, most sheep and goats are owned by farmers whose system of production and management are essentially traditional. About 96% of the traditionally managed goats are under free roaming and tethering system. Goats play significant role in the socio-economic wellbeing of the people. They are slaughtered during ceremonies and festivals, offer employments and serves as source of income to the farmers to meet their daily cash needs. In addition to miscellaneous functions, they also provide a source of investment, savings and as an insurance against disaster (Danguguwa, 1997). The skin of red Sokoto goats is well known for it is superior quality and command of high premium in the world markets (Ghude, 2017). Small ruminants play significant role in the food chain over livelihood of rural households, where they are reared largely by women and children (Lebbia, 2004).

Goat marketing is the most important and easiest step of goat farming business. Goat products like meat and milk has a huge local and global demand and popularity. Almost all types of people like goat milk and its meat. Therefore, good market is already available in almost every part of the world.

Commercial goat producers can target the international market and export the products to foreign countries (Mcreight, 2015). The marketing of goats and goat products in tropics varies and depends on location and prevailing product condition.

The viability of goat's enterprise depends not only on technical and biological efficiency, but also on a well-organized production and marketing system. At present goats production and marketing are characterized by tradition, poor management, unrealistic pricing, inadequate promising breeds as well as inadequate and inefficient feed and feeding system. Hence this study is design to investigate socio-economic characteristics of goat producers, as well as to identify major constraints affecting production and marketing in the study area.

METHODOLOGY

The research was conducted in Makoda and Ungogo local governments' areas, Kano state. Makoda has an area of 441 km^2 and Ungogo has an area of 204 km^2. Makoda has a population of 222, 399, while Ungogo has population of 369,657 at the 2006 census (NPC, 2006). The main livestock species in the study area are cattle, goats, sheep and also some species of poultry. Millet, rice, sorghum, groundnut, bean, maize and cassava are the major crops grown in the area. Multi stage sampling procedure involving purposive, proportionate and random techniques were used. Makoda and Ungogo local government areas were first purposively selected based on the existence of famous Dambatta Sunday market and growing Kwanar Ungogo small ruminant abattoir. In the second stage, sixty percent (60%) of wards of the two selected local governments areas of the study area was Proportionately taken giving a total of 13 wards (5 in Makoda and 8 in Ungogo local government).While in the third stage 10 farmers that were actively rearing goats were randomly selected in each of the 13 wards selected for the study in the areas. This gave a total of 130 goats producers selected and involved in the study. Data were collected from the respondents and analyzed using descriptive statistics that include frequencies, percentages, maximum, mean and minimum.

RESULTS AND DISCUSSION

Result in Table 1 shows the average age of the respondents was 44 years and this implies that the respondents in the study area are within the age range regarded as economically active innovative and productive. According to Ayoola (1999) young or middle age farmers are more flexible in decision making, risk taking and adoption of new ideas and technologies than older ones. The average household size of the respondents as indicated in Table 1 was 8. This implies that the more the household members, the more their contribution to the family farm/flock activities. The result is in line with finding of Bakoji *et, al*, (2012), who stressed that large household size assist to provide cheap family labour for an entrepreneurship activity like farming. By experience in farming, the result revealed a mean experience of 13 years among the respondents. This implies that the more years spent in farming, the more experience gained by farmers. The result is in line with Ihenacho (2000) who indicated that farming experience of farmers affect their managerial know – how and decision making to a large extent.

Table 1: Quantitative socio-economic characteristics of the respondents

Variable	Mean	Maximum	Minimum
Age	43.65	69	25
Farming Experience	12.68	41	02
Household size	7.92	20	01
Flock size	6.40	16	02

Source: Field survey, 2018.

Result of the study in Table 2 also shows that majority (56.90%) of the respondents were male and the remaining 43.10% were female. This impliedly shows that goat rearing among females in the area is regarded as an important economic enterprise. Majority (83.80%) of the respondents were married, with few (6.10% and 5.40%) Divorcees and widows. Only 3.8% of the respondents were singles. This finding supports the assertion by Ekong (2010) that early marriage is practiced more in rural areas than in urban centers, due to low levels of education, lower aspiration and dependence on agriculture

for livelihood. The results of the study shows that majority (56.90%) of the respondents were literates. This implies that respondents in the study area had one form of education or the other. USAID (2010) observed that the more educated the farmer is, the more the chances that the farmer would adopt innovations. Majority (57.70%) had contact with extension/veterinary extension practitioners. Extension service constitute a driving force for any agricultural development. Contacts with extension agent exposes farmers to information on new ideas, technologies and demonstrated by extension agents on regular basis (Herath and Takeya, 2003).

Table 2: Qualitative socio-economic characteristics of the respondents

Variable	Frequency	Percentage
Sex		
Male	74	56.90
Female	56	43,10
Marital status		
Divorced	06	06.10
Married	109	83.80
Widow	07	05.40
Single	05	03.80
Literacy Status		
Literate	74	56.90
Illiterate	56	43,10
Contact with extension/veterinary practitioner		
Had contact	75	57.70
No contact	55	42.30
Total	**130**	**100.00**

Source: Field survey, 2018.

Diseases, inadequate feeds, poor markets, lack of promising breeds, thefts as well as parasites shown in Table 3 are the most important constraints affecting goat production and marketing in the study area.

Table 3: Constraints militating against effective goat production

Constraints	Frequency	Percentage	Ranking
Diseases	92	70.77	1st
Inadequate feeds	75	57.69	2nd
Poor markets	31	23.85	3rd
Lack of promising breeds	25	19.23	4th
Thefts	22	16.92	5th
Parasites	15	11.54	6th

Source: Field survey, 2018.

CONCLUSION

It is concluded from this study that goat production and marketing is being constrained by a number of factors in the study area apart from non-existence of a single goat marketers or producers cooperative society in the study area. Diseases, inadequate feeds, poor markets, lack of promising breeds, thefts as well as parasitic problems were the major challenges faced by goat marketing in the study area. To reduce food insecurity, unemployment and industrial under- development through improving better goat prices and income, the following recommendations should were made.

- The farmers should be adequately mobilized/ sensitized by extension workers to form smallholder goat marketing/producers cooperative societies.
- More extension/veterinary extension personnel should be employed so as to improve easy accessibility to them by the farmers.

- Agricultural input stores such as Kano State Agricultural Supply Company (KASCO) in Kano state should be re-sustained by government.
- Superior more promising breeds better than the farmers own breeds, should be brought and be made available to the farmers by government, Non-governmental organizations, development partners etc. at affordable prices.

REFERENCES

Anaeto, M. G. O., Chioma, G. O., and Peter T.A. (2011). Health and nutrition practices among smallholder sheep and goat farmers in Ogun state. *Livestock research for rural development*, 21(11)

Ayoola, J.B. (1999). Economic Analysis of Women Entrepreneurship in Low Income Households of Benue State, Nigeria,.Ph.D thesis, Abubakar Tafawa Balewa University, Bauchi, Nigeria, 243 Pp.

Bakoji, I., Haruna, U., Nasiru, M. & Dahiru, S. I. (2012). Economic Analysis of small scale Turkey production in Toro local government area, Bauchi state, Nigeria. Journal of sustainable development

Danguguwa, D.D. (1997)). Economics of production of Kano brown goats in Dawakin Tofa local government area, Kano state. Unpublished project work submitted to Federal College of Animal Health and Production Technology, Vom, for the award of higher national diploma in Animal health.

Ekong, E.E. (2010). Rural sociology: An introduction and analysis of rural Nigeria: Dove educational publishers, Uyo, Nigeria.

FAO (2010). Food and Agriculture Organization. FAO statistics. Retrieved from http://faostat3.fao.org/home/index. Html# search data on 28/12/12.

Gall, C. (1981). Goat production. UK: Academic press incorporation, London.

Ghude,M (2017). A Higher National Diploma in Animal production Technology lecture note on sheep and goat production. Unpublished.

Herath, P. and Takeya, H. (2003). Factors determining intercropping by Rubber small scale holders in Srilanka: A logit analysis. *Journal of Agricultural Economics* 29; 159-168.

Ihenacho, A.C. (2000). Economics of millet production under different cropping system in Borno State of Nigeria. Cited in Ani, A.O.O. Ogunika and S.S. Ifah (2004) Relationship between socioeconomic characteristics of rural women farmers and their adoption of farmer technologies in southern Ebonyi State, Nigeria.

Jansen, C and K.V.D.Burg, (2004). Goat keeping in the Tropics. 4th edn, Aqronise foundation, Vageningen wehterunds, Pp. 1-6.

Lebbia, S.H.B, (2004). Goat under house hold condition. *Small Ruminant Research*, 51(2) Pp. 131-136

Mukasa,-Mugerwa, E. (1996). Possible impact of diseases and production wastages on the productivity of tropical small ruminants: An overview. Retrieved from http://www.fao.org/wairdocs/i/ri/x54736/x5473622html on 10/05/2011.

National Population Commission (2006) Provisional census figure for Kano State, Federal Government of Nigeria, Abuja

United State Agency for International Development (USAID) (2010). ICT to enhance farm extension services in Africa. FACET *Briefing paper*, Washington DC.

MARKETING OF POULTRY EGG IN ONDO-WEST LOCAL GOVERNMENT AREA OF ONDO STATE, NIGERIA

***Ibidapo, I., *Ogunsipe, M. H. & **Owombo, P. T.**
**Department of Agricultural Science, Adeyemi College of Education, Ondo.*
***Department of Agricultural Economics and Extension Ondo State*
University of Science and Technology, Okitipupa, Nigeria.
**(ibidapo68@gmail.com)*

ABSTRACT
The study investigated the marketing of poultry egg in Ondo-West local government area of Ondo State, Nigeria. The multi-stage sampling technique was employed in the selection of one hundred and twenty-five (125) poultry egg marketers for the study. Primary data collected with the aid of structured questionnaire were analysed using descriptive statistics and gross margin analysis. Result showed the mean age of respondents as 44.2±9.7 years, 63.2% were female and 36.8% were male and 72.0% were married. The mean household size was 7±3 members and 58.4% had secondary education. Price fluctuation constitutes a major challenge in poultry egg marketing. The gross margin was ₦48611.37. Marketing of poultry egg has improved the average household means of livelihoods and generate income. Hence, poultry egg marketing should be encouraged in terms of access to credit, information and provision of storage facilities.

Keywords: gross margin, marketing, poultry egg, profitability.

INTRODUCTION
The marketing of poultry eggs has been given much attention in both urban and rural areas of Ondo State and Nigeria in general. This is not unconnected with the importance of egg in the diet of an average Nigerian and consumption in every home. Poultry eggs rank second to cow milk in terms of nutritive value and are the most economically produced animal protein (Nahid and Mohammad, 2015). Animal protein is an essential part of human nutrition because of its biological significance. Iwena (2007) reported that proteins are required for the growth of young ones, formation of gametes in reproduction, formation of digestive juices, repair of worn-out tissues or cells, production of anti-bodies as well as enzymes and hormones in the body. Poultry egg marketing forms a good source of income, employment and vital source of food (protein) in the households. Marketing of poultry eggs like other agricultural products serves as means of livelihoods in both the rural areas and the urban centers. Tijani *et al*. (2006) posited that animal proteins are more biologically complete than vegetable proteins with regards to their amino-acids composition.The sales of poultry eggs contributed about 10.36% in the livestock sub-sector to the Gross Domestic Product (GDP) in the Nigeria economy (Central Bank of Nigeria, 2010). Eggs are major sources of animal protein in human diet. According to Okafor *et al*. (2007) poultry goes a long way in providing animal protein for the populace because it yields quickest returns and provides for meat and eggs in a very short time.Poultry eggs are among the most versatile food in the kitchen of an average home, and it can be served in several ways on their own, eggs add texture and moisture to baked foods and complement both sweetened savoury dishes. In the diet, poultry eggs can also boast of rich nutritional profile, provide a wide range of vitamins, minerals, and other nutrients, however, it is low calorie content.
According to Dietary for Americans 2015-2020, Poultry eggs are good sources of inexpensive high quality protein. However, despite the relative importance of eggs as sources of food, protein, income and means of livelihoods to the people, the marketing and distribution of poultry eggs is beset by serious problems both in the rural and urban areas of the country and the study area in particular. These problems include; price fluctuations, high cost of transportation, inadequate supply, and high cost of feeding, poor availability of labour, inconsistent government policies on marketing agricultural products, among others. According to Olanloye (1998) and Nahid and Mohammed (2015) farm product marketing activities is hampered by; price fluctuations, product glut, and inadequacy and poor transportation. Malnutrition and hunger have remained among the most critical problems facing the world poor. Moreover, the dearth in the quantity and quality of dietary protein supply in Nigeria is a challenge that is beyond dependence on plant protein source alone. Most countries in sub-Saharan

Africa including Nigeria are faced with the problem of insufficient poultry egg production and protein deficiency. Despite the high demand for eggs in the markets, there has been serious problem of inadequacy in meeting the needs of the consumers. Hence, the need to investigate the economic analysis of poultry egg marketing, identify the challenges facing poultry egg marketing and determine the profitability of poultry egg marketing in Ondo-West local government area of Ondo State, Nigeria.

MATERIALS AND METHODS

This study was conducted in Ondo-West Local Government Area of Ondo State Nigeria. The study area consists of 283, 672 people (NPC, 2006). The major occupation is primarily farming however trading activity is also practiced. The multi-stage sampling technique was employed in the selection of respondents. Stage one entailed a purposive selection of Ondo-West local government area due to accessibility and availability of egg marketers. Stage two consisted of the random selection of five major towns while stage three comprised the random selection of ten markets in the study area. In the final stage, One hundred and twenty (125) poultry egg marketers were selected for the study. Data collected with the aid of structured questionnaire were analysed using descriptive statistics and gross margin analysis.

RESULTS AND DISCUSSION

The result revealed (Table 1) that the mean age of respondents was 44.2±9.7 years, which implies that marketers are still at the economic active age, 63.2% were female and 36.8% were male. This indicates that poultry egg marketing is dominated majorly by females and 72.0% were married while 12.0%, 9.6% and 6.4% were widowed, single and divorced, respectively. The mean household size was 7±3 members per household indicating that poultry eggs marketers have a fairly large household size. Marketers with secondary education accounted for 58.4%. This will help the marketers in accessing information and marketing intelligence on poultry egg marketing business, 20.0% accounted for primary education, while 12.0% and 9.6% had no formal education and tertiary education respectively. On the years of experience as poultry egg marketer, the mean years of experience was 9.4±4.6 years. This indicates that the egg marketers in the study area are more experienced in egg marketing business. On sources of capital, 58.6% indicated the cooperative society as their source of credit while (21.6%) obtained credit from money lenders to start egg marketing business, others, 12.0% and 8.0% patronised friends/relatives and commercial banks for capital to finance the egg marketing business, respectively. On the quantity of poultry egg sold by marketers, 50.4% indicated that the sold between 30 and 50 crates while 24.0% sold between 51 and 70 crates of eggs, moreover, 12%, 9.6% and 4% respectively sold between 71 and 90 crates, less than 30 crates and more than 90 crates of poultry eggs. This implied that there is much demand for poultry eggs in the study area.

Table 1: Socio-Economic Characteristics of Egg Marketers n = 125

Variable	Frequency	Percentage	Mean	SD
Age (yrs)				
≤ 30	2	1.6		
31 – 40	40	32.0		
41 – 50	72	57.6		
51 – 60	8	6.4		
>60	3	2.4	44.2	9.7
Gender				
Female	79	63.2		
Male	46	36.8		
Marital Status				
Single	12	9.6		
Married	90	72.0		
Divorced	8	6.4		
Widowed	15	12.0		
Household Size (number)				
< 5	28	22.4		
5 – 10	74	59.2	7	3
> 10	23	18.4		
Experience (yrs)				
< 5	2	1.6		
5 – 10	65	52.0		
11 – 16	52	41.6		
> 16	6	4.8	9.4	4.6
Sources of Credit				
Cooperative Society	73	58.4		
Money Lenders	27	21.6		
Commercial Bank	10	8.0		
Friends/Relatives	15	12.0		
No Crates of egg sold				
<30	12	9.6		
30-50	30	24.0		
51-70	65	50.4		
71-90	15	12.0		
>90	5	4.0	57.6	9.6

Source: Field Survey, 2019

Table 2 revealed the challenges facing poultry egg marketers in the study area. Inadequate capital outlay accounted for 32.0% while price fluctuation in the price of poultry egg in the market represented 48.8%. This is in agreement with Nahid and Mohammed (2015) who identified price fluctuation and shortage of capital as some of the challenges in egg business. Others are; poor storage facilities represents 8.8%, 6.4% and 4.0% indicated labour problems and small-size of the business as the challenges facing the poultry egg marketers.

Table 2: Challenges facing poultry egg marketers n = 125

Variables	Frequency	Percentage
Challenges		
Inadequate Capital	40	32.0
Price Fluctuations	61	48.8
Poor Storage facilities	11	8.8
Labour Problem	5	4.0
Small market size	8	6.4

Source: Field Survey, 2019

PROFITABILITY ANALYSIS OF POULTRY EGG MARKETING

The profitability analysis in this study was determined using the gross margin analysis, net farm income and the cost benefit ratio thus;

G**ross margin analysis (GM):** $GM = TR - TVC$ ……1

Where; GM = Gross Margin, TR= Total Revenue and TR = Q.P.....2

Q represents the number of crates; P = Price per crate; and TVC= Total Variable Cost.

Net Income (NI): Net Income = TR - TC.....3

Where, TR= Total Revenue; TC= Total cost;

Benefit-Cost Ratio (B/C): The Benefit-Cost ratio is used to determine the profitability of poultry egg marketing business. It helps to ascertain the gain over every naira invested in the poultry egg marketing. This is expressed as; TR/TC.....4

The result of the profitability analysis indicated that ₦48611.37 was realized as gross margin while ₦18065.56 was the net income (net profit). The return on a naira invested in poultry egg marketing was 1.16. This showed that on every naira invested in the sale of poultry egg marketing ₦0.16 was realized as gain. This indicated that the marketing of poultry egg in the study area is profitable. However, the variable costs accounted for 71.6% in the cost of production while the fixed cost represented 28.4%.

Table 3: Profitability Analysis for Poultry egg marketing

Variables	Amount (₦)		Percentage
Total Revenue		125440.57	
Variable Costs			
Purchase	58375.36		54.4
Transportation	8065.51		7.5
Cost of crates	11850.75		11.0
Total Variable Cost (TVC)		78291.62	
Fixed Cost			
Rent	24000.80		22.4
Security	6545.01		6.1
Total Fixed Cost (TFC)		30545.81	
Total Cost (TFC + TVC)		107375.01	
Returns on Investment			
Gross Margin	48611.37		
Net income	18065.56		
Benefit-Cost Ratio (B/C)	1.16		

Author's Computation, 2019

CONCLUSION AND RECOMMENDATIONS

The study revealed that marketing of poultry egg in the study area is a profitable business and as means of livelihoods to generate income. However, the business is faced with the problems of inadequate capital and price fluctuations. Hence, poultry egg marketing should be encouraged in terms of access to credit, organized marketing and provision of storage facilities.

REFERENCES

Central Bank of Nigeria (2010). Annual Report and Statement of Accounts. CBN Publications. Abuja, Nigeria.

Food and Agriculture Organization (1990). The State of Food and Agriculture, Vol. 4. Rome. Pg 65-72

Iwena, O. A. (2007). Essential of Agricultural Science for Schools and Colleges Tonad Publishers Enugu, Nigeria. Pp 56-69

Nahid, K. D. and Mohammad, S. K. (2015). Analysis of the Economics of poultry egg production in Khartoun State, Sudan *Afri J Poult Farm.* 3 (5): 97-102

NPC (2006). National Population Commission. Population Census of the Federal Republic of Nigeria; Draft Report 2006.

Olanloye, A. (1998). Economics of Poultry Production in Ogun State, Nigeria. M.Sc. Agricultural Thesis, University of Agriculture, Abeokuta.

Okafor, R.M., Odii,M. A., Emayonu, C. A. and Obih, K. T. (2007). Profitability Analysis of Poultry Production in Imo State, Nigeria. *Trop. J Anim Sci.*, 1(3):392-397.

Tijani, A. A., Alimi, T. and Adesiyan, A. T. (2006). Profit Efficiency among Nigerian Poultry Egg Farmers: A Case Study of Aiyedoto Farm Settlement, Nigeria. *Res J. Agric Bio Sci.*, 2(6):256-261

Dietary for the Americans 2015-2020: Dietary Publications pp2-21.

COSTS AND RETURNS ANALYSIS OF POTATO PRODUCTION UNDER PLATEAU STATE POTATO VALUE CHAIN SUPPORT PROJECT (PS-PVCSP)

***Kolo, A[1]. & Balere ,Y[2].**

[1]*Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University Bauchi State, Nigeria*

[2]*Plateau Agricultural Development Programme, P.M.B. 2119 Dogon Dutse, Plateau State, Nigeria*

Corresponding author (Email:** abdulwahabkolo@gmail.com **GSM:08061572214)

ABSTRACT

The study analyzed costs and return of Irish potato production under Plateau State Potato Value Chain Support Project (PS-PVCSP). Multi-stage sampling technique was used to select 180 farmers across 17 local government areas. Descriptive statistics and gross margin were used for data analysis. The results show that male and female accounted for 57.78% and 42.22% of Irish potato production, respectively. The result indicated that 47.22% of Irish potato farmers were within age bracket of 36-45 years. The result revealed that majority (62.22%) of the farmers were married with a mean household size of 7 persons. The result also shows that 37.78% of Irish potato farmers had no formal education. The costs of production shows that cost of seed accounted for 51.39% of the total variable costs. This was followed by labour, estimated at 26.09%. Meanwhile, the cost of pesticides appears to be the least, representing less than 0.53% of the total variable cost. Farm gate sales accounted for the largest share of revenue, put at 78.57%. In all, total returns stand at ₦ 699,018.7, while gross margin stood at ₦ 382,842.7. Producers were faced with the incidence of blight, particularly in the wet season, as reported by 22.78%, followed by inadequate capital (15%) and high cost of inputs (11.67%). However, access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities. It can be concluded that Irish potato production in Plateau State is a profitable venture. It was recommended that project should enhance productivities and incomes of Irish potato farmers through provision of inputs as well as infrastructure and institutional development that will enhance capacity building of project beneficiaries and linkages to services such as credit, insurance and market.

Key words: Irish potato, Livelihoods, Production, Value Chain

INRODUCTION

Irish potato (*Solanum tuberosum L.*) belongs to the broad categorization of tuber crops. Irish potato was first introduced in Nigeria in the late 19th Century, through missionary activities (Obigbesan, 2009). The production was encouraged by the British Colonial Government during the Second World War as the tubers were needed to feed their armed forces in West Africa. Since then, the importance of Irish potato has been widely realized such that it is now an important commodity in both local and international trades. Irish potato is about the most fruitful and efficient tuber crop in the world in terms of tuber yields and days to maturity. The crop matures in about 60 to 90 days as compared to 9 and 12 months for yam and cassava, respectively (Kaplinsky and Morris, 2001). Kudi *et al.* (2008) revealed that the Irish potato gives the highest yield per unit area among roots and tuber crops in Nigeria and that it brings more income to farmers than other roots and tuber crops. The total annual production, was estimated at 900, 000 metric tons as at 2010 (Jwanya *et al.,* 2014) per year. Okonkwo *et al.* (2009) noted that at a price of ₦50, 000 per tonne of potato tuber, Nigeria earns over ₦45 billion from sales in the local markets and West African sub-region. Although, production of potato has increased by over 120% in the last 10 years in Nigeria (FAO, 2013), it is still grossly below demand. Apart from low quality seed and poor storage facilities, diseases, particularly blight are also a limiting factor to potato production in Nigeria (Sani *et al.,* 2015).

The production and marketing of Irish potato in the highland zones of Plateau State has become an integral part of the rural economy, both at the rainy and dry seasons, as it is cultivated as rain-fed and dry season crop (Sani *et al.,* 2015). According to Okonkwo *et al.* (1995), planting of rain-fed potato takes place from late March to August depending on local conditions while harvest occurs three to four months later, from July to November. Irrigated production starts from late October through January with harvest between January and April. The attraction to potato production in the state is largely driven by economic benefits.

Irish Potato is important for its contribution to food security and as source of cash income for large proportion of the rural households. However, improving access of potato farmers to the markets and active engagement in the Irish potato value chain are key issues in the study area. Generally, farmers' motivation for cultivating potato is to ensure adequate food supply during food shortage months. It is the best staple food crop during this period, as well as an important source of cash income (Gebremedhin *et al.*, 2013) because of its ability to provide a high yield of high-quality product per unit of input with a shorter crop cycle than major cereal crops like maize (Adane *et al*., 2010). Irish potato is considered a strategic crop by the Plateau State Government targeted at achieving food security and economic benefits to the state and the country at large (Chris, 2013).

The key challenges across the potato value chain in the state include inadequate access to and usage of improved agro-inputs, limited rural infrastructure and institutions, limited value addition, inefficient system for enforcing quality standards, poor knowledge of target market, prevalence of diseases and pests, amongst others. In-spite of these challenges, investment in potato value chain development in the state provides an opportunity for redressing the negative trend in key development outcomes in the state, including, diminished incomes of value chain actors, prevalence of poverty, limited employment creation, potato export and foreign exchange earnings. Therefore, the Plateau State Potato Value Chain Support Project (PS-PVCSP) aims to contribute to employment generation and shared wealth creation along the potato commodity value chain, as well as food security to increase access to rural infrastructure. There has been growing pressure on the governments and project implementers to be accountable and be more responsive to the demands of the citizens and other stakeholders, through showcasing the effect and impact of development interventions, through policies, projects and programmes. This will improve population growth, increase in potatoes production can improve the livelihoods of smallholder potato value chain actors across the state.

Plateau State needs to expand its crop base to meet the growing demand for staple foods for the increasing population. Potatoes offer a good candidate both as a commercial and food security crop. The increase in population coupled with the anticipated fast development of cities and towns following the recent devolution in the country lay a strong basis for promotion of potatoes as a source of fast foods desired in towns. To meet the growing demand for potatoes which is a major constituent of fast foods like chips and crisps, there is need to address factors constraining the production especially of the most popular varieties. The purpose of this study was to avail socio-economic information and other underlying factors that affect Irish potato production. Therefore, the aim of the study was to analyze costs and returns of potato production under Plateau State potato value chain support project (PS-PVCSP). The specific objectives were to:

i. describe the socio-economics characteristics of Irish potato farmers in the study area
ii. determine the costs and returns associated with Irish potato production in the study area
iii. describe the constraints associated with marketing of Irish potato in the study area

MATERIALS AND METHODS

THE STUDY AREA

The study was carried out in Plateau State which is the twelfth largest state of Nigeria; roughly located in the center of the country. It is geographically unique in Nigeria because its boundaries totally surround the Jos Plateau, having the Jos Plateau totally in its central and northern parts, with capital in Jos. It has a population of around 3.5 million people. The state is located between latitude 9°10´ N and longitude 9°45´ E. The altitude ranges from around 1,200 meters (about 4000 feet) to a peak of 1,829 meters above sea level in the Shere Hills range near Jos. Though situated

in the tropical zone, a higher altitude means that the state has a near temperate climate with an average temperature of between 18°C and 22°C. Harmattan winds cause the coldest weather between December and February. The warmest temperatures usually occur in the dry season months of March and April. The mean annual rainfall varies from 131.75 cm in the southern part to 146 cm on the Plateau. The highest rainfall is recorded during the wet season months of July and August. The upland nature of the state makes it the source of many rivers in northern Nigeria, including the Kaduna, Gongola, Hadejia and Yobe rivers. The state share boundaries with Bauchi State to the North East, Kaduna State to the North West, Nasarawa State to the South West and Taraba State to the South East. The state has an estimated area of 26,899 square kilometers.

SAMPLING TECHNIQUES AND SAMPLE SIZE

The sampling technique was multi-stage, which consisted of purposive and simple random sampling techniques. The first stage 9 LGAs out of 17 LGAs were purposively selected based on quantity of Irish potato production. Second stage, two communities were selected from each LGA. While in the final stage, the Yamane sample size determination formula was used to select 180 PVCSP beneficiaries at 5% precision level and 95% confidence level from the available profiles of the potato value chain actors.

$$n = \frac{N}{1+N(e^2)} \qquad \ldots(1)$$

where;
n= Sample size,

N= Population size and

e= level of precision

DATA COLLECTION AND ANALYSIS

Data were collected with aid of structured questionnaire. There are many analytical techniques available for use in research of this nature, and the choice of a particular one depends on the type of data collected in order to achieve the specified objectives. Descriptive statistics and inferential statistics (Gross margin and multiple linear regression analysis) were used for data analysis

GROSS MARGIN ANALYSIS

Olukosi and Ehrabor (2008) defined gross margin as the difference between total revenue and total variable costs. It is used as a measure of enterprise profitability and means of selecting farm plans. The size of gross margin depends on the services provided, market structure, market price, perishability of the product as well as the distance between producers and consumers and may be influenced by market information especially for short-run margins. According to Olukosi and Ehrabor (2008) Gross Margin Analysis (GMA) is one of the widely used analytical techniques for planning and analysis of projects by researchers. Therefore, Gross Margin Analysis (GMA) was used to estimate profit for Irish potato production. GM was calculated using the following formula:

$GM = \Sigma Pi\ Qi - \Sigma C\ j\ X\ j \cdot$ ...(2)

where;

GM = Gross Margin

P_i = Unit price of Irish potato i

Q_i = Quantity of Irish potato produced i

C_j = Unit variable cost of input j

X_j = Quantity of input used

$P_i Q_i$ = Revenue

$C_j X_j$ = Variable cost

RESULTS AND DISCUSSION

SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

The results of socio-economic characteristics of Irish potato farmers as detailed in Table 1 shows that, male and female accounted for 57.78% and 42.22% of Irish potato production, respectively. This agrees with the findings of Sani *et al.* (2015) that men always have right to land as a productive resource than women in most African societies. This result is also in line with the findings of Jwanya *et al*. (2014) who reported that male dominated Irish potato production in Plateau State, as indicated by 84.17% of the respondents. However, the results indicated that 47.22% of Irish potato farmers were within age bracket of 36-45 years and only 6.67% were above 55 years. The mean age was 38 years, the implications of these result is that farmers are still active with implications for productivity and household food security.

The result in Table 1 further, revealed that majority (62.22%) of the farmers were married and only 10% were single. The high proportion of married farmers is an indication that majority of farmers are likely to have family responsibilities and commitments, especially with regards to household food provision and upkeep, educational and health demands and savings. Furthermore, the result shows that 37.22% of farmers had household size of 6-10 persons with mean household size of 7 persons. This result is in line with the findings of Omolori (2017) who reported that most smallholder farmers in Nigeria maintained household size of between 5 and 12 persons. Large farming households has implications for household expenditures and food security and could as well be of benefit if members of the household are available for farm work.

The result on level of education of farmers under the study is also provided in Table 1. The results show that considerable proportion (37.78%) of Irish potato farmers had no formal education. The low level of formal education is likely to negatively impact on innovation, adoption of new technologies, low quality labour and farm record keeping (Adewunmi and Adebayo, 2008). The implication of this result is that PVCSP project to invest in beneficiary education, through intensive awareness creation. Aside intensifying extension support, project should endeavour to invest in disseminating technological messages in the local languages.

Table 1: Socio-economic characteristics of Irish potato farmers (n=180)

Socio-economic variables	Frequency	Percentage
Sex		
Male	104	57.78
Female	76	42.22
Age		
<25	25	13.89
25-35	40	22.22
36-45	85	47.22
46-55	18	10.00
>55	12	6.67
Mean	**38**	
Marital status		
Single	18	10.00
Married	112	62.22
Divorced/Separated	10	5.56
Widow/Widower	40	22.22
Household size		
<5	52	28.89
6-10	67	37.22
11-15	33	18.33
16-20	20	11.11
>20	8	4.44
Mean	**7**	
Level of education		
Post-Secondary School Certificate	14	7.78
Secondary School Certificate	66	36.67
Primary School Certificate	32	17.78
No formal education	68	37.78
Total	**180**	**100**

Source: Field survey, 2018

COSTS AND RETURN FOR IRISH POTATO PRODUCTION ENTERPRISE PER HECTARE

Table 2 presents the costs and return profiles of potato production in the study area. A cursory review of the costs of production shows that seed accounted for 51.39% of the total variable costs. This was followed by labour, estimated at 26.09%. Jwanya *et al.* (2014) affirmed that potato seeds and labour accounted for 56.58% and 15.91% of the costs of production under irrigation. This agrees with the findings of Obigbesan (2009) who reported that high cost of seeds, fertilizer and labor are the major challenges in Irish potato industry in most developing African countries. Meanwhile, the cost of

pesticides appears to be the least, representing less than 0.53% of the total variable cost. Farm gate sales accounted for the largest share of revenue, put at 78.57%. In all, total returns stand at ₦ 699,018.7, while gross margin stood at ₦ 382,842.7. Despite the cost of seeds Irish potato production

Table 2: Costs and return for Irish potato production enterprise per hectare

Variable inputs	**Costs**	**Percentage**
Seeds (Kg)	162,481.07	51.39
Labour (Man-hour)	82,492.31	26.09
Fertilizers (Kg)	50,757.98	16.05
Transportation	11,245.03	3.56
Pesticide for storage	1,689.59	0.53
Packaging bags	7,510.00	2.38
A. Total Valuable Cost	**316,175.98**	**100.00**
Farm gates Sales	784,915.21	78.57
Seeds sold	171,535.09	17.17
Home consumption	17,440.51	1.75
Gifts/alms	25,127.85	2.52
B. Returns	**699,018.66**	**100.00**
Gross margin (B –A)	**382,842.68**	

Source: Field survey, 2018

CONSTRAINTS ASSOCIATED WITH IRISH POTATO PRODUCTION

The constraints faced by farmers are presented in Table 3. Producers were faced with the incidence of blight, particularly in the wet season, as reported by 22.78%, followed by inadequate capital (15%) and high cost of inputs (11.67%). However, access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities. On the other hand, farmers were faced with constraint of poor road network, problem of insecurity and post-harvest lost among others.

Table 3: Constraints associated with Irish potato production

Constraints	**Frequency**	**Percentage**
Problem of blight	41	22.78
Inadequate capital	27	15.00
High cost of farm inputs	21	11.67
Poor road network	18	10.00
Problem of insecurity	19	10.56
Problem of post-harvest lost	14	7.78
Inadequate of storage facilities	11	6.11
Problem of land tenure system	9	5.00
Problem of climate change	7	3.89

Inadequate of dams or boreholes for irrigation	6	3.33
Lack of modern farming techniques	4	2.22
Poor marketing system	3	1.67
Total	180	100

Source: Field survey, 2018

CONCLUSION

Based on the findings of the study, it can be concluded that Irish potato production was dominated by married men with non-formal education. Despite the cost of seeds, Irish potato production in Plateau State is a profitable venture. However, farmers were faced with problem of disease. The following recommendations emerged from the study findings:

i. Given the skewed proportion of participants in favour of the male, there is the need to enhance female participation through awareness creation and sensitization;
ii. To effectively push the improve technologies and innovations under the project to eliminate blast diseases, it becomes imperative to enhance literacy campaigns, extension support and domicile extension messages in local languages;
iii. To enhance production and incomes of Irish potato farmers the project should provide inputs as well as infrastructure and institutional development that will enhance capacity building of project beneficiaries and linkages to services such as credit, insurance and market.

REFERENCES

Adewunmi, M. O. and Adebayo, F. A. (2008). Profitability and Technical Efficiency of Sweet Potato Production in Nigeria. *Journal of Rural Development*, **31**(5):105-120.

Adane, H., Meuwissen, M. P., Agajie, T., Lommen, W., Lansink, A. O., Admasu, T. and Struik, P. C. (2010). Analysis of Seed Potato Systems in Ethiopia. *American Journal of Potato Research*, **87**(6): 537-552.

Chris, O. N. (2013). Evaluation of Environmental Impact Assessment System in Nigeria. *Greener Journal of Environmental Management and Public Safety*, **2**(1):22-31.

Food and Agriculture organization (FAO), (2013). Policy Makers Guide to Crop Diversification: The Case of the Potato in Kenya. Food and Agriculture Organization of the United Nations, Rome.

Gebremedhin, W., Kassaye, N., Atsede, S., Abebe, C. and Berga, L. (2013). Participatory Potato Seed Production: Experiences from West and Southwest Shewa and Gurage Zones. **In**: Gebremedhin Woldegiorgis, Steffen Schulz and Baye Berihun. (eds.), Proceedings of the National Workshop on Seed Potato Tuber Production and Dissemination, 12-14 March 2012. ARARI, Bahir Dar, Ethiopia. pp. 152-172.

Jwanya, B. A., Dawang, N. C., Zarmai, D. U. and Mashat, I. M. (2014). Economic Analysis of Irrigated Irish Potato Production in Plateau State. *Developing Country Studies,* **4(**12):80-86.

Kaplinsky, R. and Morris, M. (2001). *A handbook of value chain analysis*. Working Paper prepared for the IDRC, Institute for Development Studies, Brighton, UK. 104pp.

Kudi, T. M., Apoko, I. G. and Yada, P. (2008). Resource Productivity Profitability Analysis of Irish Potato Production in Plataeu State, Nigeria. *Savanna Journal of Agriculture,* **1**(3): 47-52.

Obigbesan, G. O. (2009). Package for high quality sweet potato production: Do's and don'ts.

In: Sweet potato in Nigeria. In Akoroda M. and Egeonu I. (eds). Proceedings of the First national sweet potato conference held during 16-18 September, 2008 at the first Bank Hall, Faculty of Agriculture and Forestry, University of Ibadan, Nigeria, 6-7.

Olukosi, J. O. and Ehrabor, P.O. (2008): Introduction to Farm Management Economics, Agitab Publication Zaria, 145Pp.

OKonkwo, J. C., Ene, L. S. O. and Okoli, O. O. (1995). Potato production in Nigeria. National Root Crops Research Institute, Umudike, Umuahia, Abia State, Nigeria Pp 1-109.

Okonkwo, J. C., Amadi, C. O. and Nwosu, K. I. (2009) Potato production, storage, processing and utilization in Nigeria. National Root Crops Research Institute, Umudike, Nigeria.

Omolori, H.A. (2017). Technical Efficiency and Food Security Status of Fluted Pumpkin Farmers in Selected Local Government Areas of Niger State, Nigeria. An Unpublished Post-graduate Thesis Submitted to the Department of Agricultural Economics and Extension Technology, Federal University of Technology, Minna, Niger State, Nigeria.

Sani, U., Abdullahi, Z.A. and Zekeri, M. (2015). Economic Analysis of Irish Potato (*Solanum Tuberosum L.*) Production under Irrigation Systems in Katsina Metropolis, Katsina Local Government Area, Katsina State.

HEDONIC PRICE ANALYSIS OF SHEEP AND GOATS IN BAUCHI STATE LIVESTOCK MARKETS: IMPLICATIONS FOR MARKETING STRATEGIES

***Kolo, A. Jibril, S. A., Sani, M. H. & Mohammed, I.**
Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University Bauchi State, Nigeria
****Corresponding author Email:** abdulwahabkolo@gmail.com **GSM:08061572214***

ABSTRACT
The study determined the factors that influence price of sheep and goats in Bauchi State, Nigeria Multi-stage sampling technique was used to select 321 sheep traders and 220 goat traders. Data were collected with aid of structured questionnaire. Hedonic price regression model was employed for the study. Data analysis was performed using SPSS version 22. Hedonic price models were fitted to a sample of 6,118 sheep and 4,518 goats, respectively, for which data were collected from 14 markets over a 12-month period. The result of the estimated hedonic price regression model explains 74.1% of the variation in prices of sheep and 88.4% of the variation in prices of goats. This shows that about 74.1% and 88.4% of the variation in the prices of sheep and goats was influenced by the combined effects of the independent variables (market location, age of animal, live weight, sex, body condition, breed, coat colour and season) included in the hedonic model. The remaining proportion can be attributed to error term. F-statistics was significant at $P<0.05$, this statistic suggest goodness of fit of the model. Durbin Watson p-value of 1.02 was also reported, which indicates there is a positive first order auto correlation. Based on the findings of the study, it was concluded that, market location, sex, body condition of animal and season significantly ($P<0.05$) influenced selling price of sheep and goats in the study area. The study recommended that sheep and goats breeding strategies and activities should duly consider the preferences expressed through the prices paid for animals, these could enhance the efficiency of sheep and goat pricing system and consequently improve the livelihoods of sheep and goat keepers and traders. It is vital to train producers on the importance of market oriented (commercial) livestock production system.

Keywords: Goat, Hedonic, Price and Sheep

INTRODUCTION
Hedonic models have been widely used to evaluate the implicit prices of many agricultural commodities, especially livestock (Ramesh *et al.,* 2012). The theoretical foundation of the hedonic price model is mainly made up of two parts: Lancaster preference theory and Rosen's characteristic supply-demand equilibrium model. American scholar Lancaster first put forward a new consumer theory. The theory was expanded from the consumer theory of classical economics, also known as Lancaster preference theory. From the product heterogeneity, Lancaster analyzed basic "element" spaces that formed the product, and argued that the demand for the product was not based on the product itself, but on its characteristics. He noted that heterogeneous goods have a series of integrated characteristics, and the goods are sold as the gathering of inherent characteristics. And that households purchase these goods, use them as a kind of "investment", and turn them into utilities. Therefore, he asserted that level of utilities depends on the quantity of different characteristics, hence it is difficult to analyze such goods market with the traditional economic model, because it cannot be considered by a single total price. It is against that backdrop that, Lancaster thought to adopt a series of prices (hedonic price) to express corresponding product characteristics. Therefore, the product price is made up of hedonic prices, with each product characteristic having its own implied price, and all hedonic prices form a price structure (Bassey *et al.,* 2013). Rosen analyzed theoretically the long term and short-term equilibrium of the heterogeneous product market. Rosen's work established the

modelling foundation for the hedonic price theory, based on which, econometrics method can be used to estimate the hedonic price function, get implicit prices of product characteristics, and then analyze the demand of product characteristics.

Various studies (Kadigi *et al.,* 2013; Ramesh *et al.,* 2012; Alemayehu, 2011 and Kassie *et al.,* 2011) have been undertaken to determine factors that influence market prices of livestock especially cattle. Kadigi *et al.* (2013) used several variables as the basis of attributes used in hedonic pricing models. Characteristics used include sex, breed, lot size, frame size, muscling score, body condition, weight, time of sale, market location, among other factors. A hedonic price function relates the price of a product to the various attributes embodied in the commodity (Ramesh *et al.,* 2012). The underlying hypothesis is that products have utility-bearing attributes and the values of those attributes contribute to the price of the product. The observed price of a good is therefore a composite of the implicit values of the product's attributes. Theoretically, the prices traders receive are reflections of the utility anticipated by the buyers and this utility is derived from the attributes of the product as livestock's can be considered as quality (attribute) differentiated goods.

Parish *et al.* (2017) employed a hedonic pricing model to establish indices of genetic worth of a dairy bull in Alberta, Canada. Their study indicated that most important factors used by dairy farmers in valuing dairy bulls are milk volume, protein and fat content, general conformation, body capacity, and popularity of the bull. Kassie *et al.* (2011), similarly applied heteroscedasticity consistent hedonic price modelling to examine factors that influence cattle prices in the rural markets of central Ethiopia. The results of the study showed that season, market location, age, sex and body size are very important determinants of cattle price. Similarly, Fafchamps and Gavian (2009) employed monthly price data of over 20 years in Niger to examine the determinants of sheep and goat prices, reported that season of selling, rainfall pattern, district location and seasonal holidays influence prices of livestock.

This study focuses on the main phenotypic attributes that buyers inspect when buying sheep and goats in addition to external factors such as seasonality. The external features farmers look at and attach value to, are age, colour, body size, sex, and the place where the sheep and goats were brought from. Although in some parts of Bauchi State, economic analysis of livestock marketing has been conducted, yet, studies on sheep and goats' attributes (physical observable character) or factors which are most important in explaining variations in selling prices which can then be matched to preferences of the buyers for live sheep and goats were limited. However, studies on hedonic price analysis of sheep and goats will reveal preference for sheep and goats and other factors (physical observable characters) that influence the selling price. This could be a major input for sheep and goats' breeders, policy makers and buyers and traders as to improve production and quality of the product according to the market demand and gives indications about the market (bargaining) price to the buyers/traders. The outcomes of the study may also serve as reference for researchers to embark upon similar or related researches in other parts of the country with hope to develop a standard of marketing strategy for sheep and goats in the near future. This necessitates an empirical study on market price analysis to determine the factors that influence price of sheep and goats in Bauchi State, Nigeria.

MATERIALS AND METHODS

THE STUDY AREA

Bauchi State is one of the States in the northern part of Nigeria located in the Sudan savannah and the Sahel savannah zones between latitudes 9° 3' and 12° 3' north and longitudes 8° 50' and 11° east of the Greenwich meridian. The Sudan savannah type of vegetation covers the southern

part of the State. While The Sahel type of savannah, also known as semi-desert vegetation, becomes manifest from the middle of the State as one moves from the State's south to its north. The State occupies a land mass of about 49,119km^2 representing about 5.3% of Nigeria's total land mass (BSADP, 2015). Rainfall ranges between 1300 mm per annum in the south and 700 mm per annum in the extreme north. Therefore, there is progressive dryness toward north, culminating in the desert condition in the far north. Temperature ranges from a minimum of 9.11^{0}C in December/January to a maximum of 40.55^{0}C between April and May (BSADP, 2015). According to National Bureau of Statistics (NBS, 2017) Bauchi State has a total estimated population of 4,826,112. This large peasant population of the State engages in crop and livestock production. The major crops grown include sorghum, millet, maize, rice, groundnuts, soya beans, cowpea, sesame etc. While the major livestock reared include cattle, sheep, goats and poultry. Most of the livestock are reared under extensive management system. The predominant small ruminants are goats (breeds include Sokoto red, Sahel and West African Dwarf goat) and sheep (breeds include Uda, Yankasa, Balami and West African Dwarf sheep) while few other breeds are also found. Rearing of small ruminants, crop production and marketing form the major economic activities in the study area.

SAMPLING TECHNIQUES AND SAMPLE SIZE

The sampling technique was multi-stage. In the first stage, Bauchi State was clustered into three Agricultural zones comprising: central (Darazo, Ganjuwa, Ningi, and Warji), northern (Dambam, Gamawa, Giade, Itas-gadau, Jama,are, Katagum, Misau, Shira and Zaki) and western (Alkaleri, Bauchi, Bogoro, Dass, Kirfi, Tafawa Balewa and Toro). In the second stage, eight (8) urban livestock markets and six (6) local livestock markets was purposively selected (14 livestock markets). This was based on fact that, there are well established livestock markets in the selected LGAs and there was sufficient supply and concentration of sheep and goats' traders. In the third stage, 321 sheep and 220 goats' traders from each market were selected using simple random sampling techniques. Data were collected with aid of structured questionnaire from 321 sheep traders and 220 goats' traders from 14 markets over a 12-month period. In addition, a check list was used for observation, inspection and asking the traders verbal questions regarding price as well as sheep and goats characteristics that determine selling price such as age, sex, coat colour, size, breed and body condition. Age was measured approximated by the type and number of teeth following Fikru and Gebeyew (2015) estimation guideline. Information on sex, coat colour and breed was observed through inspection of the sheep and goats. Live weight of sheep and goats was measured in Kilogram using measuring weigh scale (1000kg). The study classifies sheep and goats based on their sizes into small, medium and large, each category weighing approximately 1-30kg, 31–50kg and 51-70kg, respectively. This classification was adopted and modified from Mohammed *et al.* (2013) that classified cattle based on their sizes into small, medium and large, each category weighing approximately 220-350kg, 350–480kg and 480-600kg, respectively in Gombe metropolis.

Data for body condition scoring in sheep and goats was an estimate of the muscle and fat cover of animal by palpation of different regions of the body. The method adopted for this study was originally described by Nsoso *et al.* (2003). The method consists of a scale of six scores, from 1 to 6, based on the fat coverage in the lumbar region. This method was subsequently modified by Khan *et al.* (2006) where sheep and goats body condition were determined by visual assessment to identify any physical deformity. It is done by feel with hand thoracic, hind leg, hump parts and tail of the animal to assess the fat content which indicates the state of health and nutrition of the animal as well as quantity of meat and fat deposited.

A hedonic price regression model was fitted to determine the factors influencing sheep and goat prices. The model was adopted to achieve the objective which is to determine the factors (live weight, sex, coat color, age of animal, breed, body condition and season) that influence price of sheep and goats.

$P = f(X)$ or $P = f(X1 \ldots Xn)$ …(1)

where;

P= Price of Sheep or Goat

X ranges from $X_1, \ldots, X_n$ = Factors

Considering f(X) as a linear function

The hedonic price regression model for sheep is expressed as:

$$P_S = a + b_1D_1 + b_2D_2 + b_3D_3 + b_4D_4 + b_5D_5 + b_6D_6 + b_7D_7 + e \quad ...(2)$$

Where;

P_S = Price of Sheep (₦)

a = Constant

D_1 = Age (1=Immature <1 year, 2= Young 1-3 year, 3= Matured 4-6 year and 4=Aged >6 years)

D_2 = Live weight (kg) (1= <10kg, 2= 10-20kg, 3= 21-30kg, 4= >30kg)

D_3= Sex (1=Ram, 2= Ewe and 3= Castrated)

D_4 = Body condition (1= Lean, 2= Moderate, 3 =Fat and 4= Very fat)

D_5= Breed (1= Yankasa, 2=Uda, 3= Balami and 4= West Africa Dwarf and 5= Otherwise)

D_6 = Coat colour (1= White, 2=Black, 3=Brown and 4 = Otherwise)

D_7 = Season (1= Early dry, 2= Late dry, 3= Early rainy and 4= Late rainy)

The reference group in the hedonic price regression model of sheep is as follows;

D_1 = Age (2= Young 1-3 year)

D_2 = Live weight (kg) (2= 10-20kg)

D_3= Sex (1=Ram)

D_4 = Body condition (2= Moderate)

D_5= Breed (1=Yankasa)

D_6 = Coat colour (1= White)

D_7 = Season (2= Late dry)

The hedonic price regression model of goat is expressed as:

$$P_G = a + b_1D_1 + b_2D_2 + b_3D_3 + b_4D_4 + b_5D_5 + b_6D_6 + b_7D_7 + e \quad ...(3)$$

where;

P_G = Price of goats (₦)

a = Constant

D_1 = Age (1=Immature <1 year, 2= Young 1-3 year, Matured 3-5 year and Aged >6 years)

D_2 = Live weight (kg) (1= <5kg, 2= 5-15kg, 3= 16-25kg, 4= >25kg)

D_3= Sex (1=Bucks, 2= Does and 3= Castrated)

D_4 = Body condition (1= Lean, 2= Moderate, 3 =Fat and 4= Very fat)

D_5= Breed (1= Red Sokoto, 2= Sahel, 3= West Africa Dwarf and 4=Otherwise)

D_6 = Coat colour (1= Red, 2=Black, 3=Brown and 4 = Otherwise)

D_7 = Season (1= Early dry, 2= Late dry, 3= Early rainy and 4= Late rainy)

The reference group in the hedonic price regression model of goats is as follows;

D_1 = Age (2= Young 1-3 year)

D_2 = Live weight (kg) (2= 5-15kg)

D_3= Sex (2=Does)

D_4 = Body condition (2= Moderate)

D_5= Breed (1=Red sokoto)

D_6 = Coat color (1= Red)

D_7 = Season (2= Late dry)

RESULTS AND DISCUSSION

ESTIMATED HEDONIC REGRESSION OF FACTORS THAT INFLUENCE PRICES OF SHEEP

The result of the estimated hedonic price regression model explains 74.1% of the variation in prices of sheep. This shows that about 74.1% of the variation in the prices of sheep was influenced by the combined effects of the independent variables (age of animal, live weight, sex, body condition, breed, coat colour and season) included in the hedonic model. The remaining proportion can be attributed to error term. F-statistics (12.66) was significant at $P<0.05$, this statistic suggest goodness of fit of the model. Durbin Watson p-value of 1.02 was also reported. Which indicates there is a positive first order auto correlation as presented in Table 1.

The location of the 14 weekly markets also has an observed effect on the prices of sheep. Market location were entered as dummy variable. The reference market was Azare market because of sufficient supply and concentration of sheep traders. The estimated coefficient for market locations shows prices are lower in markets located in distant areas than those located in close distance areas. The result of the model also shows that sheep fetch higher prices in Bogoro, Toro, Marrarraba-liman Katagum and Laraski livestock markets when compared to Azare market. This is likely due to the relatively high potential for sheep population in the northern and central zone of Bauchi State and hence high supply. Another reason is that, Azare market is the major market where traders buy sheep (supply) and resale in other markets in Bauchi State. These results imply that buyers and sellers would benefit if they carefully choose market location.

The result further revealed there was significant difference ($P<0.05$) in the price of Ram, when compared with the price of ewe and castrated sheep. Ram attracted the higher price than ewe. The reason was probably because male sheep were preferred than female because of Carcass quality. The result obtained here is also consistent with the findings of Mahmud *et al.* (2014), confirms that other things being equal, price per animal was significantly higher for males as compared to female sheep. The lower price offered for female sheep is mainly because producers only sell female animals at the end of their productive life, which makes them older than Ram and castrates offered for sale. In other hand, castrated sheep attract higher price than Ram and ewe. This is probably because castration is a widely used practice for adding value to the animals. In the overall model, there was a significant difference ($P<0.05$) in the prices of young sheep (reference group) when compared with the price of immature. While the price of matured and aged sheep is higher than the price of young sheep. This can be attributed to carcass difference. Tsedeke *et al.* (2011), also confirms that prices are highest for matured sheep relative to the immature and young sheep. However, Terfa *et al.* (2013), also confirms that age influenced sheep price significantly and negatively, implying that sheep command a higher price up to a very old age and the price will fall down as age goes up.

Live weight of sheep significantly influences market prices of sheep at $P<0.05$. Live weight range between 10-20Kg was used as reference group. Sheep with live weight of 21-30Kg and above significantly influenced prices of sheep at $P<0.05$ and attracted higher prices compared to the reference group (10-20Kg). This is a clear indication of the interests of sheep producers/buyers in the study areas probably because of the reproductive functions they are expected to perform to ensure herd growth and continuity.

The price of *Yankasa* breed of sheep were compared with price of *Uda*, and *West African Dwarf*, the result shows that the price of *Yankasa* breed were found to be statistically significant at $P<0.05$ with negative coefficient, which implies that, prices of *Yankasa* were higher than that of *Uda* and *West African Dwarf*. However, price of *Balami* and other cross breed of sheep were significantly ($P<0.05$) higher when compared with price of *Yankasa*. This probably may arise because of the meat quality and taste of *Yankasa* and *Balam* breed as confirmed by butchers. Another reason is that *Yankasa* was the most commonly breed of sheep reared in the study area, in addition, *Uda and West African Dwarf* placed in the markets by traders' lack sufficient feeding. However, coat colour of sheep were not statistically significant at $P<0.05$. In most cases, coat colour is not given special attention in the study area for sheep. Although some colours are preferred for some ritual ceremonies.

Body condition was another factor that influence market prices of sheep in the study area. The price of moderate sheep was found to be significant at $P<0.05$ and attracted higher price when compared with price lean. Furthermore, the price of fat and very fat sheep was found to be significant at $P<0.05$ with positive coefficient. This implies that fat and very fat sheep attracted higher prices

when compared with moderate (reference group) and lean sheep. The variation in the price of sheep with different body condition score in the study area may be as a result of assessment carried out by buyers in terms of quantity of fat deposit found in very fat animal when compared with moderate and lean.

In the empirical model, the early dry season corresponds to December – February; late dry season (March – May); early rainy season (June – August) and the late rainy season (September – November). The late dry season was used as the reference group for comparison of the influence of season on prices of sheep. The results show there was a significant difference ($P<0.05$) in the price of sheep across season. All the coefficients were negative, meaning that prices of sheep were higher around March to May (late dry season) when compared to price of sheep around December to February (early dry season). This is probably due to shortage of feed and high cost of feed at late dry season linked with poor financial position of rural producers. Similarly, prices of sheep were lower around June to August (early rainy season) and around September to November (late rainy season) when compared to price of sheep around March to May (late dry season). It is the period of rainfall, marketing activities during this time is usually low and therefore prices tend to be low due to low demand.

Table 1: Estimated hedonic regression of factors that influence price of sheep

Variable	Coefficient	SE	t-statistic
Market location			
Azare (Reference group)	0	0	0
Gamawa	292.119	1043.613	0.28^{NS}
Dambam	744.7455	1015.047	0.73^{NS}
Hardawa	-510.7142	1135.698	-0.45^{NS}
Sakuwa	306.9694	1152.278	0.27^{NS}
Darazo	2586.576	1133.279	2.28^{**}
Katangar warji	1543.554	1141.130	0.48^{NS}
Soro	55.49353	1143.269	0.05^{NS}
Gadan maiwa	989.9098	1175.361	0.84^{NS}
Alkaleri	-793.3391	168.536	-4.71^{***}
Bogoro	2326.3397	1146.361	2.02^{**}
Toro	3374.2348	1056.547	$3.20^{***.}$
Mararraba L/ katagum	1454.925	701.568	$2.07^{*.}$
Laraski	201.4143	126.609	1.59^{*}
Sex			
Ram (Reference group)	0	0	0
Ewe	-778.653	562.344	-1.38^{*}
Castrated	840.923	557.137	1.51^{*}
Age of sheep			
Immature (<1 year)	-925.3075	642.3107	-1.44^{*}
Young (1-3 year) (Reference group)	0	0	0
Matured(4-6 year)	1202.41	649.7913	1.44^{*}
Aged (>6 years)	1404.3715	642.0086	2.19^{*}
Live weight			
<10kg	-972.4376	640.1296	-1.52^{*}
10-20kg (Reference group)	0	0	0

21-30kg	1032.862	644.4651	1.60*
>30kg	1520.3454	647.4619	2.35**
Breed			
Yankasa (Reference group)	0	0	0
Uda	-138.4526	729.0277	-0.19NS
Balami	1435.632	728.1231	1.97*
West African dwarf of sheep	-2397.0349	716.35	-3.35***
Other wise	397.0349	731.3145	0.51NS
Coat colour			
White (Reference group)	0	0	0
Black	-646.4775	652.3576	-0.99 NS
Brown	-61.50292	644.1884	-0.10 NS
Otherwise	-417.393	640.0613	-0.65NS

Source: Field survey, 2017

Note: ***Significant at p≤0.001, **Significant at p≤0.01, *Significant at p≤0.05 and NS= Not Significant, DW= Durbin Watson.

Table 1: Estimated hedonic regression of factors that influence price of sheep cont'd

Variable	Coefficient	SE	t-statistic
Body condition			
Lean	-1385.282	728.8026	-1.90*
Moderate (Reference group)	0	0	0
Fat	1042.386	722.6943	1.44*
Very fat	1171.043	739.3885	1.58*
Season			
Early dry	-1899.569	733.1033	-2.59**
Late dry (Reference group)	0	0	0
Early rain	-1386.7376	723.1841	-1.92*
Late rain	-1353.2787	722.6815	-1.49*
Constant	37990.17	1297.949	29.27***
R^2	**0.741**		
F-statistic	**12.66***		
DW	**1.02***		

Source: Field survey, 2017

Note: ***Significant at P≤0.001, **Significant at P≤0.01, *Significant at P≤0.05 and NS= Not Significant, DW= Durbin Watson.

ESTIMATED HEDONIC PRICE REGRESSION OF FACTORS THAT INFLUENCE PRICE OF GOATS

The result of the estimated hedonic price regression model explains 88.4% of the variation in prices of goats. This shows that about 88.4% of the variation in the prices of goats was influenced by the combined effects of the independent variables (age of animal, live weight, sex, body condition, breed, coat colour and season) included in the hedonic model. The remaining proportion can be attributed to error term. F-statistics (11.8) was significant at P<0.05, this statistic suggest goodness of fit of the model. Durbin Watson p-value of 1.06 was also reported. Which indicates there is a positive first order auto correlation as presented in Table 2.

The location of the 14 weekly markets also has an observed effect on the prices of goats. Market location were entered as dummy variable. The reference market was Azare market because of sufficient supply and concentration of goats' traders. The estimated coefficient for market locations shows prices are lower in markets located in distant areas than those located in close distance areas. The result of the model also shows that goats fetch higher prices in Bogoro, Toro, Marrarraba-liman Katagum and Laraski livestock markets when compared to Azare market. This is likely due to the relatively high potential for goats' population in the northern and central zone of Bauchi State and hence high supply. Another reason is that, Azare market is the major market where traders buy goats (supply) and resale in other markets in Bauchi State. These results imply that buyers and sellers would benefit if they carefully choose market location.

The result further revealed there was significant difference ($P<0.05$) in the price of Does, when compared with the price of Bucks and castrated goats. The reason was probably because Does were preferred than Bucks because of Carcass quality. The result obtained here is also consistent with the findings of Mahmud *et al.* (2014), confirms that other things being equal, price per animal was significantly higher for Does as compared to Bucks. In other hand, castrated goats attract higher price than Bucks. This is probably because castration is a widely used practice for adding value to the animals. In the overall model, there was a significant difference ($P<0.05$) in the prices of young goats (reference group) when compared with the price of immature (<1years). While the price of matured goats (4-6 years) and aged goat (>6 years) was higher than the price of young goats (1-3 years). This can attribute to carcass difference. Tsedeke *et al.* (2011), also confirms that prices are highest for matured goats relative to the immature and young goats. However, Terfa *et al.* (2013), also confirms that age influenced goat price significantly and negatively, implying that goats command a higher price up to a very old age and the price will fall down as age goes up.

Table 2: Estimated hedonic regression of factors that influence price of goats

Variable	Coefficient	SE	t-statistic
Market location			
Azare (Reference group)	0	0	0
Gamawa	1162.98	1225.616	0.95^{NS}
Dambam	163.0691	1199.693	0.14^{NS}
Hardawa	-474.8455	1315.562	-0.36^{NS}
Sakuwa	30.00516	1342.867	0.02^{NS}
Darazo	2464.075	1310.865	1.88^{*}
Katangar warji	1135.4	1326.375	0.86^{NS}
Soro	62.03606	1336.116	0.05^{NS}
Gadan maiwa	1513.512	1079.587	1.31^{*}
Alkaleri	793.9633	1366.37	0.58^{NS}
Bogoro	1795.3818	1034.672	1.74^{*}
Toro	1654.7397	1149.561	1.44^{**}
Mararraba L/ Katagum	1585.0813	1009.862	-1.57^{*}
Laraski	1630.9361	1117.533	1.46^{*}
Sex			
Bucks (Reference group)	0	0	0
Does	-1215.848	652.4901	-1.86^{*}

Castrated	1114.0505	648.3031	1.72*
Age of sheep			
Immature (<1 year)	-1366.9706	742.3866	-1.84*
Young (1-3 year) (Reference group)	0	0	0
Matured (4-6 year)	1471.279	754.3814	1.95*
Aged (>6 years)	-1155.93797	747.4525	1.55*
Live weight			
<10kg	-1483.5217	643.9503	-2.30**
10-20kg (Reference group)	0	0	0
21-30kg	1463.2181	643.9503	2.27**
>30kg	1184.6814	655.8107	1.81*
Breed			
Red sokoto (Reference group)	0	0	0
Sahel	832.3646	844.9169	0.19NS
West African of Dwarf goat	-1209.4717	830.5463	-1.46*
Other wise	334.3254	849.547	0.39NS
Coat color			
Red (Reference group)	0	0	0
Black	521.7179	760.5353	0.69NS
Brown	-511.0618	751.9642	-0.68NS
Otherwise	-325.2574	741.6716	-0.44NS
Body condition			
Lean	-423.1406	924.8362	-0.46*
Moderate (Reference group)	0	0	0
Fat	1627.239	932.704	1.74*
Very fat	1242.589	933.1107	1.33*

Source: Field survey, 2017

Note: ***Significant at p≤0.001, **Significant at p≤0.01, *Significant at p≤0.05 and NS= Not Significant, DW= Durbin Watson.

Table 2: Estimated hedonic regression of factors that influence price of goats cont'd

Variable	Coefficient	SE	t-statistic
Season			
Early dry	-1211.8504	832.3874	-1.46*
Late dry (Reference group)	0	0	0
Early rain	-1318.4442	836.3747	-1.58*
Late rain	-1358.7319	835.7247	-1.63*
Constant	29522.56	1549.107	19.05***
R^2	**0.884**		
F-statistic	**11.18***		
DW	**1.06***		

Source: Field survey, 2017

Note: ***Significant at P≤0.001, **Significant at P≤0.01, *Significant at P≤0.05 and NS= Not Significant, DW= Durbin Watson.

Live weight of goats significantly influences market prices at P<0.05. Live weight range between 10-20 Kg was used as reference group. Goats with live weight of 21-30 Kg and above significantly influenced prices of goats at P<0.05 and attracted higher prices compared to the reference group (10-20 Kg). This is a clear indication of the interests of goat producers/buyers in the study areas probably because of the reproductive functions they are expected to perform to ensure herd growth and continuity.

The price of *Red Sokoto* breed of goats where compared with price of *Sahel*, and *West African Dwarf* goat, the result shows that, the price of *Red Sokoto* breed were found to be statistically significant at P<0.05 with negative coefficient, which implies that, prices of *Red Sokoto* were higher than that of *Sahel* and *West African Dwarf* goat. However, price of *Sahel* and another cross breed of goat were significantly (P<0.05) higher when compare with price of *Red Sokoto*. This probably may arise because of the meat quality and taste of *Red Sokoto* and *Sahel* breed as confirmed by butchers. Another reason is that *Red Sokoto* was the most commonly breed of sheep reared in the study area, in addition, *West African Dwarf goat* placed in the markets by trader's lack sufficient feeding. However, coat color of goats where not statistically significant at P<0.05. In most cases, coat colour is not given special attention in the study area for goats. Although some colours are preferred for some ritual ceremonies. Body condition of goats was another factor that influence market prices in the study area. The price of moderate goat was found to be significant at P<0.05 and attracted higher price when compared with price of lean goats. Furthermore, the price of fat and very fat goats was found to be significant at P<0.05 with positive coefficient. This implies that fat and very fat goats attracted higher prices when compared with moderate (reference group) and lean goats. The variation in the prices of goats with different body condition score in the study area may be as a result of assessment carried out by buyers in terms of quantity of fat deposit found in very fat animal when compared with moderate and lean.

In the empirical model, the early dry season corresponds to December – February; late dry season (March – May); early rainy season (June – August) and the late rainy season (September – November). The late dry season was used as the reference group for comparison of the influence of season on prices of goats. The results show there was a significant difference ($P<0.05$) in the price of goats across season. All the coefficients were negative, meaning that prices of goats were higher around March to May (late dry season) when compared to price of goats around December to February (early dry season). This is probably due to shortage of feed and high cost of feed at late dry season linked with poor financial position of rural producers. Similarly, prices of goats were lower around June to August (early rainy season) and around September to November (late rainy season) when compared to price of goats around March to May (late dry season). It is the period of rainfall, marketing activities during this time is usually low and therefore prices tend to be low due to low demand.

CONCLUSION

Based on the findings of the study, it was concluded that, market location, sex, body condition of animal and season significantly ($P<0.05$) influenced selling price of sheep and goats in the study area. Age group and body condition of the traded animals are important observable attributes of the animal reflected in the observed price.

Based on the results of this study, the following recommendations were made:

i. The findings of hedonic price analysis suggested that sheep and goats breeding strategies and activities should duly consider the preferences expressed through the prices paid for animals, these could enhance the efficiency of sheep pricing system and consequently improve the livelihoods of sheep/goats' keepers and traders. It is vital to train producers on the importance of market oriented (commercial) livestock production system.

ii. Live weight is considered a very important variable in determining the price of sheep and goats. Separate weighing machine for small and large animals should be installed at the entry point of market. This will help traders to know the exact weight of animal and brings them at par with other market agents in price bargaining. So, the good quality animals will bring more if they are sold by grade and weight.

REFERENCES

Alemayehu, K. (2011). Value Chain Assessment of Beef Cattle Production and Marketing in Ethiopia: Challenges and Opportunities of Linking Smallholder Farmers to the Markets. *Journal for Livestock Research and Rural Development*, **23**(12):255-265.

Bassey, N. E., Okon, U. E. and Ibok, O. W. (2013). Inter-market Performance and Pricing Efficiency of Imported Rice Marketing in South-South Nigeria: The Case of Akwa Ibom State Traders. *Journal for Agricultural Science*, **1**(2):53-63.

Bauchi State Agricultural Development Programme (2015) BSADP at a glance. A pamphlet Prepared by P.M.E Sub-programme.

Fikru, S. and Gebeyew, K. (2015). Sheep and Goats Production Systems in Degehabur Zone, Eastern Ethiopia: Challenge and Opportunities. *Journal of Advance Dairy Research*, **3**(2):10-19.

Fafchamps, M. and Gideon, S. (2009). The Determinants of Livestock Prices in Niger. *Journal of African Economies*, **6**(2):255-295.

Kadigi, M. J. R., Kadigi, L. I., Laswai, G. H. and Kashaigili, J. J. (2013). Value Chain of Indigenous Cattle and Beef Products in Mwanza Region, Tanzania: Market Access, Linkages and Opportunities for Upgrading. *Academia Journal of Agricultural Research*, **1**(7):20 – 30.

Kassie, G. T., Abdulai, A. and Wollny, C. (2011). Heteroscedastic Hedonic Price Model for Cattle in the Rural Markets of Central Ethiopia. *Journal of Applied Economics,* **43**(24):231-242.

Khan, H., Muhammed, F., Ahmed, R., Rahimullah, G. and Zubair, M. (2006). Relationship of Body Weight with Linear Body Measurements in Goats. *Journal of Agriculture and Biological Science,* **1**(3):51-54.

Mahmud, M. A., Shaba, P. and Zubairu, U. Y. (2014). Live Body Weight Estimation in Small Ruminants-A Review. *Global Journal of Animal Scientific Research,* **2**(2):102-108.

Mohammed, S., Isiaka, M., Ishaku, A. and Zahradden, D. (2013). Economic analysis of Cattle Marketing in Gombe Metropolis, Nigeria. *Asian Journal of Agriculture and Rural Development,* **3**(12):960-965.

National Bureau of Statistics (NBS) (2017). Demographic Statistics Bulletin, Second (2nd) Series. A Publication of D|emographic Statistics Division, pp.10-17.

Nsoso, S. J., Aganga, A. A., Moganetsi, B. P. and Tshwenyane, S. O. (2003). Body Weight, Body Condition Score and Heart Girth in Indigenous Tswana Goats During the Dry and Wet Seasons in South East Botswana. *Journal for Livestock Research and Rural Development,* **4**(15):34-45.

Parish, J. A., Williams, B. R., Coatney, K. T., Best, T. F. and Stewart, C. O. (2017). A Hedonic Analysis of Sale Lot Traits Affecting Calf Prices in Mississippi Auction Markets. *The Professional Animal Scientist,* **3**(4):240–249.

Ramesh, D., Meena, H. R. and Meena, K. L. (2012). Analysis of Small Ruminant Market System in Different Agro-climatic Zones of Southern India. *Journal for Veterinary Research,* **5**(5):288-293.

Terfa, Z. G., Haile, A., Baker, D. and Kassie, G. T. (2013). Sheep Market Participation of Rural Households in Western Ethiopia. *African Journal of Agricultural Research,* **10**(8):150 – 161.

Tsedeke, K., Girma, A., Azage, T. and Berhanu, G. (2011). Marketing Value-chain of Smallholder Sheep and Goats in Crop-livestock Mixed Farming System of Alaba, Southern Ethiopia. *Journal for Small Ruminant Research,* **9**(6):101–105.

SOCIO-CULTURAL CHARACTERISTICS OF POULTRY FARMERS IN THREE STATE OF SOUTHERN NIGERIA

C.P. Ukwu, U.C. Ezetoha, I.E. Eze, H.O. Obikaonu, M.C. Uchegbu & I.C. Okoli
Department of Animal Science and Technology, Federal University of Technology, P.M.B 1526 Owerri, Imo State, Nigeria
Corresponding author: *P.C. Ukwu; E-mail: chikodiliukwu@gmail.com*

ABSTRACTS
This study reports socio-cultural characteristics of poultry farmers in three southern states of Nigeria: Imo, Akwa Ibom and Oyo states. Fifteen poultry farmers were sampled in each state with the aid of well structure questionnaires, making a total of 45 respondents. Data generated were analyzed using descriptive statistics such as means, frequencies and percentages. Gender distribution of the farmers was 66.67% for male and 33.33% for female. The highest number of respondents were within 31- 40 years' age bracket (46.63%), followed by the age group of 41-50 years (22.10%). The results showed that 82.20% of the respondents were married, had formal education up to secondary school level, with 66.60% of them being educated up to tertiary level although most of them in the south east studied courses not related to animal agriculture, while all the graduate respondents of south-south zone studied agriculture and animal production related courses. Many of the poultry farmers (42.20%) had 6 - 10 years' experience in the industry, while another 20.00% had 11-15 years' experience. It was concluded that poultry farmers in Southern Nigeria have formal education they are likely to properly evaluate various production factors and make the appropriate decisions on adoption of modern and recent technologies in poultry production, thus making the dissemination of poultry farming improvement information in the zone easy.

Keywords: Farmers, poultry, animal agriculture, southern Nigeria

INTRODUCTION
The poultry industry has contributed significantly to the growth of the Nigerian economy through direct and indirect impact on national gross domestic product (GDP) and provision of animal protein, employment and income to the different segments of the population (Sonaiya, 1999; Oyesola and Olujide, 2000). Traditional method of poultry keeping exists side by side with the commercial system in the study area (Chima, 2011). Each of these two systems is associated with features of scale, stock, husbandry and productivity. However, between these two distinct prototypes, intermediate grades have evolved over time in response to the natural agro-economy and consumer demands (Adene and Oguntade, 2006). The poultry production systems in Nigeria are influenced by many factors such as health and diseases, housing, feeds and feeding, sales and disposal of products and socio-cultural background of practitioners (Adedeji *et al*., 2014).

The socio-cultural characteristics of farmers include the sex, age and marital status, educational background, field of study for the educated ones and duration of experience in the poultry business (Bassey *et al.,* 2018). The belief system of the farmers may also be of significance. The estimation of the socio-cultural characteristics of poultry farmer in southern Nigeria will among other benefits contribute to knowledge and provide data needed by relevant agencies for policy formulation and intervention strategies.

This study was to evaluated the socio-cultural characteristics of poultry farmers in three southern states of Nigeria namely Imo, Akwa Ibom and Oyo states.

MATERIALS AND METHODS

The study was undertaken in three states: Imo, Akwa Ibom and Oyo representing south east, south-south and south west geo political zones of southern Nigeria respectively. The states were selected purposively because of the high levels of commercial poultry activities reported in them (Akandu, 2012). Each of the three states is divided politically into three senatorial zones, and one of the senatorial zones was selected purposively in each state, namely Owerri, Uyo and Ibadan zones for south east, south-south and south west states respectively. One local government area was also selected purposively from each senatorial zone in which 15 poultry farmers were also selected from a town in each selected local government area. Thus, 90 respondents participated in the study.

SAMPLING TECHNIQUES:

The sampling design was therefore multi-stage sampling. The criteria for selection were those stated above, in addition to willingness to participate in the study and the participant having a functional poultry farming enterprise. The data for the study were generated with the aid of structured questionnaires and personal interviews. The actual survey was preceded by a preliminary informal survey of the study areas through which the researcher familiarized himself with issues associated with poultry farming in the study areas, while also explaining the purpose of the study to the participants.

STATISTICAL ANALYSIS:

Data generated were subjected to descriptive statistics such as frequency counts, percentages and means (SAS, 2001).

RESULTS AND DISCUSSIONS

Table 1 shows the socio-cultural characteristics of poultry farmers in southern Nigerian states of Imo, Akwa Ibom and Oyo. Gender distribution of the farmers as shown in the table was 9(66.67%) for male and 6(33.33%) for female. The highest number of respondents were within 31-40 years age bracket (46.63%) and was followed by the age group of 41-50 years (22.10%). The least value was however recorded by the >60 years group that recorded 6.60%. This indicates that young people are actively in poultry farming in the study area. Similar results were reported by Okoli *et al.* (2004) for Imo state, Bassey (2014) for Akwa Ibom state and Ogegbuna (2014) for Anambra state. Across the zones, south east had the highest number of youthful (20 – 40 years) poultry farmers (73.3%), followed by south west (66.6%) and south-south (33.20%). The marital status results of the respondents showed that 17.76% were single, while 82.20% are married. However, breakdown of the result showed early marriage pattern for southwest zone of the country, where all respondents are married (100%), while the married respondents were 66.66 and 80.00% for south east and south-south zones respectively.

The results of educational qualification of the respondents showed that all had formal education up to secondary school level. The overall secondary school education limit of the respondents were 40.00 and 62.10% for tertiary level. Further breakdown of the results showed that south east with 73.30% had highest number of tertiary education graduates in poultry farming, followed by the 66.70 and 40.0% recorded in the south west and south-south respectively. These results however showed that 66.60% of the tertiary level educated farmers in the southeast studied courses not related to agriculture or animal agriculture, while all the graduate respondents in the south-south zone studied agriculture and animal related courses. Similar results of highly educated small-scale pig farmers have also been reported in Imo state, especially the peri-urban farmers (Okoli *et al.,* 2009; Moses, 2019). However, the overall results of the southern region showed that 12.23% studied agriculture, 23.33% studied animal science, 26.70% studied animal health, 8.90% studied veterinary medicine, while 28.87% studied courses outside the above mentioned disciplines. These results are contrary to the finding of Moses (2019) that most small-scale pig farmers in Imo state studied courses that are not related to agriculture before venturing into livestock farming.

Majority of the poultry farmers (42.20%) spent between 6 and 10 years in the industry. This was followed by the group with 11 - 15 years experience (20.00%). However, the fewer farmers in the studied areas (8.83%) are the group that have more than twenty years of experience in poultry farming. Across states however, Akwa Ibom state recorded the highest value (53.30%) for the 6 -10

years of experience, followed Imo state (40.00%) and Oyo state (33.33%). Similar results were reported by Bassey *et al.* (2018) when comparing farmer years of experience in Akwa Ibom and Anambra state. These results also show that more farmers entered into poultry farming in Akwa Ibom and Imo states than Oyo state in the last 10 years.

Table 1: Socio-cultural characteristics of poultry farmers in three states of southern Nigeria

Parameter	**Imo State (n=15) Frequency (%)**	**Akwa Ibom State (n= 15) Frequency (%)**	**Oyo State (n=15) Frequency (%)**	**Mean (n=45) Frequency (%)**
(a) Sex				
Male	9(60.00)	11(73.40)	10(75.00)	30(66.67)
Female	6(40.00)	4(26.60)	5(25.00)	15(33.33)
(b) Age (years)				
20-30	3(20.00)	1(6.60)	1(6.60)	5(11.06)
31-40	8(53.30)	4(26.60)	9(60.00)	21(46.63)
41-50	2(13.30)	6(40.00)	2(13.30)	10(22.10)
51-60	1(6.60)	3(20.00)	2(13.30)	6(13.30)
Above 60	1(6.60)	1(6.60)	1(6.60)	3(6.60)
(c) Marital status				
Single	5(33.30)	3(20.00)	0(0.00)	8(17.76)
Married	10(66.60)	12(80.00)	15(100.00)	37(82.20)
(d) Educational qualification				
Nil	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Primary	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Secondary	4(26.60)	9(60.00)	5(33.30)	18(40.00)
Tertiary	11(73.30)	6(40.00)	10(66.70)	27(62.10)
(e) Tertiary education discipline				
Agriculture	0(0.00)	1(16.70)	2(20.00)	3(12.23)
Animal science	2(16.70)	2(33.30)	2(20.00)	6(23.33)
Animal health	2(16.70)	2(33.30)	3(30.00)	7(26.70)
Veterinary	0(0.00)	1(16.70)	1(10.00)	2(8.90)
Others	8(66.6)	0(0.00)	2(20.00)	10(28.87)
(f) Years of experience				
1-5	3(20.00)	1(6.60)	2(13.30)	6(13.30)
6-10	6(40.00)	8(53.30)	5(33.30)	19(42.20)
11-15	2(13.30)	3(20.00)	4(26.60)	9(20.00)
16-20	2(13.30)	2(13.30)	3(20.00)	7(15.53)
Above 20	2(13.30)	1(6.60)	1(6.60)	4(8.83)

CONCLUSION

Poultry farmers in Southern Nigeria have formal education, suggesting that the farmers are likely to properly evaluate various production factors and make the appropriate decisions on adoption of modern and recent technologies in poultry production, thus making easier the dissemination of poultry farming improvement information in the zone.

REFERENCES

Adedeji, O.S. (2014). Assessment of poultry production systems in Illesha West L.G.A. of Osun State, Nigeria. *J. Agric. Vet. Sci.*, 1(1): 20 – 27.

Adene, D.E. and Oguntade, A.E. (2006). The structure and importance of the commercial and village based poultry in Nigeria. Food and Agricultural Organization, Rome. 110pp.

Akandu, C.U. (2012). The structure of the poultry industry in selected states of southern Nigeria. Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Bassey, I.O. (2014). Socioeconomic and drug use habits of animal health practitioners and poultry farmers in Akwa Ibom State. Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Bassey, I.O., Ogegbuna, O.H., Achonwa, C.C., Ugwu, C.C. and Okoli, I.C. (2018). Socio- cultural characteristics and drug use habit of poultry farmers in Akwa Ibom State. 43rd Annual Conference of the Nigerian Society for Animal Production, March 18th – 22nd 2018, Fut Owerri, Nigeria.

Chima, I.U. (2011). Evaluation of disinfectants and disinfection practices of poultry farmers in Imo state, Nigeria. M.Sc. Thesis, Federal University of Technology Owerri, Nigeria.

Moses, P.C. (2019). Feeding approaches, practices and nutrient contents of smallholder pig farmers' diet at two locations in Imo state, Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Obegbuna, O. (2014). Socioeconomic and drug use habits of animal health practitioners and poultry farmers in Anambra State, Nigeria. B. Agric. Tech. Project Report, Federal University of Technology Owerri, Nigeria.

Okoli, I.C., Alaina, O.R., Opara, M.N., Uchegbu, M.C., Ezeokeke, C.T., Durunna, C.S., Nnadi, F.N., Iheukwumere, F.C and Okeudo, N.J. (2009). Socio-cultural Characteristics of educated small scale holder pig farmers and the effects of their feeding practices on the performance of pigs in Imo state, Nigeria. *Report and Opinion*, 1(4): 59-65.

Okoli, I.C., Anyaegbunam, C.N., Etuk, E.B., Uchegbu, M.C. and Udedibie, A.B.I. (2004). Socio-economic characteristics of poultry business entrepreneurs in Imo state, Nigeria. *Journal of Agriculture and Social Research*, 4(2): 100 - 111.

Oyesola, O.B. and Olujide, M.G. (2000). Role of self-help groups in rural development. *Proceedings of the Tenth Annual Conference of Nigerian Rural Sociological Association (NRSA)* Ile-Ife, Nigeria. Pp: 110 - 116.

Sonaiya, E.B. (1999). Employment, income generation and skill development through rural poultry development. In: *Proceedings 20th World's Poultry Congress.* New Delhi, India. 1: 17-22.

Splitstoesser, N.E., Martin, F.W. and Rhodes, A.M. (1973). The Nutritional Value of Some Tropical Root Crops. *Proceedings of the Tropical Region of the American Society for Horticultural Sciences*, 17: 290-294.

CAUSES AND EFFECT OF CONFLICT BETWEEN CATTLE HERDERS AND CROP FARMERS IN GIREI, ADAMAWA STATE, NIGERIA

Yahya, M. M. & Muhammad Auwal Ahmed

Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola.
Department of Agricultural Economics and Extension, Modibbo Adama University of Technology, Yola
Email: Muktarmagaji29@gmail.com
Phone: 08035016337

ABSTRACT
Crop farmers and cattle herders conflict have remained the most prevailing resource-use conflict in Girei Local Government Area of Adamawa State. Social and economic factors confined to inflame violent conflicts. The competition between these two Agricultural land user-groups threats the means of survival in the study area. The study describes socio-economic characteristics of the farmers and herders and determines the causes of conflict in the study area. Primary data were collected by the use structured questionnaire. The data were subjected to simple percentages and chi-square analysis. The study revealed that the major causes of conflict in the study area are the crop damage by cattle, and lawlessness in the society. The findings also revealed that loss of expected yield, loss of cattle and loss of human lives and properties are the major effects of conflict. The study also concludes that the conflicts sometimes spread and lead to ethnic clashes and armed robbery. Therefore it is the interest of the state to address the genuine needs of herders and crop farmers since these two provides employment for almost all the rural people. It is recommended that strange faces identified should be reported and leaders should preach the implications of conflict in the society.
Key Words: Farmers, Herders, Lawlessness, Conflict and Clashes.

INTRODUCTION
One major problem confronting world peace today is the manifestation of conflict in different dimensions across the globe. From Europe to America, Africa to Asia conflicts is common (Jeong, 2008). Conflicts have been defined in different ways by different scholars. Ekong (2003) defined conflict as the form of social interaction in which the actors seek to obtained scarce reward by eliminating or weakening their contenders. Nigeria has experienced and still experiencing conflicts on grave proportions among several ethnic and religious communities. These conflicts vary in dimension, process and groups involved. It was observed by Momale (2003) that while some conflicts arise between same resources user groups, others occur between different user groups such as herders and farmers. Adisa (2012) observed that the farmer-herders conflict has remained the most preponderant resources-use conflict in Nigeria. Social and economic factors continue to provide violent conflicts among the Fulani pastoralist and crop farmers. The intensity and variation of the conflict largely depend on the nature and type of the user groups where the pastoralists grazes. The conflicts over access right to farmland and cattle routes have become ubiquitous and seems to have defied solutions (Abbas, 2009). However, coser (2000) have noted that, the inevitability of conflict in the claim for scarce resources is considered as the bane for struggles over the inestimable value for land and its resource, with the claim for ownership and the claim for its position as a common resource. Historical tension between pastoralist and settled indigenous farmers have intensified in recent years with dwindling natural resources and land availability greatly contributing to the on-going, escalating conflict in the country (Okello *et al.*, 2014). The herder-farmer conflict is now very rampant that almost every settlement that contains both herders and farmers are facing. This study tends to describe the socio-economic characteristics of the respondents, examine the factors responsible for the conflict and determine the major effects of conflicts in the study area.

MATERIALS AND METHODS
The study was conducted in Girei which is one of the 21 Local Government Areas of Adamawa State, and is the headquarter of the local government. It is an agrarian area well suited for rain fed and irrigation due to the presence of the river Benue in the area. Farming is the main occupation of the people with emphasis on the cultivation of cereals and on irrigated lands, vegetable crops like

tomatoes, pepper, onion, carrots and cabbage are grown. Some of the farmers are involved in livestock keeping, but Fulani herdsmen dominate the rearing of livestock in the area. It is located in the central area of Adamawa State. It is located on latitude 9^0 14'N and longitude 12^0 28'E and occupies a land of 8,068km^2 with an altitude of about 185.9m above sea level and posses two distinct seasons which are rainy and dry seasons (Adebayo & Tukur, 1999).

SAMPLING PROCEDURE AND SAMPLING SIZE

A muti stage sampling procedure was used for the study. In the first stage, 3 villages were sampled from a population of 15 villages that made the study area. The purposive selection was made because the sampled area consist of the villages where crop. Cultivation and cattle rearing were most farmers and the areas where crop farmers and cattle herders' conflict occur frequently. The selected villages for the study were koh, Labondo and Gereng. A total of 5 crop farmers and 5 cattle herders from each of the 3 villages in the local government area were chosen randomly, thus giving a total of 15 crop farmers and 15 cattle herders.

METHOD OF DATA COLLECTION

Primary data was collected for the study. The data was obtained through field survey using structured questionnaire. A total of 30 questionnaires were administered throughout the selected three (3) selected villages.

ANALYTICAL TECHNIQUES

The data collected was analyzed using descriptive statistics, specifically frequently counts and percentages while chi-square analysis was also used to achieve the objectives.

RESULT AND DISCUSSION

The results of the socio-economic characteristics of the respondents as presented in Table 1 shows that majority 986.21%) of the respondents were males while 13.79% were females, most (89.66%) of the respondents are married which only 10.34% were females, most (89.66%) of the respondents are married which only 10.34% were single. The study also revealed that most (62.07%) were between the ages of 30-40years, 21.17% are above 40years which only 13.79% are below 30years, 58.62% of the respondents have 6-10 children, 20.69% have 11-15 children while only 6.90% have more than 15 children. The study also revealed that 41.38% are crop farmers, 34.48% are cattle rearers and 24.14 are those that combine crop farming and cattle rearing. Respondents' level of education shows that 51.73% attended only Quranic schools, 34.48% are primary certificate holders, 13.79% are secondary school certificate holders which none studied beyond secondary school. The result also shows that 17.24% of the respondents are Hausa, 13.79% are others who are mostly Sullubawa (cattle herders) and few Kanuri farmers and majority (68.97%) are Fulanis. This report is close to the findings of Akinola and Ironkwe (2012) who reported 63.8% males and 36.2% females, 53.7% are of ages between 41-50years, 25.43% and 31.3 of the respondents had Primary, Secondary and Tertiary certificates among poultry farmers in Rivers State respectively. Socio-economic features of ruminant animals marketers in Alaba-Rago market in Lagos shows that 83.93% are males, 64.29% married, 16.07% widows,53.57% are within the ages of 31-49years while 47.32 had Primary certificate, 33.04, 10.71, 7.14 and 1.79 had SSCE/O/L, OND/NCE, B. Sc/HND and M.Sc. respectively, Lamidi *et al.* (2012). The study revealed that the major causes of conflict in the study area were majorly crop damage by cattle and lawlessness in the society and that lost of crops, lost of animals and sometimes lost of lives as a result of conflict as the major effects of conflict in the study area.

Table 1 Socio-Economic characteristics of the respondents

Variable	Frequency	Percentage(%)	Variable	Frequency	Percentage(%)
Gender			**Educational Level**		
Male	25	86.21	Quranic	15	51.73
Female	4	13.79	Primary School	10	34.48
			Secondary School	4	13.79
			Tertiary Institution	0	0.00
Marital status	26	89.66	**Age**		
Married	3	10.34	20-29	4	13.79
Single			30-39	18	62.07
Household size	4	13.79	40 and above	7	24.14
>5	17	58.62	**Occupation**		51.38
6-10	6	20.69	Farming	12	34.48
11-15	2	6.90	Cattle Rearing	10	24.14
16 and above			Both	7	
Ethnic Group					
Hausa	5	17.24			
Fulani	20	68.97			
Others	4	13.79			

REFERENCES

Abbas, I. M. (2009). No Retreat No Surrender conflict for survival between Fulani cattle Herders and Farmers in Northern Nigeria. *European Scientific Journal* **8** (1) 331-349.

Adisa, R. S. (2012). Land use conflict between Farmers and Herdsmen-implications for Agricultural and Rural Development.Department of Agricultural Exention and Rural Development, University of Ilorin, Ilorin Nigeria.

Adebayo, A. A. and A. L. Tukur (1999). Adamawa State in Maps Paraclete publications, Yola

Akinola, L. A. F. and Ironkwe M. O. (2012). An Assessment of the Awareness level of occupational and Environmental Hazards among poultry farmers in Rivers State, Nigeria. Proceedings of 17th Annual conference of ASAN/NIAS, Abuja.

Coser, L. A. (2000). Continuities in the study of social conflict. London. MacMillan Publishers.

Ekong, E. E. (2003). An Introduction to Rural Sociology. 2nd Edition. Dove of Educational publishers, Uyo, Nigeria.

Jeong, H. (2008). Understanding conflict and confilict Analysis. London: Sage Publication..

Lamidi, A. A. , Ashorun, W. O. and Aregbosola, A. O. (2012). Economics of Ruminant Animal marketing in Lagos Metropolis: a case study of Alaba-Market. Proceedings of 17th Annual conference of ASAN/NIAS, Abuja.

Momale, S. B. (2003). Resource use Conflict in Agricultural and Pastoral area in Nigeria. In Gefu, J.. O. (Ed). Land Tenure system in Nigeria.

Okello, A. L., Majekodunmi, A. O., Malala, A., Welburn, S. C. and Smith, J. (2014). Identifying motivators for state Pastoralist Dialogue.

ASSESSMENT OF GOAT PRODUCTION CAPACITY IN FASKARI LOCAL GOVERNMENT AREA, KATSINA STATE

Aliyu, A.M[1]., E. A. Rotimi[1] & Abdulhamid S.U.[2]
[1]Department of Animal Science, Federal University Dutsin-Ma, Katsina State. P.M.B. 5001
[2]Department of Animal Health and Production Technology, Audu Bako College of Agriculture Danbatta, Kano State. P.M.B. 3159
***Corresponding Author**: Aliyu, A.M. Email; amaliyu@fudutsinma.edu.ng, +2348064209979*

ABSTRACT
The aim of this study was to evaluate the production capacity of goat in Faskari local government area, Katsina State. Data were obtained using structured questionnaires administered to the respondents in the study area. Data were also generated on breed, sex and age of goats in the study area. A total of 101 goats were randomly sampled for this study. The breeds of goat sampled were Sahelian, Red Sokoto and West African Dwarf (WAD) with 55, 38 and 8 goats respectively. Majority of goats sampled were female, 28 bucks and 71 does. Results also show that the main production constrains in goat production in the study area was marketing. The main purpose of keeping goat was for income source.

KEY WORDS: Assessment, goat, production capacity, Faskari and Katsina State.

INTRODUCTION
Indigenous goats are an important animal genetic resources for African farmers, providing meat, milk, manure, fibers hides, and satisfying various cultural and religious functions. In Africa, the survival of many indigenous goat populations is threatened by diseases, adverse climatic conditions, civil strife, pressure of economic development, abandonment of traditional farming practices, and more importantly through crossbreeding or replacement with animals from the developed world. The Red Sokoto goat or Maradi is the most predominant goat breed and accounts for about 70% of Nigeria's total goat population which has been estimated at 17.5 million (Ademosun, 1994). It was commonly found among the agro pastoralist mainly within the northern sub-humid and semi-arid zones of the country (Akpa *et al.,* 2001). The breed is predominantly reddish brown in colour and was found in the savannah zone of Nigeria (80N -110N) where it constitutes more than 90% of the goat population in that area. The West Africa Dwarf (WAD) goat is widely distributed across the rainforest belt of southern Nigeria. They are short legged and small-bodied animals, weighing between 22 and 26kg. They also present variable coat colors, ranging from black, brown, grey, red and white and sometimes combinations of these in a variety of patterns (Akpa, *et al.,* 2001). Goats are referred to as the "small man's cattle"

MATERIALS AND METHOD
Study Location
This study was conducted across Faskari Local government area (Mairua, Sheme, Dakamawa, Kanonhaki and Daudawa). The study area is located within the North- West part of Nigeria within coordinates $11^0$43'N $7^0$02'E/ 11.717^{0}N 7.033^{0}E. The study area has an average annual Rainfall of 198mm with an average annual Temperature of 28 °C (WIKIPEDIA).

EXPERIMENTAL ANIMALS AND MANAGEMENT

Goats were randomly sampled across the towns in Faskari LGA. Goats were identified by breeds, sex and age. Phenotypical observation was used to identify the breeds and sex. Goats were grouped into ages using their dentition (Wilson and Durkin, 1984). The experimental animals were managed under semi-intensive system. The goat houses were made using corn stalk for fencing and thatched roofing for protection against heat and rainfall. There was no organized health care provision in terms of vaccination and deworming. However, Veterinary officers were called to treat the animals when cases of ill-health occur. The kids were allowed to roam with their dams.

RESULT AND DISCUSSION

Table 1 shows frequency of personal information for the respondents. Majority of the respondents are between 41 to 50 years of age, representing 36.4% out of the total respondents. This result is similar to the report of Adams Ohene-Yankyera (2014), who obtained 47.29 years. Majority of the respondents sampled were male (71 and 28 respectively) representing 71.7 and 28.3% respectively. This finding is similar to that of Akpa *et al.,* (1998*)* who reported that higher number of goat producers are male (72 and 29 respectively). Majority of the respondents had non-formal education. Akpa *et al.,* (1998) asserted that there is need for an increase in the educational status of the farmers in order to improve their rate of adoption in terms of breeding and production practices. Marital status of the respondents revealed that majority of the goat producers are married. The main stable source of income for the respondents was agriculture, where trading and other sources were minor, this shows that most of goat producers depend on Agricultural activities as their source of income with 77 respondents, representing 77.8%.

Table 1: Frequencies Distribution of the Respondents' Personal Information

Parameters	Levels	Frequency	Percentage (%)
Age (years)	20-40	22	22.2
	41-50	36	36.2
	51-60	30	30.3
	61 and above	11	11.3
	Total	99	100
Sex	Male	71	71.7
	Female	28	28.3
	Total	99	100
Educational status	Primary	18	18.2
	Secondary	10	10.1
	Tertiary	07	07.1
	Non-formal education	64	64.6
	Total	99	100
Marital status	Married	86	86.8
	Divorced	04	04.0
	Single	05	05.2
	Widowed	04	04.0
	Total	99	100
Sources of income	Agriculture	77	77.8
	Trading	9	9.1
	Civil servant	10	10.1
	Others	03	3.0
	Total	99	100

Table 2 shows the production characteristics of goat in the study area. Breed of goats produced in the area are mainly Sahel. This result is however in contrast with the report of Ademosun (1994) who reported that Red Sokoto goat or Maradi is the most predominant goat breed in Nigeria, accounting for about 70% of the total goat population estimated at 17.5 million.

Higher number of female (does) goats were sampled in the area than male (bucks), 27.7% and 72.3% respectively. This result if similar with the report of Egwu et al. (1995) who reported that there is preference for keeping young and more productive female animals in the herd for reproduction and multiplication. Goats kept by the producers are majorly between the age of 2 to 4 years, 31.6% and 26.7 % respectively. Majority of goat farmers prefer to keep the animal from age 2 to 4 years for breeding while animal that are above 4 years were majorly sold out or slaughter for festival or for personal consumption (Oseni *et al*., 2008). Majority of the farmers keep flock size of 6-10 goats in the herd, indicating good prospects for goat production in the area.

Major purpose of keeping goat in the study area was for income generation followed by source of manure (57.6% and 25.2% respectively). This observation agrees with the report of Akpa, (2000) who reported that goats are kept primarily for meat and income especially by peasant farmers in Nigeria. Major constrains of goat production in the area were disease outbreak, feed and water shortage and market problems, 17.0%, 34.0%, 3.0% and 46.0% respectively. This result agrees with the finding of (Oseni *et al*., 2008) who reported that labour, disease, feed shortage were the most pertinent constrains in goat production.

Table 2: Frequencies Distribution of Goat Production Capacity

Parameters	Parameters	Frequency	Percentage (%)
Goat breeds	Red Sokoto goat	38	37.62
	Sahelian goat	55	54.46
	West African goat	08	7.92
	Total	101	100.0
Sex	Male	28	27.7
	Female	73	72.3
	Total	101	100.0
Age of the goat (years)	1	4	4.0
	2	34	31.6
	3	24	23.8
	4	27	26.7
	5	14	13.9
	Total	101	100.0
Flock sizes	1-5	23	23.3
	6-10	47	47.5
	11 and above	29	29.2
	Total	99	100.0
Purpose of keeping goat	Income generation	57	57.6
	Meat	6	6.1
	Manure	25	25.2
	Skin	7	7.1
	Religious sacrifices	4	4.0
	Total	99	100.0
Constrain to goat production	Disease	17	17.0
	Feed shortage	35	34.0
	Water shortage	3	3.00
	Marketing problem	46	46.0
	Total	101	100.0

CONCLUSION

Sahelian goats are the most predominant breed kept in the study area majorly for income generation, with more males than females engaged in the production. The average flock size in the area was 6-10 goats. The major production constrains of marketing and feed shortage.

RECOMMENDATIONS

Majority of the goat producers in the study area had non-formal education. Hence, there is need for government and non- governmental organization intervention to increase educational status of the farmers in order to improve their rate of adoption in terms of breeding and production practices. There is also need for concerted efforts towards conservation of the uniqueness of this breed in the area for maximum utilization.

REFERENCES

Adams, F. and Ohene-Yankyera, K. (2014). Socio-economic characteristics of subsistent smallruminant farmers in three regions of northern Ghana. *Asian Journal of Applied Science and Engineering*, *3(3): 351-364.*

Ademosun, A.A. (1994), Constraints and prospects for small ruminant research and development in Africa. *In:* Small Ruminant Research and Development in Africa. Proceedings of the 2nd Biennial Conference of the African Small Ruminant Research Network, Arcc, Arusha, Tanzania, 1 – 6.

Akpa, G.N., Duru, S. and Amos, T.T. (1998). Influence of Strain and Sex on estimation of within-age-group body weight of Nigerian Maradi goats from their linear body measurement. *Tropical Agriculture (Trinidad)*, 74: 462 – 467.

Akpa, G.N. (2000), Factors affecting growth and body measurements of traditionally manage Red Sokoto goats. *In*: Animal Production in the New Millennium: Challenges and options. Book of Proceedings of the 27th Annual Conference of Nigerian Society for Animal Production, Umudike, 19 – 23.

Akpa, G.N., Asiribo, O.E., Oni, O.O. and Alawa, J.P. (2001). The Influence of Non genetic factors on the shape of lactation curves in Red Sokoto goats. *Animal Science,* 72: 233 – 239.

Egwu, G.O., Onyeyilo, P.A., Chibuzo, G.A. and Ameh, J.A. (1995). Improved productivity of goats and utilization of goat milk in Nigeria. *Small Ruminant Research,* 16**:** 195- 201

https://en.wikipedia.org/wiki/Faskari.

Oseni, S.O. and Ajayi, B.A. (2008). Body weight and morphological characteristics of WAD goats under backyard units in south western Nigeria. *In proceeding of the 13th annual conference of the Animal Science Association of Nigeria (ASAN),* September, 15-19. 2008, ABU Zaria.

Wilson, R. T. and Durkin, J. W. (1984). Age at permanent incisor eruption in indigenous goats and sheep in semi arid Africa. *Livestock Production Science.* 11: 451 – 455.

CONTRIBUTIONS OF SMALL RUMINANT PRODUCTION TO FARMERS' LIVELIHOOD IN DERIVED SAVANNAH AREA OF OYO STATE

Sosina A. O.L
Department of Animal Science, University of Ibadan, Ibadan, Nigeria
Corresponding E-mail: dayososina@gmail.com

ABSTRACTS
The impact of small ruminant husbandry to farmers' livelihood is of concern to Government's policy formulation. This study investigated the contribution of small ruminant production to farmers' livelihood in derived savannah area of Oyo State, Nigeria. Small ruminant farmers were purposively selected with the assistance of extension agents using a three tier multi stage sampling technique in which 225 respondents were selected. Parameters measured include livelihood enterprises, % income on household livelihood, record of sales, 5% mortality rate and seasonality. Qualitative and quantitative data collected were transcribed into Microsoft Excel the Feed Assessment Tool (FEAST) Excel macro program. The average household livestock holdings were 20.08±2.16 (sheep), 32.00±3.26 (goats) while average weight of the animals (kg) were 20.00±4.27 (sheep), 15.00±3.89 (Goat). The dominant breed for sheep and goat was West African Dwarf breed. The ranking and % income of the livelihood enterprises were primary (60), secondary (20) and tertiary (10) for Agriculture, Livestock and remittance, respectively. The average household goats sold over the past 3 years were 15.00±1.36 (male) and 10.00 ±1.45 (female) with average weight (Kg) range 15.56±2.78 to 20.67±3.34. The average household sheep sold over the last 3 years were 25.00±3.87 (male) and 30.00±4.28 (female) with average weight (Kg) ranged 25.78±5.27 to 30.89±6.47. The seasonal average sales (₦) ranged 4,000 to 7,000 and 6,000 to 13,000 for goat and sheep, respectively. Agriculture, the main stay of the heterogeneous population in derived savannah area, with small ruminant contribution to the individual household income and livelihood cannot be undermined.

Keywords: Ecological zones, Feed resources, Household income, Livestock enterprises, Policy formulation, Seasonality.

INTRODUCTION
The continuous neglect of small ruminant production had adverse effect on economies of households especially at the system level. If small ruminant production is given the right and needed attention by famers and policy makers, there will be significant reduction in poverty, improve food security which is in line with the sustainable development goals (SDG's). The impacts on food (animal protein) and nutrition security as well as livelihood on national economy are significant and far-reaching. The sustainable livelihood approach (SLA) provides a better understanding of rural livelihood (Sinkaiye and Ajayi, 2012). While assessing the sustainable livelihood, some donor agencies provide framework to evaluate the means of livelihood in the community (Sinkaiye and Ajayi 2012), which provide information on livelihood vulnerability, resistance, risk attitudes and sources of livelihood (ATA, 2013). Average annual household income of respondents was influenced by the location, gender and livelihood enterprises (Haile et al. 2010). Income was higher from the sales of livestock and livestock products in some locations compared with sales from crop products, which was higher than the non-agricultural activities or enterprises. The purpose of the National Livestock Transformation Plan Strategy (NLTPS) was to provide structure for agricultural subsector development that can become a catalyst for building national prosperity. Strategic interventions are aimed at modernizing livestock production through the establishment of ranches, mitigating the escalating crisis between pastoralists and farmers, and improving the broader supporting architecture around these issues (FMANR report 2017).Small ruminant production adoption substantially reduces household poverty and stunting for children younger than age five thus influencing farmers' household nutrition and livelihood (Sosina et al. 2019). Furthermore, beyond nutrition and income roles, livestock serves as a buffer resource for farmers to use in responding to emergencies, such as crop failure, as well as acts as a live bank, facilitating both income distribution and savings (Kabunga 2014). Farmers' livelihood also depend on sales of matured or weaners at village markets especially among women (Sosina 2017). The significant roles played by small ruminant production in the household and national economies cannot be overemphasized. Thus the study investigated the contribution of small ruminant production to farmers' livelihood in derived savannah area of Oyo state.

MATERIALS AND METHODS

The study was conducted in the derived savannah area of Oyo State, ethnically heterogeneous with a high concentration of smallholder crop and livestock farmers. Small ruminant farmers were purposively selected using a three tier multi stage sampling technique of about 225 respondents. Parameters measured includes livelihood enterprises, % income on household livelihood, record of sales, mortality, seasonality. Qualitative and quantitative data collected through questionnaire were transcribed into Microsoft Excel the FEAST Excel macro program (www.ilri.org/feast) (Duncan 2014).

RESULTS AND DISCUSSIONS

Livestock holding of the farmers: The predominant livestock among farmers in the study area were sheep, goat and poultry with the dominant breed of sheep and goat as the West African Dwarf (WAD), the indigenous type. The average household livestock holding of sheep, goat and poultry were 20.08±2.16, 32.00±3.26 and 55.00±7.34, respectively (Table 1). The average live weight per animal (Kg) were 20.00±4.27 (sheep), 15.00±3.89 (Goat) and 2.00±0.78 (poultry).

The average live weight of the dominant livestock agreed with Sosina (2017) who reported similar range of 15-25 Kg for sheep and goat among indigenous WAD breeds. However, this result was in contrast with the report of Amole and Ayantunde (2016) higher weight for other indigenous breeds in the drier and Sahel regions. Sosina (2017) also reported low Tropical Livestock Unit (TLU) for sheep and goat among farmers' in the Ibadan/Ibarapa zone of Oyo state. Chah et al. (2013) reported the high incidence of sheep and goat production in rural areas of Enugu. Nigeria though in contrast with Samireddypalle et al (2014a) reported lower percentage of sheep and goat farmers among peri-urban farmers.

Contributions of the livelihood enterprises: FEAST also provided the opportunity to evaluate the contribution of livelihood activities to household income as in Table 2. FEAST evaluated contributors to the farmer average % of income as agriculture, livestock, business, remittance, labour and others; which agreed with Sosina (2017) who reported similar enterprises contribution to livelihood in Ibadan/Ibarapa area.

The contribution of agriculture to the livelihood activities of household income was 60%. Agriculture form the main stay of the respondents' income which supported FAO (2015) that agriculture remains the highest contributor of the populace especially in the sub-Saharan Africa. However, the result was contrary to that of ATA (2013) reported higher national income accruing from oil than agriculture. The average % contribution of livestock to the farmers' income was 20%, suggested livestock enterprise was ranked next to agriculture among respondents. This was supported by Sosina (2017) that livestock was among the major contributors to farmers' income contrary to Amole and Ayantunde (2016) that ranked livestock ahead of crop agriculture in the contribution of livelihood activities to household income. The contribution of remittance to the average respondents was 10. The remittance was income from wards, relations outside the village or systems level from cities or abroad which are very consistent or monthly (Sosina 2017). Remittance to the livelihood of respondent farmers agreed with the submission of Wassena et al. (2013) that reported high remittance level among farmers in Ethiopia. The % contributions of labour and others to the farmers' income from the study area were 3 and 2 % each. Other contributors to the farmers' income could be inconsistent and unexpected donations and gifts. Haile et al (2010) corroborated the above findings on the contributions of livelihood enterprises to household income with respect to male and female household head (MHHs and FHHs). Basically, the ranking and % income of the livelihood enterprises were primary (60), secondary (20) and tertiary (10) for Agriculture, Livestock and remittance, respectively. The lower ranked contributors to livelihood income were Business, Labour and others were 3%, 5% and 2%, respectively.

Income: The household income and livelihood of farmers' in the study area was dependent on the number of small ruminants put to sale especially female household head (FHHs) (Table 3). The number of male and female animals, sheep and goat put for sales at nearby or village market determines the income and livelihood of the household. Market price of small ruminants is a function of the size and location. The number of male goats and sheep over the past 3 years were (15.34±1.27)

and (25.82 ± 2.38), respectively. The number of female goats and sheep over the past 3 years were (10.27 ± 1.45) and (30.78±3.67), respectively. The approximate weight of male goats and sheep sold over the past 3 years were (15.47± 1.78) and (25.27±2.78), respectively. The approximate weight of female goats and sheep were (20.47±2.67) and (30.72±3.89), respectively. The live weight of male goats and sheep sold were similar to the results of Sosina (2017) of small ruminants sold at village markets and household assets (Babayemi et al. 2014b). However, Duku et al (2010) reported higher live weight and number while examining the dynamics of small ruminant production in the derived savannah.

Average local market price of goat and sheep: The average market prices of sheep and goat largely depends on a number of factors which include the festive periods and market forces of demand and supply (Table 4). Moreover, the average market prices of sheep and goat ranged (6000.02 ± 12.78) to (13000.29 ±13.89) and (4000.13 ± 8.35 to 7000.38 ± 10.89), respectively. The average weight of sheep (male and female) are usually higher than that of goat which also reflect on the market prices as well. The result agreed with the submission of Samireddypalle et al (2014b) and Sosina et al (2019). Furthermore, the breeds and management as well as the physiological state of the small ruminant influences the average market prices. Kabunga (2014) reported higher live weights for sheep and goats in Kenya while lower weights were recorded for indigenous breeds of Ghana (Duku et al 2010).

CONCLUSION

Crop-livestock production system of management is a panacea to crop farmers and pastoralists crises in the tropics. The livelihood of the small holder farmers' is largely influenced by the weight of the animals, number of animals put to sales, prices of the animals and period of sales. Hence, government policies should look for means of increasing livestock production among small holder farmers.

REFERENCES

Amole T.A. and A.A. Ayantunde (2016). Assessment of Existing and Potential Feed Resources for Improving Livestock Productivity in Niger. *International Journal of Agricultural Research* 11: 40-55.

ATA.MNAR (2013).FMARD Nigeria .GES live data dashboard. Retrieved on 02/12/2014 from http://www.fmard..ng/ges-live-data-dashboard Score card FMA&RD Mid-Term Report January, 2013

Babayemi O. J., A. Samireddypalle, A.O. Sosina, A. A. Ayantunde, I. Okike and A. J. Duncan (2014) Characterization of farming and livestock production systems using the feed assessment tool (FEAST) in selected local government areas of Osun state, Nigeria. Research program on integrated systems for the humid tropics ILRI Technical Report, December, 2014

Duku S., J. Akke., Z.Van der Zijpp., P. Howard (2010). Small ruminant feed systems: Perceptions and practices in the transitional zone of Ghana. *Journal of Ethno-biology and Ethno-medicine,* 6:11 http://www.ethnobiomed.com/content/6/1/11

Duncan A., L. York, B. Lukuyu, A. Samaddar and W. Stur (2012).Feed Assessment Tool (FEAST) : A systematic method for assessing local feed resources availability and use with a view to designing intervention strategies aimed at optimizing feed utilization Questionnaire for Facilitators (Version 5.3) update 15 July 9, 2012 ILRI, Addis Ababa, Ethiopia.

FAO (2015). The state of food and agriculture: social protection and agriculture: breaking the cycle of rural poverty. FAO publication

FMANR report (2017). National Livestock Development Programme strategy framework submitted to the Federal Ministry of Agriculture and Natural Resources (FMANR). 2017.

Haile G, Haile A and G. Asghedom (2010).Baseline Survey emergency response addressing livelihood (food) security of former IDPS/expellees, host communities and drought affected rural populations in Eritrea. A UNDP project report, Asmaria, Eritrea.

Kabunga N (2014) Adoption and Impact of Improved Cow Breeds on Household Welfare and Child Nutrition Outcomes: Empirical Evidence from Uganda. Contributed Paper prepared for presentation at the 88th Annual Conference of the Agricultural Economics Society, Agro Paris Tech, Paris, France 9 - 11 April 2014.

NLTP, FMANR (2017) National Livestock Transformation Programme report submitted to the Federal Ministry of Agriculture and Natural Resources, (FMANR).

Samireddypalle A., A. Ayantunde, A. Okike, O.J. Babayemi, A.O. Sosina and A. Duncan (2014a) Assessment of livestock feed value chain in Ido and Ogo Oluwa local government areas of Oyo state. CGIAR Research program on Integrated Systems for the Humid Tropics. ILRI Technical Report December2014 www cg space.cgiar.org

Samireddypalle A., A. Ayantunde, A. Okike, O.J. Babayemi, A.O. Sosina and A. Duncan (2014b) Assessment of Livestock feed value chain in Ayedire and Atakumosa East local government areas of Osun state. CGIAR Research program on Integrated Systems for the Humid Tropics. ILRI Technical Report December2014 www cg space.cgiar.org

Sinkaiye T. and Ajayi A. O. (2012) Participatory Rural Appraisal and Planning Methodologies for Sustainable Development. ISBN: 978-978-51134-1-9.

Sosina A.O. (2017). Assessment of crop residues as feed resources for crop-livestock production Systems in Ibadan/Ibarapa area of Oyo State, Nigeria. A Ph.D. thesis submitted to the Department of Animal Science, University of Ibadan, Nigeria.

Sosina A.O., Babayemi O.J. and A.E. Adekoya (2019) Crop-livestock production systems contributions to livestock diet and farmers' livelihood in Ibadan/Ibarapa area, Oyo state, Nigeria. *Wayamba Journal of Animal Science* (WJAS), Vol.11, Pg 1827- 1835.

Wassena F.J., W. Lukuyu, B. Mangesho, W. E. Laswal, G. H. Bwire, J. M. N. Kimambo, A.E and B.L. Maass (2013). Determining Feed Resources and Feeding Circumstances; Usefulness and Lessons learnt by applying FEAST in Tanzania. From http; //www.tropentag.de/2013/a.

Table 1: Livestock holding of the farmers.

Table 1: Livestock holding of the Farmers

Type of Animal	Average Number of animals	Approximate weight per animal (kg)	Dominant Breed
Sheep	20.08±2.16	20.00±4,27	WAD
Goats	32.00±3.26	15.00±3.89	WAD
Poultry - village conditions	55.00±7.34	2.00±0.78	Local birds

Table 2: Contributions of the livelihood enterprises

Name	Rank	%of income
Remittance	Tertiary	10
Livestock	Secondary	20
Agriculture	Primary	60
Labour		3
Business		5
Others		2

Table 3: The household farmers' income from the sale of small ruminants

Type of Animal sold	Number	Approximate weight
Number of male goats sold over the past 3 years	15.34 ± 1.27	15.47 ± 1.78
Number of female goats sold over the past 3 years	10.27 ± 1.45	20.47 ± 2.67
Number of male sheep sold over past 3 years	25.82 ± 2.38	25.27 ± 2.78
Number of female sheep sold over past 3 years	30.78 ± 3.67	30.72 ± 3.89

Table 4: Average local market price of small ruminants across the year

Month	Market price for Sheep (per head)	Market price for Goat (per head)
January	6000.02± 12.78	4000.13 ±8.35
February	8000.29±13.67	5000.67 ±9.58
March	10000.27±14.62	7000.37 ±10.25
April	10000.38±14.89	7000.68 ±10.35
May	6000.34±11.72	5000.48 ±9.75
June	6000.89±12.63	4000.78 ±8.46
July	6000.87±11.89	4000.47 ±8.19
August	12000.56±13.75	7000±.38 10.89
September	13000.29±13.89	7000.46 ±11.27
October	8000.31±12.26	5000.68 ±9.46
November	9000.78±13.78	4000.65 ±8.46
December	10000.48±14.86	7000.78±10.87

RICE FARMERS' LOAN ACCESS AND DISPOSABLE INCOME GENERATION IN WESTERN ZONE OF BAUCHI STATE, NIGERIA

Moshood, H. B., Sani, M. H. and Bose, A. A.
Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi ,Nigeria
Corresponding Authors' Email: moshoodhalima@gmail.com Tel.: 08100190677

ABSTRACT
The study was conducted to examine the rice farmers' access to agricultural loan and disposable income generation in western zone of Bauchi State, Nigeria. Multistage sample technique was employed to select 313 rice farmers sampled through structured questionnaire. Data were analyzed using multiple regression and binomial logistic regression. The multiple regression results showed that the determinants of the rice farmers' disposable income of farmers' initial capital, farm size, loan amount, market tax and interest rate were significant at P≤0.001 and farm resource at P≤ 0.01. The result of the logit regression disclosed that age, sex, years of experience, interest rate, off farm income, loan distance significantly (P≤0.001) affected the likelihood of farmers' access to loan, membership at (P≤0.05) and disposable income (P≤0.01). The study recommended that credit should be made available at the right time in the farming preparation season and financial institutions or credit sources should be strategically localized to enable easy access by the farmers.

Keywords: Access, Agriculture, Disposable income, Loan, Rice farmers.

INTRODUCTION
Access to loans has been recognized as one of the significant intercession required to quicken development and improvement of farming household in developing countries. Extending agricultural loans is one of the solid alternatives for empowers financial development, decreasing destitution, and improving food security. Hermes and Lensink (2011) contended that, access to loan may add to dependable increments in income from a rise of investment in income-generating activities and a conceivable broadening of source of income for low- income groups, especially rural households from destitution, encourage savings, and improve interest in physical and human capital which vitalizes economic development. Sani (2017) define Agricultural finance as the economic study of the acquisition and utilization of capital in agriculture that is the supply and demand for fund in agriculture. It has been contended that the vast majority of these farmers are excessively poor and cash- strapped to be able to benefit from any form any form of access to loan even if they received adequate supplies of the right inputs, their land has a binding constraint which are so severe that any increase in productivity will fall short of guaranteeing their food security.

Farm income is an important component of rural life. Income is considered as wealth for the households. This household wealth includes the endowment such as land, housing, etc. The probability to access sufficient credit is positively linked to wealth. According Sani (2017) farmers' income is the total savings of the farmer from his farm productive activities. The saving is the total assets plus his wealth and investment; he also defined farmers' disposable income as the summation of the farmers' consumption expenditure from his total savings. A study from Li *et al.* (2011) reveals that farmers' income affects the likelihoods of accessing microcredit in Hubei province China. There is a positive and significant relationship between income and credit access by rural farmers in China. Higher income farmers are likely to have their microcredit application accepted. Household that earn higher income tend to have more investment and might have more confident on repayment of loan.

Rice is a main staple crop in Nigeria cultivated and consumed in all pieces of the nation. It is the Agricultural commodity with the third most astounding overall production after sugarcane and maize (Food and Agriculture Organization [FAO], 2012). Its domestic supply has incredible ramifications for food security and self-sufficiency in the country. Rice production rose gradually over the years with area expansion to overtake major rice producing countries like Cote d'Ivoire and Sierra Leone (Ayanwale and Amusa, 2011). The broad objective of the study was to examine the effects of rice

farmers' access to agricultural loan and income generation, the study determined the factors affecting the disposable income of the farmers; and also estimated the various determinants of the farmers' access to agricultural loans.

MATERIALS AND METHODS

THE STUDY AREA

The study area is western agricultural zone of Bauchi State. It is located between latitude $9^{o}03`$ and $10^{o}30`N$ and longitude $8^{o}50`$ and $11^{o}3E$ of Greenwich meridian in Nigerian Sahel and Sudan Savannah at an altitude of 600m above sea level. The zone consists of 7 Local Government Area (LGA) which includes Alkaleri, Bauchi, Bogoro, Dass, Kirfi, Tafawa Balewa, and Toro. The zone has a population of 2,518,204 people based on 2006 (NPC, 2006) figure and a projected figure of 3,696,723 people at 3.6% growth rate per annum with land area of 24,270.701 km^2 (NPC, 2019). The climate of the area is tropical based on the inter-tropical convergence zone, which gives rise to Northeast and Southwest winds system. The Northeast wind system has a temperature range of $40.55^{o}C$, (maximum) and $9.11^{o}C$ (minimum). The area has an annual rainfall range of 600-1200mm. The area is characterized by distinct rainy (April-October) and dry (November-March) seasons. The economic activities of the zone are rearing of large and small ruminant, crop production, marketing of agricultural products.

SAMPLING TECHNIQUES

A multi-stage random sampling technique was used in selecting the respondents for the study. In the first stage, three (3) Local Government Areas (LGAs); Bauchi, Alkeleri and Dass were selected from the zone using randomly sampling technique. In the second stage, two (2) districts were randomly choosing from each of three (3) LGA selected making a total of six (6) districts. In the third stage, three (3) villages were randomly selected from each of the districts selected using simple random sampling technique making a total of 18 villages. In the final stage, using a confident level of 95%, the sample size of (10%) was proportionately selected from each of the 18 villages to give 312 rice farmers for the study area (Table 1).

Table 1: Sampling Frame and Sample Size Selection Plan

LGA	Districts	Village	Sample Frame	Sample Size (10%)
Bauchi	Galambi	Inkil	360	36
		Turum	157	16
		Kangyere	336	37
	Miri	Kundum	230	23
		Durum	160	16
		Birshi	157	16
Sub-total			**1,750**	**144**
Dass	Bundot	Bagel	138	14
		Bundot	95	10
		Baraza	93	9
	Dot	Lukshi	92	9
		Ung. Mal.Shuaibu	95	10
		Durr	135	14
Sub-total			**648**	**66**
Alkaleri	Alkaleri	Alkaleri	263	26
		Pali	185	19
		Gar	128	13
	Duguri	Yalo	138	14
		Digire	122	12
		Gwana	183	18
Sub-total			**1,019**	**102**
Total			**3,417**	**312**

Source: Field survey, 2019

METHOD OF DATA COLLECTION

The research utilized primary data. The primary data were collected in the study through the administration of structured questionnaires to respondents with the assistant of trained enumerators.

ANALYTICAL TECHNIQUES

The research employed the use of Multiple Regression and Logit Model to analyze the objectives. The multiple regression model specified was subjected to four (4) functional forms and the lead equation was selected based on the econometric and statistical criteria. The estimated functions were evaluated in terms of the significance of the coefficients and the magnitude of the standard errors. The four functional forms to be fitted are linear, semi log, double-log, and quadratic forms.

The specified model was:

$Y = X_{1,}X_2, X_3, X_{4,}X_{5,}X_6, X_7, X_8, X_9, X_{10}, X_{11}$ …(1)

The explicit form of this function takes the following forms:

1. Linear:

$Y = \beta_\circ + \beta_1X_1 + +\beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + +\beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \cup_1$

2. Semi-log: …(2)

$Y = \beta_\circ + \beta_1I_nX_1 + \beta_2I_nX_2 + \beta_3I_nX_3 + \beta_4I_nX_4 + \beta_5I_nX_5 + \beta_6I_nX_6 + \beta_7I_nX_7 + \beta_8I_nX_8 + \beta_9I_nX_9 + \beta_{10}I_nX_{10} + \beta_{11}I_nX_{11} + \cup_1$ …(3)

3. Double-log:

$I_nY = \beta_\circ + \beta_1I_nX_1 + \beta_2I_nX_2 + \beta_3I_nX_3 + \beta_4I_nX_4 + \beta_5I_nX_5 + \beta_6I_nX_6 + \beta_7I_nX_7 + \beta_8I_nX_8 + \beta_9I_nX_9 + \beta_{10}I_nX_{10} + \beta_{11}I_nX_{11} + \cup_1$ ...(4)

4. Quadratic:

$Y = \beta_\circ + \beta_1X_1 + +\beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + +\beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \cup_1$ ...(5)

where;

Y = disposable income (₦)
X_1 = initial capital (₦)
X_2 = farm size (hectare)
X_3 = household size (numbers of individual)
X_4 = farm resources (₦)
X_5 = farm output surplus (tonnes)
X_6 = loan amount (₦)
X_7 = labour used (₦)
X_8 = household consumption (₦)
X_9 = membership (yes 1; otherwise 0)
X_{10} = interest rate (%)
X_{11} = market tax (₦)
a = Constant term
$X_1 – X_{11}$= variable input
$b_1 – b_{11}$ = the coefficients of independent variables and
U_1= error terms.

For binary logit models to regress the dependent variable on the independent variables using ordinary least squares would produce nonsensical results as the disturbances are not normally distributed, hence a nonlinear probability function with special limiting properties is employed. (Gujarati, 2009).

$Y= \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + …Ei$ ….(6)

where Y= Access to loan = 1, otherwise 0.
a = constant
b_1-b_{10} = Regression coefficients;
X_1 = farm size (hectare)
X_2 = sex (male= 1; otherwise 0)
X_3 = age of the respondent (years)
X_4 = loan interest rate (%)

X_5 = education level (years)
X_6 = household size (Number of people)
X_7 = farmer disposable income (₦)
X_8 = off-farm income (yes =1; otherwise 0)
X_9 = marital status (1= yes; otherwise 0)
X_{10} = distance from loan source (1=yes; otherwise 0)
X_{11} = value of collateral (₦)
X_{12} = years of experience (years)
Ei = error term

RESULTS AND DISCUSSION

The econometric model employed in measuring the effects disposable income as a dependent variable (Table 2).

Table 2: Factors Affecting the Disposable Income of the Farmers

Variables	Linear	Quadratic	Semi log	Double log
Constant	-122177.14 (-4.541)	138452.940 (12.008)	-2.986E6 (-7.644)	5.588 (7.420)
Initial capital (X_1)	0.251 (1.075)	2.975E-6 (3.203)	27417.31 (1.107)	0.135 (2.721)***
Farm size (X_2)	111557.7 (7.687)	0.451 (9.037)	160354.07 (4.596)***	0.368 (4.759)
Farm resources (X_3)	1.476 (3.978)	25718.562 (3.258)	85559.55 (3.433)	0.082 (1.599)*
Household size (X_4)	480.56 (.395)	101.521 (3.990)	-18414.10 (-.896)	-0.030 (-0.804)
Loan amount (X_5)	0.585 (4.557)	1.422E-6 (3.610)	121791.24 (4.531)	0.226 (4.270)
Labour used (X_6)	0.921 (2.741)*	7.284E-6 (3.944)	20680.837 (1.073)	0.032 (0.842)
Home consumption (X_7)	2072.10 (.726)	-371.941 (-3.422)***	25918.57 (1.337)	0.056 (1.497)
Membership (X_8)	37710.529 (2.165)**	1205.961 (.229)	164382.63 (3.559)	0.132 (1.422)
Interest rate (X_9)	-2146.303 (-2.542)***	-65.713 (-1.920)**	-26741.36 (-2.293)**	-26741.36 (-2.293)***
Market tax (X_{10})	18.619 (7.327)	0.001 (6.740)	63533.81 (-2.293)***	0.207 (5.440)
Farm output surplus (X_{11})	-11393.164 (-1.012)	1254.315 (.489)	-17646.39 (-.829)	0.014 (1.320)
R^2	0.854	0.876	0.671	0.760
Adjusted R^2	0.848	0.871	0.657	0.750
Std error	104253.251	95925.465	163591.309	0.31976
F-ratio	155.892	188.977	47.483	74.369

*significant at 10%, **significant at 5% and ***significant at 1%; values in parenthesis are the t-values.
Source: Field survey, 2019

The double log model was chosen as the lead equation because it has a relative low mean square error, highest level of significant. The econometric result showed that the major determinants of rice farmers' disposable income are initial capital (0.135), interest rate (-26741.36) and farm resources

(0.082). These variables were significant at the 1%, and 10% probability level. The result showed that initial capital and farm resources would increase the disposable income because they have a positive coefficient and these sign are consistent with the a *priori* expectation. Increase of initial capital will lead to more productivity because initial capital can be increased with the aid of loan accessibility. This means that farmers who accessed agricultural credit have higher farm income than those without. This is an important finding since farmers would be able to retrench their credits. Empirically, Shah *et al*. (2008) also estimated a positive effect of credit on crop yield and income of the borrowers over the non-borrowers. Farm resources also have a positive and significant relationship with disposable income. This means that increase in the farm resources will increase the disposable income by 0.072. On the other hand, interest rate had a negative but significant relationship with disposable income. This is because as the interest rate on loan increases, the farmers' disposable income reduces. However, high interest rate reduces the lending capability of the farmers.

The coefficient of multiple determinants (R^2) was 0.760 implying that the explanatory variables in the model were able to explain 76% of the variation in the disposable income. The F statistics is not significant; this means that the overall regression equation was not statistically significant.

FARMERS' ACCESS TO AGRICULTURAL LOANS

The positive sign of age agrees with the *a priori* expectation implied that the younger the farmer, the higher the likelihood of having access to credit and is significant at 1%.Younger farmers are still active, mobile and ready to take risk which may induce them into taking loans. As presented in Table 3, the positive effect of age found in this study corroborates with the finding of Henri-Ukoha *et al.* (2011) who reported that, the age of the farmers, level of education, farming experience, farm size and marital status significantly affect the amount of loan acquired by small scale farmers in Ohafia agricultural zone of Abia State, south-east Nigeria. Sex of the respondent has a positive coefficient of 12.226 and is significant at 1%. This implies that the male farmer have higher credit access compare to their female counterpart. This is in line with the findings of Ololade and Olagunju (2013) who suggested that the males have better access to loan in Oyo State, Nigeria. Farmer disposable income has a positive coefficient of 2.930 and was significant at 10%.the credit need of rice farmer is determine by their disposable income, increase in the farmer disposable income will lead to increase in access credit. This implies that people with higher income tend to take higher credit amount since the anticipated higher disposable income in the future. Also, Adegbite and Adeleye (2011) who found a positive relationship between farmer's income and loan access to microcredit in Oyo State, Nigeria. Membership has an inverse relationship with the loan access and was significant at 1%. This implies that been a member of a cooperative society do not guarantee credit accessibility, the rice farmer need to partake in the activity of the society such as monthly saving, and punctuality. This contradicts the finding of Akinbode (2013) who reported a positive relationship between group membership and access to credit. Interest (26.048) was found to have a positive relationship with access loan and was significant at 1%. It means that a 1% increase in the interest rate results in 26% increase in high access to loan. This agrees with the study of Ololade and Olagunju (2011) who found a significant positive relationship between farmer's access to loan and interest loan charged in Oyo State, Nigeria.

The Cox and Snell R^2 were 0.44 which indicates about 44% of farmers' likelihood of accessing loans is influenced by the explanatory variables included in the model. The log likelihood is statistically showing the overall model fit. If farmers have adequate access to credit, agricultural production can be carried out without disruption on an economically sustainable basis. Access to credit has been said to be able to break the vicious cycle of low productivity and poverty common among peasant farmers in developing countries such as Nigeria.

Table 3: Determinants of the Farmers' Access to Agricultural Loans

Variables	Coefficient	Std. error	z-statistic	Sig.	Exp.(B)
Intercept	92.994	9.7208	91.519	.000	2.437
Age	.454***	.1434	10.010	.002	1.574
Marital status	-1.442	3.6711	.154	.694	.236
Sex	12.261***	4.3183	8.061	.005	2.112
Years of experience	-1.101	.1997	30.403	.000	.332
Household size	.247	.5362	.213	.644	1.281
Educational level	.157	.3515	.200	.654	1.170
Farm size	5.120	4.2378	1.460	.227	167.350
Disposable income	2.930*	1.5914	3.390	.066	1.000
Interest rate	26.048	.6374	1670.236	.000	2.053
Value of collateral	7.616	.0001	.313	.576	1.000
Off farm income	.050	1.6990	296.598	.000	1.000
Membership	-2.929***	1.1536	6.447	.011	.053
Loan distance	-63.573	2.9398	467.646	.000	2.457
Likelihood Ratio Chi-Square (13)	7.81			.000	
Log Likelihood	-254.0				
Cox & Snell R Square	0.44				

***significant at 1%, *significant at 10%.
Source: Field survey, 2019

CONCLUSION AND RECOMMENDATIONS

The major determinants of rice farmers' disposable income were initial capital, interest rate and farm resources while age, sex, disposable income, and membership of cooperative affected the likelihood of the farmers having access to agricultural credit. The study recommended that:

i. Credit should be made available to farmers at the right time in the farming preparation season.
ii. Financial institutions or credit sources should be strategically positioned to be easily accessible to farmers whiles reducing the cumbersome processing for credit among farmers who are less educated.

REFERENCES

Adegbite, D. A. and Adeleye, O. A. (2011). Determinant of Farmer Access to Microcredit in Oyo state, Nigeria *Journal of agricultural research and development,* **10**(1): 55-80.

Akinbode, S.O. (2013). Access to Credit its Implication for Sustainable Rice Production in Nigeria, *journal of sustainable development in Africa,* **15**(1): 13-30.

Ayanwale, A. B. and Amusan, C. A. (2011). Gender Analysis of Rice Production Efficiency in Osun State: Implication for the Agricultural Transformation Agenda. *Nigerian Journal of Agricultural Economics*, **4**(1): 12-24.

Food and Agricultural Organization (FAO) (2012). FAO Rice Conference 2011. Accessed Online at*www.fao.org* On 3rd November, 2019.

Gujarati D. N. (2009). *Basic Econometrics*. 5th Edition. McGraw-Hill Book Company, New York. Pp.580-601.

Hermes, N. and Lensink, R., (2011). Microfinance: Its Impact, Outreach, and Sustainability *World Development*, **39**(6): 875-881.

Henri-Ukoha A., Orebiyi J. S., Obasi P. C., Oguoma N. N., Ohajianya D. O., Ibekwe U. C. and Ukoha I. I. (2011). Determinants of loan acquisition from the financial institutions by small-scale farmers in Ohafia Agricultural zone of Abia State, South East Nigeria. *Journal of Development and Agricultural Economics,* **3**(2): 69-74

Li, X., Gan, C. and Hu, B. (2011). Accessibility to microcredit by Chinese rural households. *Journal of Asian Economics*, **22**(3): 235-246.

National Population Commission [NPC] (2006). *Population census figures of Nigeria.*

National Population Commission [NPC] (2019). *Projected population census figures of Nigeria.*

Ololade, R. A. and Olagunju, F. I. (2013). Determinants of Access to Credit among Rural Farmers in Oyo State. *Nigeria Global Journal of Science Frontier Research*, **8**(2): 16-22.

Sani, M. H. (2017). *Agribusiness Management for Development: No Strategy=No Effectiveness.* Stirling-Horden Publishers Limited., Gaaf building, Ibadan. First Edition, 265p.

Shah, M. K., Khan, H., J. and Khan. Z. (2008). Impact of agricultural credit on farm productivity and income of farmers in mountainous agriculture in northern Pakistan: A case study of selected villages in district Chitral. *Sarhad Journal of Agriculture***, 24**(4): 713-718.

ANALYSIS OF PROFITABILITY AND DETERMINANTS OF CONSTRAINTS TO SMALL RUMINANTS MARKETING IN KATAGUM LOCAL GOVERNMENT AREA OF BAUCHI STATE, NIGERIA

[1]Yakubu, S., [2]Yakubu, S. A., [1]Atman, F.M., [1]Sani, M.H., [1]Fagam, A.S

[1]Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria.
[2]Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Kano University of Science and Technology, Wudil, Kano State, Nigeria.
***Corresponding Author:** E-mail: suleimanyakubu2003@gmail.com**Tel.:** 08069097919*

ABSTRACT
The study examined the analysis of profitability and determined the constraints to small ruminants in Katagum Local Government Area of Bauchi State. A multi-stage sampling technique was used to select 120 sheep farmers in the study area. Data were collected using structured questionnaires and were analysed using farm budget techniques and simple descriptive statistics. The result revealed that purchasing cost for live animal constituted 93.19% of the total marketing costs. Moreover, the result revealed average net income of ₦85,926.28. The return per naira invested was ₦ 0.2015. The gross margin was found to be 88,628.25. Inadequate capital was critical; which was attributed to inadequate sources of credits. Market facilities such as clean environment and security were also lacking. However, improvement in the existing infrastructural facilities will help promote expansion of the present scale of operations. Governments and other financial institutions should do more to extend funds as soft loans to the marketers to improve efficiency.
Keywords: Constraints, Data, Income, Profitability, Questionnaires

INTRODUCTION
In Nigeria, sheep production and marketing are private owned investments, and had been categorised into three, those that are mainly; collection market that serve the function of transferring slaughter stock and live animals from production regions to consumption regions (Francis, 1990). Sheep and goats also serve as important store of wealth and insurance; a function that is extremely important in the absence of well-developed rural financial markets and gave significant covariate risk due to climate, civil unrest, and epidemiological shocks. Sometimes the animals are consumed directly, but more often, are sold; where the proceeds are used to purchase grains and to settle for other bills (Kogsey e*t al.*, 2003). With regards to important due to the fact that sheep and goats are easily managed, that require a relatively small initial investment and their short generation interval lends itself to a fast return to investment. Moreover, small ruminants have often been found to be superior to saving money in the bank, because their net annual returns are much higher than the interest to be realized from the banks' savings. The demand for sheep and their products is destined to increase by more than 250% in Sub-Saharan Africa, especially the West Africa (Fafchamps e*t al.*, 1997). This was because of the population growth, accelerated urbanization, incomes generation and consequently increased purchasing power of the population. In economic terms, small ruminant rearing plays a major role in household incomes. The ultimate goal of intervention aimed at enhancing productivity of small ruminants, needs to consider the market aspect simultaneously. Therefore, farmers need to be aware of the preferred characteristics of the animals as well as price patterns so that they can adequately plan for breeding and fattening programs consistent with the best seasonal prices and consumers' preference. However, marketing system must provide information flows from the consumer back to the producer through some physical and facilitating functions. The producer responds to the price signals by producing commodities in relative quantities dedicated by prices and costs. An important aspect of production and its response to demand and supply is knowledge of markets and marketing systems. Good marketing system reduces the marketing costs, ensures high returns to the producers, provides good quality of agricultural produce at

affordable price to the consumers and minimises the number of intermediaries (Andargachew, K. 1990). The performance of agricultural markets has long been recognised by economists, planners and policy makers as a critical component in the development process.

A multi-stage sampling technique was used to select 120 sheep marketers from the three districts of major small ruminants' markets in the study area. In stage I, Azare livestock market was purposively selected being the largest livestock market of the State, and also assumed to have contained majority of the target population for the study. In stage II, the study area was delineated into two major sheep market districts; the Chinade and Madara district were purposively selected. In stage III, from each of the 3 districts (Azare, Chinade and Madara districts), forty (40) sheep marketers were purposely selected for interview scheduled with questionnaires making a total of one hundred (120) sheep marketers for this study. The data collected were analysed using farm budget techniques and simple descriptive statistics.

RESULTS AND DISCUSSION

PROFITABILITY ANALYSIS OF SHEEP MARKETING IN BAUCHI STATE

The results from table 1 revealed the average total costs of marketing 20 heads of live animals to be ₦21,319.91. The results further revealed the average variable costs to be ₦21,184.81and accounted for 99.37 % of the average total costs of marketing live animals. In terms of returns; the average gross margin (GM) of ₦4,431.41was realised from the sales of 20 heads of live sheep. The result further revealed that the average income ₦4,296.31 perheadoflive animal. Moreover, sheep marketing in Katagum Local Government Area of Bauchi State was regarded profitable as confirmed by the rate of returns to investment as each ₦1 invested on a live sheep will give additional₦0.2015from every live animal. This confirmed that small ruminants' marketing was a profitable venture in Nigeria. The result also implied that99.37% of the total revenues give to pay for the total variable costs of marketing live animals.

Table 1: Profitability analysis of sheep marketing in Katagum Local Government Area of Bauchi State, Nigeria

Variable costs	Amount (₦)	% of TC
Supply cost of animals	397,344.05	93.19
Variable marketing costs	26,352.26	6.18
Total variable costs	423,696.31	99.37
Fixed costs		
Depreciation on durable items	1,244.64	0.29
Fixed marketing costs	1,457.33	0.34
Total fixed costs	2,701.97	0.63
Total costs	426,398.28	100
Return components		
Sales of animals	512,324.56	-
Gross margin	88,628.25	-
Net return	85,926.28	-
Returns per naira	0.2015	-

Source: Field survey data, 2019

CONSTRAINTS TO SHEEP MARKETING IN BAUCHI STATE

Table 2 reveals that 98.33 of sheep marketers in Katagum L.G.A. had complained seriously of non-remunerative prices on sales. This corroborates with high marketing costs especially the commission fees, transportation costs as a result of far distance from the source of supply and as well as high purchasing prices of the animals. Inadequate capital (93.33%) was also critical as far as sheep marketing in Katagum L.G.A is concern; this was attributed to

inadequate sources of credits; and had stated that if they had enough money, they would be able to increase the number of animals per supply, thereby making more profit and expand market size. Moreover, inadequate finance hinders marketers from getting the necessary resources and technologies which could assist them achieve higher marketing efficiency. Brokers also create price instability so as to benefit themselves by misinforming traders about the prevailing market prices. This indicated that of the marketers faced difficulties in forecasting their gross returns, leading to poor planning. Also, too much seasonal variation in price especially during religious festivities, such that low price did not offer sufficient incentive for sufficient supply. This necessitated the fact that frequents price variations of farm produce is a major concern to producers, marketers and consumers. Commodity prices may reflect seasonal production patterns by being at the lowest at the peak of production and highest at lean period. In addition, 85.00% of the marketers had complained of transport related problems, which had much dispersion. Most of the marketers depended on commercial vehicle as their means of transportation. In some cases, there were no or the roads were seasonal. This probably increased the transport fares. During the rainy season many of the villages and rural markets were not accessible with the town markets. Increased cost of transportation due to the increased in oil price is also another problem mentioned. However, high transportation costs accounted for high proportion of the total marketing costs in most parts of the country. The result also revealed that, armed robbers used the opportunity of having bad roads; attacked and sometimes even killed marketers. The implication here is that, transportation problems are largely responsible for the slow increase in marketing efficiency and lead to continuous subsistence level of production in many parts of the supply sources. This also made both producers and marketers to resort sales at the nearby markets thereby losing greater proportion of their supposedly income to exploitatively dubious middlemen in the area. Moreover, any of the available modes of transportation in Dambam Local Government Bauchi State had its own inherent problem which results to emaciation, loss and death of the animals in transit. Also, the activities of unregulated livestock produce checking points and theft cases along these routes compound the marketing problems. This drastically reduces the profit of sheep marketers in the study area. Table 2 further revealed that 95.00% of the respondents had problems of low access to formal loan to boost their marketing activities. Lack of credit access associated with the volume of loan, cumbersome procedures, interest rates, lack of collaterals and several trips to the bank before loan was granted were identified as the major marketing problems. Small-scale agribusiness firms faced a number of barriers in obtaining credits because most of them operate within a vicious cycle of poverty that prevent them access to such formal loans. Moreover, the marketers had problems of; scarcity of animals during festivals, diseases and pests, risks of buying unhealthy animals, theft insecurity and as well as low educational level. Other market facilities such as clean environment, good sheds, veterinary services, fire services, banks, security, water supply, and good toilets etc. which contribute to efficient marketing were also lacking.

Table 2: Constraints to sheep marketing in Katagum Local Government Area of Bauchi State

	Constraints	*Frequency	Percentage	Ranking
1.	Non-remunerative prices	118	98.33	1st
2.	Lack of credit access	114	95.00	2nd
3.	Inadequate capital	112	93.33	3rd
4.	Poor market infrastructures	110	91.67	4th
5.	Scarcity of animals during festivals	109	90.83	5th
6.	Diseases and pests	106	88.33	6th
7.	Transportation problems	102	85.00	7th
8.	Risk of buying unhealthy animal	96	80.00	8th
9.	Price fluctuations	90	75.00	9th
10	High marketing costs	85	70.83	10th
11.	Poor market intelligence	80	66.67	11th
12.	Low educational level	75	62.50	12th
13.	Theft/insecurity	70	58.33	13th

*** Multiple responses**
Source: Field survey, 2019

CONCLUSION

The results obtained from this study concluded that the marketing of sheep enterprise is profitable. The total returns recorded by the study implied that all the participants were able to cover the total costs incurred in sheep marketing in the study area. This is a clear indication that the business is efficient and has the potentials of increasing the marketers' income; which can induce and attracts new entrants into the market.

RECOMMENDATIONS

However, based on the findings of the study, the following recommendations were made for improving the performance of sheep marketing in Katagum Local Government Area of Bauchi State, Nigeria;

a) Individuals and government should focus in this sector of sheep enterprise so that production and marketing of sheep will become a focal and highly commercial business away from its present subsistence status.

b) Governments and other stakeholders should provide favourable and functional market regulating framework that can eliminate illegal fees or taxes charged along marketing channels for small ruminants.

c) Governments should improve policies on security measures; to help reduce the rate of insecurities like armed robbery on the highways.

REFERENCES

Andargachew, K. (1990). Sheep Marketing in the Central Highlands of Ethiopia, Unpublished M.Sc. Thesis; Ale Maya University of Agriculture, School of Graduate Studies, Dire Dawa, Ethiopia, 168pp.

Francis, P. A. (1990) Small Ruminant Marketing in Southwest Nigeria. *Journal of Agric. Econs.* 5 (20): 71–90.

Fafchamps, D., Marcel, H. A. & Sarah, G. (1997). The Determinants of Livestock in Niger. *Journal of African Economics*, 6 (2):255–295.

Kogsey, I. S., VanArendonk, J. A. M. & Barker, R. (2003). Economic Value for Traits of Meat Sheep in Medium to High Production Potential Areas of the Tropics. *Small Ruminants Research*. 50 (9): 187–202.

SOCIO – ECONOMIC ANALYSIS AS A DETERMINING FACTOR OF INCOME AMONG SMALL RUMINANT FARMERS IN BAUCHI STATE: A STRATEGIC WAY OF EFFECTIVE LIVESTOCK PRODUCTION IN NIGERIA

***[1]Yakubu, S., [2]Yakubu, S. A., [1]Atman, F.M., [1]Sani, M.H., [1]Fagam, A.S**

[1]Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

[2]Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Kano University of Science and Technology, Wudil, Kano State, Nigeria.

Corresponding Author: E-mail: suleimanyakubu2003@gmail.com**Tel.:** 08069097919

ABSTRACT

This paper examines some of the socio-economic factor determining an income of small ruminant farmers in Bauchi State. Data were collected with the aid of 500 structured questionnaires and the collected data were analysed using simple descriptive statistics and regression analysis. The result revealed that majority of sheep and goat farmers falls within the age bracket of 31-60 years (72.4%) while distribution of respondents by marital status reveals that more than half are married (53.8 percent). Educational distribution of respondents indicates that only about one-third (32.4 percent) are educated up to the tertiary level. While about 45.8 percent did not receive formal education, the rest received either primary or secondary education. However, age,educationalstatus(P<0.01),householdsize(P<0.00),povertystatus(P<0.01)extensioncontact,membership ofcooperatives(P<0.10)andsizeofflock(P<0.00)areimportantdeterminants of income realized from small ruminants farming. The coefficient of educational level, extension contact, membership of cooperatives and flock size are positively related to income realised from small ruminants farming. On the other hand, the coefficients of age of household size and poverty status are negatively related to it. In conclusion, the importance of small of small ruminants in meeting social and economic need of rural farmers in Bauchi Statecannotbeoverempha- sised. This has to do with the different roles that these animals played in providing a sigh of relief in production shortfalls and unexpected ill health. Based on the findings from the study, it is recommended that government should intensify efforts at building capacity of small ruminant farmer in Bauchi State through education which can enhance their productivity as education is empowerment which can translate to better adoption of technology that will invariably enhance output and increase revenue.

Keywords: Analysis, Descriptive, Ruminant, Status, Structured

INTRODUCTION

Small ruminants have a number of advantages for being an integral component of the pastoral production system. Sheep and goats are kept for a variety of economic reasons including savings and investment, security and insurance, stability, and social functions. Sheep and goats appear to withstand drought better than cattle, and their short reproductive cycle allows them to quickly recover from rapid resumption of breeding following drought or devastating disease infestation. The small size of sheep and goats has distinct economic, managerial, and biological advantages. Economically, low individual values mean a small initial investment and correspondingly small risk of loss by individual deaths. The role of sheep and goats as a continuous source of protein during and immediately following a period of drought is one major reason for making them the most important component of livestock in pastoral and agro-pastoral production system (Wilson, 1991). Managerially, they are conveniently cared for by women and children, occupy little housing space, lower feed requirements, and supply both meat and milk in quantities suitable for immediate family consumption.

In contrast to large ruminants like cattle which are normally concentrated and remain in the hands of a restricted number of producers (high income rural households), small ruminants are dominant in almost every low income rural household. In the dry areas of Northern Nigeria, fewer than 20 percent of farmers own cattle (ILCA, 1980). In Côte d'Ivoire, Barry (1985) reported that, on average, fewer than four cattle are found on farms where there are ten sheep/goats. Small ruminants are a source of food and financial security for the rural poor. According to FAO (1983), more than 50 percent of milk

produced for human consumption is from sheep and goats in Niger and Somalia. This ownership pattern characterises the legacy of sub-Saharan Africa's rural economy as capital constraints limit access to cattle among poor households whilst small ruminants are well suited for their financial and labor resource capabilities. It is generally more suitable to slaughter a sheep or a goat than a large animal such as a cow to feed community members en- gaged in communally private fieldwork. Small ruminants also provide cultural and economic benefits for households. In the same vein, while a 10 to 15 kg small ruminant carcass is easily handled by a rural household for either home consumption or sale without means of preservation, slaughtering even a steer (when it is available) for the same purposes is generally impracticable and uneconomical and is therefore a rare event.

The study was carried out in Bauchi State in which 500 small ruminants farmers were randomly selected in the 20 Local Government Areas of the State.
Descriptive statistics and regression analysis were used to analysed the data collected from the structured questionnaires.

RESULT AND DISCUSSION

Socioeconomic Characteristics of Respondents

Table 1 revealed that majority of sheep and goat farmers falls within the age bracket of 31-60 years (72.4%) and had an average age of respondents in the study area is 46 years old, implying that they are young and able to work. Distribution of respondents by marital status reveals that more than half are married (53.8 percent), while only about 21.6 percent are single. The rest are either divorced or widowed (24.6 percent). Educational distribution of respondents indicates that only about one-third (32.4 percent) are educated up to the tertiary level. While about 45.8 percent did not receive formal education, the rest received either primary or secondary education. Average household size of respondents is six, and this large household size decreases respondents' per capita income, further lowering their poverty status. Respondents distribution by membership of social group/association (especially cooperative societies) indicates that over three-quarter (74.4 percent) belong to one association or another. Such association is very important in creating a platform to showcase what they have to sell thereby enhancing the ease of converting small ruminants into credit facility or ready - made cash. Occupational distribution of respondents shows the relatively high importance of farming (agriculture–crop/animal husbandry) compared to other occupations available in the study area. Thus, while about 57.8 percent of the respondents indicate armingastheirmainsourceoflivelihood,overtwo-thirdsindicatefarmingasanalternativesourceofincome. Next to this are artisans (18 percent). Only about 12.2 percent are engaged as civil servants in the government parastatals or ministries.

Table 1: Distribution of respondents by socioeconomic characteristics

Variable	Frequency	Percentage
Age		
< 30	75	15
31 – 40	92	18.4
41 – 50	166	33.2
51 – 60	104	20.8
> 61	63	12.6
Total	500	100
Marital Status		
Married	269	53.8
Single	108	21.6
Widowed	57	11.4
Divorced	66	13.2
Total	500	100
Educational status		
No formal education	229	45.8
Primary	62	12.4
Secondary	47	9.4
Tertiary	162	32.4
Total	500	100
Household size		
1-3	86	17.2
4-6	107	21.4
7-9	181	36.2
10-12	86	17.2
13 and >	40	8.0
Total	500	100
Membership of social group		
Yes	372	74.4
No	128	25.6
Total	500	100
Primary occupation		
Farming	289	57.8
Trading	33	6.6
Civil Service	61	12.2
Artisans	90	18
Private salaried job	27	5.4
Total	**450**	**100.0**

Source: Field Survey, 2019

Determinants of Income from Small Ruminants Farmers in Bauchi State

In explaining the determinants of income realized from small ruminants' rearing (Table 5) among women in the study area, the ordinary least squares regression model was employed and the result shows that:

Table 2 revealed that age, educational status (P<0.01), household size (P<0.00), poverty status (P<0.01) extension contact, membership of cooperatives (P<0.10) and size of flock (P<0.00) are important determinants of income realized from small ruminants farming. The coefficients of educational level, extension contact, membership of cooperatives and flock size are positively related to income realized from small ruminants farming. On the other hand, the coefficients of age, household size and poverty status are negatively related to it. For example, the higher the educational status and the higher the flock size of respondents, the higher the income to be realized from small ruminants farming. This is because education enhances adoption of better management practices that can boost productivity and sales of farm produce especially among farmers. Thus, increased/enhanced income is assumed to be a determining factor of being able to meet household financial obligations.

Table 2: Regression result showing how small ruminants assisted respondents in meeting financial obligations

Variable	Coefficient	Standard Error
Age (X_1)	0.0132	(0.836)
Mstat (X_2)	-0.0082	(0.074)
Eduyrs (X_3)	0.260**	(0.126)
Povstat (X_4)	-0.011**	(0.005)
Hsize (X_5)	-0.124***	(0.022)
Extcont (X_6)	4.521	(3.157)
Coopmem (X_7)	0.054*	(0.034)
Flock size (X_8)	0 .821***	(0.171)
Experience (X_9)	0.0205	(0.047)
Other asset (X_{10})	0.203	(0.472)
Constant	0.947***	(0.072)

*Coefficients significant at 10%; **Coefficients significant at 5%;

***Coefficients significant at 1%; Source: Computed from survey data

CONCLUSION

The importance of small ruminants in meeting social and economic needs of rural farmers in Bauchi State cannot be over emphasized. This has to do with the different roles that these animals played in providing a sigh of relief in production shortfalls and unexpected ill health.

RECOMMENDATIONS

Based on the findings from the study, it is recommended that:

1. Government should intensify efforts at building capacity of small ruminant farmer in Bauchi State through education which can enhance their productivity as education is empowerment which can translate to better adoption of technology that will invariably enhance output and

increase revenue.

2. Governments should intervene to encourage small ruminant farmers to engage in cooperative activities by providing the initial take-off capital needed and fostering an enabling environment for cooperative activities to thrive.
3. Householdsizeofrespondentsinthestudyareashouldbeputundercheckthroughsensitisationtofamilypl anningtechniques as increased household size reduces income per head (per-capita income) which invariably leads to increased poverty.

REFERENCES

Barry,M.B.(1985).AstrategyfortheintensificationofproductionsystemsusingsmallruminantsinCôted'I voire.In:R.T.WilsonandD.Bourzat (eds). Small ruminants in African Agriculture. Proceedings of a conference held at ILCA, Addis Ababa,Ethiopia.

ILCA (1980). Economic trends. Small Ruminants. Bulletin 7. International Livestock Centre for

Africa,Addis Ababa, Ethiopia.

Wilson,R.T.(1991)Husbandry,nutritionandproductivityofgoatsandsheepintropicalAfrica.In:GatenbyR. M.andT.railJ.C.M.(eds).Small ruminant breed productivity in Africa. Proceedings of a seminar held at ILCA, Addis Ababa,Ethiopia.

MARKETING CHAINS OF COW-MILK BY FULANI WOMEN IN BAUCHI METROPOLIS

Abashi, J. T; Paul, Y. S and Rabo, E.K
Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, Bauchi
ephraimrabo@yahoo.com/paulsulim99@gamil.com; 07036973263

ABSTRACT
The study assessed marketing chains and channels of cow-milk by fulani women in Bauchi metropolis**.** The data was collected using questionnaires administered to 100 respondents and were analyzed using descriptive statistics. The respondents were selected using simple random sampling techniques. The results showed that 60% of the respondents were within the age range of 31-40 years and 75% were married. The results also revealed that 58% and 55% had Qur'anic education with 11-15 years of market experience respectively in the study area. Furthermore, majority (60%) of the respondents were retailers consisting of 70% of the respondents who processed dairy products themselves. It was observed that 95% of the respondents sale the products during raining season when the market have the highest supply (90%). The major constraints to cow-milk marketing included poor storage facility (60%), low patronage (25%), seasonal supply (10%) and poor transportation (5%). It can therefore be recommended that basic infrastructure especially electricity, roads and permanent shops may be improved upon while dams and other sources of water should be provided by the government. Grassing areas should be reserved or protected against farming activities and cow milk marketers should be encouraged to form association.
Keynotes: marketing, chains, cow, milk, Fulani

INTRODUCTION

Milk is a white liquid production by the mammary gland of mammals. It is the primary source of nutrition for the young mammals before they are able to digest other types of food. Milk consists of many nutrients such as protein, Vitamin A, calcium, thiamin and riboflavin. Milk with many its products (butter, cheese, un-skimmed milk and skimmed) are important diets required for healthy human growth and development (Blasko, 2011). Milk have medical, cultural and cosmetic value and this might explain why since the early stages of civilization, man has domesticated mammalian animals such as cattle, goat, sheep and camels and utilized them along with other uses, for the production of these vital products for his consumption. Overtime, concern for the improvement and development of the production of milk and its products has been stressed in the agricultural development policies of most countries United Nation Industrial Development Organization (UNIDO, 2004), while in the developed countries of the world, appropriate technologies have been invented to improve on the production, preservation and marketing of these products (Agra Center for Euro-Atlantic Studies, CEAS, 2006). Although in most of African countries, the livestock sub-sector is dominated by traditional system of production, however, processing and marketing seem to be inadequate in meeting the demand for dairy products in the ever increasing population of the developing countries. This demand pressure is especially high in African cities that are experiencing rapid and sustained population growth due to high rate of rural-urban migration.

MATERIALS AND METHODS

The study was conducted in Bauchi, Bauchi State. Bauchi State is located on latitude $10^{0}17^{1}$N and longitude 9^{0} 45^{1}E. Sample size of one hundred (100) Fulani Cow-milk marketers were used in the study, purposive sampling was adopted because it was only Fulani women that are engaged in cow-milk marketing .One (01) *Fulani* woman out of every three (03) marketers was selected. A total number of five (05) markets were selected and the criteria for selection of the markets included spatial spread within the metropolis and the presence of designated areas of sales deports for local dairy products by *Fulani* women. Random sampling techniques was utilized in selecting five (05) markets which included MudaLawan, Wunti, Tashan mass, Kofarwambai and SabuwarKasuwa. In each of the market units, twenty (20) respondents were selected which gave a total sample of one hundred (100) respondents. The data for this study were collected using questionnaires/interview schedule distributed to respondents with the help of an interpreter. The data collected was analyzed using simple descriptive statistics such as frequency tables and percentages.

RESULTS AND DISCUSSION

Table 1: Distribution of respondents according to age of the respondents

Age ranges (years)	**Frequency**	**Percentage**
21-30	22	22
31-40	60	60
41 – above	18	18
Marital status		
Married	75	75
Single	20	20
Widow	5	5
Household size		
1-5	35	35
6-10	30	30
11-15	20	20
16-above	15	15
Educational level		
Never been to school	32	32
Quranic school	58	58
Primary school	10	10

Source: Field Survey, 2014.

Table 2: Dairy products marketed

Dairy products sell	**Frequency**	**Percentage**
Sour milk, (*fura and youri*)	30	30
Butter only	0	0
Sour milk and butter	70	70
Total	**100**	**100**

Source: Field Survey, 2014.

Table 3: Marketing experience of cow milk marketers

Years	**Frequency**	**Percentage**
1-5	18	18
6-10	20	20
11-15	55	55
16 and above	07	7
Total	**100**	**100**

Source: Field Survey, 2014

Table 4: Constraints to cow-milk marketing

Constraints	**Frequency**	**Percentage**
Poor Storage Facilities	60	60
Low Patronage	25	25
Poor Transportation	5	5
Seasonal Supply	10	10
Total	**100**	**100**

Source: Field Survey, 2014

The result in Table 1 showed that majority (60%) of the respondents fell within the age range of 31-40 years. Indicating that majority of the Fulani women milk sellers were in their active age hence they carry out marketing activities vigorously. This agrees with the finding of Oseni (2011) who asserted that it is logical to think that an individual's performance efficiency or productivity declines with increasing age. Majorities (75%) of the respondents were also married, suggesting that, the low participation of the unmarried may be attributed to the fact that they were mostly young and still dependent. Widows participation in low milk marketing was also low, probably as a result of no husband to supply milk. Marital status has significance on milk marketing. This result is in line with Kees (1995) who said that lactating cows are milked by men and then distributed among their women.
The study also revealed that 35% of the respondents have family sizes ranging from 1 to 5; 30% between 6 to 10; and 20% between 11 to 15 members, while 15% of the total respondents have family size of 16 and above members. This result agrees with the finding of Ibeauchi and Dalyop (1995), who found that quantity of milk that enters the traditional market, depends on household and calf requirements.
The result from Table 1 also showed that 58% of the respondents had quaranic education, 32% never been to school and 10% only attended primary school. The result indicated that 32% of the respondents in the study area could not read or write but 68% of the total respondents are literate. This implies that majority of cow milk marketers had acquired one form of education ranging from formal to non-formal. This is a healthy situation because through education people could acquire skills and knowledge, which are important in obtaining and analyzing information about market situations, thereby increasing the social and economic wellbeing. It is also important in management of risk associated with marketing activities in the study area. This finding is in line with Njoku (1999) who observed that formal education has a positive influence on adoption of innovation.
Marketers generally handle for sale, one or combination of products at a time in the market; some commodities have derived demand especially agricultural products. Therefore they are sold together; the demand for dairy products, except that of industrially processed yoghurt is complementary in nature. They are consumed along with or in relation to other commodities such as sour milk with millet processed into local foods (*fura and youri*), tea, bread and cokes in some cases. The result in Table 2 showed that 70% of the total respondents sell sour milk and butter but there was no respondent on the sale of butter only, while 30% of the respondents were selling sour milk, *fura and youri* only.

The result in Table 3 indicated that 55% of the respondents between1 to 15 years experience in cow-milk marketing, while those with longer years of experience (11 years and above) accounted for 62% of the total number of respondents in the study area. This could be likened to their maturity in understanding the market situation as regard market intelligence, taking and managing risk and uncertainties in marketing activities in an attempt to generate more profit. And this could have contributed in maintaining them in the business, in agreement with, Haruna (2002), who stressed that knowledge and experience in marketing information has been shared among marketers since time immemorial and passed from one generation to another.
From Table 4, majority (60%) of the respondents complained of poor storage facilities This result is similar to the findings of UNDO (2004) who identified constraints of marketing of dairy products to include; poor infrastructure, electricity supply, road, inadequacy of storage facilities, etc. It agrees with Mohammed *et al*. (1990) who identified the problems of informal marketing as remoteness of production sites, high transaction cost and poor infrastructure among others.

CONCLUSION AND RECOMMENDATIONS

From the study conducted, it was concluded that, the major constraints to cow-milk marketing included poor storage facility, low patronage, seasonal supply and poor transportation. It can therefore be recommended that basic infrastructure especially electricity, roads and permanent shops may be improved upon while dams and other sources of water should be provided by the government. Grassing areas should be reserved or protected against farming activities and cow milk marketers should be encouraged to form association.

REFERENCES

Agra Center for Euro-Atlantic Studies, CEAS.(2006). Desktop Study into Demand for Dairy Products. **Final Report for Dairy Supply Chain Forum.** Submitted by Agra CEAS Consultingwww.ceasec.com56Pp.

Blasko (2011).World Importance and present tendencies of dairy sector. http://en.wikipedia.org/wiki/Milk

Haruna, A.A, Obatolu, V.A and Adeborate, E.As (2002). Comparative Evaluations of Yoghurt Samples From Goat and Commercial Retailer outlet. *Nigeria Journal of Animal Production***34** (182): Pp 163-171.

Ibeawuchi, J.A and Dalyop, D.M (1995) Composition and Quality of Fresh Cow Milk Offered for Sale in part of plateau State of Nigeria.*Nigerian Journal of AnimalProduction***22**: (182): Pp 83-86.

Kees, P.M. (1995). Rural Cheese Making in Benin Republic, FSA Agricultural Rural Development 2.

Mohammed, M. A., Larsson, R. and Mohammed, M. A. (1990).Hard Cheese Making from Camel Milk.Chwissenschaft.**45**: 716 -718.

Njoku, M.F and Ney, D.M. (1999).Potential for enhancing the nutritional properties of Milk fat. Journal of Dairy Science, **74**: 4002-4005.

Oseni, J.O. (2011). Effects of Deregulation Policy on Cocoa Marketing in Ondo State, Nigeria Unpublished Ph.D Thesis, the Federal University of TechologyAkure, Nigeria.

UNIDO (United Nations Industrial Development Organization). (2004). **The Dairy Sector in Nigeria**, Report of a Study Commissioned by UNIDO – Lagos Business School, Partnership on the Development of the Small and Medium Scale Enterprises in Nigeria. Pp.11.

NON-CONVENTIONAL FEEDSTUFF, THEIR INFORMATION CHANNELS AND UTILIZATION PRACTICE, IN NIGERIA

AnnateI[1].,Y. Ahmad[1,] Bala A.[2]

[1]National Agricultural Extension and Research Liaison Services
Ahmadu Bello University, Zaria
[2]National Veterinary Research Institute

ABSTRACT

A study on the information management on the availability, adoption and utilization of Non-conventional Feedstuffswas conducted. The study involved a survey of 253 poultry and 259 pig farmers from six States in Nigeria. Friends and neighbours (40.4% of poultry and 53.3% of pig farmers) were found to be the most important source of information on NCF followed by Extension Agents (36.5 % of poultry and 36.8% of pig farmers). Extension guides and bulletins were found to be more important sources of information on NCF than Radio or TV. The percentage of farmers who reported using guides and bulletins were 22.6% for poultry and 13.6% for pigs in contrast to only 3.2% for radio and 11.1% for TV amongst poultry farmers; 2.3% for radio and 1.1% for TV amongst pig farmers. The main source of NCF for farmers is the open market. This was reported by 44.7% of poultry and 68.8% of pig farmers. However, while oniy 26.1% of poultry farmers reported sourcing NCF from household wastes up to 57.1% of pig fanners did so. Similarly, only 14.1% of poultry farmers compared to 42.9% of pig farmers reported sourcing NCF from the industry. On farm sourcing was done by 10.7% of poultry in contrast to 36.7% of pig fanners. The difference between farmers who said they were satisfied with NCF use (39,2%) and those dissatisfied (34.5%) was marginal in the case of poultry farmers. Similarly, pig farmers that were satisfied with* NCF were 46.6% compared to 41.5% that were dissatisfied. Very few fanners said they were highly satisfied with NCF use: 2.6 % of poultry and 8.3% of pig farmers. Most of the farmers acknowledge that they share information on NCF with other farmers (56.9% of poultry and 82% of pig farmers). Some 28,3% of poultry farmers and 51.5% of pig farmers said they employ additional labour as a result of using NCF. For poultry farmers the number employed were 1-2 by 12.3%, 3-5 by 11.9% and >6 by 2.6%. For pig farmers, the number employed were 1-2 by 61.3%, 3-5 by 29.4% and >6 by 9.3%. This result shows the high potential that exists for employment generation through promoting the use of NCF. Given an average of 2 workers per farmer, the 259 pig farmers interviewed created additional 518 jobs. It is concluded that given the complex nature of most NCF, the use of well-trained Extension agents and contact farmers complemented with good Extension publications will greatly enhance the use of NCF by poultry and pig farmers.

INTRODUCTION

Nigeria is basically an agricultural country with a greater per cent of its people living in villages. Their livelihood is dependent mainly on agriculture and animal husbandry. Though we have a huge livestock population,the National Agricultural Sample Survey in 2011, indicated that Nigeria was endowed with an estimated 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 28,000 camels, 145 million chickens, 11.6 million ducks, 1.2 million turkeys and 974, 499 donkeys, yet the production of livestock products is relatively low. It is evident that we are highly deficient in various livestock products. Oneof the main reasons for the low productivity of our livestock is malnutrition, under-nutrition or both, besides the low genetic potential of the animals.(Umesh*et al*., 2014). Likewise availability, vis-a-vis the requirement of green-fodder crops and concentrates, there is a huge gap between demand and supply of all kinds of feeds and fodders. The formation of a Presidential Task Force on Alternative Formulation of Livestock Feeds by the Federal Government of Nigeria in 1989 was the climax of that recognition in this Country (Babatunde, 1999). The purpose of this study was to identify the channels by which farmers get information on NCF and the factors associated with their use.

Non-conventional feed resources (NCF):

The non-conventional feed (NCF) refer to all those feeds that have not been traditionally used in animal feeding and or are not normally used in commercially produced rations for livestock. NCF include commonly, a variety of feeds from perennial crops and feeds of animal and industrial origin. The term NCF has been frequently used to describe such new sources of feedstuffs as pallet oil mill effluent and palm press fiber (oil palm by-products), single cell proteins, and feed material derived from agro industrial by-products of plant and animal origin like mango fruit pulp, mango fruit peel and mango seed kernel(Rao *et al.* 2000; Soomro*et al.* 2013; Diara and Uaman 2008; Berardini*et al.* 2005; Palma *et al.* 2009). Poor-quality cellulosic roughages from farm residues such as stubbles, haulms, vines and from other agro-industrial by-products such as slaughter-house by-products and those from the processing of sugar, cereal grains (maize bran, rice bran, rice husk, the mustard seed

hulls), citrus fruits and vegetables from the processing of food for human consumption also comes under category of non-conventional feedstuffs. Many of these feed resources are yet to be incorporated into the feed bank for low cost of livestock production despite the fact that they could be gotten free or at a very low cost(Orayaga and Anugwa 2014).

Need of Non-conventional feed:

There are serious shortages in animal feeds of the conventional type,which alarms the livestock nutritionists to discover a new arena for endowing nutritional security on animals for optimum production. (Amandeep, 2016). The grains are required almost exclusively for human consumption. These feedstuffs can be put to use for animal feeding as they provide no competition from their human counterparts. Mostly these are the byproducts which are obtained after the removal of main product for human use. With increasing demand for livestock products as a result of rapid growth in the world economies and shrinking land area, future hopes of feeding the animals and safeguarding their food security will depend on the better utilization of unconventional feed resources which do not compete with human food. The availability of feed resources and their rational utilization for livestock represents possibly the most compelling task facing planners and animal scientists in the world. The situation is acute in numerous developing countries where chronic annual feed deficits and increasing animal populations are common, thus making the problem a continuing saga.(Umesh*et al*., 2014)

Thus non-conventional feeds could partly fill the gap in the feed supply, decrease competition for food between humans and animals, reduce feed cost which is said to account for up to 70% of the cost of production. Dried mango waste included in finishing pig diets at 10% as reported, had no deleterious effect on feed conversion ratio, animal performance and was cost effective and contribute to self-sufficiency in nutrients from locally available feed sources (Rao *et al.* 2000). It is therefore imperative to examine for cheaper non-conventional feed resources that can improve intake and digestibility of low quality forages. Feedstuffs such as fish offal and kitchen leftovers (i.e., potato peel, carrot peel, onion peel, and cabbage leftover), poultry litter, local brewery and distillery by-products are commonly used(Amandeep, 2016) and could be invaluable feed resources for small and medium size holders of livestock.More information is required on chemical composition, nutritive value and their utilization. Farmers are mostly not aware of the nutritive value of some feed sources and the way for their efficient integration in livestock feeding, a viable proposition could be the inclusion of non-conventional feed resources in livestock rations with suitable and complete feed technology that can utilize the feed sources with maximum efficiency.Over a period of time a wide range of new feed resources have been successfully evaluated and results of on-farm trials evaluating the use of several non conventional feed resources in broiler diets under small holder conditions Ravindran (1993) highlighted that the intention of those trials were to demonstrate the possible use of relatively cheaper, locally available by products by proportionately reducing the expensive concentrate feeds. The new technology helped to cut production cost drastically by improving the feed efficiency from 3.5 in 1980 to 2.2 in 1990 and reducing the growth span from 90 to 42 days. The involvement of local extension agencies and other means of communication in technology development for efficient use of NCF, assessment and transfer of the information is equally important and would provide first-hand knowledge of these feedstuffs from various livestock extension agencies, thus providing nutritional security to animals.

METHODOLOGY

A survey was conducted by NAERLS using a structured questionnaire through well trained enumerators which was complemented with the results of interview schedules and Rapid Rural Appraisal Techniques. A total of 253 poultry and 259 pig farmers were involved in the study from Abia, Adamawa, Akwalbom, Borno, Enugu and Lagos States about sources of information on Non-conventional Feedstuffs. A simple random sampling was used (Ikaniet al. 2001).

RESULTS AND DISCUSSION

The sources from which farmers get information are given in Table 1. Some 40.4% of poultry farmers and 53.3% of pig farmers said they got information about NCF from neighbours and friends. Extension agents were the source of information for 36.5% of poultry and 36.8% of pig farmers. The results obtained on the importance of neighbours/friends and Extension agents are in agreement with the results obtained by several other investigators. (Ikani, et al., 2001). Chikwendu*et al*., 1996, in an extensive study, on the effectiveness of communication channels for disseminating information on improved

farm practices to farmers involving about 950 farmers nationwide obtained similar results. However, in contrast to the results of that study, extension guides and bulletins were found to be more important sources of information on NCF than Radio. The percentage of farmers who reported using guides and bulletins were 22.6% for poultry and 13.6% for pigs in contrast to only 3.2% for radio and 11.1% for TV amongst poultry farmers; 2.3% for radio and 1.1% for TV amongst pig farmers. The market was a source of information to 5.2% of poultry and 10.7% of pig farmers. The main source of NCF for farmers is the open market. This was reported by 44.7% of poultry and 68,8% of pig farmers. However while only 26.1% of poultry farmers reported sourcing NCF from household wastes up to 57.1% of pig farmers did so. Similarly, only 14.1% of poultry farmers compared to 42.9% of pig farmers reported sourcing NCF from the industry. On-farm sourcing was done by 10.7% of poultry in contrast to 36.7% of pig farmers. These results indicate that pig farmers use more locally available NCF than poultry farmers. This is not surprising considering the fact that poultry depend more on refined feeds. Pigs have the capacity to effectively utilize many raw or semi-processed NCF directly whether wet or dry. From Table 2 it can be observed that a sizeable proportion of the farmers had used NCF for only 3 years or less. This was cited by 54.9% of poultry and 39.3% of pig farmers. About one third (31.4%) of poultry and a quarter of pig farmers had used NCF for more than six years. Inspite of the seemingly massive use of NCF, the difference between farmers who said they were satisfied (39.2%) with NCF use and those dissatisfied (34.5%)were marginal in the case of poultry farmers . Similarly, pig farmers that were satisfied with NCF were 46.6% compared to 41.5% that were dissatisfied. Very few farmers said they were highly satisfied with NCF use: 2.6 % of poultry and 8.3% of pig farmers. Most of the farmers acknowledged that they shared information on NCF with other farmers (56.9% of poultry and 82% of pig farmers). Some 28.3% of poultry farmers and 51.5% of pig farmers said they employ additional labour as a result of using NCF. For poultry farmers, the number employed were 1-2 by 12.3%, 3-5 by 11.9% and >6 by 2.6%. For pig farmers, the number employed were 1-2 by 61.3%, 3-5 by 29.4% and >6 by 9.3%. These results show the high potential that exists for employment generation through promoting the use of NCF. Given an average of 2 workers per farmer, the 259 pig farmers interviewed created an additional 518 jobs. The farmers were very conversant with the advantages associated with NCF use (Tables 3). Cheapness and availability were cited as the major advantages by 26.8% of poultry and 36.9% of pig farmers. Only 14.6% of poultry and 14.6% of pig farmers cited cost effectiveness / economical considerations as one of the benefits of NCF use.

CONCLUSION

The main reason for the poor animal production is the inadequate supply and low level of feeding due to serious shortage of feedstuffs. A major gap exists between the requirements and supplies of nutrients for feeding of animal, the non-conventional feeds could partly fill this gap. More information is required on chemical composition, nutritive value and their utilization. Farmers are not aware of the nutritive value of some feed sources and the way for their efficient integration in livestock feeding. The involvement of local extension agencies in technology development for efficient use of NCFR, assessment and transfer is equally important. Several factors may account for their limited use, among which is their low nutritive value, Seasonal availability, high cost of handling and transportation from the production site to the farm, presence of anti-nutritional factors. It is essential to increase feeds by growing more fodders, propagating agro and social forestry, improving the nutritive value of crop residues and utilising other NCFRs. Crop residues, Agro-industrial By-Products and browse foliage are certainly an increasingly important role as feeds in the future, as human and livestock populations expand and an intervention through training on feed treatment and supplementation is essential to improve the feeding value of crop residues and clear cut duration of time for how long a feed has been used as a feed for livestock should be put to distinguish it as conventional or non-conventional feed resource. The best information sources are those that involve visual aids and practical demonstrations. The use of well-trained Extension agents and contact farmers complimented with good extension publications are strongly recommended as ways of disseminating information and acquisition of the necessary skills required by farmers to adopt the use of NCF effectively.

Table 1: Sources of information about NCF to Farmers

Variables	Poultry Farmers		Pig Farmers	
	F	%	F	%
Radio				
Yes	6	3.2	6	2.3
No	176	96.8	255	97.7
Total	185	100.0	261	100.0
Television				
Yes	23	11.1	3	1.1
No	184	88.9	258	98.9
Total	207	100.0	261	100.0
Guide/bulletin				
Yes	49	22.6	36	13.8
No	168	77.4	225	86.2
Total	217	100.0	261	100.0
Extension Agent				
Yes	77	36.5	96	36.8
No	134	63.5	165	63.2
Total	211	100.00	261	100.0
Market				
Yes	12	5.2	28	10.7
No	218	94.8	233	89.3
Total	230	100.0	261	100.0
Friends/neighbour				
Yes	88	40.4	139	53.3
No	130	59.6	122	46.7
Total	218	100.0	261	100.0
Others				
Yes	28	12.2	48	18.4
No	202	87.2	213	81.6
Total	230	100.0	261	100

Table 2: Duration of using NCF

	Poultry Farmers		Pig Farmers	
	F	%	F	%
Duration of NCF use				
1-3years	28	54.9	35	39.3
3-6years	7	13.7	31	34.8
>6years	16	31.4	23	25.8
Total	51	100.0	88	100.0
Extended information on NCF to others				
Yes	55	60.4	52	57.1
No	36	39.6	39	42.9
Total	91	100.0	91	100.0
Addition labour employed				
Yes	26	28.6	31	29.2
No	65	71.4	75	70.8
Total	91	100	106	100

Table 3: Availability and reliability of using NCF

Criteria	Poultry Farmers		Pig Farmers	
	Farmer	%	Farmers	%
Cheap	36	24.2	26	16.6
Cheap & available	40	26.8	58	36.9
Cheap & economical				
Cost effective/Economic	14	9.4	23	14.6
Available	11	7.4	21	13.4
Better/satisfactory animal performance	23	15.4	8	5.1
Less fat in the pork	-	-	-	-
Profitable	5	3.4	5	3.2
Reliable in terms of quality	13	8.7	-	-

REFERENCES

Amandeep, S. (2016). Non Conventional Feedstuff for Nutritional Security of Animals https://asia.ypard.net/2016-april-14/non-conventional-feedstuffs-nutritional-security-animal

Babatunde, G.M. 1999. The Presidential Task Force on Alternative Feed Resources: Challenges and Way Forward. NSAP Newsletter. Vol. 17 No.2. Dec. 1998

Berardini, N. ,Knodler, M. , Schieber, A. and Carle, R.(2005). Utilization of mango peels as a source of pectin and polyphenolics. *Innovative Food Science and Emerging Technologies*, 6 (4): 442-45.

Bakshi, M.P.S. and Fontenot, J.P. (1998). Processing and nutritive evaluation of broiler litter as livestock feed. Anim. Feed Sci. Technol. **74:** 337-345

Farag, M.D.E.H. (2001). The enhancement of the nutritive value of mango seed kernels for poultry by thermal treatment and radiation processing. Archives of Anim. Nutr. **54**(1): 61-79

Chikwendu, D. 0., Zaria, M. B., Omotayo, A. M., Yusuf J. 0., and Omenesa, Z. 0. (1996). Evaluation of the
Effectiveness of Extension Communication Channels on Improved Farm Practices to Farmers in Nigeria.

A Research Report Submitted to the National Agricultural Project, Federal Ministry of Agriculture, Abuja,

Diarra, S. S. and Usman , B. A. (2008). Growth performance and some blood variables of broiler chickens fed raw or boiled mango kernel meal. *International Journal of poultry science*. 7 (4): 315-318.

Ikani, E.I, Dafwang, I. I., Chikwendu, D.O., Adesehinwa, A. 0. K., Annatte, A. I., and Iwuanyanwu, I. E. J. 2001.

Proceedings of the 26thAnnual Conference of the Nigerian Society for Animal Production Volume 26,2001

NAERLS. (1997)

Orayaga, K.T. and Anugwa, F.O.I (2014). The proximate composition of boerhaviadiffusadried leaves and it effect on the growth performance of weaned rabbits. Proceedings of 39thConferenceNigerian Society for Aninal Production 16-19 March, 2014. Babcock University Ilishan-Remo, Ogun State Nigeria. Eds A.R. Abdullah, G.O. Tayo, A.O. Akubanjo and O.A. Akinsoyinu. Pp297-300.

Palma Castillo, O. R. and Hurtado, E. A. (2009). Productive behavior in rabbits during the fattening growth period-fed with mango *(Mangiferaindica)*peelsas partial substitution of the commercial balanced food. *RevistaCientífica UDO Agrícolata*, 9 (4), 968-971.

Rao, D. S., Ravi, A., and Yedukondalu, R. (200). Inclusion of dried mango peels in finisher rations of pigs on their performance. *Indian Journal of Animal Nutrition*., 20 (1): 120-123.

Ravindran V, Rajkumar A A and Sahama T M I R 1993. Animal Production Research in Srilanka, 1960 – 1990. An Annotated Bibliography, University of Peradeniya, Sri lanka 109 pp

Soomro, H., Rind, M.I., Sanjrani, S.N., Magsi, A.S, Barham, G.S., Pirzada, S.A. and Sahito, H.A. (2013). Effect of partial mango pulp mixing in ration on behavior and production of broiler. International Journal of plant and Animal Science. 1(2):30-36.

Umesh S., Vishnu K., Bisitha B. and Muneendra K. (2014). *Dairy Cattle Nutrition* Archives of Anim. Nutr. **54**(1): 61-79

LENGTH-WEIGHT RELATIONSHIPS AND CONDITION FACTOR OF *CLARIAS GARIEPINUS* AND *OREOCHROMIS NILOTICUS IN* GUBI DAM, BAUCHI STATE

[1]Ishaku, S., [1]Abdulkarim, M., [1]Mancha, Y.P., [1]Buba, S.A, [2]Yusuf, Z.I. & [1]Mahmood, S.1

[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria
[2]Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria
Corresponding Author: email:Sylveku@gmail.com

ABSTRACT

Studies were conducted to determine the length-weight relationships and condition factor (k) of *Oreochromis niloticus* and *Clarias gariepinus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State Nigeria were evaluated for a period of four months, (September, October, November, and December, 2019). The following fish species where encountered and identified: *Oreochromis niliticus, Clarias gariepinus, Alestes nurse, Labeo senegalensis, Barillu senegalensis, Distinchodus engycephalus, Heminchromis faciatus* and *Schilbe mystus.* Atotal of three hundred and twenty two (322) *O. niloticus* and one hundred and twenty seven (127) *C. gariepinus* were collected in the dam by artisanal fishermen using drag net and traps. The length and weight of *Oreochromis niloticus* and *Clarias gariepinus* were measured using meter rule and electronic weighing scale (T500Y) respectively. Model equations of *O. niloticus* and *C.* gariepinus were $W = 0.0692 \times L^{2.3857}$ and $W = 0.0342 \times L^{2.5559}$. The fish species had negative allometric growth pattern (b<-3). The length-weight relationships of the fish species (*Oreochromis nilotiuss* and *Clarias gariepinus*) showed no significant difference $P > 0.05$. *Oreochromis niloticus* had a good condition factor with (k) value of 1.7525 while *Clarias gariepinus* had poor condition factor (K) with value of 0.7510. The condition factor (K) for dry season ranges from 1.7705 (*O. niloticus*) to 1.8474 (*C. gariepinus*) indicating that the fish species were in good nutrition condition. The condition factor (k) values for both species were (K >1) indicating the fishes in dam were in good condition except *C. gariepinus* obtained in wet season. Fishing regulations should be introduced in Gubi Dam.

Key Words: length-weight relationship, condition factor, *Oreochromis niloticus, Clarias gariepinus,* Gubi Dam.

INTRODUCTION

Length– weigh relationship studies of fishes are considered as an important tool for understanding the growth pattern of fish species. Length is a linear measure (in centimeter) and weight of a fish (in gram) is approximately equal to its volume (cubic centimeter). Hence weight of a fish is a function of length. The relationships can be expressed by the hypothetical law $W= aL^3$. The value of exponent may considerably deviate from the value 3, as most fishes change their form or shape when they grow (Martin, 1949). This variation form expected weights to the actual weight of individual fish is assessed by analyzing the length – weight relationships. Le Cren (1981) proposed the relative condition factor in preference to condition factors as the letter is influenced by many environmental and biological factors. Condition factor measures the deviation from a hypothetical ideal fish whereas relative condition factor measures the deviation from the average weight or length of fish. There is paucity of information on the length weight relationships and condition factor of fish species in Gubi Dam. This may not be unconnected with insufficient literature and research of all fish species in the dam.

MATERIAL AND METHODS

STUDY AREA

The study was carried out in Gubi dam Bauchi State. Bauchi State is located at longitude 10- 10°N arid altitude 9°40E, it is 69020cm above sea level. It cover an estimated area of about 3,354 kilometers with a population about 344750 people. The state experience two seasons in a year that is, rainy season and dry season. The annual rainfall is 905.3mm with temperature range of 11°c-4°c mean. Monthly hour of sunshine is 300.5 hour and decrease to 150 one hour in August experience minimum relative humidity of about 66.5% and February record lowest of 16.4%. The vegetation is open Savannah and with species of tin or more but the vegetation have been reduced to shrubs due to cultivation and burning effects. There are brown grasses of low nutritive value.

IDENTIFICATION OF FISH SPECIES

Fish species caught were identified by their local names. Fish identification key refer to monograph for their scientific names (Reed et al., 1907)

FISH SAMPLING TECHNIQUES

A total of 322 *Oreochromis niloticus* and 127 *Clarias gariepinus* were collected in the dry and wet seasons. Field visited was conducted once in a month in both dry and wet seasons in 2019. The local fishermen operating at the Dam deployed drag net and traps for their catches. The fish sample caught were immediately immersed in 10% formalin and transported to the laboratory for identification using the key provided by fish base (2013).

DATA COLLECTION AND ANALYSIS

The variations in the length weight represented by 'b' were recorded. The total length (TL) of each fish was measured from the tip of snout (mouth closed) to end of the caudal fin using meter ruleThe relationship between length and weight of the fish was examined by simple linear regression using WINKS software.. Body weight was measured using electronic digital balance (OHAUS). The parameter of length-weigh relationship of sampled fish species were evaluated using the equation.

$W = aL^b$ (Rickter, 1973) ….. equation 1

Where, W is weight of the fish (g), L is length of the fish (cm), a is the intercept

growth coefficient, and b is the slope growth coefficient. The value of constant 'a' and 'b' were estimated after logarithmic transformation as described by Zar (1984) to give

$Log_{10}{}^a + b\ Log_{10}L$ …….. equation 2.

The 95% confidence interval (CL) of 'b' was computed using the equation (Egbal*et al.*, 2011):

$CL = b \pm (1.96 \times SE)$ ….. equation 3

Where SE is the standard error of 'b'. The condition factor was calculated by the formula (Pauly, 1983):

Condition Factor (K) = $100W/L^3$

Where w is weight (g) and L is total length (cm).

RESULTS

Table 1: Length-weight Relationships Parameters of *Oreochromis niloticus*and *Clarias gariepinus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State (2019)

Species	Regression coefficient a	b	Correlation coefficient (r)	Model ($W=a \times L^b$)	±SE	N	Growth pattern
O. niloticus	0.0692	2.3857	0.7050	$W= 0.0692 \times L^{2.3857}$	0.38	322	NA
C. gariepinus	0.0342	2.5559	0.6618	$W= 0.0342 \times L^{2.5559}$	0.51	127	NA

N=number of Specimen used, **NA=** negative allometry, SE = Standard Error

Table 2: Condition Factor Values (k) of *Oreochromis niloticus*and *Clarias gariepinus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State for Wet season (2019)**.**

Species	Maximum (k) Value	Minimum (k) Value	Average (k) Value	N	Remark
O. niloticus	2.5451	0.1374	1.7525	161	Good condition
C. gariepinus	2.4303	0.1942	0.7510	74	Not in good condition

Table 3: Condition Factor Values (k) of *Oreochromis niloticus*and *Clarias gariepinus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State (Dry Season 2019)

Species	Maximum (k) Value	Minimum (k) Value	Average (k) Value	N	Remark
O. niloticus	2.5451	0.1521	1.7706	161	Good condition
C. gariepinus	2.7166	0.7140	1.8474	53	Good condition

DISCUSSION

The (b) value of the fish species from Gubi dam recorded during the period of study, fell within 2.3857 and 2.5559. this result contradicts the reports of Egbal*et al*, (2011) whose study showed that the 'b' value of the fish species from both Atbara and Khashm el-Girba reservoir in Sudan were within the range of 2.278 and 3.680, and Pauly (1983) who also recorded 'b' value range of 2.5 to 4.0 for many fish species. It is also reported that when b=3, the fish grows isometrically, resulting in ideal shape of fish (Olurin and Aderibigbe, 2006). When the values of b is less than 3.0 the fish experiences a negative allometric growth (Sudan, 1950). However, when the value of b is more than 3.0 the fish grows following the positive allometric growth pattern. Ibrahim (1984) reported that, the value of b then becomes greater than 3 as the fish is slimmer. Nevertheless, it was observed that the two sampled fish species in the study neither showed isometric nor positive allometric growth pattern but all suffered from negative allometric growth. All value observed for fish collected from the Dam during the study period indicates that, the two sampled fish species experienced this pattern of growth. The coefficient of determination r^2 for the length-weight relationship was high for *O. niloticus* (0.7050) and O.6618 for *C. gariepinus* indicating that the length increased with increased in weight of fish at

Dam. This is an agreement with previous findings (Laleye, 2006). The 95% interval of ranged from 0.0692-2.5451. lazima *et al*, (2007). However, reported a 95% CL of b value range between 2.329 and 3.919 of 12 fresh water fishe species in the Kenian River Basin and Pedu Lake.

The condition Factor (k) gives information on the physiological condition of Fish in relation its welfare, Perry *et al*, (1996) reported that fish with low condition index are presumably believed to have experience adverse physical environmental or insufficient nutrition. According to Maguire and Mace (1993), from a nutritional point of view, increase in k values indicates the accumulation of fat and sometimes general development. Angelscu*et al* (1958) reported that from a reproductive point of view, the highest k value are reached in species if the fish is fully mature and have higher reproductive potentiality. It was observed that the two fish species sampled in the study recorded inconsistent condition factors, with *O. niloticus* in wet season having 1.7252 and *C. gariepinus* having 0.7510. With *O. niloticus* falling within the normal range indicating good condition, while *C. gariepinus* falling below the normal range indicating not good condition. While in dry season all the fish species sampled in the study had condition Factor $\geq$ 1, and were within the normal ranges recommended by Ujjania*et al*, (2012) who stated that condition factor greater than or equal to one is good, indicating a good level of feeding, and proper environmental condition. Benegal and Tech (1978) recommended k value range (2.9-4.8) as suitable for matured fresh water fish. The condition factors of the two fish species sampled in the study revealed that the fish species had their k values outside and within the ranged recommended as suitable for matured fish in fresh water. This could be caused due to environmental factor such as damming the river. Abdullahi and Ahmad (2013) reported the predominance of cyanobacteria and spirogyra, phytoplankton species in Wudil Rivers, which suggest an indication of organic pollution, reflecting human interference to pollute the river. LWR Parameters (a and b) and the k value of the fish has been reported to be affected by factors such as feeding intensity, availability of food, fish size, age, sex, season, stage of maturation, fullness of the gut, degree of muscular development.

CONCLUSION

The following fish species were encountered and identified (*Oreochromisniloticus, Clariasgariepinus, Alestes nurse, Labeo senegalensis, Barillus senegalensis, Distinchodus engycephalus, Hemichromis faciatus, Schilbe mystus*) in the Dam.Length-weight relationships of the fish species indicated negative allometric growth pattern in the fish species. The lengh thas a close relationships with the weight. The fish species in the Dam were in better condition of wellbeing in the dry season.

REFERENCES

Abdullahi J.M. and Ahmad A.M. (2013). Survey of phytoplankton in Wudil River, Kano State Nigeria. *Aquatic Biology Research,* 1 (1), 10-16 DOI: 10.12966.abr.08.02.2013

Angelescu V., Gneri F.S. and Nani A. (1958). Argentine sea hake (biology and taxonomy) Secr. Mar. Serv. Hydrogenation. Nav. Public, H1004: 1-224

Bagenal T.B. and Tesch F.W. (1978). *Methods of Assessment of Fish Production in Fresh Waters.* IBP Handbook No. 3, 3rd ed. Oxford Blackwell Scientific Publication, London. Pp. 101-136

Clay D (1979). Population biology, growth and feeding of the African catfish (*Clarias gariepinus*) with special reference to juveniles and their importance in fish culture. *Arch. Hydrobiologia Supp.* **87**:453-482

Egbal O.A., Mohammed E.A. and Afra A.A. (2011). Length-weight relationships and condition factors of six fish species in Atbara River and Khashm El-Girba Reservoir, Sudan. *International Journal of Agriculture Sciences,* 3 (1), 65-70

Elias D (2000). Reporoductive biology and feeding habit of catfish. *Clarias gariepinus* Burchell (*Pisces: Clariidae*) in Lake Awassa, Ethiopia. SINET: Ethiop. J. *Sci*. **23**: 231-246.

Fishbase (2013). Online fish identification sheet. Available at http://www.fishbase.org/search.php, accessed on 10/06/2013

Ibrahim A.M. (1984). The Nile: Description, hydrology, control and utilization. *Hydrobiologia*, 110, 1-13

Laleye P.A. (2006), Length-weight relationships of fishes from the Oueme River in Benin (West Africa). *J. Appl. Ichtholo*, 22, 330-333

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in Parch Perca, Fluvatilis, *J. Anim. Ecol.*, 20:201-219

Lizama M., De Los A.P. and Ambroso A.M. (2002). Condition factor in nine species of fish of the Characidae family in the upper Parama River floodplain, Brazil. *Braz. J. Biol*, 62 (1), 113-124

Maguire J.J. and Mace P.M. (1993). Bilogical reference points for Canadian Atlantic Gadoid stocks. In: Smith S.J., Hunt J.J. and Rivard D. (eds.), *Risk Evaluation and Biological Reference Points for Fisheries Management. Can. Spec. Publ. Fish. Aquat. Sci.*, 120, 67-82

Nyamweya CS, Mlewa CM, Ngugi CC and Kaunda-Arara B (2010), Validation of daily growth of African catfish *Clarias gariepinus* (Burchell 1822) young-of-the-year from Lake Baringo, Kenya. Lakes and Reservoirs: Research and Management **15**: 341-345.

Olurin K.B. and Aderibigbe O.A. (2006). Length-weight relationship and condition factor of pond reared *Oreochromis niloticus. World Journal of Zoology*, 1 (**2**), 82-85

Pauly D. (1983). Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Tech. Pap., FAO Rome, 234, 52

Perry R. I., Hargreaves N.B., Waddell B.J. and Mackas L. (1996). Spatial variations in feeding and condition of juvenile pink and chum salmon off Vancouver Island, British Columbia. *Fish Oceanogr*., 5 (**2**), 73-88

Rickter W.E. (1973). Linear regression in fisheries research. *J. Fish. Res. Board Can.,* 30 (**3**), 409-434

Spataru P, Viveen WJAR and Gophen M (1987). Food composition of *Clarias gariepinus (Cypriniformes, Clariidae)* in Lake Kinneret (Israel). *Hydrobiologia **144**: 77-82.*

Tesfaye W (1998). Biology and Management of fish stocks in Bahir Dar Gulf, Lake Tana, Ethiopia. Ph.D. dissertation. Wageningen Agricultural University, Wageningen. 142 pp.

Ujjania N.C., Kohli M.P.S. and Sharma L.L. (2012). Length-weight relationship and condition factors of Indian major carps (*C. catla, L. rohita and C. mrigala*) in Mahi Bajaj Sagar, India. Research Journal of *Journal of Biology*, 2 (**1**), 30-36

Viveen WJAR, Richter CJJ, Van oordt PGWJ, Jansen JAL and Huisman EA (1986). *Practical Manual for the Culture of the African Catfish (Clarias gariepinus).* Department of Zoology of the University of Utrecht. The Hague. 121 pp.

AWARENESS AND ADOPTION OF INNOVATION ON IMPROVED FISH FEEDING TECHNIQUES AMONG FISH FARMERS IN OBIO/AKPOR LOCAL GOVERNMENT AREA OF RIVERS STATE, NIGERIA

***[1]Ogunremi, J.B., [2]Olatunji, S.O. [1]Igbani, F.**

[1]Department of Fisheries and Aquaculture, Federal University Wukari, Taraba State, Nigeria
[2]Department of Agricultural Economics and Extension, University of Port Harcourt, River State, Nigeria
* jogunremi@gmail.com

ABSTRACT

The study assessed the adoption of innovation on improved fish feeding techniques among fish farmers in Urban and Rural communities in Obio/Akpor Local Government areas of Rivers State. Multistage sampling technique was used; the first stage fifteen (15) communities were purposively sampled and the next stage fish farmers were sampled randomly from the communities to obtain a sampled size of 100. Data were collected through structured questionnaire and interview scheduled. Descriptive statistics such as frequency, percentages and mean were used for data analysis. The results revealed that 22% farmers major source of information was through family and friends, while awareness rate was high 100% for the use of floating feed, about 85% of them used live food and most adopted innovation on improved fish feeding techniques were floating feed (X= 4.99) and use of live food (X= 4.23) constraints to adoption of innovations were high cost of improved fish farming techniques and technical knowhow. It was recommended that Government should provide funds in form of loan at a reduced interest rate to the fish farmers and extension agents should organize timely training for the fish farmers to enable them adopt innovations introduced to them.

Keywords: Awareness, adoption, fish farmers, fish, techniques

INTRODUCTION

The low domestic fish production was attributed to the fact that fish production in Nigeria is highly dependent on artisanal fishing, which is characterized by the use of crude fishing gear and equipment, low catch, lack of access to credit facilities and information on improved fishing technologies The fishermen, who rely on the use of small fishing gear, operate on creeks, lagoons, inland waters or rivers which extend beyond 5 nautical miles of seashore. Hence, increasing the domestic fish production in Nigeria would require among others the adoption and use of improved fishing technologies which consists of required equipment and practices for finding, handling, processing and distribution of fish resources and their products (Olaoye *et al,* 2018). Nigeria aquaculture development has been driven by social and economic objectives, such as nutrition, improvement of rural areas, generation of supplementary incomes, diversification of income activities and the creation of employment (Ozigbo *et al,* 2014).

There has been an increased effort at development of technologies for increased production. Agricultural Extension Agents are constantly engaged in the transfer of developed farming technologies to farmers for adoption (Olatunji, and Ogunremi *2016).* Adoption is a decision making process which involves a number of stages. Adoption as the integration of an innovation into farmers' normal farming activities is not a permanent behaviour (Ekong 2010).

The roles innovations are to simplify and make fish production more effective and efficient. It is therefore pertinent to investigate the extent to which fish farming technologies have been transferred to farmers and the extent to which the technology end-users have taken advantage of these technologies. Therefore, the study aimed at examining awareness and adoption of innovation on improved fish feeding among fish farmers in Obio-Akpor Local Government Area of Rivers State. The specific objectives of the study were to: (i) examine awareness of innovation on improved fish feeding technologies among the respondents, (ii) identify information sources of respondents on innovation (iii) determine adoption of innovations (iv) identify constraints to adoption of innovations by the respondents.

MATERIALS AND METHODS

AREA OF STUDY

The study was carried out in Obio/Akpor Local Government Area in the metropolis of Port Harcourt, one of the major cities of Niger Delta, located in Rivers State. The Local Government Area covers 260 km2 and had a population of 464,789 people at the 2006 census. Obio/Akpor is bounded by Port Harcourt (Local Government Area) to the south, Oyigbo to the east, Ikwerre to the North and Emuoha to the west. It is located between the latitude 4^0 45' N and 4^0N and longitude 6^0 5 ' E and 8^0 00' E. It is mainly made up by people of Ikwerre ethnic nationality. The major occupations of the people are arable crop farming, trading and fishing. Obio/Akpor has a total number of three kingdoms which are Apara, Evo and Akpor Kingdoms from which 54 communities are found (Obio/Akpor geographical location, 2017)

SAMPLING PROCEDURE

Multistage sampling technique was used to select respondents for the study. The first stage was a purposive sampling of fifteen (15) rural and urban communities that have more fish farmers than the others. The next stage involved random selection of one hundred (100) fish farmers in the selected fifteen communities. Thus, the total population size was 100 fish farmers.

DATA COLLECTION AND METHOD OF ANALYSIS

Questionnaire were used for data collection and supplemented with scheduled interview where respondents do not have formal education. Data collected were analyzed using descriptive statistics such as frequency percentage and mean.

RESULTS AND DISCUSSION

Table 1 showed that 22% of the fish farmers' main source of information on improved fish farming techniques was family and followed by other farmers which was 18%, internet source had 15% while extension agents had 2% respondents. The implication is that informal sources of information on improved fish farming were high. Reason for low level of information source from extension agents could be attributed to poor ratio of extension agents to fish farmers. In a similar study Ogunremi *et al*, (2018) reported low level of information dissemination by extension agents to fisher folks. However, Ifejika *et al.,* (2008) reported extension agents as the major source of information on fish technologies.

Table 1: Sources of information on improved fish farming techniques in Obio-Akpor Local Government Area of Rivers State

Variable	Frequency	Percentage
Extension agent	2	2
Internet	15	15
Private consultant	8	8
Family and friends	22	22
Fish buyer	4	4
Other farmers	18	18
Total	100	100

Source: field survey, 2019

Table 2 indicated that 100% of respondents were aware of floating feed, 85% were aware of use of live feed, 53% of respondents were aware of automatic feeder and only 12% were aware of pulse feeding. High level of awareness on floating feed was a function of dissemination sources, also

majority of floating feed available in the market were imported which could be attributed to the mentality that imported fish feed are superior to locally manufactured feed. Live feed such as maggot is also widely acceptable to fish farmers which prompted it level of awareness among fish farmers in the study area.

Table 2: Awareness about improved fish farming techniques in Obio-Akpor Local Government Area of Rivers State

Improved fish farming techniques	Frequency	Percentage
Automatic feeder	53	53
Pulse feeding	12	12
Alternative feed	26	26
Floating feed	100	100
Use of live feed	85	85

Source: field survey, 2019

Table 3 indicated that floating feed and use of live feed were adopted by fish farmers in the study area while automatic feeder, pulse feeding and alternative feed were not adopted. Ashley-dejo *et al,* (2013) in a similar study reported high level of fish farmers' awareness on use of live feed among fish farmers. The implication for the adoption of floating feed is because it enable fish farmers to monitor response of fish to feeding, also prevents feed wastage because feed floats on water unlike the local feed that sink and uneaten feed easily pollute the water. Live feed on the other hand like maggot when fed to fish helps in reduction of amount spent on feeding fish. Non adoption of automatic feeder could be attributed to high financial implication involved since most fish farmers could not afford it. Tosan (2008) reported that cheap technology will be adopted faster than an expensive one, because farmers are eager to make money.

Table 3: Adoption of innovation on improved fish feeding techniques in Obio-Akpor Local Government Area of Rivers State

S/N	Variables	Adoption	Mean	Remark
1	Automatic feeder	0	1.37	Not adopted
2	Pulse feeding	0	1.22	Not adopted
3	Alternative feed	2	1.43	Not adopted
4	Floating feed	99	4.99	Adopted
5	Use of live food	72	4.23	Adopted

Mean Criterion = 3

Table 4 showed lack of awareness of improved fish farming techniques, high cost of improved fish farming techniques, technical knowhow, limited or no access to credit facilities affected the adoption of innovation on improved fish feeding techniques. Innovations can be widely adopted when all channels of creating effective awareness are maximally utilized. Adoption of innovation is a function of credit facilities which can be finance or equipment. The services of experts on innovation utilization are paramount in training fish farmers who are willing to adopt innovations on fish feeding.

Table 4: Constraints to fish farmers' adoption of innovation on improved fish feeding techniques in Obio-Akpor Local Government Area of Rivers State

S/N	Constraints	VSC	SC	MC	NC	Total	Mean	Remark
1	Lack of awareness of improved fish farming techniques	93	5	2	0	359	3.59	Agree
2	The high cost of improved fish farming techniques	94	1	3	2	387	3.87	Agree
3	I don't know how to put the new techniques to use	57	11	16	16	309	3.09	Agree
4	Poor marketing structure is affecting the adoption of improved techniques	19	13	40	23	218	2.18	Disagree
5	Limited or no access to credit facilities affect the adoption of improved techniques	86	9	1	4	377	3.77	Agree

Mean criterion: 2.5

VSC= Very strong constraint, SC= Strong constraint, MC= Mild constraint. NCAA= Not constraint at all

CONCLUSION AND RECOMMENDATION

Fish farmers were aware of some innovations on improved fish feeding techniques and had adopted only a few of them which can be related to the constraints like high cost of the innovation, technical knowhow and limited or no access to credit facilities. It was recommended that Government should provide funds in form of loan at a reduced interest rate to the fish farmers and extension agents should organize timely training for the fish farmers to enable them adopt innovations introduced to them.

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REFERENCES

Ashley-Dejo S. S, Olaoye, O. J, Fakoye, E. O, Ikeweinwe, N. B, Idowu, A. I, Bolarinwa K. K & Adelaja O. A..2013. Limitations to the Adoption of Recommended Aquaculture Production Technologies by small Scale Fish Farmers in Oyo State Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary 13 (9): 1-10

Ekong, E.E. (2010) Rural Sociology -Third Edition. Uyo: DOVE Educational Publishers. pp.438.

Ifejika, P.I., Ayanda, J.O., Nwabeze, G.O and Obetta, N. C. 2008. Contribution of Information Channels To Adoption Of Aquaculture Technologies Among Fish Farmers in Anambra State and Implication for Training. Journal of Agriculture and Social Research (Jasr) Vol. 8 (2): 1-6

Obio/Akpor Geographical Location International 2017.Re trieved from https:// en.m. wikipidia.org/wiki/Obio-Akpor 2008

Ogunremi, J.B., Nzanwi, R.F. and Sadiq, H.O. 2018. Fishing Inputs Supply and Accessibility among Fisher Folks in Gassol Local Government Area, Taraba State, Nigeria. *Delta Agriculturist Vol. 10(2):49 – 57*

Olaoye, O. J., Ojebiyi, W. G., Olukoga, A. S. and Ogunremi, J. B. 2018. Awareness and Adoption of Improved Fishing Gears among Fishermen in Ogun Waterside Local Government Area of Ogun State, Nigeria. Nigerian Journal of Fisheries and Aquaculture 6(2): 11 – 18

Olatunji, S. O. and Ogunremi, J. B. *2016.* Assessment of Awareness and Adoption of Fish Farming Technologies in Obio-Akpor Local Government Area of Rivers State, Nigeria *The Journal of Agricultural Sciences Vol. 11(3): 147-154*

Ozigbo, E.A.G., Adegbile, O. And Kolawole, P.2014. Review of aquaculture production and management in Nigeria. American Journal of Experimental Agriculture. 4(10), 1137-1151.

Tosan, F. (2008). Diffusion and Adoption of innovation, school of science and technology, national open university of Nigeria. Pp 32 – 76.

EVALUATION OF SOME SELECTED LEAVES FOR FEEDING AFRICAN GIANT LAND SNAIL (*Achatina achatina* L.)

A. Ahmed and R. A. Hamzat
Department of Animal Science, Faculty of Agriculture and Agricultural Technology, Federal University Dutsin-ma, Dutsinma, Katsina State, Nigeria.
**Corresponding Author: abdulm53abc@gmail.com +2347037731323*

ABSTRACT
Feeding trial was conducted on One hundred and twenty (120) to evaluate the utilization of four different leaves used for feeding of African Giant Land Snail (*Achatina achatina*). Grower snails were used in a Completely Randomised Design with 4 treatments replicated 3 times with 10 snails per replicate. The treatments were *Spinach olaracea* Leaves, *Ipomoea asarifolia* leaves, *Cucurbita pepo* leaves and *Commiphora africana* leaves. Weight gain, Shell length, Shell breadth, Aperture breadth, and Feed intake were measured weekly. The result obtained showed significant difference ($p<0.005$) among the treatment means in final weight, weight gain, shell length, shell breadth, aperture breadth and feed intake. Feed conversion ratio was highest ($p<0.005$) for snails fed with *Spinach olaracea,* followed by *Ipomoea Asarifolia,* then *Cucurbita pepo* and *Commiphora africana* leaves. Therefore, the final Weight gain, Shell length, Shell width, Aperture width and Feed intake of the experimental Snail fed the selected edible leaves was represented in this descending order: *Ipomoea asarifolia* > *Spinach olaracea* > *Cucurbita pepo* > *Commiphora africana* leaves. The result of this study indicated that *Ipomoea asarifolia, spinach olaracea Cucurbita pepo* and *Commiphora africana* leaves can serve as feed for African Giant Land Snail (*Achatina achatina*).
Key words: *Ipomoea asarifolia, Curcubita pepo, Commiphora africana, Spinach olaracea, Achatina achatina*

INTRODUCTION
Snails dwell mostly in humid forest areas in West Africa from where they are gathered by villagers for consumption and other uses (Ademosu, Omidigi, 1999). In recent times, the wild snail population has declined considerably due mainly to the impact of man and other anthropogenic factors including deforestation, slash and burn agricultural practices and overexploitation of this animal resource stemming from the world teaming population hence the few remaining species are captured before they reach maturity. Usually, snails become scarce during the dry season hence expensive at this period (Amusan, 2002). The need to enhance the mass production of snails cannot be overestimated because snails can be reared both on small scale and large-scale production systems. Snail rearing can be seen as a veritable means of generating income and to achieve self sufficiency in hard times as presently experienced in Nigeria today. It is therefore necessary to domesticate snails in order to save the species from going in to extinction. To effectively do this, various plant materials need to be evaluated as feedstuff for snails. The present research is focused on evaluation of some selected leaves: (*Spinach oleracea, Ipomoea asarifolia, Commiphora africana, Curcubita pepo*) as feed resource for snails.

MATERIALS AND METHOD
A total of 120 (one hundred and twenty) average weight (0.538 g) grower snails were used for this research. This experiment was carried out in a local snail farm (Bayan Area Council) in Dutsinma Local Government, Katsina State, for the period of 6 weeks. The snails were weighed on arrival and randomly allotted to four treatments in a completely randomized design. Each treatment was in triplicate, having ten sails each. The snails were housed in a discarded car tire's and covered with mosquito net. The treatments were *Spinach olaracea* Leaf, *Ipomoea asarifolia* leaf, *Cucurbita pepo* leaf and *Commiphora Africana* leaf. Weight gain, shell length, shell breadth, aperture breadth, and feed intake were measured weekly. The thirty marked snails from each treatment were weighed and measured at the end of the experiment. Proximate analysis was carried out on the experimental diets and the fecal sample per replication using standard AOAC methods. Analysis of variance was carried out to determine the Growth performance of African Giant Land Snail (Achatina Achatina) on experimental diets using SAS (SAS 2001).

RESULTS AND DISCUSSION

The snails in all the treatments gained appreciable weight across all the treatments as can be seen in table (2). The highest weight gain was observed in treatment B (*Ipomoea asarifolia*) leaves, with a mean total weight gain of 2.510 grams/snail followed by treatment A (*Spinach olaracea*) leaves, with 1.587 grams/snail, treatment C (*Cucurbita pepo*) leaves, 1.507 grams/snail, while treatment D (*Commiphora Africana*) leaves recorded the lowest weight gain with 0.863 grams/snail. The result indicated that there were significant differences ($p<0.05$) in the treatments diets but no significant differences ($p>0.05$) were observed between treatment A (*Spinach olaracea*) and treatment C (*Cucurbita pepo*) leaves.

Significant differences ($p<0.05$) were observed in diet B (*Ipomoea asarifolia* leaves) with average mean shell increment of 0.078 mm/snail, this conformed with reports of Aribisala (1999) that there is direct correlation between shell length increment and growth of the snails, every factor that affects the growth rate would also affect the shell length increment. It also conformed with the reports of Eze *et al., (*2013) who indicated that when snails were fed herbages and poultry waste based diet, the gain in length was significantly higher ($P<0.05$) than gain in length as a result of feeding standard poultry diet and this indicate positive impacts of herbages/leaves in shell length increment of snails despite the availability of calcium in the standard poultry diets even though the shell of snail is made of calcium which is present in the Ash (Hamzat 2004; Omole *et al* 2008).Thus, no significant differences ($p>0.05$) were observed between treatment A (*Spinach* olaracea) 0.042 mm/snail and treatment C (*Cucurbita pepo*) 0.031 mm/snail while treatment D (*Commiphora africana*) recorded the lowest 0.019 mm/snail.

The analysis of variance shows that there were significant differences ($p<0.05$) between the treatments in terms of shell breadth increment. Treatment A (*Spinach olaracea*) had the highest breadth increment with 0.206 mm/snail followed by treatment B (*Ipomoea asarifolia*) 0.145 mm/snail while treatment C (*Cucurbita pepo*) had 0.090, treatment D (*Commiphora africana*) recorded the lowest 0.060 mm/snail, but no significant difference ($p>0.05$) were observed between treatment C and D 0.090, 0.060 mm/snail respectively.

The values across all the treatments showed that the snails did well on the four treatments in terms of shell aperture increment and there was significant difference ($p<0.05$) between the treatments diets. Highest increment was observed in treatment C (*Cucurbita pepo*) 0.097 mm/snail, there was also significant difference ($p<0.05$) between treatment B (*Ipomoea asarifolia*) 0.031 mm/snail and treatment A (*spinach olaracea*) 0.020 mm/snail, while treatment D (*Commiphora africana*) was the least having 0.019 mm/snail.

Highest feed intake was observed in treatment A (*Spinach olaracea*) 47.63 grams/snail followed by treatment B (*Ipomoea asarifolia*) 45.47 grams/snail While Treatments C and D (*Cucurbita pepo and Commiphora africana*) recorded 29.96 and 20.06 grams/snail respectively. The analysis of variance shows that significant difference exists between the treatments ($p<0.05$).

The highest feed conversion ratio as can be seen in (table 2) was observed in treatment A (*Spinach olaracea*) 26.980 followed by treatment B (*Ipomoea asarifolia*) 24.343 and treatment C (*Cucurbita pepo*) 23.905 while the lowest feed conversion ratio was recorded in treatment D (*Commiphora africana*) 20.790. The analysis of variance shows that there is significant difference ($p<0.05$). The zero mortality rate recorded could be due to proper management practices adhered to during the course of the feeding trial. Again it could be due to "hardy" nature of snail. This observation is in line with of (FAO 1986, Amusan and Omidiji 1998) that the snail is "hardy" in nature and can tolerate adverse environmental conditions better than other livestock.

CONCLUSION AND RECOMMENDATION

CONCLUSION

The results obtained in this study indicated that *Achatina achatina* respond positively to all treatment diets used in this study. Best performance in terms of growth response, feed intake and feed conversion ratio was obtained in *Achatina achatina* Snails fed with (*Ipomoea asarifolia*) leaves, followed by (*Spinach olaracea*) leaves and (*Cucurbita pepo*) leaves. Apart from the good performances of snails fed with these treatment diets, (*Ipomoea asarifolia*) leaves was available all the year round all over the country to the farmers since it can be obtained at little or no cost.

RECOMMENDATIONS

1. *Ipomoea asarifolia* plant and *Cucurbita pepo* leaves which has been hitherto been thought of as an undesirable plant material (weed) could be used in feeding of *Achatina achatina.*

2. Being able to use *Ipomoea asarifolia* plant and *Cucurbita pepo* leaf as feed stuff offers the opportunity of making the environment pollution free and farmers can be encouraged to raise snails to generate additional income.

3. *Ipomoea asarifolia* was considered easily accessible and available all the year round all over the country to the farmers and it can be obtained at little or no cost.

4. Utilization *Spinach olaracea* leaf, *Ipomoea asarifolia* plant and *Cucurbita pepo* leaf will effectively reduce the cost of snail production.

5. Future research should be conducted to determine the cost implication of utilizing the selected leaves.

TABLE 1: Proximate Composition of the Experimental Diets

Parameters	**Treatment (A) (*Spinach*)**	**Treatment (B) (*Ipomoea*)**	**Treatment (C) (*C. pepo*)**	**Treatment(D) (*C. africana*)**
Moisture	36.8	15.61	9.65	6.03
Ash	6.96	7.10	9.68	11.59
NFE	20.25	20.79	40.50	33.77
Crude Protein	11.10	32.00	21.70	8.57
Ether Extract	3.51	7.60	7.11	3.84
Crude Fibre	21.3	16.90	11.36	36.2

TABLE 2: Growth performance of African Giant Land Snail (*Achatina Achatina*) on the selected leaves.

Parameters	Trt. (A) (*Spinach*)	Trt. (B) (*Ipomoea*)	Trt. (C) (*C. pepo*)	Trt. (D) (*C. africana*)	SEM
Initial weight (g)	17.230	17.557	15.280	14.440	1.721
Final weight (g)	18.817 [b]	20.067 [a]	16.787 [c]	15.303 [d]	1,787
Total weight gain (g)	1.587 [b]	2.510 [a]	1.507 [b]	0.863 [c]	0.606
Shell length increment (mm)	0.031[b]	0.078[a]	0.042[b]	0.019[c]	0.055
Shell breadth increment (mm)	0.206[a]	0.145[b]	0.090[c]	0.060[d]	0.070
Shell aperture increment (mm)	0.020[c]	0.031[b]	0.097[a]	0.019[c]	0.089
Total feed intake (g)	47.63[a]	45.47[b]	29.96[c]	20.06[d]	0.000
Feed conversion ratio	26.980[a]	24.343[b]	23.905[c]	20.790[d]	4.233
Mortality (%)	0.00	0.00	0.00	0.00	

a, b, c, d, means within rows bearing same superscript are not significantly (P>0.05) different, Trt. = Treatment, SEM = Standard Error of the Means

TABLE 3: Proximate Composition of the Feacal Samples

Parameters	Treatment (A) (*Spinach*)	Treatment (B) (*Ipomoea*)	Treatment (C) (*C. pepo*)	Treatment (D) (*C. africana*)
Moisture	5.80	7.80	5.20	4.20
Ash	4.96	2.20	3.50	5.30
NFE	76.712	76.095	76.150	79.840
Crude Protein	2.888	3.325	3.150	3.062
Crude Fibre	9.60	10.58	12.00	7.60

REFERENCES

Ademosun, A.A., Omidiji, M.O. (1999). The nutrient value of African giant land snail (*Archachatina marginata*). *Journal of Animal Protection Resear*ch 8(2): 876 – 877.

Agbogidi, O.M. Okonta, B.C. and Ezeani, E.L. (2008). Effects of two edible fruits on the growth performance of African giant land snail. (*Archachitina marginata* Swainson). *Journal of Agricultural and Biological Sciences* 3(3): 26- 29.

Amusan, J A Amusan, O.M. (2002). The techniques of snail farming as a viable and profitable venture. Oak Ventures Publishers, and Omodiji M O (1998). Edible Land Snail: A Technical Guide to Snail Farming in the Tropics. Verity Printer Limited, Ibadan.:96pp.

Aribisala, A.O (1999) Utilization of fruits in snail nutrition and their effects on growth and reproductive performance of the African giant land snail (*Archachatina marginata*). Masters thesis at the Department of Animal Science, University of Ibadan.

Awesu, M.D (1980) Observation on the Biology and management of the West African Giant Snail (*Archachatina marginata*). M. Phil Dissertation, University of Ibadan.

Cobbinah, J.R (1993) Snail Farming in West Africa CTA Publication pp11

Eze, J. N., Akpodiete, O. J., Okonkwo, J. C. and D. Eruvbetine (2013). Cost Benefit Analysis and Effects of Feed Preference on Performance of Giant African Land Snail (*Archachatina marginata*) Reared Intensively. *Journal of Applied Agricultural Research* 2013, 5(1): p83-90

FAO (1986). Farming Snails by FAO Better Farming Series, 3/33 Rome, Italy.

Hamzat, R. A. (2004) Utilization of Kola testa (*Cola nitida*, Ventenat Schott et Endheher). in the feeding of African Giant Land Snail (*A. Marginata*), PhD Thesis, Dept. of Animal Science, University of Ibadan, Nigeria

McDonald P., Edwards, R A and J FD Greenhalgh 1987 (4th ed) Anima Nutrition. Longman limited. 4th edition.

Omolara O.A (2005) Utilization of Cocoa Pod Husk by African Giant Land Snail (*Archachatina marginata*). Undergraduate Project submitted to the Department of Animal Science, University of Ibadan, Oyo State, Nigeria.

PROXIMATE AND CHEMICAL COMPOSITION OF CLARIAS GARIEPINUS FED HIBISCUS SABDARIFFA MEAL DIETS

Adewole, A. M.
Department of Animal and Environmental Biology,
Adekunle Ajasin University, P.M.B. 001, Akungba -Akoko, Ondo State, Nigeria.
E-mail:adeyemo.adewole@aaua.edu.ng;
adewoleyemo68@gmail.com
Phone: 07037354046 / 08116352281

ABSTRACT

The use of medicinal plants that can enhancement of immunity eases of stress through its richness in antioxidant and stimulating effects on appetite and performance is a well –known facts based on the diverse array of phytomolecules. The qualities and quantities of food products is now a serious concern to the consumers in term of its hygiene and safety, Therefore, the effect of graded levels of *Hibiscus sabdariffa* meal diets on the proximate and mineral composition of *Clarias gariepinus* were evaluated after feeding for 84days. The effect of *H. sabdariffa* on the carcass composition of *C. gariepinus* showed that the moisture, protein, lipid, ash and NFE did not vary significantly ($p<0.05$) within the tested groups and the control, but the crude fibre contents varied significantly as the increasing concentration of *H.sabdariffa*. The results revealed that the highest phosphorous and magnesium values (0.35±0.02; 2.78±0.05*) were from the fish carcasses fed HSM1 and HSM5 diets and the lowest values (2.50±0.08; 0.30±0.02) were from the carcass fed HSM2 and HSM1diets respectively. Carcass quality of African catfish fed *H. sabdariffa* was not compromised.

INTRODUCTION

Nutritional quality of a feed is influenced not only by nutrient contents but also by many other aspects such as feed presentation, hygiene, palatability and effect on intestinal health. Feed additives provide a mechanism by which such dietary deficiencies can be addressed, which benefits not only the nutrition and thus the growth rate of the animal concerned but also its health and welfare (Fefena, 2007) and higher profitability (Adewole**,** 2014). The qualities and quantities of food products is now a serious concern to the consumers in term of its hygiene and safety, in the process of meeting these demands, there is need for intensification of the husbandry processes which has the resultant effects of inducing stress. This has led to the use of antibiotics and other drugs that have been known to have untold consequences on the health of the animals and human respectively. Therefore, there is the need to seek for alternative non conventional resources that is as effective and with health proven benefits. *H. sabdariffa* (locally called Zobo) is very rich in its nutritional and medicinal profile and have been reported to be effective in blood pressure management, hepatoprotection, anti-cancer, anti-inflammation, antibacterial and improvement of digestion due to the presence of vitamins, minerals and flavonoids. Its utilization as dietary additive in fish production and economic advantages has been reported (Adewole, 2018). This study therefore seeks the effect of *H. sabdariffa* meal diets on the proximate and chemical composition of *C. gariepinus*.

MATERIALS AND METHODS:

STUDY LOCATION: The study was carried out at the Department of Aquaculture and Fisheries Management's Teaching and Research Laboratory, University of Ibadan, Ibadan, Nigeria.
EXPERIMENTAL PROCEDURES: Collection and identification of plant material, preparation and processing of Roselle Calyx (*H. sabdariffa)* and calculated dosage values were based on (Adewole, 2018; 2014).

FORMULATION OF EXPERIMENTAL DIETS AND EXPERIMENTAL DESIGN:

Six isonitrogenous diet (40% crude protein) were formulated using algebraic method along the least cost formulae and coded as HSM1 (Control), HSM2, HSM3, HSM4, HSM5 and HSM6 respectively. A Completely Randomized Block Design was used to the design of the experiment. Twenty juvenile *C. gariepinus* of initial mean weight and length: 10.94±0.02g and 10.28±0.04cm respectively were stocked in triplicates per treatments, fed twice daily at 5% body weight, for 12 weeks (Adewole, 2018; 2014).

PROXIMATE ANALYSIS AND MINERAL COMPOSITION:

Proximate composition of the fish were carried out according to AOAC (2005), while the mineral elements were determined using Atomic Absorption Spectrophotometer (AAS-Buck 205 model). Flame photometer was used for the determination of sodium and potassium ions (Sogbesan, 2007).

DATA ANALYSIS:

Analysis of Variance (ANOVA) at (α0.05) and significant treatment means compared using Duncan Multiple Range Test (SAS, 1999).

RESULTS

The final carcass moisture contents ranged from 73.40 ± 0.85 to 76.33 ± 0.26%. The highest final moisture value was from the fish fed the control (HSM1) diet and the lowest value was from the fish fed HSM2 diet. Within the treatments, there was no significant difference (P>0.05) in the moisture contents of fish fed the experimental diets (Table 1).The final carcass crude protein content varied from 65.26 ± 1.1 to 68.07 ± 2.00%. The highest final crude protein value was from the fish fed HSM5 diet and the lowest crude protein value was from the fish fed the control diet. Within the treatments, the flesh of the fish fed the control diet was insignificantly lower (p<0.05) in the crude protein contents compared to the flesh from fish fed other diets (Table 1). The final carcass crude lipid contents ranged from 9.63 ± 0.02 to 10.16 ± 0.36%. The highest crude lipid value was from fish flesh fed the HSM2 diet, while the lowest crude lipid was from the fish flesh fed HSM1 diet. Within the treatments, the fish flesh fed the control diet was insignificantly lower (P<0.05) in the final crude lipid contents compared to the fish flesh fed other diets (Table 1). The final carcass crude fiber contents varied from1.32 ± 0.02 to 1.64 ± 0.03%. The highest final carcass crude fiber was from the fish fed HSM6 diet and the lowest crude fiber content was from the fish flesh fed the control diet. Within the treatments, the fish flesh fed the control diet was significantly different (P<0.05) in the final crude fiber contents compared to the fish flesh fed the other diets (Table 1). The final crude ash contents ranged from 16.72 ± 0.24% to 17.30 ± 0.17%. The highest final carcass crude ash content was from the fish fed HSM4 diet, while the lowest final crude ash content was from the fish fed HSM6 diet. Within the treatments there was no significant difference (P>0.05) in the final carcass crude ash contents between the control diet and the other treatments (Table 1). All the final protein, fibre, and ash values were higher than initial.

The mineral element Sodium ((Na^+) ion concentrations ranged from 0.71 ± 0.06 to 0.80 ± 0.04 (units). The highest Na^+ ion concentration was from the carcass of fish fed HSM4 diet and the lowest concentration was from the carcass of fish fed HSM2 diet. The final Na^+ ion concentrations were higher than the initial. Within the treatments, the fish flesh fed the control diet was insignificantly lower (p<0.05) in final Na^+ ion concentration compared to the other treatments (Table 1).The Potassium (K^+) ion concentration varied from 1.33 ± 0.01 to 1.50 ± 0.05. The highest K^+ value was from the fish flesh fed the HSM1 diet and lowest from fish flesh fed HSM2 diet. The final potassium ion concentrations were higher than the initial. Within the treatments, the fish fed the control diet had insignificantly higher (p<0.05) final potassium compared to the others (Table1).The calcium (Ca^{2+}) ions concentration ranged from 2.78 ± 0.14 to 3.34 ± 0.20. The highest Ca^{2+} ion concentration was from the carcass of the fish fed HSM3 diet and the lowest was from the fish flesh fed HSM4 diet. All

the final Ca^{2+} ion concentrations were higher than the initial. The fish flesh fed HSM3 diet had significantly ($P<0.05$) higher Ca^{2+} ions concentration than the fish flesh fed HSM4 diet, but not significantly different from the other fish fleshes (Table1). The phosphorus ion concentration varied from 2.50 ± 0.08 to 2.78 ± 0.05. The highest was from the fish fed the HSM1 diet and the lowest was from the fish fed HSM2 diets. All the final phosphorus ion concentrations were higher than the initial. Within the treatments, the fish fed the HSM1 diet was significantly higher in the final phosphorus ion concentration compared to the fish fed HSM2 diet, but not significantly different from the others (Table1).The final carcass magnesium ion concentration ranged from 0.28 ± 0.02 to 0.35 ± 0.02. The highest was from the fish fed HSM5 diet and the lowest value was from the HSM1 diet. All the final magnesium contents were higher than the initial, but otherwise for the fish fed the control diet. Within the treatment, fish fed HSM5 diet had insignificantly higher ($p<0.05$) magnesium compared to the other treatments.

DISCUSSION

The result of the feeding of the different concentrations of HSM diets on the protein content of *C. gariepinus* obtained in the present study showed numerical increase as the concentration of HSM diets increase. This is similar to the observation of (Adeparusi *et al*, 2010) fed *Oreochromics niloticus* graded levels of ginger. The slight increase in the protein composition of *C. gariepinus* in this result when compared to the control at ($p<0.05$), may be due to the improvement in liver and other organs functions which synthesized plasma protein (Metwally; 2009).The moisture contents of *C. gariepinus* fed *H. sabdariffa* meal decreased insignificantly when compared to the control, but increase as the concentration of HSM diets inclusion levels increased. This is similar to a general decrease in percentage moisture contents which decrease inversely with increasing fat content of the fish carcasses (Olukunle, 2009) and were similar to 58.60 and 80.70% (Makanjuola, 2012).For the fat composition of *C. gariepinus* there was also slight increase as the concentration of *H.sabdariffa* meal's diet increases, this is similar to the results (Adeparusi *et al*, 2010) (9.38-10.11%) fed *O. niloticus*. This may be due to higher contents of the fat contents of the diets, which increased as the concentration of HS's diet increases, hence the higher fat deposit in the body of *C. gariepinus*. The mineral electrolytes/elemental composition of *C. gariepinus* fed HSM's diet showed that Na and Mg increased insignificantly within the tested groups when compared to the control, while elements like Ca and Phosphorus decreased significantly with the increase in HSM's diet levels, while K decreased insignificantly when compared to the control. The mineral element Na values obtained in the present study were similar to 0.73-0.80% reported for some selected species of fresh water, while the remaining mineral elements were higher than the values obtained by Fawole *et al*, (2007). Thus the study of mineral elements in living organisms is of biological importance, since many of such elements take part in some metabolic processes and are known to be indispensable to all living things. Conclusively, the use of *Hibiscus sabdariffa* at the different levels did not compromise the nutritional qualities of African catfish.

REFERENCES

Adeparusi, E.O., Olufayo, M.O. and Omosowone, O.O.2010. Effects of garlic and gingers on the proximate composition of *Oreochromis niloticus* carcass. *Conference Proceeding of Faculty of Science*. 2nd International Bi-ennial Conference. 8th – 11th November, 2010. 65-76.

Adewole, A.M. (2018). Organosomatic indices and histopathological response of *Clarias gariepinus* fed Roselle (*Hibiscus sabdariffa*) meal diets" *Nigerian Journal of Animal Production*, 45 (5) 199-206 (Nigeria).

Adewole, A.M. (2014). Effects of Roselle as dietary additives on growth performance and production economy of *Clarias gariepinus. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS).* 5 (7):1-8.

AOAC. 2005. Assoociation of Official Analytical Chemist. Official methods of chemical analysis. 18th Edition, Washington, D.C. U.S.A.

Fawole,, O.O. Ogundiran, M.A.,Ayandiran, T.A. and Olagunju, O.O. (2007). Proximate and mineral composition in some freshwater fishes in Nigeria. *Internet Journal of Food Safety* Vol.9, Pp. 52-55.

Olukunle, O. 2009. Utilization and growth response of *Clariasgariepinus* fingerlings fed varying inclusion levels of Livestock vitamin grower's premix. *24th Annual Conference of Fisheries Society of Nigeria. Conference Proceedings*, held at the Federal University of Technology, Akure, 26th-28th October, 2009. 170-173.

Makanjuola, O. M. 2012, Chemical analysis of flesh and some body parts of different fresh fish in South West Nigeria. *Pakistan Journal of Nutrition* 11 (1). 14-15.

SAS (1999). SAS/STAT user's guide, v. 8 for windows. Statistical analysis Systems Institute, Cary.

Sogbesan, A. O., 2007. Culture and utilization of some non- conventional animal protein feedstuffs in the diets of *Heterobranchuslongifilis* (Valencienes, 1840) Ph.D. Thesis in the Department of Zoology, University of Ibadan, Ibadan 298pp.

Table 1: ***Proximate profile and chemical composition of Clarias gariepinus fed Hibiscus sabdariffa meal diets for 84 days***

Parameters	Initials	HSM1	HSM2	HSM3	HSM4	HSM5	SM6
Moisture (%)	78.62±0.01	76.33±0.26	73.40±0.85	74.42±1.63	74.14±1.98	75.53±1.00	75.84±0.76
Crude protein (%)	62.86±0.01	65.26±1.13	66.60±2.63	67.19±2.71	67.87±2.00	68.07±2.00	67.14±2.44
Crude lipid (%)	8.65±0.01	9.63±0.02	10.16±0.36	9.89±0.24	10.01±0.05	9.99±0.03	9.93±0.11
Crude fiber (%)	1.28±0.00	1.32±0.02^{b}	1.50±0.09^{a}	1.54±0.04^{a}	1.53±0.03^{a}	1.51±0.02^{a}	1.64±0.03^{a}
Ash (%)	16.68±0.06	17.05±0.03	16.96±0.11	17.15±0.18	17.30±0.17	16.79±0.24	16.72±0.24
Nitrogen Free Extract (%)	10.54±0.05	6.75±1.12	4.78±2.49	4.22±2.87	3.29±1.87	3.63±1.96	
Gross Energy (Kcal/kg)	2974.00±0.00	3984.00±0.00^{c}	4104±0.03^{b}	4003±0.04^{c}	3997.00±0.04^{c}	4030.67±0.03^{c}	4032.67±0.05^{a}
Sodium (Na%)	0.38±0.00	0.72±0.03	0.71±0.06	0.76±0.05	0.80±0.04	0.77±0.01	0.79±0.03
Potassium (K%)	1.16±0.00	1.50±0.05	1.34±0.05	1.33±0.01	1.38±0.02	1.35±0.02	1.34±0.01
Calcium (Ca%)	2.96±0.00	3.22±0.10^{ab}	3.33±0.20^{ab}	3.40±0.20^{a}	2.78±0.14^{b}	3.18±0.22^{ab}	3.19±0.19^{ab}
Phosphorous (P%)	2.08±0.00	2.78±0.05^{a}	2.50±0.08^{b}	2.63±0.10^{ab}	2.69±0.09^{ab}	2.62±0.03^{ab}	2.61±0.07^{ab}
Magnesium (Mg%)	0.28±0.00	0.30±0.02	0.32±0.04	0.34±0.03	0.32±0.02	0.35±0.02	0.32±0.03

Values with different superscripts in each row are significantly different (P<0.05)

EFFECTS OF RAW AND DIFFERENTLY PROCESSED *Mucuna pruriens* SEED DIETS ON THE GROWTH PERFORMANCE OF *Cyprinus carpio* FINGERLINGS

[&]*D.G. KAKWI, **B.S. AUDU and * D. O. OSHIBANJO

**Animal Production Department, University of Jos, Jos*

***Department of Zoology, University of Jos, Jos*

[&]*kakwidaniel@yahoo.com*

[&]*+2348023627524*

ABSTRACT

The dietary effects of raw and differently processed *Mucuna pruriens* seed diets on growth and haematology of *C. carpio* fingerlings was investigated. The Mucuna seeds were boiled with distilled water (DW), fresh tamarind pulp extract (TP) and maize cob ash solution (MCA) for 60 minutes. The raw (RM) and resulting meals from the differently processed Mucuna seeds were included at 20% substitution of soya bean meal in 4 (four) treatment diets designated RMD, DWD, TPD and MCD respectively, while a reference diet with no mucuna served as the control diet (NMD). The experimental set up consisted of 15 (fifteen) 40 x 30 x 25cm rectangular plastic tanks (15L capacity) in a static and aerated water system in an indoor hatchery. The treatment diets and control were fed in triplicate groups to *C. carpio* fingerlings (average weight, 15.40g) for 56 days in a completely randomized design. Data obtained was subjected to analysis of variance at $\alpha_{0.05}$. Results obtained showed that growth performance and feed utilization indices were lowest for fish fed RMD diet. The MCD diet gave the best growth indices thus considered the most appropriate processing method of *Mucuna pruriens* seeds for dietary inclusion in the feeding of *C. carpio* fingerlings.

Key words: Processed *Mucuna pruriens* Seed, Growth performance, *Cyprinus carpio* fingerlings, Fish and haematology

INTRODUCTION

Mucuna pruriens seeds like other legumes contains a high level of crude protein (28 to 35%), vitamins and minerals (Ukachukwu *et al*., 2002; Bressani *et al*., 2003) which makes it a suitable alternative plant protein source for fish feed. Previous studies have only focused on the improvement of the nutritional status of plant seeds as protein sources such as *Phaseolus lunatus* (Alegbeleye *et al*., 2005); *Mucuna utilis* (Akinmutimi and Okwu, 2006; Vadivel and Pugalethi, 2009); *Ricinus commnis* (Balogun *et al.*, 2008); *Vigna sinesis* (El-Saidy and Saad, 2008); *Vicia faba* (Azaza *et al*., 2009) and *Pisum sativum* (Davies and Gouveia, 2014).

The problem of biochemical components of plant protein sources which limit their utilization as potential alternative in fish diets has drawn much attention considering the fast growth of aquaculture industry (Bressani *et al*., 2003; Tacon and Metian, 2008). To enhance utilization of plant protein in aquaculture production, thermal processing and biochemical evaluation of feedstuff diets for fish are therefore essential (Davies and Gouveia, 2008; Tacon *et al*., 2009).

In this study, the dietary effects of inclusion of raw and differently processed *Mucuna pruriens* seeds by boiling the seed in distilled water, fresh tamarind pulp extract and maize cob ash solution were investigated on the growth response and digestibility indices of *C. carpio* fingerlings.

MATERIALS AND METHODS

The Mucuna seeds were boiled with distilled water (DW), fresh tamarind pulp extract (TP) and maize cob ash solution (MCA) for 60 minutes. The raw (RM) and resulting meals from the differently processed Mucuna seeds were included at 20% substitution of soya bean meal in 4 (four) treatment diets designated RMD, DWD, TPD and MCD respectively, while a reference diet with no mucuna

served as the control diet (NMD). The experimental set up consisted of 15 (fifteen) 40 x 30 x 25cm rectangular plastic tanks (15L capacity) in a static and aerated water system in an indoor hatchery. The treatment diets and control were fed in triplicate groups to *C. carpio* fingerlings (average weight, 15.40g) for 56 days.

EXPERIMENTAL DESIGN

Completely randomized design.

DETERMINATION OF GROWTH AND NUTRIENT UTILIZATION INDICES

At the end of the feeding trials, growth performance and digestibility parameters were calculated as follows: Mean Live Weight Gain (MWG), Food Conversion Ratio (FCR), Specific Growth Rate (SGR % day ¯1), Protein Efficiency Ratio (PER), Protein Productive Value (PPV), Apparent Protein Digestibility Coefficient (APDC).

STATISTICAL ANALYSES.

All experimental data obtained were subjected to One-way Analysis of Variance (ANOVA) and means were compared using Duncan's multiple-range test (DMRT) (Duncan, 1955). The PC software SPSS version 17 was used for the analyses.

RESULTS

Growth responses and nutrient utilization of *C. carpio* fingerlings fed the four experimental (RMD, DWD, TPD, MCD) and control (NMD) diets are as shown in Table 5 and Figure 1. The fish were observed to feed voraciously on all the diets at onset of feeding regime. Growth responses showed the mean live weight gain (MLWG) was highest (10.28g) for the NMD diet followed by the MCD diet (MLWG, 8.87g). Diets DWD and TPD gave MLWG of 6.93 and 5.66g respectively, while the RMD diet had the poorest MLWG of 3.34g. The differences were statistically significant ($P<0.05$). Similarly, there was significant difference ($p<0.05$) in the food conversion ratio (FCR) of the different diets which was least (1.61) in the NMD diet followed by MCD (2.18). Other processed diets (DWD and TPD) had FCR of 3.66 and 3.79 respectively, while the RMD diet had the highest (3.84) FCR. The protein utilization parameters such as protein efficiency ratio (PER), apparent net protein utilization (ANPU) and protein productive value (PPV) appeared to follow the same trend as the growth parameters which were significantly different ($p<0.05$) among all the experimental diets (Table 1).

Table 1: Effect of Differently Processed *M. pruriens* Diets on Growth and Nutrient Utilization of *C. carpio* Fingerlings Fed for 8 Weeks

	Treatments					
Parameters	**RMD**	**DWD**	**TPD**	**MCD**	**NMD**	**SEM**
Initial mean weight (g)	15.10^{a}	15.10^{a}	15.10^{a}	15.10^{a}	15.10^{a}	0.26
Final mean weight (g)	18.44^{e}	22.03^{c}	20.76^{d}	23.97^{b}	25.28^{a}	0.26
Mean live weight gain (g)	3.34^{e}	6.93^{c}	5.66^{d}	8.87^{b}	10.28^{a}	0.28
Mean live weight gain (%)	22.12^{e}	45.89^{c}	37.36^{d}	58.74^{b}	67.63^{a}	0.26
Feed intake (g/day)	1.52^{e}	2.01^{c}	1.84^{d}	3.32^{b}	3.86^{a}	0.21
Food Conversion Ratio	3.84^{a}	3.66^{c}	3.79^{b}	2.18^{d}	1.61^{e}	0.26
Specific Growth Rate (%)	1.08^{e}	1.24^{c}	1.16^{d}	1.88^{b}	2.25^{a}	0.26
Protein Efficiency Ratio	0.72^{c}	0.76^{b}	0.72^{c}	0.89^{a}	0.92^{a}	0.12
PPV	22.56^{e}	24.00^{c}	23.46^{d}	27.97^{b}	29.73^{a}	0.18
ANPU (%)	25.60^{e}	28.78^{c}	26.66^{d}	38.76^{b}	46.36^{a}	0.18
APDC (%)	65.58^{d}	67.34^{c}	65.75^{d}	78.28^{b}	84.52^{a}	0.26
Survival Rate (%)	60^{d}	80^{c}	85^{b}	98^{a}	98^{a}	1.00

Values on the same horizontal row followed by the same superscript are not significantly different from each other at * ($p<0.05$)

TREATMENT DIETS

RMD = Raw Mucuna Diet,
DWD = Diet from *M. pruriens* seed boiled with distilled water
TPD = Diet from *M. pruriens* seed boiled with tamarind pulp extract
MCD = Diet from *M. pruriens* seed boiled with maize cob ash solution
NMD = Control diet
ANPU= Apparent net protein utilization
PPV = Protein productive value

DISCUSSION

From the results of this study, the differently processed mucuna diets (DWD, TPD and MCD) showed improved performance in the specific growth rate (SGR), food conversion ratio (FCR) and protein efficiency ratio (PER) of the *C. carpio* fingerlings as compared to the raw diet (RMD) suggesting an improvement in the nutritive values of the processed seeds which encouraged better utilization of the mucuna diets. In similar studies (Fagbenro *et al*., 2003; Siddhuraju and Becker, 2003) the authors reported that the improvement in the nutritive value of the processed seeds can be due to the detoxification and reduction on the quality and quantity of ANF in the raw seeds by various hydrothermal treatments. This study has shown that the lower level of residual anti-nutritional factors in the MCD diet made the Common carp fingerlings to better efficiently utilize the protein of MCD diet than protein of DWD and TPD diets. This is evident in the higher protein productive value (PPV), apparent net protein utilization (ANPU) and apparent protein digestibiblity coefficient (APDC) for *C.*

carpio fingerlings fed the treatment diets which showed higher values for MCD diet. Davies and Gouveia (2014) reported on the reduction of anti-nutrients in pea seed meals (*Pisum sativum*) with thermal processing, which subsequently made it more palatable and increased consumption resulting to higher growth performance of *Cyprinus carpio* fish. Similar observations were also reported by Alegbeleye *et al*. (2005) and Tiamiyu *et al*. (2006) in which anti-nutrients in lima bean and soybean respectively reduced significantly ($p<0.05$) with boiling, thus making the seed meals more palatable and acceptable when fed to fish.

CONCLUSION

The MCD diet gave the best growth indices thus considered the most appropriate processing method of *Mucuna pruriens* seeds for dietary inclusion in the feeding of *C. carpio* fingerlings.

REFERENCES

Akinmutimi, A.H. and Okwu, N.D. (2006). Effect of quantitative substitution of cooked *Mucuna utilis* seed meal for soyabean meal in broiler finisher diet. *International Journal of Poultry Science*, 5(5): 447-481.

Alegbeleye, W.O., Odulate, D.O., Obasa, S.O. and George, F.A.O. (2005). Potential of toasted Lima bean (*Phaseolus lunatus*) as a substitute for full fat soya bean meal in the diets for *Oreochromis niloticus* fingerlings. *Moor Journal of Agricultural Research*, 6(2): 92-98.

Azaza, M.S., Wassim, K., Mensi, F., Abdemouleh, A., Brini, B. and Kraiem, M.M. (2009). Evaluation of Faba beans (*Vicia faba*) as a replacement for soybean meal in practical diets of juvenile Nile tilapia *Oreochromis niloticus*. *Aquaculture*, 287 (1-2): 174 -179.

Balogun, J.K., Auta, J., Abdullali, S.A. and Agboola, E.O. (2008). Potentials of Castor seed meal (*Ricinus commnis*) as feed ingredients of *Oreochromis niloticus*. *Proceedings of the 19th Annual Conference of Fisheries Society of Nigeria* (FISON), Araoye P.A. (Ed). pp 838-843.

Bressani, R., Lau, M. and Silvia-Vargas, M. (2003). Protein cooking quality and residual content of dehydroxyphenylalanine and trypsin inhibitors of processed Mucuna beans (*Mucuna* spp). *In*: M.Eilita, J.Mureithi, R.Muinga, C.Sandoval, and N.Szabo (Eds), *Increasing Mucuna's Potential as a Food and Feed Crop. Proceedings of an International Workshop*. 23-26 September, 2002. Mombasa, Kenya. *Tropical and Sub- tropical Agro-Ecosystems*, 1(2-3):197-212.

Davies, S.J. and Gouveia, A.(2008). Enhancing the nutritional value of pea seed meals (*Pisum sativum*) by thermal treatment or specific isogenic selection with comparison to soyabean meal for African catfish, *Clarias gariepinus*. *Aquaculture*, 283(1-4): 116-122.

Davies, S.J. and Gouveia, A. (2014). Response of common carp fry fed diets containing pea seed meals (*Pisum sativum*) subjected to different thermal processing method. *Aquaculture*, 305(1): 117-123.

Duncan D.B. (1955).Multiple Range and Multiple F-Tests.*Biometrics*,11:1-42.

El-Saidy, D.M.S.D. and Saad, A.S. (2008). Evaluation of cow pea seed meal, Vigna sinesis, as a dietary protein replacer for Nile tilapia, *Oreochromis niloticus* (L.), fingerlings. *Journal of the World Aquaculture Society*, 39(5): 636-645.

Fagbenro, O.A., Adeparusi , O.E. and Fapohunda , O.O. (2003). Feedstuffs and dietary substitution for farmed fish in Nigeria.*In* A.A.Eyo (Ed) *Proceedings of the National Workshop on Fish Feed Development and Feeding Practices in Aquaculture*, 15th – 19th September, 2003 National Institute for Fresh water Fisheries Research, New Bussa, Nigeria. pp 60-72.

Siddhuraju, P. and Becker, K. (2003). Comparative nutitional evaluation of differently processed mucuna seeds (*Mucuna pruriens* (L.) on growth performance, feed utilization and body composition of Nile tilapia (*Oreochromis niloticus*). *Aquaculture Research*, 34(6): 256.

Tacon, A.G.J., Metian, M. and Hasan, M.R (2009). Feed ingredient and fertilizers for farmed aquatic animals; sources and composition. FAO (Food and Aquaculture Organization) *Fisheries and Aquaculture Technical Paper*, No. 540. 209 pp

Tiamiyu, L. O., Solomon, S. G. and Oketa, E. J. (2006). Effects of different boiling time of soybean (*Glycine max*) on growth performance of tilapia (*Oreochromis niloticus*) fingerlings. *Journal of Aquatic Sciences*, 21(1): 15-18.

Ukachukwu, S.N., Ezeagu, I.E., Tarawali, G. and Ikeorgu, J.E.G. (2002). Utilization of Mucuna as food and feed in West Africa pp. 189-217.*In*: *Food and Feed from Mucuna: Current uses and the way forward, Proceedings of an International Workshop, Tegucigalpa, Honduras*, April 26-29, 2000. Flores, M.B., Eilitta, M. Myhrman, R. Carew. L.B. and Carsky, R.J. (Eds.). CIDICCO.CIEPCA. Judson College.217pp

Vadivel, V. and Pugalethi, M. (2009). Effect of soaking in sodium bicarbonate solution followed by autoclaving on nutritional and antinutritional properties of Velvet bean (*Mucuna pruriens*) seeds. *Journal of Food Processing and Preservation*, 33:60-73.

PROXIMATE COMPOSITION AND AMINO PROFILE OF RAW AND PROCESSED *MUCUNA PRURIENS* SEEDS

***&D.G. Kakwi. **B.S. Audu, ***S.A. Okunsebor & *Igoche L.**
**Animal Production Department, University of Jos, Jos*
***Department of Zoology, University of Jos, Jos*
****Department of Fisheries, Nasarawa State University, Lafia*
&kakwidaniel@yahoo.com
&+2348023627524

ABSTRACT

A comparative nutritional evaluation of raw and differently processed *Mucuna pruriens* seeds. The processing methods adopted were boiling the Mucuna seed for 60 minutes with distilled water (DW), fresh tamarind pulp extract (TPS) and maize cob ash (MCA) solution. The raw and resulting meals from processed Mucuna seed were included at 20% substitution of soya bean meal in 5 treatment diets with the control diet (no Mucuna). Data obtained was subjected to analysis of variance at $\alpha_{0.05}$. There were significant different in the proximate composition. The result shows that MCA treatment as the best among other tested processing methods of *M. pruriens* seeds for inclusion in diet. Although the amino acid profile shown no significant different, but the MCA had the highest methionine and lysine compared to other treatment. In conclusion, this study has revealed that *M. pruriens* seeds processed with MCA has high feed promise and could be used as an alternative protein ingredient in fish diets.
Key Words: Processing Method, *Mucuna pruriens* seed meal proximate composition and amino acid profile.

INTRODUCTION

The use of plant-derived diets in animal feeding is technically limited by the presence of high levels of anti-nutritional factors, poor palatability, low protein content and digestibility, which at some levels result to lower growth (Francis *et al.,* 2001; Fagbenro *et al*., 2003). However, the utilization of potential plant protein material can be improved upon by adequate processing under controlled time and temperature which usually reduces or completely eliminates the effect of anti-nutrients, improves the protein quality and amino acid content of food grain legume (Makkar and Becker, 1999; Siddhuraju and Becker, 2001).

Soya bean has been the most commonly used feed ingredient for aquaculture feeds, however, it has become competitive for both human and animal uses (Tacon *et al*., 2009). Therefore, the need to source for alternative and cheaper plant protein sources has become imperative. *Mucuna pruriens* seed has not been intensively explored as a protein source for fish feed despite its good prospect. Previous study (Francis *et al*., 2001) on the analyzed chemical content of mucuna seed meal revealed crude protein content of between 25 to 32%, with approximately 3.5% lipid. The aim of this investigation therefore, is to determine potential nutritional value of processing Mucuna seeds in different solutions.

MATERIALS AND METHOD

PROCESSING OF *M.PRURIENS* SEEDS INTO FEEDSTUFF

A total weight of 2 kilograms of *M. pruriens* seeds was obtained from National Animal Production and Research Institute (NAPRI), Shika- Zaria in Kaduna State, Nigeria. The seeds were divided into four lots; three of which were subjected three indigenous processing methods in order to detoxify the seed materials viz: boiling at 105°C for 60 minutes in distilled water (DW), fresh tamarind pulp extract (TP) and maize cob ash (MCA) solution respectively, while the fourth was left raw (R). At the end of boiling duration, the processed seeds were washed with distilled water and screened-dried in open air under a shed for 3 days after which the raw and the processed dried samples were weighed, ground and preserved in air tight container and kept at 4^{0}C for analyses and diet preparation.

Chemical Evaluation of Raw and Processed *M. pruriens* Seeds

The *M. pruriens* seed samples were analyzed for percentage proximate compositions of moisture, crude protein, lipid, ash fibre and mineral contents which were determined using validated analytical method of Association of Analytical Chemists International (AOAC, 2005). Amino acids profiling was done for all the five treatments using the Technician Sequential Multi-sample Amino Acids analyser (TSM) (Spackman *et al*., 1958).

RESULTS AND DISCUSSIONS

The analysed proximate and amino acid profile of the experimental diets are shown in Table 1and 2 respectively. There are significant different in the proximate composition. The control with contains the fish meal had the highest total proximate values. Next to the control is the maize cob ash (MCA) solution soaked mucuna which shows a closely proximate values to the control. Although the amino acid profile shown no significant different but the MCA had the highest methionine and lysine compared to other treatment.

Although the differently processed mucuna seeds appeared to be at par statistically, but subjectively, MCA processed enhanced better results. The RMD caused reduced food utilization and severe effect on nutritional status which showed direct involvement of unprocessed antinutritional factors in the raw samples. Thus boiling mucuna seeds with maize cob ash solution for 60 minutes as a locally adaptable processing method was considered most suitable for nutritional improvement of *M. pruriens* seeds for dietary inclusion to enhance growth and nutrient utilization.

CONCLUSION

In conclusion, this study has revealed that *M. pruriens* seeds processed with MCA has higher nutritional content and could be used as an alternative protein ingredient in fish diets.

REFERENCES

AOAC (Association of Official Analytical Chemist) (2005). Official Methods of Analysis of AOAC International (18th edition). W. Horwitz and G. W. Latimer (Eds.). ISSN: 1080-0344. Arlington, Virginia.

Fagbenro, O.A., Adeparusi , O.E. and Fapohunda , O.O. (2003). Feedstuffs and dietary substitution for farmed fish in Nigeria.*In* A.A.Eyo (Ed) *Proceedings of the National Workshop on Fish Feed Development and Feeding Practices in Aquaculture*, 15th – 19th September, 2003 National Institute for Fresh water Fisheries Research, New Bussa, Nigeria. pp 60-72.

Francis, G., Makkar, H.P.S. and Becker, K. (2001). Antinutritional factors present in plant derived alternate feed ingredient and their effects in fish. *Aquaculture*. 199:197-227.

Siddhuraju, P. and Becker, K. (2001). Effects of various domestic processing methods on anti-nutrients and in-vitro protein and starch digestibility of two indigenous varieties of Indian tribal pulse, (*Mucuna pruriens* var.utilis) in common carp (*Cyprinus carpio*): an assessment by growth performance and feed utilization. *Aquaculture*, 196: 105 – 123.

Spackman, D.H., Stein, W.H. and Moore, S. (1958). Amino acid analysis, *Analytical Chemistry*, 30: 1190-1206.

Tacon, A.G.J., Metian, M. and Hasan, M.R (2009). Feed ingredient and fertilizers for farmed aquatic animals; sources and composition. FAO (Food and Aquaculture Organization) *Fisheries and Aquaculture Technical Paper*, No. 540. 209 pp

Table 1: Analyzed Nutrient Content (% Dry Matter)[1] of Raw and Differently Processed *M. pruriens* Diets and the Control Diet (NMD)

Parameters	RMD	DWD	TPD	MCD	NMD
Moisture (%)	6.20 ± 0.20^{b}	6.20 ± 0.20^{b}	6.12 ± 0.22^{c}	6.14 ± 0.20^{c}	6.40 ± 0.20^{a}
Crude protein (%)	30.10 ± 0.40^{c}	30.60 ± 0.40^{c}	30.42 ± 0.22^{d}	31.80 ± 0.24^{b}	32.52 ± 0.20^{a}
Ash (%)	8.32 ± 0.20^{a}	7.60 ± 0.24^{c}	7.91 ± 0.30^{b}	7.52 ± 0.26^{d}	7.52 ± 0.24^{d}
Crude lipid (%)	4.63 ± 0.25^{d}	4.80 ± 0.20^{c}	4.83 ± 0.25^{c}	5.20 ± 0.24^{b}	5.50 ± 0.21^{a}
Crude fibre (%)	4.30 ± 0.22^{a}	4.10 ± 0.30^{b}	4.52 ± 0.21^{a}	4.00 ± 0.26^{c}	4.15 ± 0.22^{b}
NFE[2]	52.70 ± 0.14^{a}	52.50 ± 04^{a}	52.20 ± 0.04^{a}	51.50 ± 0.25^{b}	50.42 ± 0.22^{c}
Gross energy (Kcal/g)	4.40 ± 0.22^{c}	4.58 ± 0.22^{b}	4.56 ± 0.24^{b}	4.58 ± 0.22^{b}	4.65 ± 0.16^{a}

[1]No. of samples for each determination =3; [2] Nitrogen free extract.

(Means + S.E) a, b, c: Mean values in the same horizontal row with different superscripts are significantly different ($P<0.05$)

TREATMENTS:
RMD = Raw Mucuna Diet,
DWD = Diet from *M. pruriens* seed processed with distilled water

TPD = Diet from *M. pruriens* seed processed with tamarind pulp extract

MCD = Diet from *M. pruriens* seed processed with maize cob ash solution

NMD = Control diet

Table 2: Analysed Amino Acid Content of Raw and Processed Mucuna Diets

Amino acid	RMD	DWD	TPD	MCD	NMD
Methionine	0.68	0.97	0.75	0.99	1.09
Valine	1.26	1.97	1.98	2.07	2.03
Isoleucine	1.31	1.71	1.75	1.74	1.66
Leucine	4.62	4.09	4.65	3.57	2.88
Phenyalanine	2.14	1.96	2.16	1.86	1.63
Histidine	0.92	0.97	0.95	1.08	1.07
Lysine	1.54	1.86	1.57	2.38	2.73
Threonine	2.10	2.22	2.10	2.57	2.71
Arginine	1.44	1.5	1.47	1.65	1.70
Tryptophan	0.36	0.38	0.37	0.42	0.50

TREATMENT DIETS
RMD = Raw Mucuna Diet,
DWD = Diet from *M. pruriens* seed boiled with distilled water
TPD = Diet from *M. pruriens* seed boiled with tamarind pulp extract

MCD = Diet from *M. pruriens* seed boiled with maize cob ash solution

NMD = Control diet

SIMPLE TECHNIQUES FOR MAGGOT PRODUCTION: TECHNICAL REPORT

[*]Gaddafi, S., *Saulawa L.A., [*]Usman, H.B., [*]Alkali, M.M & [**]Bichi, J.M

[*]Department of Animal Science, Federal University Dutsin-Ma, Katsina State, Nigeria,
[**]Department of Animal Science, Bayero University Kano, Nigeria.
Corresponding author: sanigaddafi4@gmail.com, GSM: +234(0)7067212353

ABSTRACT

Searching for cheaper and less tedious methods of producing maggot with good nutritional value will be a pragmatic approach to address issues of livestock feed insecurities thereby increasing farmer's income. Several attempts have been made to find inexpensive and relatively abundant nutrient substrates to partially or, even completely, replace expensive components among are fruits residues, brewery by-products, feather, abattoir wastes product, hatcheries and dairy waste although the sustainability of these requires skills, labour, capital and accessibility to companies producing such by-products. This paper highlights simple techniques of producing qualitative and quantitative maggots from readily available materials without elaborated maggotry building and equipment. Techniques involved from site selection for maggotry, substrate tanks (by uses of 200 litter capacity drum), choice of available substrate and flies attractant, harvesting techniques, processing and preservation. Photograph 1 - 6 provide practical demonstrations of techniques involved. Simple techniques of maggot production will save cost, labour and minimized threat of livestock waste product that imposes serious pollution problems to the incumbent environment and human health.

Keywords: Techniques, Maggot and Production**.**

INTRODUCTION

In developing nation like Nigeria, the cost of commercial livestock farming and fish feeds have become very expensive (John, 2015) account for over 60% of the recurrent overhead costs of livestock farming and about 70% of a fish farming venture (Sogbesen *at al.,* 2005). This is due mainly to the fact that most of the protein ingredients such as fishmeal are imported while locally available alternatives like soyabeans and groundnut also serve as food for humans. Maggot meal have been used extensively to replaced conventional expensive feed ingredient with better utilization by various classes of livestock such as Broiler chickens (Adeniji, 2007; Hwangbo *et al.,* 2009), Layers (Agunbiade *et al.,* 2007), rabbit (John, 2015), Pig (Adeniji, 2008), and Fish (Ebenso and Udo, 2003; Sogbesan *et al.,* 2006).

Sogbesan *et al.,* (2006) reported that about 932.5 tonnes of poultry manure is produced annually in Nigeria due to the well-established poultry and livestock industries which are expanding at 6-8% annually (Adejinmi, 2000). This large turn-out of poultry waste imposes threat of disposal to the poultry industries and as well serious pollution problems to the incumbent environment and man`s health. Therefore, recycling this waste will help to assumed significant role in livestock and aquaculture for the enhancement of detritus food chain and production of high quality protein. Maggot and other non-conventional insects have been explored to check their nutrient contents, relative abundance, use and conversion into processed meals, incorporation into formulated diets and subsequent development of technique(s) for on-farm mass production (Ugwumba and Ugwumba, 2003). The objective of this paper is to highlights simple techniques of maggot production.

MAGGOT PRODUCTION

Maggots: Are the larvae of the domestic fly (*Musca domestica*). Maggot serves as a solution to the high cost of feed in fish and livestock production especially poultry production.

ROLE OF MAGGOT PRODUCTION

1. As product for aquaculture: feeding of fresh maggots to tilapia and catfishes is can be done twice daily (late in the morning and later afternoon). It provides rich sources of nutrients.
2. Maggot provides a source of nutrient for chicken, quail, turkeys, guinea fowl, ducks etc.
3. It provides fertilizer for crop production; the spent substrates are used to fertilize directly plants in the field. The spent substrates are incorporated into the compost production.
4. It also helps to protect the environment as wastes are concentrated and decomposed.
5. The technology for maggot production is simple and cost effective for farmers.

POINT TO CONSIDER IN SITE SELECTION FOR MAGGOTRY

1. Maggotries should preferably be located away from human residence.
2. The place should be surrounded with trees and vegetation to absorb offensive odour from the maggotry and reduces the excessive high ambient temperature.
3. The housing should preferably be oriented in an East-West direction to reduce the effect of direct sunlight on the substrate.
4. The roof can be made up of corrugated iron sheets or thatch. The garble roof type of building with openings at the top and sides for ventilation is recommended.
5. In the absent of housing, maggotry can be sited under the trees.

MAGGOT CULTURE

To produce maggots, the following prerequisites must be satisfied:

1. Substrates: these can be fermented grain residue, maize bran, brewery spent grain.
2. The fly attractants: these include substances that arouse the attention and attract flies to enter substrate tanks. These include animal manure like pig and poultry waste; animal offal from the abattoir, slaughtered birds visceral, crack and spoiled eggs, dead lizards, birds, rats and other animals. Decaying fruits like mangoes; Fermented parkia seeds (*Daudawa*) and other good attractant.
3. Flies: preferably house fly (Musca domestica).



Photograph 1: substrate and flies attractant application in drum.



Photograph 2: covering the substrate after flies deposited eggs for 2 days.



Photograph 3: harvesting maggot using sedimentation technique



Photograph 4: washing maggot with clean water



Photograph 5: frying maggot for preservation



Photograph 6: sundrying method for maggot preservation

TECHNIQUES OF MAGGOT PRODUCTION

Maggot production is an aerobic fermentation process. Maggot can be produce in a clean substrate tank (plastic or metallic 200 liters drum) place 20kg full of fresh animal manure (poultry litres), 5kg full of fresh brewery spent grain or maize bran and 5 litters of water should be sprinkled on top and mix them together.

Cut the animal offal into small pieces (10cm length) or other flies attractant such as blood, cracked eggs and spread them in the middle on top of the substrate. The flies are attracted immediately to lay eggs. During dry weather, water the prepared tank (drum), using a watering can. Small maggots will be observed about 6 hours later (after first contact of flies with substrate), cover the drum with mosquito net to prevent coming out of maggot from the drum. Water the substrate daily. The drier the weather, the more frequent the watering. Avoid water logging of substrate.

At day 7 after flies contact with substrate the drum should be open and harvesting will be done by sedimentation process where about 15 litters of water should be added into drum to facilitated maggot floatation, floated maggot is then harvested using rubber sieve materials and maggot will then quickly empty into bucket containing clean water to reduce dirty and substrate from maggot. Maggot will later sieved again and fried in a fried pan for 5 minutes to reduce moisture content thereby sterilizing possible microorganisms and later sun dried for 1 hour. About 4 to 6 kg of maggot will be obtained from each drum. The processed maggot will be serve to animals or incorporated into other feed ingredient for fish, poultry, pig and rabbit or packaged in a bag and stored for more than 6 months.

CONCLUSION

Maggot, the larvae of the domestic fly (Musca domestica) has ability to grow on a large range of substrates and this can make them useful to turn wastes into a valuable biomass rich in protein and fat for livestock. Therefore, qualitative and quantitative maggot can be produce without elaborated building structures, equipment, and using available substrate and flies attractant in an area.

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REFERENCES

Adejinmi, O.O. 2000. The chemical composition and nutritional potential of soldier fly larvae (*Hermetica elucens*) in poultry rations. University of Ibadan, PhD Thesis, Pp:292.

Adeniji, A.A. 2007. Effect of replacing groundnut cake with maggot meal in the diet of broilers. *International Journal of Poultry Science,* 6(11):822-825.

Adeniji, A.A. 2008. The feeding value of rumen content-maggot meal mixture in the diet of early weaned piglets. *Asian Journal of Animal Veterinary Advances,* 3(2):115-119.

Agunbiade, J.A., Adeyemi, O.A., Ashiru, O.M., Awojobi, H.A., Taiwo, A.A., Oke, D.B. and Adekunmisi, A.A. 2007. Replacement of fish meal with maggot in cassava-based layer`s diets. *Journal of Poultry Science,* 44(3):278-282.

Ebenso, I.E. and Udo, M.T. 2003. Effect of live maggot on growth of the Nile Perch, Oreochromis niloticus (Cichlidae) in south Eastern Nigeria. *Global Journal of Agricultural Science,* 2(2):72-73.

Ernst, L., Vagapov, R., Posdeeva, E., Zhemchuzhima, A. and Zvereva, E. 1984. A high-protein feed from poultry manure. *Ptitsevoclstve,* 1:30.

Hwangbo, J., Hong, E.C., Jang, A., Kang, H.K., Oh, J.S., Kim, B.V. and Park, B.S. 2009. Utilization of house fly-maggot, a feed supplement in the production of broiler chickens. *Journal of Environmental Biology,* 30(4):609-614.

John, M.O. 2017.Maggot meal: A sustainable protein source for livestock production-A Review. *Advances in Life Science and Technology,* 31, 35-41.

Sogbesan, O.A., Ajuonu, N.D., Ugwumba, A.A.A AND Madu, C.T. 2005. Cost benefits of maggot meal as supplemented feed in the diets of *Clarias gariepinus x Heterobranchus longifilis* hybrid fingerlings in outdoor concrete tanks. *Journal of Science and Industrial Studies,* 3(2):23-29.

Sogbesan, A.O., Ajuonu, N., Musa, B.O. and Adewole, A.M. (2006). Harvesting techniques and Evaluation of maggot meal as animal dietary protein source for "*Heteroclarias*" in outdoor concrete tanks. *World Journal of Agricultural Sciences,* 2(4):394-402.

Ugwumba, A.A.A and Ugwumba, A.O. 2003. Aquaculture options and futute of fish supply in Nigeria. *The Zoologist,* 2(2):96-122.

LENGTH–WEIGHT RELATIONSHIPS AND CONDITION FACTORS OF *OREOCHROMIS NILOTICUS* IN GUBI DAM, BAUCHI STATE, NIGERIA

[1*]Joel, J., [1]Abdulkarim, M., [1]Bello, K. M. & [2]Yusuf, Z. A.

[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria
[2]Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria
**Corresponding Author: email: jummaijoel49@gmail.com GSM: 07030088552*

ABSTRACT
Length-weight relationships and condition factor of *Oreochromis niloticus* in Gubi were conducted to determine the growth pattern and condition of well-being of the fish species in the dam. Four hundred and seventy two (472) fish species were obtained from fishers fishing with 1 inch cast nets between June - November, 2019. *Oreochromis niloticus* obtained in the dam had a total length range (5.5 - 24.5 cm) and weight range (3.1 - 234.45g). The fish species had allometric growth pattern (b = 2.9063). Condition factor range from 0.307502 - 4.38052 with average value of 1.831002 indicating that the fish species population was in good condition of well-being in the dam. Repeating similar research in the dam for other fish species and in other water bodies intermittently is recommended as part of eco-bio - monitoring strategies for developing and implementing conservation programmes.

Keywords: *Oreochromis niloticus*, Length-weight relationships, eco-biomonitoring strategies, conservation

INTRODUCTION

Length-weight relationships (LWR) are of great importance in fishery assessments (Ayoade and Ikulala, 2007). Length and weight measurements in conjunction with age data can give information on the fish stock, age at maturity, life span, mortality, growth and reproduction (Kumar *et al*, 2014). Length-weight relationships of fish is widely recognized as an important tool in fisheries science especially in ecology population dynamic and stock management (Abdoli and Rasooli, 2008).
Fish is said to exhibit isometric growth when length increases in equal proportion with body weight, the regression co-efficient for isometric growth is '3' and values greater than or less than '3' indicates allometric growth (Olurin and Aderibigbe, 2006).

Condition factor is good parameter that shows the wellbeing of fishes in their natural habitat or in aquaculture and it is represented as by the coefficient of body condition. It is an indicator of different biological and ecological factors in relation to fishes feeding habits.

Oreochromis niloticus is a species of tilapia, a cichlid fish native to Africa from Egypt; south to east and central Africa, and as far as west (Gambia). It is also native to Israel (Froese and Pauly, 2015). There is paucity of information on the length – weight relationships in Waya dam.

The effective management of any fishery requires considerable knowledge of population parameters such as length-weight relationships. This relationship is allow estimation of average weight of the fish of a given length group and stressed the importance in modelling aquatic ecosystems (Kulbicki *et al*,. 2005).

MATERIALS AND METHODS

STUDY AREA

The study area is Gubi Dam, Bauchi local government area, Bauchi state. The state is in the Sudan Savannah of the Northern Nigeria. Gubi Dam is located on latitude 10.4203N and longitude 9.8789E with two distinct seasons (dry and wet), with reservoir capacity of 38millions meters cube and with a height of 27m. The dam had total surface area of 179 km^2. It was created from the damming of four converging rivers (Gubi, Makaranta, Ran and Tagwaye) located at Piro, a village about 12 km North-East of Bauchi metropolis and 8 km off Bauchi - Maiduguri road for the primary purpose of providing potable and palatable water to Bauchi and its environs (Ezra and Nwankwo, 2001). The dam lies within

the boundary of longitude 10° 25'N to 10° 26'N and latitude 9° 51' E to 9° 52'E (Wufem *et al*., 2009).

DATA COLLECTION

Four hundred and seventy two (472) *Oreochromis niloticus* were randomly collected with 1 inch cast net from the fishers fishing in the Gubi dam in wet and dry seasons (2020). The fish species were identified using field guide by Olaosebikan and Raji (1998) and FAO (1992).

FISH MEASUREMENT

Total length (TL) and standard length (SL) were measured in centimetres with measuring tape to the nearest centimetre. The weight of the fish species were measured with a top loading weighing balance (model LP502.A) to the nearest 0.0lg.

STATISTICAL ANALYSIS

The length-weight relationships were determined using conventional formula described by Ekeng (1990).

$W = a \times L^b$ …1

Where: W = weight of fish in grams; L = standard length or total length of fish in cm; a = constant; b = an exponent.

The equation wasl therefore be transformed into lnW = lna + blnL Microsoft Excel 2007 was used for the analysis.

CONDITION FACTOR

The condition (k) was determined for each fish using the conventional formula described by Worthington and Richard (1931) as adopted by Afamdi (2009):

$K = 100W/L^3$ …2

Where: K = condition factor; W = weight in grams. **L** = standard length or total length in cm. Microsoft Excel 2007 was used for the analysis.

RESULT AND DISCUSSION

Table 1: Length-weight Relationships Parameters of *Oreochromis niloticus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State 2019.

Species	Range of Length (cm)	Range of Weight (g)	Regression coefficient A	b	Correlation coefficient (r)	Model (W= a x L^b)	±SE	N	Growth pattern
Total Length	5.5 - 24.5	3.1 - 234.45	0.0227	2.9063	0.9391	W= 0.0227X $L^{2.9063}$	0.16	472	A
Standard Length	4.1- 19.6	3.1 - 234.45	0.0757	2.6620	0.8409	W= 0.0757X $L^{2.6620}$	0.26	472	A

N=number of Specimen used, **A=** Allometric, SE = Standard Error

Table 1 shows that four hundred and seventy two (472) *Oreochromis niloticus* with total length range (5.5 - 24.5 ±SE 0.16) and weight range (3.1 - 234.45 ±SE 0.26) were obtained from the dam between June to November, 2019. The fish species had allometric growth pattern (2.9063). This may be due on set of early reproductive cycle of the fish in the dam. Bhatt (2004) reported that most fish attained maturity when they were approximately 10 cm long. Lagler *et al.* (1971) reported that for most fish

the b values are closer to 3. Model equation for length- weight relations of *O. niloticus* was W= $0.0227X\ L^{2.9063}$.

Table 2: Condition Factor Values of *Oreochromis niloticus* from Gubi Dam, Ganjuwa Local Government Area, Bauchi State

Minimum Value	Maximum Value	Average Value	N	Remark
0.307502	4.38052	1.831002	472	Good condition

Condition factor ranges from 0.307502 - 4.38052 with average value of 1.831002 indicating that the fish was in good condition of well-being. Ipinjolu *et al.* (1996) reported that individual condition factor of *Hyperopisus bebe ocindentalis* ranged from 0.69 to 1.10 (0.87$\pm$ 0.08SD) this suggests good nutrition and adaptation to habitat (Table 2). However, this is contrary to the suggestion of Nehemia *et al*.,(2012), who reported that K-values greater than 1 suggests the fish is in good condition and the mean K value found in this research for *O. niloticus* is greater than one.

CONCLUSION

Based on biological analysis *Oreochromis niloticus* had allometric growth pattern and in good condition of well-being in the dam. Model equation for LWR of the fish species: $W= 0.0227X\ L^{2.9063}$ is recommended for predicting weight from length of *O. niloticus*. Repeating similar research in the dam for other fish species and in other water bodies intermittently is recommended as part of eco-biomonitoring strategies for developing and implementing conservation programmes.

REFERENCES

Abdoli, A., and Rasooli, P. (2008). Length-weight relationship of 10 Species of fishes collected from *Iranian fresh waters, Journal of Applied Itchyology*, 22, 156-157

Afamdi, A. (2005) Condition Factor of Four Cichlid Species of a Man – made Lake in Imo State. South-Eastern Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences* ***5****: 43-47.*

Bhatt, V.S (2004) Studies on the biology of some fresh water fishes Parth iv. Mystus Cavasius (Ham). pp 1- 3**.**

Ekeng, E. O. (1990). Length-weight and diet composition of *Ethinalosefimbriata*(Bowchch).Pliscea:clupeidae in Cross River estuary, Nigeria. B.Sc.Project University of Calabar. Cross River State, Nigeria, 36pp.

Ezra, A.G. and Nwankwo, D.I. (2001).Composition of phytoplankton algae in Gubi Reservoir, Bauchi, Ni-geria.Journal of Aquatic Science. 16(2): 115 – 118.

FAO. (1992). FAO yearbook 1990. Fishery statistics. Catches and landings. FAO fish. Ser. (38). FAO stat. ser. 70: (105):647 p.

Froese, R and Pauly, D (2015). *Oreochromis niloticus* in Fish Base. November 2015 version.

Ipinjolu, J.K., B.C Nwosu and S.T Osanaiye (1996) Some aspects of biology of *Hyperopisus bebe occindentalis* (Gunther) in Goronyo dam (Sokoto State). Nigeria. *Nigerian Journal of Basic and Applied Sciences.* **5** (1&2):25-30.

Kulbicki, M., Guillemot, N. and Amand, M. (2005).A general approach to length-weight relationships for New Caledonian Lagoon fishes. *Cybium*, 29: 235- 252.

Kumar D.B., Singh N.R., Bink D. and Devashish K. (2014).Length-weight relationship of Labeorohita and Labeogonius (Hamilton-Buchanan) from SoneBeel, the biggest wetland of Assam. *Indian Journal of Environmental Research and Development* 8 (3).

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch Percafluviatilis, *.J. Anim. Ecol., 20*(2): 201-219.

Lizama, M. De los A. P. and Ambrósio, A. M.(2002). Condition factor in nine species of fish of the characidae family in the Upper Paraná River floodplain, Brazil.*Braz. J. Biol., 62(1): 113-124.*

Nehemia A., Maganira J.D., and Rumisha C., (2012). Length – Weight Relationship and condition factor of Tilapia species grown in marine and freshwater ponds. Agriculture and Biology Journal of North America Vol. 3(3): 117 – 124.

Olaosebikan, B.D. and A. Raji.(1998).Field guide to Nigerian freshwater fishes. Federal college of freshwater fisheries technology, Newbussa, Nigeria. 106 p.

Olurin K.B. and Aderibigbe O.A. (2006). Length-weight relationship and condition factor of pond reared *Oreochromis niloticus.World Journal of Zoology*, 1 (2), 82-85

Lagler, K.F. Bardach, J.E., Miller, R.R. and Asino, D.R.M. (1971) Ichthyology 2nd Ed. Willey and Sons, New York. p 506.

Wufem, B.M., Ibrahim, A.Q., Gin, N.S., Mohammed, M.A., Ekanem, E.O. and Shibdawa, M.A. (2009).Speciation of heavy metals in the sediments of Gubi Dam, Bauchi State, Nigeria.Global Journal of Environmental Science.8(2). 55 – 63

ASSESSMENT OF HEAVY METALS CONCENTRATION IN SOME ORGANS OF NILE TILAPIA(*Oreochromis niloticus)*IN WAYA DAM, BAUCHI.

[1]Magaji, I.M.,[1]Abdulkarim, M., [1]ALBABBA, S.M. & [2]Yusuf, Z.A.
[1]Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Nigeria
[2]Department of Biological Sciences, Abubakar Tafawa Balewa University Bauchi, Nigeria
Corresponding Author: email: isahmuhdmagaji@gmail.com

ABSTRACT
The study was conducted in Waya dam, Bauchi state, Nigeria to determine the concentrations of heavy metals in bones, gills and muscle tissues of *Oreochromis niloticus*. Nine *O. niloticus* were obtained from fishers fishing in the dam in May, 2018. Fish tissues collected were digested with concentrated HNO_3 and H_2SO_4 according to standard procedures. Heavy metals concentrations (Fe, Cd, Cu, Zn, Pb and Ni) after digestion were analyzed using 210 VGP atomic Absorption Spectrophotometer. The result shows that gills had highest concentrations (1.590±0.767 mg/kg) of Fe and lowest concentrations (0.004±0.001 mg/kg) of Ni. Gills tissues had highest mean heavy metal load than bones and muscle tissues. Mean concentrations of Zn was highest (0.228±0.076 mg/kg) in gills and lowest (0.077±0.076 mg/kg) in bones. Mean concentrations of the heavy metals in *O. niloticus* tissues studied were of the order: Fe>Zn>Cu>Cd >Pb>Ni. The mean heavy metal concentrations obtained in the study indicated that the fish species was safe for human consumption. It is recommended to periodically monitor the concentrations of heavy metals in Waya dam and in similar water bodies in order to prevent possible related health hazards.

Keywords: Heavy metals, Spectrophotometer, Fish Tissues, Digestion, *Oreochromis niloticus*

INTRODUCTION
Fish plays a vital role in feeding the world's population and contributing significantly to the dietary protein of hundreds of millions of the populace (Ayo-olusi, 2014). The aquatic environment with its water quality is considered the main factor controlling the state of health and diseases in both cultured and wild species (Olusola and Festus, 2015). Malik *et al*.(2010) stated that, pollution of heavy metals in aquatic ecosystem is growing at an alarming rate and has become an important worldwide problem. This situation has arisen as a result of the rapid growth of population, increased urbanization and expansion of industrial activities, exploration and exploitation of natural resources, extension of irrigation and other modern agricultural practices as well as the lack of or poorly enforced environmental regulation (Idowu, 2004). An increase in agricultural and human activities in an area directly influences the quality of water. Fish in water bio-accumulate heavy metals through different gateways including intake of food and water, suspended particulate matter as well as metal ion exchange through gills and skin (Ibemenuga, *et al*., 2019). Heavy metals cause the mutation of fish inner organs, disturb immune reactions, change blood parameters, reduce an organism's adaptation qualities, vitality and resistance to diseases (Staniskiene, *et al*., 2006).

In Nigeria, the levels of toxic and non-biodegradable heavy metals in fish samples had been reported for some water bodies including River Niger, Onisha shelf, Anambra state (Ibemenuga, *et al.*, 2019), Njuwa Lake, Adamawa sate (Ibrahim *et al*.,2018), Coastal waters of Ondo state (Olusola and Festus, 2015). The target tissues of heavy metals in fish are metabolically active ones which accumulate high level of metals such as liver, kidney and gills, while muscles and skins accumulate less level of metals due to low metabolic activities (Ekpo *et al*., 2013).

The present study investigates the accumulation of iron (Fe), cadmium (Cd), lead (Pb), zinc (Zn), nickel (Ni) and cupper (Cu) in the gills, bones and muscles of *Oreochromis niloticus*, as well as levels of the temperature and pH of water in the dam.

MATERIALS AND METHODS

STUDY AREA

Waya dam is a medium sized earth dam located in Ganjuwa Local Government Area of Bauchi State, Nigeria. The dam is twenty five kilometers (25km) away from Bauchi town. It lies within latitude 10.30982^{o}N and longitude 9.84517^{o}E. It has a reservoir storage capacity of thirty million cubic meters (30cm^{3}). Its embankment has features which include width: 96m, crest width: 6m, crest length: 370m and elevation: 505m (Isma'ila, 2014). Subsistence and commercial fishing activities are carried out on the dam.

SAMPLING AND WATER QUALITY PARAMETERS

Samples of nine *O. niloticus* were obtained from fishers fishing in the dam in May, 2018. Temperature and pH were measured using Potable digital meter (Model: PH 009 (1) Pen type) within the sampling period.

PREPARATION AND ANALYSIS OF HEAVY METAL IN FISH TISSUES

The fish samples were washed and dissected to remove gills, bones and muscles. The tissues were thoroughly washed and placed in labeled plastic bottles rinsed with nitric acid. The tissues were oven dried at 105°C, until dry and constant weight was obtained after which they were separately grinded with laboratory mortar and pistil.

DIGESTIONS

Grinded fish tissues collected were digested with concentrated HNO_3 and H_2SO_4 according to procedures recommended by AOAC (2002).

Heavy metals concentrations(Fe, Cd, Cu, Zn, Pb and Ni) after digestion were analyzed using 210 VGP atomic Absorption Spectrophotometer at the Faculty of Engineering, Abubakar Tafawa Balewa University Bauchi.

STATISTICAL ANALYSIS

Data of fish samples were presented as mean ± standard error (SE) and analyzed with SPSS version 25 (SPSS, IBM.2017).

RESULTS

Table 1: Temperature and pH of Waya Dam (May, 2018).

Portions	Temperature	pH
Upper	36.9	6.5
Middle	35.3	6.0
Tail	37	5.9

Waya dam water temperature values recorded in the month of May, 2018 were Upper (35.3^{o}C), Middle (36.9^{0}C) and Tail (37^{0}C) (Table 1). The pH values were 6.5, 6.0 and 5.9 for Upper, Middle and Tail portions of the dam respectively.

Table 2: Mean ± SE of heavy metals concentration (mg/kg) in some tissues of *Oreochromis niloticus* from Waya dam, Bauchi (May, 2018).

Tissue	Fe	Cu	Zn	Pb	Cd	Ni
Bones	0.273±0.767	0.058±0.030	0.077±0.076	0.013±0.003	0.005±0.006	0.006±0.001
Gills	1.590±0.767	0.013±0.030	0.228±0.076	0.009±0.003	0.013±0.006	0.004±0.001
Muscles	0.250±0.767	0.001±0.030	0.170±0.076	0.007±0.003	0.018±0.006	0.005±0.001

Iron concentration ranged from 0.250±0.767 mg/kg in muscles to 1.590±0.767 mg/kg in gills. Copper concentration was from 0.001±0.030 mg/kg in muscles to 0.058±0.030 mg/kg in bones .Concentration of Zinc was from 0.077±0.076 mg/kg to 0.228±0.076 mg/kg in gills while Lead ranges from0.007±0.003 mg/kg in muscles to 0.013±0.003 mg/kg in bones. Cadmium ranged from 0.005±0.006mg/kg in bones to 0.018±0.006mg/kg in muscles and Nickel ranged from 0.004±0.001mg/kg in gills to 0.006±0.001mg/kg in bones. However, Iron was the most accumulated metal while the least was Nickel.

DISCUSSION

Waya dam water temperature values recorded in the month of May, 2018 were 35.3^{o}C, 36.9^{0}C and 37.0^{0}C for upper, middle and tail portions of the dam respectively (Table 1). The temperature recorded in the tail water may be suitable for fish growth and reproduction. Temperature affects the distribution, health, and survival of aquatic organisms (CWT, 2004). The water temperature range in Waya dam is within the range of 10°C - 50°C for river and dam water meant for domestic purposes and fish culture in tropical waters (WHO, 1984; Huett, 1977). The water pH values of Waya dam in May, 2018 were slightly acidic(5.94 - 6.5), This may be as a result of horticultural activities prominent around the dam that might have led to run off of fertilizers into the dam water. The lowest value of pH was recorded at the tail portion (5.94) of the dam. Aquatic organisms accumulate heavy metals from water and food either by absorption or ingestion (Ibemenuga *et al*. (2019). Fish bio-accumulate heavy metals, thus act as good bio-indicators of pollution (Ibemenuga, 2013). In the tissues of *O. niloticus* studied, the metals were bio-accumulated to varying levels. Iron was present in fish tissues in the highest concentration while Nickel in lowest quantity (Table 2). Ibrahim and Sa'id (2010) and Monday and Nsikak (2007) recorded highest concentration of Zinc in the muscles of Tilapia species they studied.

Gills tissues had higher mean metal load than bones and muscles tissues. Jobling (1995) attributed the high accumulation of heavy metals in gills tissues to the metallothionein proteins which are synthesized in liver and gills tissues when fishes are exposed to heavy metals and detoxify them. Cadmium and Lead are toxic non-essential heavy metals even at low concentrations and have no known biological functions (Bernad, 2008 and Tchounwou *et al*., 2012).

In this study mean concentration of Zinc was highest (0.228±0.076mg/kg) in gills and lowest (0.077±0.076mg/kg) in bones unlike Ibemenuga *et al*. (2019) who reported that mean concentration of Zinc was highest in the intestine and lowest in the muscle. Goel (2006) observed that fish and other organisms that respire through the gills can absorb metals through their respiratory surfaces. However, the mean metal concentrations obtained in the study indicated that the tissues are safe for human consumption as the heavy metals concentration in the tissues of *Oreochromis niloticus* studied were below the permissible limit according to FAO (2003).

CONCLUSION

The results obtained in the study, indicated that Waya dam was contaminated to varying levels of heavy metals. Gills were the highest metal accumulated tissue followed by bones and then muscles. Heavy metals concentration in the tissues of *Oreochromis niloticus* studied were below the permissible limits; therefore, the fish species is safe for human consumption.

RECOMMENDATIONS

It is recommended to be periodically monitoring the concentration of heavy metals in Waya dam and similar water bodies in order to prevent health hazards.

REFERENCES

Abdulkarim, M. and Yusuf, Z.A. (2015). Essentials of Fisheries and Aquaculture Techniques. Finix Publications Bauchi state Nigerian, 112 pp.

AOAC (2002). Official Method of Analysis, Association of Official Analytical Chemists (19thEd.), Maryland Chemists, USA.

APHA, (1998). American water works association and water environment federation, standard methods for the examination of water and wastewater (20th Ed,) APHA, New York, 95-97 pp.

Ayo-olalusi, C.I. (2014). Length-weight Relationship, Condition Factor and Sex Ration of African Mud Catfish (*Clarias gariepinus*) Reared in Flow-through System Tanks. *Journal of Fisheries and Aquatic Science*, **9**:430-434.

Bernard, A. (2008). Cadmium and its adverse effects on human health.*Indian J Med Res* **128**(4):557-564.

Clean Water Team (CWT) (2004). Dissolved Oxygen Fact Sheet. In: *The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment*, Version **2.0.**Division of Water Quality, California State Water Resources Control Board, Sacramento.

Ekpo, F. E., Agu, N. N. and Udoakpan, U. I. (2013). Influence of Heavy Metals Concentration in Three Common Fish, Sediment and Water Collected within Quarry Environment, Akamkpa Area, Cross River State, Nigeria. *European Journal of Toxicological Sciences*.**3**:52-64.

Food and Agriculture Organisation (FAO). Heavy Metals Regulations- Faolex (2003). Legal Notice no.66/2003. Pp.34-41.

Goel, P. K. (2006). Water Pollution Causes, Effects and Control. Revised (2nd Ed).New Age International Publishers, New Delhi, 418pp.

Huett, M. (1977).Text Book of Fish Culture, Breeding and Cultivation of Fish (2nd Ed), News Book Publ. University Press, Cambridge, Pp438.

Ibemenuga, K.N. (2013). Bioaccumulation and toxic effects of some heavy metals in freshwater fishes.*Anim Res Int*. **10**(3): 1792-1798.

Ibemenuga, K.N., Ezike, F.A., Nwosu, M.C., Anyaegbunam, L.C., Okoye, E.I. and Eyo, J.E. (2019). Bioaccumulation of some heavy metals in some organs of three selected fish of commercial importance from Niger river, Onisha shelf, Anambra State, Nigeria. *Journal of Fisheries Science.com*.**13**(3): 001-012.

IBM Statistical package for social sciences (2017) version **25**.

Ibrahim, D., Ibrahim, A.S., Paul, E.D., Umar, M. and Zannah, U.A.S. (2018). Determination of some heavy metal content in Tilapia and Catfish species in Lake Njuwa, Adamawa State, Nigeria. *J. Appl. Sci. Environ. Manage*. **22**(8):1159-1165.

Ibrahim, S. and Sa'id, H.A. (2010). Heavy metals load in *Tilapia* species: a case study of Jakarariver and Kusalla dam, Kano state, Nigeria. *Bayero Journal of Pure and Applied Sciences*. **3**(1): 87-90.

Idowu, R.T. (2004). Limnological Studies of Lake Alau Maiduguri, Borno State, Nigeria. Ph.D.Thesis, University of Nigeria, Nsukka, Nigeria. Pp. 189.

Ismaila, S (2014). Case study of Waya Dam small hydro power pilot project.Retrieved September 21, 2014 from *http://www.esi-afriea.com/.../SULAIMAN%201*..

Jobling, M. (1995). Environmental Biology of Fisheries (1st ed). Great Britain. Chapman and Hall, London. Pp. 455.

Malik, N., Biswas, A.K, Qureshi, T.A., Borana, K. and Virha, R. (2010).Bioaccumulation of Heavy Metals in fish tissues of a freshwater lake of Bhopal. Environmental Monitoring Assessment.**160**: 267-276.

Monday, U.E. and Nsikak, U.B. (2007). Cadmium, Copper, Lead and Zinc Levels in BongaShad (*Ethamasolafimbriata and Tilapia guinensis*) caught from Imo River, Nigeria. *American Journal of Food Technology*. **2**(1): 181-189.

Olusola, J.O. and Festus, A.A. (2015).Assessementof Heavy Metals in Some Marine Fish Species Relevant to their Concentration in Water and Sediment from Coastal Waters of Ondo State, Nigeria.*J Marine Sci Res Dev*. **5**:163.

Staniskiene, B., Matusevicius, P., Budreckiene, R. and Skibniewska, K.A. (2006).Distribution of heavy metals in tissues of freshwater fish in Lithuania. *Polish J. of Environ. Stud*. **15**(4): 585-591.

Tchounwou, P.B, Yedjou, C.G, Patlolla, A.K. and Sutton, D.J. (2012).Heavy metals toxicity and environment.*Experientia Suppl*.**101**:133-164.

W.H.O, (1984), Guidelines for Drinking water Quality. World Health Organization, Geneva. Pp.211.

ASSESSMENT OF MACROBENTHIC INVERTEBRATES OF GUBI DAM, GANJUWA – BAUCHI STATE.

1. Magaji, I. M.; 1. Abdulkarim, M.; 2. Yusuf, Z. A. and 1.Aliyu, M.H.
1. Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Nigeria
2. Department of Biological Sciences, Abubakar Tafawa Balewa University Bauchi, Nigeria
Corresponding Author: email: isahmuhdmagaji@gmail.com

ABSTRACT
Macroinvertebrates of Gubi dam, Ganjuwa Local Government Area, Bauchi state, Nigeria was studied with the aim of understanding their diversity and abundance. Macrobenthic samples were randomly collected in the month of January, 2018 at three different locations: Head water (Tatumari station), Middle water (Polo station station) and Tail water (Spill way station) using standard method. The samples collected were identified with the aid of microscope in a well illuminated laboratory and later referred to monograph for comfirmation. The individual abundance was expressed in percentages and biodiversity indices were determined. The results showed that 105 individual benthic invertebrates belonging to 7 orders and 8 families were identified. Hemiptera had two families while Neotaenioglossa, Diptera, Plecoptera, Coleoptera, Odanata, and Ephemeroptera had one family each. *Aquarius remigis* (43) and *Goniobasis livescens* (29) were the most abundant benthic invertebrates caught in Gubi dam while the least abundant species were *Ranatra elongata* (2.86), *Dytiscus marginalis* (2.86) and *Tanytarsus sylvaticus* (0.95). Spillway had more individuals benthic fauna (40) than Tatumari (33) and Polo (32). The benthic invertebrates were evenly distributed (E=0.75). It is recommended that physicochemical parameters of the dam be studied. Also similar research should be carried out in more water bodies in Nigeria.

Keyworsds: Macrobenthic, Abundance, Biodiversity indices, Physicochemical, *Aquarius remigis*

INTRODUCTION
Macrobenthic invertebrates can be found in aquatic environment from small pond to large lakes. Within a water body, aquatic invertebrates inhibit a variety of habitats. In lotic they occur under stones or woody debris, buried in sand or sediment and crawling or sprawling on rocks, leaf packs and snags (Bouchard, 2004). Benthic invertebrates in freshwater can be used as indicators of changes in water quality. They also form an important part of the aquatic ecosystem food chain especially for larger animals (Uwadiae, 2010). They play a vital role in the circulation and recirculation of nutrients in aquatic environment.

According to Mooraki *et al*. (2009) rivers act as an important ecosystem that maintains the coastal biota and thus, is high in productivity and serve as nursery and breeding ground for many organism that occupies it. Pond fertilization enhances algae growth and produce macroinvertebrate suitable for larval fish. Several studies in Nigeria have investigated benthic invertebrate communities especially in some specific rivers: Anambra River (Eyo and Ekwonye, 1995), (Ogbeibu and Egborge, 1995) and Ogba River (Olumukoro and Okologume, 2008).

Invertebrate communities change in response to changes in physicochemical factors and available habitat. Chatzinikolaun *et al*. (2016) stated that human induced hydrological changes and other physical disturbances like habitat alteration, urban land use, chemical contamination, surface run-off, intensive agriculture and so on are examples of processes responsible for a broad scale deterioration of lotic ecosystems. The abundance of benthic fauna greatly depends on physical and chemical properties of the substratum.

Elias *et al*. (2014) stated that in tropical African regions, researches on the status and trends of freshwater macroinvertebrates in rivers have not been given much attention compared to non-tropical regions. It became necessary and important to study benthic invertebrates abundance and diversity because of the role they played as bioindicators of specific environment and habitat conditions. Increased anthropogenic activities increases pollution and causes varying degree of damage to the benthic ecosystem. Danladi *et al*. (2013) stated that highlighting the abundance of invertebrates in lotic and lenthic water bodies is paramount as they provide useful information on natural and anthropogenic disturbance gradients.

There is very scanty information on the composition and abundance of macro invertebrate in Gubi dam. Therefore, the goal of this research is to identify the macroinvertebrates present in the dam and to determine their composition and abundance as well as the diversity indices of macrobenthic invertebrate in the dam.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in Gubi dam, Ganjuwa Local Government, Bauchi State, Nigeria. Gubi dam lies within 9° 5' 30" E and 10° 24' 32" N. The embankment of the dam have a length of 3.86 km. The area has two distinct seasons; a short (June-September) wet season and a long (October-May) dry season.

SAMPLING PROCEDURE

Macrobenthic samples were randomly collected in the month of January, 2018 at three different locations: Head water (Tatumari), middle water (Polo) and tail water (Spill way) in the dam, according to the method described by Andem*et al*. (2012). The collected samples were sorted into different groups and preserved in 10% formalin solution.

IDENTIFICATION OF FISH SPECIES

The samples collected were identified with the aid of microscope in a well illuminated laboratory using a magnifying glass and later referred to a combination of monographs (Batchellar, 2017; Danladi*et al.,* 2013 and 10WATER, 2005) for confirmation**.**

DATA ANALYSIS

The individual abundance of macrobenthic invertebrate was expressed in percentage composition of each order.

STATISTICAL ANALYSIS

The macrobenthic data obtained were subjected to diversity indices to determine: Shannon index (H`), Evenness (E), Simpson`s dominance index (D) and Margalef`s diversity index (d) using the following diversity indices formulas (Ogbeibu, 2005)

Shannon index (H') = $\sum (\frac{n}{N})\text{In } (\frac{n}{N})$ . . . i

Where n = number of abundance of each species in the sample

N = total number of all species in the sample.

Evenness index (E) = $\frac{H'}{InS}$ . . . ii

Where S = number of distinct order in all the samples

Simpson's species dominance (D) = $\frac{S}{\sqrt{N}}$ . . . iii

Margalef's diversity index (d) = $\frac{S-1}{In\ N}$ . . . iv

RESULTS

Composition and abundance of macrobenthic invertebrates collected in Gubi dam were showed in table 1. A total of 105 individuals benthic invertebrates belonging to 7 orders and 8 families were identified. Hemiptera had two families while Neotaenioglossa, Diptera, Plecoptera, Coleoptera, Odanata, and Ephemeroptera had one family each. *Aquarius remigis* (43) and *Goniobasis livescens* (29) were the most abundant benthic invertebrates caught in Gubi dam while the least abundant species were *Ranatra elongata* (2.86), *Dytiscus marginalis* (2.86) and *Tanytarsus sylvaticus* (0.95). Spillway had more individuals benthic fauna (40) than Tatumari (33) and Polo (32).

Diversity indices of benthic invertebrates in the study area were in Table 2. Simpson's, Shannon, Evenness and margalef's indices were 0.26, 1.56, 0.75 and 1.50 respectively.

Table 1: Composition and Abundance of Macrobenthic invertebrates in Gubi dam

Order	Family	Species	Location And Abundance			Total(%)
			Head water (Tatumari)	Middle water (Polo)	Tail water (Spillway)	
Hemiptera	Gerridae	*Aquarius remigis*	16	18	9	43(40.95)
	Nepidae	*Ranatra elongata*	2	0	1	3(2.86)
Neotaenioglossa	Pleuroceridae	*Goniobasis livescens*	4	7	18	29(27.62)
Diptera	Chironomidae	*Tanytarsus sylvaticus*	0	1	0	1(0.95)
Plecoptera	Perlidae	*Acroneuria carolinensis*	2	3	0	5(4.76)
Ephemeroptera	Baetidae	*Baetis bicaudatus*	4	1	1	6(5.71)
Odonata	Gomphidae	*Paragomphus genei*	4	0	11	15(14.29)
Coleoptera	Dytiscidae	*Dytiscus marginalis*	1	2	0	3(2.86)

Table 2: Diversity and Dominance Indices of Benthic invertebrates in Gubi Dam

Parameters	Values
Margalef's species richness (d)	1.50
Evenness index (E)	0.75
Shannon index (H')	1.56
Simpson's index (D)	0.26
Simpson's reciprocal index (D')	3.78

DISCUSSION

A total of 8 species comprising of 105 individuals shared within 7 orders and 8 families were recorded in this study. The species diversity of the macrobenthic organisms in the dam were less diverse compared to those reported by Asibor (2015) in Asijire reservoir, similarly, it also varied from a total of 19 species belonging to 4 phyla, 6 classes and 12 families identified by George *et al*. (2009) at Okpoka creek and 28 species identified by Ezekiel *et al*. (2011) at Sombreiro River, Niger Delta. These differences are attributable to difference in location, time, nutrient availability and prevailing physical and chemical characteristics of these aquatic bodies Iyagbaye*et al*. (2017).

Hemipterans were presence at all the 3 sampling stations and were the most abundant macrobenthic encountered. Diptera appeared only in Polo sampling station. Orders recorded at the tail water (Hemiptera, Neotaenioglossa , Ephemeroptera and Odonata) were fewer when compared with those at the head water (Hemiptera, Plecoptera, Ephemeroptera, Neotaenioglossa, Odonata and Coleoptera) and the middle water (Hemiptera, Diptera, Neotaenioglossa, Ephemeroptera, Odonata and Coleoptera), this could be as a result of great waste discharge in the tail water due to more intense human activities.

Higher diversity results when many species have equal or near-equal opportunity to co-exist. Mckintosh (2000), in support of this, observed that in the absence of disturbance, community composition may be strongly influenced by abiotic interactions such as competition and predation. Simpson's dominance index in this study was low (0.26). Evenness value was 0.75 indicating that the benthic invertebrates were evenly distributed. The high evenness and low dominance indices in this study indicates high diversity of benthic invertebrates in Gubi dam, since the higher the evenness the higher the diversity, and the lower the dominance index, the higher the diversity(Ogbeibu and Victor,1989). Shannon index was 1.56 and species richness was better (1.5).

CONCLUSION

A total of 105 macro benthic invertebrates represented by seven (7) orders and eight (8) families were recorded in Gubi dam. The benthic invertebrates were diverse with *Aquarius remigis* dominating the total catch. It is recommended that physicochemical parameters of the dam be studied. Also similar research should be carried out in more water bodies in Nigeria.

REFERENCES

Andem, B.A., Okorafor, E.K.A. and Ekpo, P.B. (2002). Ecological Impact Assessement and Limnological Characterization in the Intertidal Region of Calabar River Using Benthic Macroinvertebrates as Bioindicator Organisms. *Int. J. Fishe. Aqua. Studies*. **1**(2): 8-14.

Asibor, G.I. (2015). Seasonal biodiversity assessment of benthic macro ivertebrate of Asejire reservoir. Southwest Nigeria *Journal of sustainable development*, 8(2); 257-269.

Bouchard, R. W., Jr. (2004). Guide to aquatic macroinvertebrates of the Upper Midwest, Water Resources center, University of Minnessota. St. Paul, MN.pp.208.

Chatzinikolaou, Y., Dakos, V., Lazaridou, D. (2006). Longitudinal impacts of anthropogenic pressures on benthic macroinvertebrate assemblages in a large transboundary Mediterranean river during the low flow period. *Actahydrochim Hydrobiol*. 34: 453-463.

Danladi, M. U. Jon S. H. and Michael J. W. (2013) Fresh Water Invertebrates of the Mammbila Plateau, Nigeria. School of Biological Sciences, University of Canterbury, Christchurch 8140 - New Zealand. www.biol.canterbury.ac.nz. 88p.

Elias, J. D., Ijumba, J. N. and Mamboya, F. A. (2014). Effectiveness and Compatibility of Non-tropical Biomonitoring Indices for Assessing Pollution in Tropical Rivers- A review. *International Journal of Ecosystem*. **4**(3):128-134.

Eyo, J. E. and Ekwonye, U. C. (1995). The Macroinvertebrate fauna of pool in the floodplain(fadama) of the Anambra river, *Nigeria. Freshwater Forum.* **5**(23):160-162.

Ezekiel, E.N., Hart, A.I. and Abowei, J.F.N. (2011). The Distribution and Seasonality of Benthic Macroinvertebrates in Sombreiro River, Niger Delta, Nigeria. *Research Journal of Applied Sciences, Engineering and Technology.* **3**(4): 264-271.

Geoge, A.D.H., Abowei, J.F.N. and Daka, E.R. (2009). Benthic Macroinvertebrate Fauna and Physicochemical Parameters in Okpoka Creek Sediment, Niger-Delta, Nigeria. *Internat. J. Anim. Vet. Adv.* **1**(2): 59-65.

Ikomi, R. B., Arimoro, F.O. and Odihirin, O. K. (2005). Composition, distribution and abundance of macro invertebrate of the upper reaction of river Ethiope Delta State, Nigeria. *The zoologist*, 3:68-81.

IOWATER. (2005). Benthic Macroinvertebrate Key, IOWATER Volunteer Water Quality Monitoring.

Iyagbaye, L.A.,Iyagbaye, R.O. and Omoigberale, M.O. (2017). Assessment of benthic macro-invertebrates of freshwater ecosystem: A case study of Ovia river (Iguoriakhi), Edo state, Nigeria. *European Scientific Journal*. **13**(26).

Mckintosh, A.B. (2000). Aquatic predators-prey interaction. In: New Zealand Stream invertebrates: Ecology and Implication for Management. New Zealand Limnological Society.

Mooraki, N., Esmaeli, S. A., Soltan, M. and Valinassab, T. (2009). Spatial distribution and assemblage structure of macrobenthos in a tidal creek in relation to industrial activities. Int. J. Environ. Sci. Tech. ***6****(4):651-662.*

Nkwoji, J.A., Igbo. J.K., Adeleye, A.O., Obienu, J.A. and Tony-Obiagwu, M.J.(2010). Implications of bioindicators in the ecological health study of a coastal lagoon, Lagos, Nigeria. *Agriculture and biology Journal of North America*, 1(4):683-689.

Ogbeibu, A.E. (2005). Biostatistics: a practical approach to research and data handling. Mindex Publishing Company Limited. Pp. 264.

Ogbeibu, A. E. and Egborge, A. B. M. (1995). Hydrobiology studies of water bodies in the Okonu forest Reserve. *Tropical Freshwater Biology.* 4.1-27.

Ogbeibu, A.E. and Victor, R.(1989). The effect of road construction on the banrk-root macrobenthic invertebrates of Southern Nigerian Stream. *Eviron Pollut.* 56: 856-100.

Olomokoro, J.O. and Okologume, U. (2008). Macoinvertebrate colonisation of artificial substrates in a Nigerian river 1: gravel and leaf litter. *African Journal of Aquatic Science.* **33**(2):143-148.

IOWATER. (2005). Benthic Macroinvertebrate Key, IOWATER Volunteer Water Quality Monitoring.

Uwadiae, R. E. (2010). An inventory of the Benthic macrofauna of Epe lagoon, South-West, Nigeria. *Journal of Sci. Res. Dev.* 15:161-171.

EFFECTS OF FEED FORMS AND FEEDING FREQUENCY AND GROWTH PERFORMANCE OF *Clarias gariepinus* FED COMMERCIAL FEED

[1*]Mahmood, S.1[1]Abdulkarim, M., [1]Magaji, I.M., [2]Yusuf, Z.I. & [1]Buba, S.A.

[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

[2]Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Corresponding Author: email: salisububa336@gmail.com

ABSTRACT

This review investigated the effect of feed form and feeding frequency of *Clarias gariepinus* fed floating and sinking pellet feeds, growth performance of *Clarias gariepinus* fed fish feeds, similarly to evaluate growth of *C. gariepinus* fed 5 difference commercial feeds. Fish fed with floating pellet had highest Final Weight Gain with the value of 9.50g than those fed with sinking pellet feed with the value of 8.98g. Final Weight Gain and Daily Feed Intake of *C. gariepinus* fed floating or sinking pellet feed fed twice a day and thrice a day were significantly higher than those fed once a day ($p < 0.05$). There were significant difference ($p < 0.05$) in Specific Growth Rate (SGR) with value of 2.79 and Protein Efficiency Ratio (PER) with value of 1.97 in *C. gariepinus* fed Aqua and Rana feeds. Furthermore, there were significant difference ($p < 0.05$) in the survival rate of the fish species fed Coppens (93.33%) while lowest (46.67%) in *C. gariepinus* fed with Aqua feed. *C. gariepinus* juvenile fed with Coppens, Multifeed and Eurogold with Final Mean Weight value of 181.54, 179.92, 0.95 and 139.92 respectively, while Final Mean Weight for Vital and Ajanla were 110.1 and 119.03respectively. Fish fed with Coppens had the highest SGR (3.19%) and lowest (2.71%) in those fed with Eurogold feed. *C. gariepinus* can be fed floating and sinking pellet feeds twice or thrice per day for optimum growth. *C. gariepinus* should be fed with feed that have macronutrient composition 7of 45% crude proteins, 12% crude fat, 1.5 crude fiber and 9.5% Ash in order to promote better growth.

INTRODUCTION

Catfish (*C. gariepinus*) are the major commercial culture species in Nigeria for good market reasons. Since 2000 there had been a rapid expansion in urban aquaculture and a significant increase in catfish culture (Anetekhai *et al., 2004*).

Optimal feeding for fish species especially African catfish was yet to be clearly defined and this had led to uncertainty in the feeding routines used by many farmers. Under feeding can be detrimental to the health of the fish and may cause reduction of weight and poor feed utilization. This will increased susceptibility to infection (Priestley *et al., 2006*). Specific growth rate (SGR) and the efficiency of feed conversion as have been observed to be directly related to feed ration and frequency of feeding (Dwyer *et al., 2002*). This study aimed to find the appropriate feeding frequency for optimum culture of *C. gariepinus* and to assess the impact of feed type/forms on the growth quality of fish seed production and assessment of *C. gariepinus*.

MATERIALS AND METHODS

EXPERIMENTAL FISH, REARING CONDITIONS AND FEEDING TRIAL

Two hundred and twenty five fish *Clarias gariepinus* were obtained from a local hatchery in Ibadan, with average weight of 3.12 ± 0.04g. They were stocked into 15 (60-liter) aquaria each holding 15 fish. Five feeds: Coppens (T1), Aqua (T2), Ranna (T3), Pira (T4) and Durante (T5) were used for this study.

Experimental trial was conducted at the laboratory of Bowen University, Iwo, Nigeria. A total of 360 *C. gariepinus* fingerlings were used. Three feeding frequencies were adapted, two different feed forms (floating and sinking pellets) were used, thus giving a total of 6 treatments.

Research on feeding trial were also carried out at the family testing unit of ARAC Nigerian limited. Some 500 nine week old *C. gariepinus* juveniles were purchased from Belem fish farm, Port Harcourt.
A completely randomized design was used with 5 treatments (commercial catfish feed): Coppens, Multifeed, Eurogold, vital and Ajanla feeds and 3 replicates per treatment.

GROWTH PARAMETERS
Growth performance of the fish was determined following the methods adapted by Ajani *et al.* (2011).

Measurement of weight and the survival of *C. gariepinus* Fingerlings/Juveniles
Weights of fingerlings were determined at the beginning of each treatment and subsequently at weekly intervals basis. Electronic digital weighing scale: ACCULAB model meter balance 2000 was used for measuring the weight of the fish species (Ajani *et al.* (2011).

STATISTICAL ANALYSIS
Data collected were subjected to analysis of variance (ANOVA). Significant difference means ($P< 0.05$) were separated using Duncan's New Multiple Range Test (Duncan). The statistical analysis was done using SPSS (Windows version 15.0).

RESULTS AND DISCUSSION
Table 1: Growth Performance and survival of *C. gariepinus* fish fed floating and sinking pellet once, twice and thrice/day

	Floating Pellet			**Sinking Pellet**		
	1x	2x	3x	1x	2x	3x
Mean Initial Wt(g)	3.03±0.05	3.10 ± 0.02	2.97±0.57	3.15 ±0.06	3.05±0.41	3.00 ±0.18
Mean final wt(g)	12.44 ±2.01	12.27 ± 3.04	12.47 ±2.31	12.04 ±4.42	12.02 ±0.36	11.96 ± 4.05
Mean wt gain (g)	9.41 ± 3.20[a]	9.17 ±2.32[a]	9.50 ± 1.08[a]	8.89 ±2.40[a]	8.97 ±4.24[a]	8.96±2.09[a]
Sd SGR (%)	0.062 ±0.01[c]	0.64 ±0.04[c]	0.68 ±0.21[c]	10.58 ±0.07[c]	0.60 ±0.71[c]	0.52 ±0.01[b]
FCR	2.88 ±0.02[a]	2.68 ±0.50[b]	2.50 ±0.06[b]	2.92 ±0.0[1a]	2.85 ±0.12[a]	2.82 ±0.08[a]
Survival (%)	95.00 ±3.41[b]	98.0 ±1.81[b]	95.5 ±181[b]	85.0 ±3.22[a]	98.0 ±1.24[b]	98.0 ±1.41[b]

Mean values with different superscript along each row are significantly different from each other ($P<0.05$). Source: Ajani *et al.* (2011).

Table 1 revealed that the floating pellet feed fed thrice a day had the highest mean weight gain with the value of 12.44±2.31 while sinking pellet feed fed thrice per day had the lowest mean weight gain with value of 11.96±4.05. The highest final weight gain recorded in the fish species fed floating pellet feed fed to *Clarias gariepinus* had the highest with the value of 12.44±2.31 while The lowest final weight gain in fish species fed with sinking pellet feed fed thrice per day may be attributed to nature of feed types. Ajani *et al.* (2011) noted that floating pellets float on the water and doesn't disintegrate easily like sinking pellet feeds.

Table 2: Growth performance and survival rates of *C. gariepinus* fed different feed brand

	Treatments				
	Aqua	Coppens	Durate	Pira	Rana
Initial Weight	3.12 ±0.2	3.12 ±0.1	3.1 ±0.1	3.11± 0.2	3.10 ±0.2
Final Weight	57.18 ±4.05	33.38 ±33.2	39.28 ±3.64	42.93 ±3.72	24.82±2.57
Weight Gain	54.07 ±4.37	30.26 ±2.46	36.17 ±3.54	39.83±3.86	21.73±2.30
Percentage Weight Gain	1734.87±142.28	969.77^{bc}±100.32	1165.88^{b}±106.87	1282.07±110.09	704.01±80 a
Specific Growth rate	2.79^{a} ±0.76	2.25^{b} ±0.32	2.41^{b} ± 0.43	2.51^{b}±0.46	1.97^{a} ±0.21
Feed Conversion Ratio	1.59^{a} ±0.06	1.95b ±0.08	1.88ab ±0.06	1.79ab±0.05	2.13b±0.09
Protein Efficiency Ratio	1.49^{a} ±0.02	1.22^{b}±0.02	1.30^{ab} ±0.04	1.33^{ab}±0.03	1.12^{b}± 0.04
Survival Rate	46.67^{c} ±2.46	93.33^{a} ±3.24	57.78^{c} ±3.76	91.11^{ab} ±2.55	62.22^{b}±3.65

Source: Ajayi *et al.* (2016).

The initial weight gain of *C. gariepinus* fed Aqua feed had the highest final weight gain with value of 57.18g while the fish species fed Rana feed had the lowest final weight gain with the value of24.82±2.57. No significant difference existed among Coppens, Dorante and Pira. The best feed was Aqua with feed conversion ratio and protein efficiency ratio values of 1.69 and 1.49 respectively.

There was no significant difference in FCR among Aqua, Durante and Pira. Feed fed with Coppens (table 2). Booth *et al.,* (2008) observed that different feeding regime doesn't not have a significant effect on weight gain.

Proximate composition *C. gariepinus* fed with Coppens, Multifeed, Eurogold, Vital and Ajanla and Multifeed had the highest percentage C.P with the value of 45% while vital had the lowest percentage C.P value of 38%. The crude lipid content of Coppens and Multifeeds had the highest with the percentage value of 12% while Ajanla had the lowest with the percentage value of 8%.A significant difference was observed in the percentage fat and ash content recorded from carcass of the fish fed different feed types feed brands. It may be due to losses due to volatisation between constituents (Micheal *et al.,* 1995).

Another feeding trial carried out indicated that Aqua had the highest final weight gain with the value 1734.87g while the Rana had the lowest final weight gain. There were no significant difference existed among Coppens, Dorantea and Pira. There were significant differences in the FCR among feed type with Rana feed brand. According to Haulihan *et al.* (2001) FCRs should never go above 2. According to the author opined that FRC vary with fish species, activity levels of fish and culture system.

Proximate composition in Coppens, Multifeed, Eurogold, Vital and Ajanla indicated that vital feed lowest C.P The crude lipid content of Coppens and Multifeeds had the highest value of 12% while Ajanta had the lowest value. According to Agokei (2011) significant highest growth performance of *C. gariepinus* was found in the diet that contained < 2% fibre content. This could be due to inability of the fish species to digest and utilized high content in the feed. Alam *et al.,* (2012) reported that ash content in the feed of *C. gariepinus* should not be less than 8%.

Growth performance of similar feeding trial indicated that Coppens feed fed to *C. gariepinus* had the highest final weight gain while the vital had the lowest final weight gain. Earlier worked of Fagbenro *et al.* (1992) ascertained that African cat fish tend to require at least 40% crude protein. Specific growth rate (SGR) was highest for fish fed Coppens but was not significantly different from SGR for fish fed Multifeed.

CONCLUSIONS

There was no significant difference in final weight gain in *C. gariepinus* fed floating and sinking pellet feeds although fish fed floating pellet feed exhibited higher final weight gain. It was also revealed that floating pellet feed can be fed to *C. gariepinus* three times a day for optimum growth while the best feeding frequency for sinking pellet feed in order to obtain optimum growth for *C. gariepinus* were twice and thrice per day.

Macronutrient combinations with 45% CP, crude fat, 12%, crude fibre 1.5% and Ash 9.5% will promote higher growth rates of *C.* gariepinus than other feed ingredients combination in the diets of the juvenile fish species.

REFERENCES

Allam, M.A., Habib, M.A. and Tahmid, M.S, (2012). Survey on commercial fish feed used as fulpur area in Meymensingh district. *Journal of Bagaladesh Agricultural University*. **10** (1): 75 – 78p.

Ajani, F., Dawodu, M.O. and Bello-Olusoji, O.A. (2011). Effects of feed forms and feeding frequency on growth performance and nutrient utilization of *Clarias gariepinus* fingerlings. *African journal of Agricultural Research* **Vol. 6**(2), Pp 318-322.

Anetekhai, M.A. (2004). Steps ahead for aquaculture development in Sub Sahara Africa the case of Nigeria. *Aquaculture journal*. 237-248p.

Agokei, E.O., Oparah, A.A., Aranyo, V.C., Alozie-Chidi and Apapa, U.A. (2010). Growth of *Clarias gariepinus* juveniles fed five commercial feed. 25th Annual international conference and exhibition in administrative staff college of Nigeria (ASCON). Topo-Badagry, Lagos, FSN-NU 0007.

Booth, M.A., Turker, B.J., Allan, G.L. and Stewart, F.B. (2008). Effects of feeding regime and fish size on weight gain, feed intake and gastric evacuation in juvrnile Australian snapper pangis auratus. *Aquaculture* 282, issues, **1**(4): 104 -11p.

Dwyer, K.S. (2002). Feeding frequency effect food consumption, feeding pattern and growth of juvenile yellow tail flounder (Limanda Ferruginea). *Aquaculture* **123** (1-4) 279-292p.

Fagbenro, O.A. Balogun, A.M., and Anyanwu, C.N. (1992). Optimun dietary protein levels for *Heterobranchus birdosalis* fingerlings fed compounded diets. *Isrseli Journal Aqau. Bami.* **44** (3): 87 – 92p.

Haulihan, D., Boulard, T. and Jobling M. (2001). "Food intake in fish". USA: Iowa State Press. Blackwell Science Ltd. 418pp.

Michael, B.N., Albert, G.J.T. and Imbre, C. (1995). Farm made aquafeeds in Utama, G.M.C. ed. Aquafeeds and feeding strategies in Malaysia, 282 – 285p.

Priestley, S.M. (2006). The influence of feeding frequency on growth and body composition of the common goldfish (*Carrassiu auratus)*. *J. Nutri.,* **136:**19795-19815p.

EVALUATION OF CONDITION FACTORS WITH STOMACH CONTENT OF *Clarias gariepinus* IN RIVER GWALLAGA, BAUCHI STATE

[1*]Mahmood, S.1.,[1]Abdulkarim, M., [1] Egbo, M.L., [2]Yusuf, Z.I., & [1]Buba, S.A.

[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

[2]Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Corresponding Author: email: Salisububa336@gmail.com

ABSTRACT

This study was aimed at investigating some biological aspects of *Clarias gariepinus* Cought in River Gwallaga Bauchi state. The river was divided into four stations: head water (Jamaa), upper middle (Rafin Shaa), and lower middle (Maleka) and tail water (Jamjale) as stations A, B, C and D respectively. Ten (10) *Clarias gariepinus* were caught fortnightly from each station during the dry season (February - April 2019) and wet season (May – August 2019). A total of 480 fish were collected during the period of the research. Morphometric indices of the fish were measured. The fish were dissected, gut length and stomach weight were measured and stomach content were identified. The data obtained were used to determine morphometric relationships through correlation and regression analysis, using Microsoft Excel 2007 version. The stomach content analysis of *C. gariepinus* revealed Plant Parts had the highest importance index of 50.37 in the dry season and 28.81 in the Wet season out of the five feed items found in the stomach. Chi-square (X^2 =29.27; df = 12 P> 0.05) (X^2 18.20; df = 9; P> 0.05) showed that there was association between stomach repletion of the fish and the stations from which they were caught in wet and dry Seasons respectively. The average condition factor (K) of fish from station A (K = 0.6818), B (k = 0.5458), C (K = 0.8132) and D (k = 0.5510) for dry season and wet season: A (K = 0.526758), B (k = 0.589765), C (K = 0.738035) and D (k = 0.725151). All the K-value were less than 1; It can be concluded that *C. gariepinus* caught in River Gwallaga were not in good physiological condition and association between fish stomach repletion level and station from which they were caught; shows that feed items in the fish stomach was inadequate. Therefore, it is recommended that fertilization and some form of supplementary feeding practice should be carried out particularly in the dry season.

INTRODUCTION

Fisheries management and research often require the use of biometric relationship in order to transform data collected in the field into appropriate indices (Ecoutin and Albarel, 2003). Length and Weight Relationships (LWR) of fishes are important in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them (Sarka *et al*., 2008; and Mir *et al*., 2012). Length–weight relationship (LWR) is an important expression and plays paramount role in fishery biology as it serves several purposes. Like any other morphometric characteristics, the LWR can be used as character for differentiations of taxonomic unit on the relationship changes with various developmental events in life, such as metamorphosis at onset of maturity (Thomas *et al.,* 2003). Fishes exhibited growth in length and the increments in weight, both this developmental activities during it lifetime. It is very important to have information on the food and feeding habits of fish in fresh water bodies especially River Gwallaga that is located within Bauchi metropolis. The River is exposed to various sources of pollutants and effluence from residential areas surrounding it.

MATERIALS AND METHOD

SAMPLING TECHNIQUES AND STOMACH CONTENT ANALYSIS

Field visit were carried out fortnightly. Two (2) out of four station (4) (A, B, C and D) were randomly visited twice a week. Ten (10) *C. gariepinus* was collected with the help of local fishers using traditional fishing gear (Traps and Long Lines). A total of 480 *C. gariepinus* species were collected from the four stations within the period of wet and dry seasons during (Three months per seasons). Total Length of sample fish was measured to the nearest 0.1cm using measuring tape.

A total of ten (10) *Clarias gariepinus* were dissected from each station per visit. The gut were removed and measured, stomach content were placed in a petri dish and were assessed with hand magnifying lens, the feed items consumed by *Clarias gariepinus* were identified in dry season (February, 2019 to April, 2019) and wet season (May, 2019 August, 2019). Stomach repletion were indicated as 0% for empty, 1, 2, 3 and 4 for 25%, 50%, 75% and 100% respectively.

Volumetric index, Gravimetric index, Frequency of occurrence importance index and condition factor (K)

Mi = Σ [stomach score * (1/number of feed item in the stomach)/(total number of analysed stomach)

VI = 25 x M 01

Where Mi average point of each feed item identified

Gravimetric index formula:

GI = wi/w x 100 02

Where wi is cumulative weight of individual feed items and w is the total weight of all the feed items.

Wi = is cumulative weight of individual feed items.

W = is total weight of all the feed items.

Frequency of occurrence formula (F):

F = ni/n x100 03

Where ni is the number of stomach were each feed items is found and n is the total number of stomach where feed items were found.

Importance Index (AI):

AI = (F x VI x GI)/ 1000. 04

Condition Factor (K)

The condition factor will be calculated using the formula:

Condition factor (K) = $100W/L^3$ (Pauly, 1984)
..... 05
Where
W = Weight of fish (g)

L = Total body length of fish (cm)

Statistical Analysis

Correlation and regression analysis were carried out using Microsoft Excel 2007 version to determine the LWR of *Clarias gariepinus* in River Gwallaga.

Results and discussion

Table 1: Stomach content analysis of *C. gariepinus* in (Dry Season) (February – April, 2019)

Feed Items	Frequency of occurrence (F)	Volumetric index (V)	Gravimetric Index (GI)	Importance index (AI=(F,V,GI)/1000)	RANKING
Plant Parts	58.47	17.50	49.23	50.37	1
Insect/Insect Parts	33.98	7.75	19.23	5.06	2
Fish/Fish Parts	10.68	4.75	24.24	1.22	3
Water	6.31	1.50	3.32	0.03	4
Unidentified	3.88	1.25	3.95	0.01	5

Table 1 shows that Plant Part had the highest importance index with the value of (50.37) while unidentified had least importance index with the value of (0.01) foods items.

Table 2: Condition Factors of *C. gariepinus* in Dry Season (February – April, 2019)

S/No	Sampling Stations	Condition Factor (k) Values Minimum	Maximum	Average
1.	Jamaa (A)	0.2840	2.2263	0.6818
2.	Maleka (B)	0.2171	0.9985	0.5458
3.	Rafin Shaa (C)	0.2166	2.3900	0.8132
4.	Jamjale (D)	0.2462	1.1425	0.5510

Table 2 shows that *C. gariepinus* obtained in Rafin Shaa (C) had the highest value of (0.8132), followed by Jamaa (A) and the least value of (0.5458) was in Jamjale (D) dry season.

Stomach content analysis of *C. gariepinus* in River Gwallaga in dry and wet season indicated that the fish species feeds on Plant Part, Insect/Insect Part, Fish/Fish Part, Water and unidentified feed materials. Plant Part had the highest importance index with the value of (50.37) while unidentified had least importance index with the value of (0.01) foods items (table 1).

Condition factor (K) *C. gariepinus* obtained in Rafin Shaa (C) had the highest value of (0.8132), followed by Jamaa (A) and the least value of (0.5458) was in Jamjale (D) dry season (table 2). Reported that the study of condition factor is important for understanding the life cycle of fish species and it contribute adequately to management of species which will lead to achieving equilibrium in the ecosystem Lizama *et al.* (2002).

CONCLUSIONS

Based on the research the morphometric indices relationships shows a negative allometric growth pattern in the fish species. The food items consumed by *C. gariepinus* in River Gwallaga were identified as plant parts, insect/insect parts, fish/fish part, water and unidentified. The condition factor of the fish species in River Gwallaga being less than 1 indicated that they were in poor condition.

REFERENCES

Albaret, J.J. (2003).*Length Weight Relationship of 52 fish species from West African estuaries and Lagoons Cybium*, 27, 3-9.

Ecountin, J.M. and Albaret, J.J. (2003).*Length Weight Relationship of 52 fish species from West African estuaries and Lagoons Cybium*, 27, 3-9.

Lizama, M., de los, A.P. and Ambrosio, A.M. (2002) Condition factor in nine species of fish of the Characidae family in the upper Parana River Flood Plain, Brazil. *Journal of Biology* Brazil. **62** (1): 113-124.

Mir, J.I., Rebello S.C., Pal, and Singh S.P. (2013). Length Weight Relationship and condition factor of selected freshwater fish species found in river Ganga, Gomti and Rapti India *Journal of environmental biology* .**34**, 951 – 956.

Pauly D. and Gayamlo Jr. F.C. (1997). A. Bee an alternative approach to estimating the parameter of Length Weight Relationship from length – frequency sample and their bulk weight *NAGA ICLARM fishbyte*. **1(2)**: 9 – 13.

Sarkar, U.K., Khan G.E., Dabas A., Pathak A.K., Mir J.I, Rebello S.C., Pal A., and Singh S.P. (2013). Length Weight Relationship and condition factor of selected freshwater fish species found in River Ganga, Gomti and Rapti India. *Journal of environmental biology* .**34**, 951 – 956.

Thomas, J.S., Venus and Kurup B.M. (2003). Length Weight Relationship of some deep-sea fish inhibating continental slope beyond 250m depth along west coast of India. *Naga, world fish center quart.***26**, 17 – 21.

APPARENT DIGESTIBILITY COEFFICIENTS OF DIFFERENTLY PROCESSED POULTRY AND FISH OFFAL MEALS FOR AFRICAN CATFISH *Clarias gariepinus* (Burchell, 1822) JUVENILES

O. Orisasona, W.A Asipa & A. A Tiamiyu

Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria

Corresponding author: osasonagbenga@gmail.com

ABSTRACT

Wastes from poultry and fish processing plants whose disposal presently raises a major environmental concern may be a source of animal protein in fish diet, if properly processed. This study was carried out to determine the apparent digestibility coefficients (ADCs) of nutrients in differently processed poultry and fish offal for *Clarias gariepinus*. A reference diet (R) was formulated to contain 40% crude protein. Test diets contained 70% reference diets and 30% of test ingredients, with chromic oxide as the inert marker. The test diets were poultry offal paste with wheat offal as carrier (P1), oven-dried poultry offal (P2), autoclaved poultry offal (P3), autoclaved fish offal (F1), oven-dried fish offal (F2) and fish offal paste with wheat offal (F3). A total of 315 African catfish, *Clarias gariepinus* juveniles (average weight; 5.50±0.50 g) were randomly distributed into 21 plastic tanks of dimension 0.42m x 0.29 m x 0.25m at 15 fish per tank. Diets R, P1, P2, P3, F1, F2 and F3 were fed to triplicate groups of fish twice daily at 5% body weight for 8 weeks and excess feed siphoned out 30 minutes after each feeding. Faecal collection was done 8 hours after every feeding and pooled for each treatment for chemical analysis. Apparent Digestibility Coefficients of nutrients varied significantly across treatments ($p<0.05$). ADC of crude protein was highest in F3, fish offal paste/wheat offal (78.63%) and lowest in F1, Autoclaved fish offal (65.83%). ADC lipid was highest in F3 (81.37%) followed by F2, oven dried fish offal (80.54%) and F1 (73.94%). ADC of phosphorus was highest in F2 (97.27%) followed by F3 (86.71%) and least in F1 (81.27%). The result of this study reveals that fish offal subjected to oven drying and the one blended with wheat offal showed high nutrient digestibility and therefore, can be utilized as protein source in the diets of *Clarias gariepinus*.

Key Words: *Clarias gariepinus*, Poultry Offal, Fish Offal, Processing, Digestibility

INTRODUCTION

Nutrition plays a critical role in intensive aquaculture as it influences not only the production cost but also fish growth, health and waste production (Gatlin, 2002). For profitability and success in fish farming, ingredients for feed production must be readily available and cheap to produce diets that are cost-effective. Similarly, the bioavailability of nutrients in ingredients is very crucial for successful fish nutrition. The conventional feed ingredients for fish are mainly from plant and animal products especially by-products of processing plants. Some of these products are also used as human food (SRAC, 2010). Feed is the single most expensive factor in aquaculture production and the protein component of fish diet constitutes the highest cost, this is because the fishmeal that supplies the bulk of the protein is very expensive (Aniebo *et al.*, 2009). The proportion of protein in fish diets is higher than those of other cultured animals, thus making feeds very exorbitant (Aniebo *et al.*, 2009). Depending on the stage of growth, studies have shown that the African catfish requires between 35-50% crude protein in their diet, with resultant cost implication (Wilson and Moreau, 1996; Adebayo and Quadri, 2005). For sustainable and profitable fish farming, there is therefore a pressing need to reduce feed cost through the use of locally available, cheap and accessible materials.

Wastes generated from poultry and fish processing are potential protein source for cultured fish. In Nigeria, there is a rapid expansion of small and medium-scale poultry farms with huge amount of

waste generation. Similarly, the fish processing industry generates wastes consisting of discarded parts (internal organs such as liver, heart, kidney, eggs, gills, and gonads, bone and sometimes head) which are not fit for human consumption. The huge quantity of wastes has caused some serious environmental havoc such as vectors for insects, vermin, bacteria, and viruses, which may result in water contamination (leaching of nutrients and pathogenic microorganisms) and air pollution (FAO, 2011). However, instead of being wasted and dumped, they can be utilized to produce fish feed and indirectly helps towards a greener environment.

The utilization will however require some form of processing, as feeding of fresh fish offal to fish was reported to cause mycobacteriosis (Francis-Floyd, 2011). The reduction or elimination of pathogens is mostly achieved through heat treatment (Sauli *et al*., 2005), as it is simple and easy to adopt among local farmers. They however do have the potential to damage useful nutrients if appropriate processing technique is not applied (Papadopoulos, 1989). It is also of utmost importance that the nutrients present in feedstuffs are completely available to the animal body. Otherwise, large portions of the nutrients are excreted in the faeces because of not being digested in the alimentary tract. Digestibility study is thus very important in the selection of feed ingredients for feed formation. It is described it as one of the most important aspects in evaluating the potentials, efficiency of animal feedstuffs and basic requirements for formulating fish diets (Allan et al., 2000; Cho and Kaushik, 1990).

This study is aimed at determining the nutrient digestibility of differently heat treated poultry and fish offal meals by *Clarias gariepinus.*

MATERIALS AND METHODS

PROCESSING OF OFFAL

Offal of fish and poultry were procured from processing plants in Ile-Ife, Osun State. The fish and poultry offal were divided into three portions each.

Autoclaved Fish and Poultry offal meals: A portion of fish offal and poultry offal were seperately autoclaved at 15 psi for 20 minutes and then oven dried at 70°C for 24 hours, milled (Giri *et al.*, 2000) and designated as F1 and P1 respectively.

Oven-dried Fish and Poultry offal meals: A second portion of fish and poultry offal each were dried in hot air oven at 55^{0}C for 48 hours, milled (Giri *et al*., 2000) and designated as F2 and P2 respectively.

Offal in wheat meals: A third portion of fish and poultry offal were blended into paste (using an electric blender) and mixed with wheat offal at ratio 7:1 (Offal:Wheat), (slight modification of Makinde and Sonaiya, 2012) and oven dried at 50 ^{0}C for 48 hours, milled and designated as F3 and P3 respectively.

EXPERIMENTAL DIETS

A reference diet was formulated using Pearson square method to contain 40% crude protein (Table 1). Test ingredients for digestibility test were autoclaved fish offal (F1), autoclaved poultry offal (P1), oven-dried fish offal (F2), oven-dried poultry offal (P2), fish offal paste with wheat offal (F3) and poultry offal paste with wheat offal (P3). The test diets contained 70% reference diet and 30% of each of the test ingredients on a dry weight basis (Dong *et al.*, 2010; Luo *et al.*, 2009; Falaye *et al.*, 2014), with chromic oxide (Cr_2O_3) as inert marker (Cho and Slinger, 1979). Test ingredients were thoroughly mixed with other ingredients with cassava starch as binder. The mash was then pelletized with 2 mm

die hand-driven pelletizer to form pellets. The diets were then sundried at atmospheric temperature and humidity for 2 days and packed into well-labeled air-tight plastic containers until ready to use.

Table 1: Feed Formulation for Reference and Experimental Diets (g/100g)

Ingredient	Reference Diet	Experimental Diet
Fish meal	8.70	6.13
Soybean meal	43.75	30.63
Groundnut cake	17.50	12.25
Maize	24.49	17.14
Vitamin premix	1.00	0.70
Dicalcium phosphate	1.00	0.70
Lysine	0.50	0.35
Cr_2O_3	0.50	0.35
Salt	0.50	0.35
Starch	1.00	0.70
Palm Oil	1.00	0.70
Test Ingredient	----	30
Total (g)	100	100

EXPERIMENTAL DESIGN AND PROCEDURE

The experiments were carried out in rectangular plastic tanks of 0.42 m x 0.29 m x 0.25 m with water volume maintained at 20 L in each. After a 7-day acclimatization to laboratory conditions, a total of 315 African catfish, *Clarias gariepinus* juveniles with an average weight (5.50±0.50 g) were randomly allocated into 21 experimental plastic tanks at the rate of 15 juveniles per tank.

Diets were fed to triplicate groups of fish twice daily, between 7.00 - 8.00 am and 4.00-5.00 pm at 5% body weight throughout the experiment. The ration was adjusted every two weeks when new mean weights of fish for the various experimental units were determined. Leftover (uneaten) feed in each tank was siphoned 30 minutes after feeding to avoid leftover feed contaminating the faeces. Faeces in each tank were gently siphoned out using siphoning hose of 2 mm diameter every 8 hours after feeding. The faeces were pooled for each treatment and dried.

CHEMICAL ANALYSIS

The mineral and proximate composition of different diets and fecal samples were done as described by A.O.A.C (2005). Chromic oxide contents were determined as described by Farukawa and Tsukahara (1966).

APPARENT DIGESTIBILITY COEFFICIENT (ADC)

The apparent digestibility coefficients (ADCs) of protein, lipid and phosphorus for test and reference diets were calculated as follows (Cho and Slinger, 1979)

$$ADC\ nutrient = 100 - 100(\frac{Cr_2O_3\ in\ diets}{Cr_2O_3 in\ feaces} \times \frac{Nutrient\ in\ feaces}{Nutrient\ in\ diets})$$

Since the test ingredients substituted 30% of the reference diet, the ADC of the ingredients were calculated according to the following equation (De silva and Anderson, 1995):

$$\mathrm{ADCn} = \frac{\mathrm{ADCTD} - (\mathrm{Y\ x\ ADCRD})}{\mathrm{Z}}$$

ADCn: Apparent digestibility coefficient of nutrient in test ingredient, ADC_{TD}: Apparent digestibility coefficient in test diet and ADC_{RD}: Apparent digestibility coefficient in reference diet, Y is the reference diet proportion and Z is the test diet proportion.

STATISTICAL ANALYSIS

All data resulting from the experiment were subjected to one way analysis of variance (ANOVA) and subjected to Duncan's multiple range test at $p<0.05$. Analysis was carried out using SAS (statistical analysis software) system 2003 version.

RESULTS AND DISCUSSION

The proximate composition of test diets is presented in Table 2. The moisture in the diets ranged from 7.68% in F2 to 8.92% in P2. Ash content in diets varied significantly ($p<0.05$) ranging from 6.75% in P3 to 10.26% in F2. P3 and F3 groups with wheat offal meal had the least ash contents among the two. Crude fibre values were significantly lower ($p<0.05$) in the P2 and F2 groups, with the highest value recorded in P3 group. Similarly, crude protein was significantly lower in P2 and F2. The crude protein is significantly higher ($p<0.05$) in P1. The variation in proximate compositions of the test diets is attributed to the effect of the processing techniques used in this present study. Similar variations were reported for feedstuffs subjected to various heat treatments in Hueze *et al*, (2015).

Table 2: Proximate Composition of Experimental Diets

PARAMETER (%)	P1	P2	P3	F1	F2	F3	R	SEM
Moisture	8.64^{b}	8.92^{a}	7.82^{d}	8.29^{c}	7.68^{d}	8.76^{ab}	8.86^{a}	0.131
Ash	7.03^{f}	7.21^{e}	6.75^{g}	9.46^{b}	10.26^{a}	8.43^{c}	7.57^{d}	0.343
Crude Fibre	3.44^{bc}	2.73^{f}	3.70^{a}	3.57^{ab}	2.99^{e}	3.29^{cd}	3.12^{de}	0.089
Crude Protein	39.81^{a}	38.50^{d}	39.38^{b}	38.94^{c}	37.63^{e}	38.94^{c}	38.50^{d}	0.180
Lipid	21.53^{a}	21.84^{a}	17.86^{b}	14.34^{d}	16.41^{c}	13.50^{e}	7.31^{f}	1.296
NFE	19.55^{f}	20.80^{e}	24.49^{d}	25.40^{c}	25.03^{cd}	27.58^{b}	34.64^{a}	1.270

Means with the same superscripts along rows are not significantly different (P>0.05)

P1: Autoclaved Poultry offal diet, P2: Oven-dried Poultry offal diet, P3: Poultry offal paste + Wheat offal diet, F1: Autoclaved Fish offal diet, F2: Oven-dried Fish offal diet, F3: Fish offal paste + Wheat offal diet, R: Reference Diet

Result of the apparent digestibility coefficients (ADCs) of nutrients is presented in Table 3. Apparent digestibility of protein varied significantly as a result of heat treatment. Protein digestibility was significantly highest in P2 (83.36%) and least in P1 (56.06%). The apparent digestibility for crude protein in this study was lower than that reported by Hossain and Jauncey (1989), where observed apparent digestibility coefficient for crude protein of fish meal in carp was 88.9%. Also higher value of fish meal digestibility for *Labeo rohita* was also reported by Salim *et al.*, (2004). The ADCs for protein obtained in P2, F3 and F2 are in agreement with the range of protein digestibility values of 75 to 95% reported for freshwater fish fed selected diets (Koprucu and Ozdemir, 2005), while the ADCs of protein in F1, P3 and P1 are significantly lower than the range. It is important to note that protein content can be affected by heat treatment (Falaye *et al.*, 2014), and subsequently, the digestibility, as observed in F1 and P1 in this study. Part of the variation in the ADC of protein in different ingredients may also be explained by differences in the chemical composition resulting from processing techniques used for various feed ingredients (Koprucu and Ozdemir, 2005; Watson, 2006). Excessive heat as demonstrated in autoclaved meals denatures protein and thus negatively affects digestibility as affirmed by Falaye *et al.* (2014).

The apparent crude fat digestibility coefficients varied significantly ($p<0.05$) across treatments, with the highest recorded also in P3 (96.30%) followed by P1 (95.37%), P2 (91.74%) and the least in F1 (73.94%). The apparent digestibility coefficients of crude fat in F1, F2 and F3 in this study were lower than the values reported for fishmeal by NRC (1993), while the values of ADCs of lipid in P1, P2 and P3 are in line with reported values of 85-95% for fish meal. Crude fat digestibility in F2 and F3 groups are similar to 81.35% reported by Jalal *et al*., (2000). However, the apparent fat

digestibility coefficients obtained in this study were higher than the 68% reported by Gaylord and Gatlin (1996).

The apparent phosphorus digestibility increased from 74.31% in P3, 81.27% in F1, 85.37% in P2 86.71% in F3, 97.27% in F2 to 99.57% in P1. Phosphorus is a very important factor in aquaculture. Its utilization in fed diets is critical in aquaculture effluent as it affects eutrophication (Falaye *et al.*, 2014).

Table 3: Apparent Digestibility Coefficients of Protein, Lipid and Phosphorus of Experimental Diets

PARAMETER (%)	**P1**	**P2**	**P3**	**F1**	**F2**	**F3**	**SEM**	**P-VALUE**
ADC Protein	56.06^{f}	83.36^{a}	57.09^{e}	65.83^{d}	76.96^{c}	78.63^{b}	3.20768	<0.0001
ADC Lipid	95.37^{b}	91.74^{c}	96.30^{a}	73.94^{f}	80.54^{e}	81.37^{d}	2.52817	<0.0001
ADC Phosphorus	99.57^{a}	85.37^{d}	74.31^{f}	81.27^{e}	97.27^{b}	86.71^{c}	2.63729	<0.0001

Means with the same superscripts along rows are not significantly different (P>0.05)

The result of this study reveals that autoclaving reduced crude protein digestibility as observed in P1 and F1, thus reducing the nutritive value of these ingredients. It can be concluded that oven-dried meals were better digested by *Clarias gariepinus* when ADC protein, lipid and phosphorus are considered and therefore should be explored in growth experiment for this species.

REFERENCES

Adebayo O. T. and Quadri I. C. (2005). Dietary protein level and Feeding rate for African catfish (*Clarias gariepinus*) diets. *Revista UDO Agricola.* 9(3):666-671

Allan, G.L, S. Parkinson, M.A Booth, D.A.J. stone, S.J .Rowland, J. Frances and R. warner-smith, (2000). Replacements of fish meal in diets for Australian silver perch, (Bidyanus bidyanus. Digestibility of alternative ingredients. *Aquaculture*, 186; 293-310)

AOAC, (2005). Association of Official Analytical Chemists of Official Methods of Analysis. 18th Edn., AOAC, Maryland, Washington, DC., USA.

Cho, C.Y. and Slinger S. J. (1979). Apparent digestibility measurements in feed stuffs for rainbow trout. *In: Halver, J.E., Tiews, K. (Eds.), Finfish Nutrition and Fish feed Technology, Vol. 2. Heinemann, Berlin, Germany, pp. 239–247.*

De Silva, S. S and Anderson T.A. (1995). Fish Nutrition in Aquaculture. *Chapman and Hall, London, 319 pp*

Falaye A.E, Omoike A. and Orisasona O. (2014). Apparent digestibility coefficient of differently processed lima bean (*Phaseolus lunatus L.). Journal of Fisheries and Aquatic science*, 9(2):75-84

FAO (2011). Regional review of status and trends in aquaculture development in sub-saharan Africa, by Benedict P Satia. *FAO Fisheries and Aquaculture Circular No. 1135/4. Rome, Italy.*

Farukawa A. and Tsukahara H. (1966). On the acid digestion method for the determination of chromic oxide as an index substance in the study of digestibility of fish feed. *Bull. Jap. Soc. Sci. Fish., 32: 502-506.*

Francis-Floyd R. (2011). Mycobacterial Infections of Fish; *SRAC Publication No. 4706*

Gatlin III, D.M. (2002) Nutrition and Fish Health. In: Halver, J.E. and Hardy, R.W., Eds., Fish Nutrition, *3rd Edition, Academic Press, London, 671-702.*

Gaylord T. G. and Gatlin D. M. (1996). Determination of digestibility coefficients of various feedstuffs for red drum (*Sciaenops ocellatus*). *Aquaculture, 139(3): 303-314.*

Hardy R.W. (2003) Understanding and using apparent digestibility coefficients in fish nutrition. *Aquac. Mag., 23, 84–89.*

Hossain M. A. and Jauncey K. (1989). Studies on the protein, energy and amino acid digestibility of fish meal, mustard oil cake, linseed and sesame meal for common carp (*Cyprinus carpio* L). Aquaculture, 83: 59-72. Hybrid Clarid Catfish, *Clarias gariepinus x Heterobranus bidorsallis* in homestead tanks. *Journal of Applied Aquaculture 17 (1): 97-106.*

Jalal K. C. A., Ambak M. A., Saad C.R., Hassan A. and Abol M. A. B. (2000). Apparent digestibility coefficients for common major feed ingredients in formulated feed diets for tropical sport fish, *Tor tambroides* fry. *Pakistan J. Biol. Sci., 3(2): 261- 264.*

Koprucu K. and Ozdemir Y. (2005). Apparent digestibility of selected feed ingredients for Nile tilapia, *Oreochromis niloticus.* Aquaculture 250, 308–316.

NRC (National Research Council), (1993). Nutrient Requirements of Fish. National Academy Press, Washington, DC. USA.

Paulraj R. and Easterson D. C. V. (1999). *Determination of digestibility coefficient.* CMFRI special publication- Manual of Research Methods for Fish and Shellfish Nutrition (8*).* pp. 75-81.

Rustad T. (2003). Utilization of marine by-products. *Electr J Environ, Agricult and Food Chem*2(4):458-463

Salim M., Aziz I., Sultan J. I. and Mustafa I. (2004). Evaluation of apparent digestibility of fish meal, sunflower meal and rice polishing for *Labeo rohita. Pakistan J. Life Soc. Sci., 2(2):139-144.* Southern Regional Aquaculture Centre (SRAC) (2010) Principle of Fish Nutrition. *SRAC Publication No 5003, 1-7.*

Cho, C.Y. and S.J. kauskik,(1990).Nutritional energetics in fish; energy and protein utilization in rainbow trout (salmo gairdneri). World Rev. Nutrient diet, 61;132-172.

Wilson R. P and Moreau Y. (1996). Nutrient requirements of catfishes (Siluroidei). In: M. Legrende and J. P. Proteau (EDS) Biology and culture of catfishes. *Aquatic Living Resources 9, Horse series,* p. 103-111.

ASSESSING RISKS MANAGEMENT STRATEGIES AMONG BACKYARD SNAIL FARMERS IN OWO METROPOLIS, ONDO STATE, NIGERIA

P. T. Owombo[1], I. Ibidapo[2] R. E. Mbossoh[3]

[1]Department of Agricultural Economics and Extension, Ondo State University of Science and Technology, Okitipupa, Nigeria
[2]Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria
Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

just like any other farming enterprise is faced by a number of production militating risk factors, ranging from production through to marketing. Risk is a condition that relates to the possibility that yield or output levels will be lower than projected (Ibekwe & Andopara, 2016). Etchu *et al*. (2008) itemized snail production limiting risk factors to include climate change, pests and diseases as well as lack of good quality stock. In addressing production limiting factors called risk, farmers adopt risks management techniques for the purpose of ensuring optimum production. Risk management in agriculture is an essential tool employed by farmers to guide against production shock (OECD, 2011). Risks threatens output, returns and the overall performance of a farm business (Hamid & Chiaman, 2010). Hamid & Chiaman (2010), added that selecting appropriate risk The study was conducted to assess risk sources and management strategies employed in backyard snail farming in the study area. The study employed a snowball sampling procedure to select 29 respondents for the study. Data were collected with the aid of structured questionnaire. Data collected were analysed with the aid of descriptive statistics such as frequency count, simple percentage and standard deviation. Results of analysis showed that the mean age of the respondents was 50.55±5.1 years. Results also showed that 40.3% of respondents had no formal education while the mean year of production experience was 4.97±3.1. Results further showed that 100, 89.7 and 79.3% of respondents indicated climate change/drought, poor quality foundation stock and theft as major sources of risk in backyard snail farming while watering and building mini fence were the major risks management strategies employed in the study area. Snail producers should be encouraged to adopt right risk management strategies for efficient performance.

Keywords: Assessing, management, strategies, backyard, snail

INTRODUCTION

Snail farming is a micro-livestock enterprise that creates supporting source of livelihood for both rural, semi-urban and urban dwellers. Snail farming is now a popular micro livestock enterprise in Africa, Nigeria, inclusive owing to high protein demand, biodiversity conservation and livelihood option (Rekha *et al*., 2015). The spread of the non-conventional farming system is on the increase probably due to awareness of its nutritional, therapeutic, cosmetic and industrial properties (Ezeano, 2016). Snail farming management techniques is a right decision in the right time as a guide against production failure. The study therefore, investigate the sources of risks and risks management strategies employed by snail farmers in the area.

RESEARCH METHODOLOGY

The study was conducted in Owo metropolis in Owo Local Government Area (LGA) of Ondo State. The town is selected in the LGA for the study based on household's involvement in backyard snail farming. Ondo State is located in the western part of Nigeria. The state falls on longitude 4^0 $45^{1`}$ and $6^0$00 east of the Greenwich meridian and latitude $4^0$ $45^{1`}$ north of the equator. The inhabitants of the metropolis are mainly civil servants and artisans who engage in secondary occupation mainly backyard farming among which is snail keeping. Snowball sampling procedure was used for the study. A backyard snail producer was located who helped identify other snail keepers in the study area. A total of 29 backyard snail keepers were identify for data collection. Data were collected on socio-economic characteristics of snail producers, risk sources and risk management strategies employed in the study area. Data collected were analysed with descriptive statistics such frequency counts, simple percentage, mean and standard deviation.

RESULTS AND DISCUSSION

SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Table 1 shows socioeconomic characteristics of respondents. The results in the table show that 72.41% of the respondents were male while just 27.59% of them were female. This implies that backyard snail farming in the

area is dominated by male farmers. The results also show that majority (34.4%) of respondents fell in the age range of 41-50 years while 20%, 25%, 9.4% and 10.6% fell in the age ranges of ≥40 years, 51-60 years. 61-70 years and ≥71 years, respectively. This implies that active men were in the enterprise. The results further show that 45% of the respondents were widowed while 6.9%, 31.4%, and 16.1% were single, married and divorced, respectively. Majority (43.9%) of the respondents had household size range of 8-9 while 18.9%, 19.4% and 16.1% percent had household size ranges of ≤2, 3-4 and 5-7, respectively. The mean household size in the area was 5.01±2.4. Majority (40.3%) of the respondents had no formal education while 35.6%, 14.5% and 9.1% of respondents had primary, secondary and tertiary education, respectively. Also, 43.9% of respondents had snail production experience range of 4-5 years while 17.5%, 19.7% and 16.7% of respondents had snail farming experience ranges of ≤1 year, 2-3 years and 6-7 years, respectively. Majority (65.52%) of the respondents owned the building they live in while 34.48% of them indicated otherwise. Building ownership might be the reason for involvement in the enterprise.

Table 1: Socio-economic characteristics of the respondents

Variable	Frequency	Percentage	Mean ± Std. Dev.
Sex			
Male	21	72.41	
Female	8	27.59	
Age of respondents			
≤40	6	20	
41-50	10	34.4	50.55±5.1
51-60	7	25	
61-70	3	9.4	
≥71	3	10.6	
Marital status			
Single	2	6.9	
Married	9	31.4	
Divorced	5	16.1	
Widowed	13	45	
Household size			
≤2	5	18.9	
3-4	6	19.4	5.01±2.4
5-7	5	16.1	
8-9	13	43.9	
Level of education			
No education	12	40.3	
Primary education	10	35.6	
Secondary education	4	14.5	
Tertiary education	3	9.1	
Year of snail keeping			
≤1	5	17.5	
2-3	6	19.7	
4-5	13	43.9	4.97±3.1
6-7	5	16.7	
Ownership of building			
Owned	19	65.52	
Otherwise	10	34.48	

Std. Dev = Standard deviation

Risk sources in snail farming

Table 2 showed the risk sources in backyard snail farming in the study area. The result showed that all respondents (100%) indicated climate change/drought as major source of risk in backyard snail production. This was ranked 1st source of risk in backyard snail farming in the study area. The table further showed that 89.7% indicated poor quality foundation stock as major source of risk in the study area. This was ranked 2nd major source of risk in the area. Also, 79.3% and 37.9% indicated theft and pest/disease as major sources of risk in backyard snail farming. Theft and pest/disease were ranked 3rd and 4th major sources of risk in the study area. This implied that backyard snail farming in the area is faced with several risk factors.

Table 2: Risk sources in snail farming

Item	Frequency	Percentage	Rank
Climate change/drought	29	100	1st
Poor quality foundation stock	26	89.7	2nd
Theft	23	79.3	3rd
Pest/disease	11	37.9	4th

MULTIPLE RESPONSES

RISK MANAGEMENT STRATEGIES

Table 3 showed the risks management strategies in backyard snail farming in the study area. The result showed that 93.1% managed climate change/drought by periodic watering of snailry. The result also showed that just 48.3% of respondents sought experts' advice before stocking while 82.8% and 31% managed theft and pest/diseases risks by building mini fence round the snailry and checking snailry for pest picking. This implied that backyard snail farmers in the area managed risk factors for efficient performance of snailry.

Table 3: Risk management strategies

Management strategies	Frequency	Percentage
I carryout periodic watering	27	93.1
I seek expert's advice before stocking	14	48.3
I build mini fence round my snailry	24	82.8
I check snailry for pest picking	9	31.0

CONCLUSION

The study concluded that the backyard snail farmers in the area were still in their active ages. The major production risks faced in backyard snail farming in order of severity were climate change/drought, poor quality foundation stock, theft and pest/disease. The major risks management strategies employed by snail farmers were periodic watering and building mini fence round snailry. Small scale snail farmers should be encouraged to manage drought and theft risks by watering the snailry as well as building mini fence round the snailry.

REFERENCES

Etchu, K. A, Mafeni JM, Ngenwi AA (2008). Comparative performance of three edible snail species using intensive cage housing system in Cameroon. Bull. Anim. Health Prod. Afr. 56:345-352.

Etchu and K. J. N. Ndamukong (2013). The perception of climate and environmental change on the performance and availability of the edible land snails; a need for conservation. *African Journal of Agricultural Research*, 8(11): 1457-1465.

Ezeano, C. I. (2016). Challenges of Small-Scale Snail Farmers in Oji-River Local Government Area, Enugu State, Nigeria.*International Journal of Agriculture and Biosciences*,Challenges of small-scale snail farmers in Oji-River Local Government Area,Enugu State, Nigeria. Inter J AgriBiosci, 5(6): 370-372.

Hamid, M. Y. and Chiaman, E. S. (2010). Risk and Uncertainty Assessment of Nomadic Cattle pastoralist in Mubi-North Local Government Area of Adamawa State, Nigeria.Proceedings of 11th Annual National Conference of National Association of Agricultural Economics (NAAE), FUT, Minna.pp109 – 113.

Ibekwe, U. C. and Andopara, T. C. (2016). Risk management strategies and its adoption levels in frozen fish business in Imo state, Nigeria. proceedings of the Nigerian association of agricultural economists, pp1021-1025.

OECD (2011) Risk Management in Agriculture: What Role for Government. Organization for Economic Cooperation And Development Documents Retrieved from WWW.oecd.org/agriculture.

Rekha, S. R., Munsi, M. andNeelavara, A. A. (2015). Effect of Climate Change on Invasion Risk of Giant African Snail (*Achatinafulica*Férussac, 1821: Achatinidae) in India.PLoSONE10(11): e0143724. https://doi.org/10.1371/journal.pone.0143724.

ANALYSIS OF PROFITABILITY IN CATFISH PRODUCTION A CASE STUDY OF LOKOJA LGA KOGI STATE

Saliu H.O, & Ayegba F.I

Department of Agricultural Education, Kogi State College of Education(Technical), Kabba, Kogi State, Nigeria.

ABSTRACT

This study examined the profitability of catfish farming in lokoja local government area of Kogi State, Nigeria. A multi-stage random sampling procedure was used to collect primary data for the study. The first stage involved a purposive selection of lokoja local government areas based on predominance of catfish production. The second stage involved a random selection of 4 villages. The final stage involved the random selection of catfish-producing households from the villages selected. Data were analysed using descriptive statistics and gross margin analysis. The result of the analysis shows that the mean age of the respondents was 38 years; the majority of the farmers do not have formal education. The mean household size was 6, farming experience had the mean of 5 years and mean for the amount of credit obtained was ₦6000. The average rate of returns on investment (return per naira invested) was 1.91, indicating that for every ₦1 invested in catfish production in the study area; a profit of 91 kobo was made. Thus, it could be concluded that catfish production in the study area though on a small scale, was economically viable.

INTRODUCTION

Aquaculture refers to the cultivation of aquatic organisms under controlled or semi-controlled conditions for economic and social benefits. Aquaculture has been the world's fastest growing food production system over the past decade (Fourier, 2006). In Nigeria, fishery in the agricultural sector is important (Kudi *et al*., 2008). It serves as a source of income and job creation for a good number of people, most especially in the rural areas where agriculture is their major source of livelihood. Also, fish is a source of protein, minerals and vitamins in the diet of Nigerians (Kingdom and Alfred-Ockiya, 2009). Despite the importance of fish in the diet of Nigerians, supply is far below that required to meet the dietary needs of the teeming populace, thereby exposing them to dangers of malnutrition and other resulting health implications (Oyakhilomen and Zibah, 2013). This shortage in supply is seen in the importation and consumption rates of animal protein in Nigeria. Animal protein consumption is 8grams per caput per day (Ugwumba, and Chukwuji, 2010), a far cry from the Food and Agriculture Organization (FAO, 1991), minimum recommendation of 35 grams of animal protein per caput per day for sustainable growth and development, The raising of fish in Nigeria cuts across both the extensive and intensive system of farming and the rearing of different species. However, catfish is among the most commonly cultured species of fish (Issa *et al*., 2014). Catfish commands very good commercial value in the market (Ugwumba, 2011).

Materials and Methods

The study was conducted in Lokoja Local Government Areas of Kogi State of Nigeria. Kogi State is located between latitudes 60 33'and 80 44'North and longitudes 50 22' and 70 49' East of the Equator (Kogi State Government, 2007). The state has a total population of about 3,278,000, with an average of about 228,964 farm families (NPC, 2007). Based on 3.2 percent annual growth rate, the projected population of Kogi State as at 2019 was 4,417,000. About 70% of the people live in rural areas and are engaged in agricultural production. The average farm family is made up of 7 people, with an average farm size of about 2 hectares per farmer (Kogi State Government, 2007).

The two largest rivers in Nigeria (Niger and Benue) flow through the state with all their tributaries. In addition to farming as the major occupation, some of the citizens are civil servants while others are engaged in buying and selling of goods and services.

A multi-stage sampling technique was used for the selection of respondents. The first stage was purposive selection of Lokoja Local Government Areas in Kogi State, based on the predominance catfish production in the area. Secondly, four villages were randomly selected from the Local Government Areas, Thirdly, random sampling method was used to select ten percent of the catfish farmers from the villages through the use of random numbers from the list of the sample frame.

For this study, only primary data were used. The primary data were collected for the 2018 season with the aid of structured questionnaire. The information collected includes:

The socio-economic characteristics of the respondents such as age, catfish farming experience, household size, educational level, extension contact, amount of credit obtained and membership of farmers' group/associationsnand the cost(Naira) of inputs; output of cat fish (Kilogramme) and the sales (Naira), and the constraints associated with catfish production in the study area.

The analytical tools that were used to achieve the objectives of this study include descriptive statistics and gross margin analysis.

RESULTS AND DISCUSSION

RETURNS TO INVESTMENT IN CATFISH PRODUCTION

Results presented in Table indicate that the total revenue (TR) was ₦63,354.08 while the total variable cost (TVC) was ₦33,155. The gross margin was therefore ₦30,199.08. The average rate of returns on investment (return per naira invested) was 1.91, indicating that for every ₦1 invested in catfish production in the study area; a profit of 91 kobo was made. Thus, it could be concluded that catfish production in the study area though on a small scale, was economically viable.

Average costs and returns of catfish production

Variables	Values (₦)	% Contribution
A. Variable cost		
i fingerlings (kg)	3,020	9.1
ii feeds (kg)	9,047	27.3
iii labour (man-days)	19,344	58.3
iv agrochemical (litres)	1,744	5.3
B. Total variable cost	33,155	100
C. Total Revenue	63,354.08	
D. Gross Margin (C -B)	30,199.08	
F Return per Naira Invested (C/B)	1.91	

CONCLUSION

Based on the findings of this study, it could be concluded that catfish production in the study area was profitable by returning 91 kobo to every ₦1.00 spent.

REFERENCE

Issa, F. O., Abdulazeez, M. O., Kezi, D. M., Dare, J. S., and Umar, R. (2014). Profitability analysis of small-scale catfish farming in Kaduna State, Nigeria. *Journal of Agricultural Extension and Rural Development*, 6(8): 267-273.

Kingdom, T., and Alfred-Ockiya, J.F. (2009). Achieving the millennium development goals through fisheries in Bayelsa State, Niger Delta, Nigeria. *Asian Journal of Agricultural Sciences*, 1(2):4347.

Kudi, T. M., Bako, F. P., and Atala, T. K. (2008). Economics of fish production in Kaduna State, Nigeria. *ARPN Journal of Agricultural and Biological Science*, 3(5&6): 17-21.

Okoror, O.T.*, Izekor, O.B. and Ijirigho, P.A. (2017). Measurement of Technical Efficiency of Catfish Farmers in Benin Metropolis, Edo State, Nigeria: A publication of the School of Agriculture and Agricultural Technology, The Federal University of Technology, Akure, Nigeria. 22(1): 52-58.

Oyakhilomen, O., and Zibah, R.G. (2013). Fishery production and economic growth in Nigeria: Pathway for sustainable economic development. *Journal of Sustainable Development in Africa*, 15(2): 99-109.

Ugwumba, C. O. A., and Chukwuji, C. O. (2010). The economics of catfish production in Anambra State, Nigeria: a profit function approach. *Journal of Agriculture and Social Sciences*, 6(4):105-109.

Ugwumba, C.O.A., and Okoh, R.N. (2010). African Catfish farming in concrete and earthen ponds: A comparative profitability analysis. *Journal of Research in National Development*, 8(2): 1-6.

Ugwumba, C.O.A. (2011). Technical efficiency of catfish production in Anambra State, Nigeria: A translog stochastic frontier production function approach. Agricultura Tropica et Subtropica, 44(1): 30-36.

NUTRITIONAL POTENTIAL OF AFRICAN YAM BEAN MEAL AS SUBSTITUTE FOR SOYBEAN MEAL IN THE DIETS OF GROWING SNAILS (*ARCHACHATINA MARGINATA*)

Popoola[1], Y.A, Omole[1], A.J., Okpeze[2], V.E Fayenuwo[1], J.O., Owosibo[1],T.O
1. Obafemi Awolowo University, Institute Of Agricultural Research and Training Moor Plantation, Ibadan,Nigeria
2 Federal College of Agriculture Moor Plantation., Ibadan, Nigeria.
omoleboye@yahoo.com

ABSTRACT
The study was conducted to determine the effect of replacing soyabean meal with different levels of African Yam Bean meal (AYB) in the diet of growing snails. A total of one hundred and twenty growing snails (*Archachatina margi*nata) of mean weight 73.42 ± 2.5g of about 3 months of age were used for the feeding trial. Four diets were formulated to contain African Yam beans (AYB) at 0% (AYB_1) Control, 50% (AYB_2), 75% (AYB_3) and 100% (AYB_4) as replacement for maize fraction in the diet of growing snails. Completely randomized design was used for the trial and each treatment was replicated thrice with 10 snails per replicate. The mean feed intake in 0% and 75% replacement of SBM with AYB were not significantly affected by the dietary treatments (P> 0.05). The mean weight gain in AYB_1, AYB_2 and AYB_3 were relatively the same (P>0.05). The feed conversion ratio (FCR) was relatively the same in all the treatments. The mean shell width increment was relatively the same across the treatments (P> 0.05). The lowest cost/weight gain was recorded in the diet containing 75% AYB as replacement for soybean meal while the highest cost/weight gain was recorded in the diet containing 100%SBM. African Yam Bean meal could be harnessed as alternative feed resource for snail production. It could be recommended that 75% of AYB could be used to replace soybean meal fraction of the diet in order to reduce feed cost

Keywords: African yam bean meal, cost per weight gain, feed intake, soybean meal, weight gain,

INTRODUCTION
Snail meat contains low fat and low cholesterol level which makes the meat a good antidote for fat related diseases. The cost of production in terms of housing and feed is relatively low compared to other conventional livestock (Odeyinka, 2014). One of the major limitations to the efficient snail rearing is the availability of quality feed at affordable price (Omole, *et.al*., 2016). Quality feed at affordable price has negative effects on livestock production in Nigeria and Africa in general. A lots of livestock farms have been closed down which has resulted in to high cost of livestock products such as meat, eggs and other products (Omole, *et.al*., 2016). Conventional feed ingredients such as soyabean meal, groundnut cake meal and fish meal which are major sources of protein in diet of livestock are expensive (Omole, *et.,al.,*2016; Odeyinka, 2014). The cost of groundnut cake meal and soya bean meal as of the time of conducting this study were ₦135 and ₦160 respectively hence there is need to look for alternative source of protein which is available and affordable **(**Agbulu *et al.,*2010). It has been established by authors that substituting conventional feed ingredients with unconventional ones has led to reduction of cost (Odeyinka, 2014). African yam beans is common in Nigeria but it is considered as underutilized legume (Adewale, *et al.,*2013). There is paucity of information in the use of African yam bean meal in the diet of snails hence the study was conducted to determine the effect of replacing soyabean meal with different levels of African yam bean meal in the diet of growing snails.

MATERIALS AND METHOD
A total of one hundred and twenty growing snails (*Archachatina margi*nata) of mean weight 73.42 ± 2.5g of about 3 months of age were used for the feeding trial. Four diets were formulated to contain African Yam beans (AYB) at 0% (AYB_1) Control, 50% (AYB_2), 75% (AYB_3) and 100% (AYB_4) as replacement for Soybean fraction in the diet of growing snails. Completely randomized design was used for the trial and each treatment was replicated thrice with 10 snails per replicate. The diets were formulated to contain about 24% crude protein and energy of 2400 kcal/kgME. (Table 1). The snails

were reared in a cage of 12 compartments and each compartment had a dimension of 0.5x 0.5m^2. All management practices were adhered to. African Yam beans (AYB) was purchased from a market in Ibadan, Oyo state, Nigeria. It was toasted and ground before incorporated with other feedstuffs. Feed intake and weight gain were measured on daily and weekly basis with the use of sensitive weighing balance. Feed intake was calculated by subtracting the left-over feed from the feed given while the weight gain was calculated by deducting the initial weight from the final weight. Shell length and width were measured on weekly basis with vernier caliper. Micrometer screw gauge was used to measure the shell thickness on weekly basis. Feed conversion ratio was calculated as the ratio of feed intake to weight gain. Feed cost and cost per weight gain were also calculated. The feeding trial lasted for 12 weeks. The chemical composition of the experimental diets and the foot were done according to the method of A.O.A.C. (1990). All data were subjected to statistical analysis using analysis of variance and the means were separated if they were significantly different using Duncan Multiple Range Test (SAS,2000).

RESULTS AND DISCUSSION

The results of growth performance of the snails fed varying levels of AYB in the diet is shown in Table 2.The mean total feed intake was significantly influenced by the varying inclusion of AYB in the diet ($P<0.05$) The highest feed intake was recorded in AYB_1.. The mean feed intake in 0% and 75% replacement of SBM with AYB were not significantly affected by the dietary treatments ($P> 0.05$). The values ranged between 930.39g to 928.35g for the twelve weeks. The mean weight gain was significantly influenced by the varying inclusion of AYB as substitute for SBM in the diets of growing snails ($P<0.05$). The mean weight gain in AYB_1, AYB_2 and AYB_3 were relatively the same ($P>0.05$). The highest mean weight gain was ($p<0.05$) was recorded in the control diet containing 0% AYB as replacement for soybean meal. The feed conversion ratio (FCR) which is the ratio of feed intake to weight gain was relatively the same in all the treatments as shown in Table 2. The relatively the same FCR reported in the study is an indication that AYB could be used to replace SBM in the diet of growing snails. The FCR reported in this study was in agreement with observation of several authors (Omole *et. al.,* 2016; Hamzat and Longe *et.al.,* 2014). The mean shell length increment was not significantly influenced by the dietary treatments ($P> 0.05$). The mean shell width increment was relatively the same across the treatments ($P> 0.05$). The shell thickness were not significantly influenced by the dietary treatments ($P>0.05$) as shown in table 2. This observation also buttressed the fact that AYB could be used as replacement for SBM. Also there was no case of shell deformity in all the treatments. The low mortality recorded in all the treatments could be due to proper management practice such as cleaning of the environment, regular washing of feeding and water troughs, proper shading and others as recommended by different authors (Omole *et al.,* 2016; Hamzat and Longe *et.al.,* 2014). The zero mortality reported could also be due to fact that the test ingredient used in this study was well processed and preserved and did not have any deleterious effect on the snails. **(**Agbulu *et al.,*2010). The report of zero mortality was an indication that AYB could be used as feed resource for snail. The lowest cost/weight gain was recorded in the diet containing 75% AYB as replacement for soybean meal while the highest cost/weight gain was recorded in the diet containing 100%SBM. The reduction in feed cost was due to low cost of AYB compared to soybean meal.. The prevailing market price of AYB and soybean meal during the course of the experiment was ₦135/kg and ₦160/kg respectively. This buttressed the reports of authors that replacing the conventional feedstuffs with unconventional ones led to reduction in the cost feed and total cost of production (Hamzat and Longe *et.al.,* 2014; Omole *et al.,* 2016). The lowest cost/weight gain reported in AYB_3 implies that AYB could replace soybean meal fraction of the diet of growing snails partially up to 75%.

CONCLUSION:

The lowest cost/weight gain was recorded in the diet containing 75% AYB as replacement for soybean meal while the highest cost/weight gain was recorded in the diet containing 100%SBM. African Yam Bean meal could be harnessed as alternative feed resource for snail production. It could be recommended that 75% of AYB could be used to replace soybean meal fraction of the diet in order to reduce feed cost.

Table 1: Gross Composition of Experimental Diet.

Ingredient (%)	Cost (₦ /kg)	AYB_1 (0%)	AYB_2 (50%)	AYB_3 (75%)	AYB_4 (100%)
Maize		22.0	22.0	22.0	22.0
Soybean meal		24	12.00	4	0.0
African yam beans		0.0	12.0	20.0	24.0
Fish meal		4.0	4.0	4.0	4.0
*Othersfeed ingredients		54.0	54.0	54.0	54.0
Total		**100.0**	**100.0**	**100.0**	**100.0**
Cost/kg (N)		110.23	108.78 [a]	104.45	103.12
Calculated Composition					
Crude protein (%)		24.22	24.21	24.13	24.08
Metabolizable energy (kcal/KgME)		2605.2	2599.3	2589.45	2572.12

*Others fixed ingredients: G.N.C. – 10.0; rice-bran -14.0; Bone meal -2.3; Brewer dry grain-9.45, Oyster shell – 9.70; Methionine - 0.1; Lysine - 0.1; Premix 0.25; Salt-0.1.

Table 2 Summary of Performance and Cost benefits of Snail fed diets containing African Yam bean meal (AYB).

Parameters	AYB_1 (0%)	AYB_2 (50%)	AYB_3 (75%)	AYB_4 (100%)	± SEM
Daily weight gain(g)	3.97 [a]	3.96 [a]	3.95 [a]	3.89 [b]	0.12
Total weight gain (g)	278.56 [a]	277.98 [a]	277.12 [a]	271.12 [b]	4.68
Total feed intake (g)	930.39	928.45	928.35	924.52	12.88
Daily feed intake (g)	10.34 [a]	10.32 [a]	10.32 [a]	10.27 [a]	0.21
Feed conversion ratio (g)	3.34	3.34	3.35	3.41	0.25
Shell length increment (mm)	14.23	13.58	13.57	13.59	0.35
Shell width increment (mm)	11.87	11.88	11.78	11.76	0.24
Shell thickness increment (mm)	0.15	0.15	0.14	0.14	0.03
Total feed cost (₦)	102.52 [a]	101.16 [a]	97.1 [b]	94.87 [b]	1.78
Cost/weight gain (₦ /kg)	366.07 [a]	361.26 [a]	346.78 [c]	351.37 [b]	5.89

Means along rows with different superscript are significantly different from each other (P<0.05)

REFERENCES

Adewale, B., Daniel, A., & Aremu, C. O. (2013). The Nutritional Potentials and Possibilities in African Yam bean for Africans. *International Journal of Agriculture*, 3(1), 8-19.

Agbulu, O., Gyau, A.M., Abakura, J.B., (2010). Effect of the Replacement of Sesame Seed for Methionine in Broiler Production in Middle Belt Region , Nigeria. *Journal Emerging. Trends Educaional. Resource. Poultry. Studies., (1), 16-21.*

Hamzat, R. A. and O. G., Longe (2014) Performance characteristics and economics analysis of snailets (*Achahatina marginata*) fed varying dietary inclusion of Kola Testa. Proceedings of the 3rd International Conference on Giant African Land Snails held at Federal College of Education Osiele, Abeokuta on 1st 4th June, 2014.

Odeyinka S.M., (2014) Animal feed industries and snail farming lecture delivered at the 3rd International Conference on Giant Land Snail (GALS) Proceedings of the 3rd International Conference on Giant African Land Snails held at Federal College of Education Osiele, Abeokuta on 1st 4th June, 2014.

Omole, A.J., Fayenuwo, J.O., Popoola, Y.A., Odejide, J.O., Okpeze, V.E. (2016) Utilization Of Quality Protein Maize In The Diets Of Giant African Land Snails (*Archachatina marginata). Journal Of Molluscan Research 2:17--23*

PERFORMANCE AND ECONOMICS OF PRODUCTION OF BROILER CHICKENS FED DIFFERENT COMMERCIAL DIETS

[1]Hafizu, R. R., [2]Doma, U.D. & [2]Kalla, D. J. U.
[1]Ministry of Education Science and Technology, Dutse, Jigawa State, Nigeria
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

ABSTRACT
An experiment was conducted to evaluate the response of broiler chickens to five different commercial diets. Two hundred and fifty day-old chicks were randomly allotted to five diets in replicates of three containing 16 birds each in a completely randomized design. Feed and water were supplied *ad libitum* and the feeding trial lasted for 42 days. Results for performance showed that at 4 weeks, birds on diet B had significantly (P<0.05) higher weight (2129.69g) than those on the other diets. Feed conversion ratio was also better (P<0.05) on birds fed diet B (1.35) than those fed other diets. A similar trend was observed for final weight, with birds on diet B recording the highest (P<0.05) mean weight of (2660.38g) compared to those on other diets (1792.37 – 2114.33g). Feed cost per kg was similar and higher on diets B and E (₦158.00). However, feed cost per kg body weight gain was lowest on diet B (₦306.01) and higheron dietE (₦441.63). It was therefore concluded that diet B gave better performance at reduced feed cost, hence recommended for broiler chicken producers.

Keywords: Broiler chickens, Commercial diets, Performance, Economics of production

Corresponding Author: hafizurabiu2015@gmail.com; Phone no: 08063390882

Introduction

In addition to its ability to bridge the protein deficiency gap which exists among average Nigerian families, Poultry production can also provide job opportunities in the areas of commercial feed production and retail, hotel/restaurant industry, sales of roasted chickens carriage and transport of feed ingredients, finished feed, live and dressed birds (Afzal and Khan, 2019). However, the success of any poultry enterprise rests squarely on adequate and proper nutrition. Accordingly, poultry diets are formulated to provide specific levels of nutrients that are needed for optimum performance (Oluyemi and Roberts, 2013). Feed cost alone was reported to stand at about 75% of the total cost of broiler chicken production (Alagawany *et al.*, 2018). Against this background, a focus on efficient feed utilization in order to maximize profits and avoid loses becomes a necessity.

Due to inadequate knowledge of feed formulation techniques and weak capital base, several poultry farmers prefer to buy commercial feeds rather compounding their own. This has made the demand and cost for commercial feeds to be relatively high (Malebogo *et al.*, 2016). The demand factor, partly occasioned by the increasing number of people venturing into poultry business in Nigeria, has made some poultry feed manufacturers to produce sub-standard products, especially as the quality control agencies in Nigeria are not playing effectively their statutory roles (Okoli*et al*., 2009). Ordinarily, poultry feeds, based on type of birds, purpose and stage of growth, produced by different companies are supposed to be similar in composition in order to meet the birds' requirements. However, considering the selfish tendencies of some feed producers to maximize profit and that of some quality control agents to enrich themselves at the detriment of the poor farmer, sub-standard commercial feeds are bound to be found in the Nigerian markets (Jones, 2005). It is therefore the aim of this study to evaluate some of the commercial broiler feeds sold in Bauchi metropolis.

Materials and methods

The experiment was carried out at the Poultry Teaching and Research Farm, College of Agriculture, Bauchi, Bauchi State. Five selected commercial broiler starter and finisher feeds were purchased from feed vendors in Bauchi town. Two hundred and fifty day-old broiler chicks were randomly allotted to five different commercial diets, designated as A, B, C, D and E in replicates of 3 of containing 16

birds each in a completely randomized design. Recommended vaccinations were administered accordingly. Similarly, all routine sanitary operations were carried out during the study period lasted for 6 weeks of 4 and 2 weeks starter and finisher phases respectively. Data was collected for feed intake, weight gain and feed conversion ratio. Prices of feeds, total feed intake and total weight gain were the indices used in computing the economics of production. All data obtained was subjected to analysis of variance (Steel and Torrie, 1980). The statistical software employed was SPSS v. 23.0. mean seperation was according to Duncan Mutiple Range Test (Duncan, 1955).

Results and Discussion

Result of performance of broiler chickens fed different commercial diets during the starter phase is presented in Table 1. Initial weight of birds, which did not differ among diets ranged between 131.25 – 132.87g. Weight of broiler chickens at week 4 was significantly (P<0.05) influenced. Birds on diet B (2129.69g) had higher average weight than those on other diets (1480.38 – 1618.82g) which were similar. This agrees with Sogunle *et al.,* (2009). Daily feed intake (DFI) which ranged from 84.12 to 96.00g, was not significantly affected. However, daily weight gain (DWG) followed the same trend with week 4 weight. Birds on diet B (71.34g) gained higher (P<0.05) than those on other diets (48.12 – 53.10g) which did not differ. Feed conversion ratio (FCR) was also significantly (P<0.05) better on diet B (1.35) than on other diets (1.69 – 1.85).

The result of broiler chickens performance at the finisher phase is presented in Table 2. During the finisher segment, final weight of birds reveled that those on diet B (2660.38) outweighed (P<0.05) those fed other diets (1792.37 – 2114.33g) which were the same. Daily feed intake (124.08 – 139.20g) showed no significant influence of diet. However, DWG significantly (P<0.05) differed among treatments. Diet C (44.82g) which was higher, did not differ from diets A (38.91g), B (37.90) and diet D (43.54g). Birds on diet E (27.05g) had lower value of DWG which was comparable to diets A, B, and D. This concurs with the report of Uchegbu *et al* (2009) in finisher broiler. Feed conversion ratio was also better on diets A (3.52), C (3.15) and D (2.86) than diet E (4.98) which did not differ from diet B (3.95).

The overall phase (Table 3) indicated that total weight gain of birds fed diet B (2528.31g) was higher (P<0.05) than those on other diets (1659.50 – 1982.40g) which were similar. Daily feed intake (107.25 – 116.74g) did not show any significant influence of diet. However, daily weight gain was highest (P<0.05) on diet B (54.63g) and lowest on E (38.76g). Similarly, FCR was best (P<0.05) on diet B (2.14 and poorest (P<0.05) on diet E. This result is in conformity with findings of Sanusi *et al.,* (2015).

The economic analysis of broiler birds fed commercial diets is presented in Table 4. Birds on diet 2 consumed more feed (4.90 kg) than those on other diets (4.50 – 4.81 kg). Feed cost per kg was highest on diets 2 and 5 (₦158.00) which were the same, and lowest on diet 4 (₦150.00). Total feed cost was highest on diet 2 (₦774.20) and lowest on diet 4 (₦675.00). However, feed cost per kg gain was lowest on diet 2 (₦306.01) compared to other diets (₦364.86 – 441.63).

Table 1: Performance of Broiler Chickens Fed Five Different commercial Feeds (1-4 weeks)

	Diets					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
Initial Weight(g)	131.25	132.08	131.93	132.66	132.87	4.26^{NS}
Week 4 weight	1480.38^{b}	2129.69^{a}	1618.82^{b}	1510.81^{b}	1546.59^{b}	74.26^{NS}
Daily Feed intake (g)	84.12	96.00	89.92	90.44	90.34	4.11^{NS}
Daily weight gain (g)	48.18^{b}	71.34^{a}	53.10^{b}	49.22^{b}	50.49^{b}	2.60*
Feed Conversion ratio	1.76^{b}	1.35^{a}	1.69^{b}	1.85^{b}	179^{b}	0.07*
Mortality (%)	2	1	0	1	2	-

a,b Means within row with different superscripts differed significantly. * = (P<0.05), SEM = Standard Error of the Mean, NS = Not significant

Table 2: Performance of Broiler Chickens Fed Five Different commercial Feeds (5-6 weeks)

	Diets					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
Final Weight(g)	2025.12^{b}	2660.38^{a}	2114.33^{b}	1987.67^{b}	1792.37^{b}	104.84*
Daily Feed intake (g)	136.02	137.48	139.20	124.08	130.41	8.73^{NS}
Daily weight gain (g)	38.91^{ab}	37.90^{ab}	44.82^{a}	43.54^{ab}	27.05^{b}	5.12*
Feed Conversion ratio	3.52^{a}	3.95^{ab}	3.15^{a}	2.86^{a}	4.89^{b}	0.41*
Mortality (%)	0	0	1	0	0	-

a,b Means within row with different superscripts differed significantly. * = (P<0.05), SEM = Standard Error of the Mean, NS = Not significant.

Table 3: Performance of Broiler Chickens Fed Five Different commercial Feeds (1-6 weeks)

	Diets					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
Final Weight(g)	2025.12^{b}	2660.38^{a}	2114.33^{b}	1987.67^{b}	1792.37^{b}	104.84*
Total weight gain (g)	1893.87^{b}	2528.31^{a}	1982.40^{b}	1855.01^{b}	1659.50^{b}	103.93*
Daily Feed intake (g)	110.07	116.74	114.56	107.25	110.38	6.15^{NS}
Daily weight gain (g)	43.55^{bc}	54.63^{a}	48.96^{ab}	46.38^{abc}	38.76^{c}	2.91*
Feed Conversion ratio	2.53^{b}	2.14^{a}	2.35^{ab}	2.31^{ab}	2.85^{c}	0.09*
Mortality (%)	2	1	1	1	2	-

a,b,c Means within row with different superscripts differed significantly. * = (P<0.05), SEM = Standard Error of the Mean, NS = Not significant

Table 4: Economic Analysis of Broiler Chickens Fed Five Different commercial Feeds

	Diets				
Parameters	**1**	**2**	**3**	**4**	**5**
Total feed intake (kg)	4.62	4.90	4.81	4.50	4.64
Feeed cost per kg (₦)	151.00	158.00	152.00	150.00	158.00
Total feed cost (₦)	697.62	774.20	731.12	675.00	733.12
Total weight gain (kg)	1.89	2.53	1.98	1.85	1.66
Feed cost per kg gain (₦)	369.11	306.01	369.25	364.86	441.63

Conclusion

Based on the results of this study, commercial broiler feed B was utilized better by the chickens which translated into higher total weight gain. Performance of birds on other diets was almost the same. Feed cost per kg weight gain was lower on diet B and therefore recommended for broiler producers.

References

Afzal, M. and Khan, M. (2019). Economic analysis of broiler poultry farms: a case study of District lower Dir. *Sarhad Journal of Agriculture,* **33**(1): 183-188

Alagawany, M., Elnesr, Sh. S. and Farag, M. R. (2018). The role of exogenous enzymes in promoting growth and improving nutrient digestibility in poultry. *Iranian Journal of Veterinary Research,* **19**(3):157-164

Duncan, D.B. (1955). Multiple Range and Multiple F. Test. *Biometrics.***11:** 1-42.

Jones, T. P. (2005). Quality control in feed manufacturing. AvitechTechnica bulletin. Retrieved January 15, 2020 from http://thepoultrysite.com/articles/526/quality-control-in-feed-manufacturing.

Malebogo, V. R., John, C. M., Molebeledi, H. D. M. and Patrick, M. K. (2016). Effect of feeding commercial broiler diets on growth performance of Tswana and Orpington chickens reared up to 18 weeks of age under intensive system. *International Journal of Poultry Science,* **15**:407-413

Okoli, B.O, Oluwalana, E.O. and adepegba, O.A (2009). Poultry self – compounded feed in Ibadan area of Oyo state, Nigeria. *Agriculture and Human values,* **23** (19): 245.

Oluyemi, J. A. and Roberts, F. A. (2013). **Poultry Production in Warm Wet Climates**, Spectrum, Ibadan. Pp 153-155

Sanusi, M., Rabi, A., Doma, U. D. and Haruna, J. (2015). Comparative effect of self-formulated and four commercial diets on the growth performance, carcass and haematological parameters of broiler finisher in the tropics. *Sokoto Journal of Veterinary Sciences,* **13**(2*)*:14-19

Sogunle, O. M., Ekunseitan, D. A., Adeoti, M. T., Iyanda, A. I. and Fanimo, A. O. (2009). Performance and carcass characteristics of two strains of broiler chickens fed three different commercial feeds. *Journal of Applied Agricultural Research,* **1***:53 -59.*

Steel R. G. D. and Torrie, J. H. (1980). **Principles and Procedures of Statistics: A Biometric Approach** (2nd ed.) McGraw-Hill publishers, New York, pp 633

Uchegbu, M. C., Igbokwe, N. O., Omede, A. A., Ekwuagana, I. C., Okoli, I. C. and Esonu, B. O. (2009). Performance evaluation of some commercial broiler finisher rations sold in Nigeria. *International Journal of Poultry Science,* **8** (12):1162-1164

PERFORMANCE OF BROILER CHICKENS FED DIFFERENT COMMERCIAL FEED IN BAUCHI, BAUCHI STATE, NIGERIA

[1]Mu'azu, M.S., [2]Doma, U.D.,[2]Kalla, D.J.U.
[1]Department of Animal Production Technology, Bauchi State college of Agriculture, Bauchi
[2]Department of Animal Production, Abubakar Tafawa Balewa University Bauchi State, Nigeria
Corresponding author email: muazumuhammadsani@gmail.com
+ 2347061212378

ABSTRACT
An experiment was conducted to evaluate the performance of broiler chickens fed different commercial feeds available in Bauchi, Bauchi State, Nigeria. A total of 225-day old broiler chickens from Zartech Ltd were fed 5 different commercial feeds for duration of 35 days to compare the performance of broiler chickens. Feed intake of the dietary groups differed significantly (P<0.05). T4 dietary group showed high trend of feed consumption (75g) while the lowest feed intake was recorded in treatment 3 (48g).The body weight gain was highest (44.79g) in T5 dietary group (P<0.05) which was statistically similar with T2 and T4 groups and lowest body weight gain was observed in treatment 3 (20.91g). Higher FCR value (P<0.05) was observed in T3 dietary group which indicated low feed conversion efficiency. T3 showed high percent of survivability. Significant difference was obtained for meat yield parameters such as body weights, liver weight, abdominal fat, heart weight, dressed carcass and edible carcass weight. The result of the experiment from biological responses of birds gave an impression that commercial feeds of the feed mills T2, T4 and T5 were found to be better than those of T1 and T3 for the production of broiler chickens for the age duration of day old to 35 days.

Keywords: broiler chickens, performance, feed intake

INTRODUCTION
Poultry feeds are made up of many ingredients which are broadly grouped into providers of energy (fat and carbohydrates), protein (amino acids), vitamins, minerals and feed additives. Cereal grains such as maize, sorghum, wheat and millet provide energy while soya beans and groundnut provide protein. These ingredients are combined in such a way as to provide energy, protein, vitamins and minerals for poultry through the process of feed formulation.However, several factors may affect both feed quality and feed manufacturing parameters (Loar and Corzo, 2011). The nutritional value of grains used in poultry feed varies with the grain cultivars, its chemical characteristics and non-starch polysaccharide content, diet physical form, availability of energy and bird category (Gutierrez-Alamo *et al.,* 2008). These factors in addition to the choice of feedstuffs and quantity incorporated in the finished feed by different feed manufacturers has given to variation in the nutritive value of manufactured feeds and performance of birds fed different brands of feeds.
Poultry feeds are primarily produced to optimize the growth potentials of the target birds through a defined nutritional specification but more than 10% reduction in chicken growth rates has been observed when birds are offered different feed brands (Uchiegba*et al.,* 2009). It means there are variations in the compositions of different feed brands meant for the same class of birds. Knowledge of the nutritive value of feed brands is therefore imperative for the poultry industry.This research is aimed at determining the effect of differentcommercial feeds on growth performance of broiler chickens.

Materials and Methods
The experiment was conducted at the Poultry Unit of Bauchi State College of Agriculture Bauchi Teaching and Research farm. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East (BSD, 2009).
A total of two hundred and twenty-five (225) broiler chicks were used for the experiment. They were randomly divided into five treatment groups of 45 chicks per group in a completely randomized design (CRD) consisting of three replicates of 15 birds each. Birds were reared on a deep litter, with feed and water provided *ad libitum*. Left over feed and body weight of birds were monitored on a

weekly basis for the starter and finisher phases of the experiment and routine vaccines were given as recommended. All feed not consumed were removed, weighed and deducted from feed given daily to get the daily feed intake.

Five (5) broilers super starter, starter and finisher diets of different selected commercial brand were purchased and label as diet 1,2,3,4 and 5 which is given to treatment groups 1,2,3,4 and 5 respectively. All these feeds differ in composition of energy, crud protein, crud fibre, ether extract among others.

Results and Discussions

The daily feed intake values ranges from (48.93-75.25g) is similar to 53.00-75.55g as reported bySanusi, *et al.*, 2015, in comparative effect of self-formulated and four commercial diets on the growth performance, carcass and haematological parameters of broiler finishers in the tropics. This result is also similar to values obtained by Doma*et al* (2001) in broilers fed different commercial diets.The daily weight gain was significantly ($P<0.05$) influenced at the overall phase. The daily, the values obtained ranges from 20.91 to 44.79g were comparable to the report of Doma*et al* (2001) who reported that low protein diet lead to poor performance.Feed conversion ratio was significantly affected by the dietary treatment. The result is similar to what was obtained by Sanusi*et al* (2015). Birds on diet T5 were having better feed conversion ratio of 1.65 which is similar to 1.82 and 1.86 of treatments 4 and 2 respectively. Similarly, feed conversion ratio is obtained on birds in treatment 1 and 3 which is 2.11 and 2.36 respectively.

The average live weight ranged between 875.67 to 1738.33g on treatments 3 and 5 respectively, there was significant ($P>0.05$) difference among the treatments. Other parameters measured such as plucked weight, carcass weight, dressing percentage, lungs weights, head and legs weight, intestinal weight, liver weight, and abdominal fat weight showed significant ($P>0.05$) difference. But parameters such as heart weight, spleen weight, intestinal length, pancreas weight, caecal length and kidney weight showed no significant difference among the dietary treatment. This result is similar to similar to what was obtained by Hossain et al (2006) in his work titled performance of broiler chickens fed with different commercial compound feeds of Bangledesh.

The highest feed cost/kg is recorded in dietary treatments 3 and 5 while all the other dietary treatment had the same feed cost. The feed cost/gain ranged between 260.74 to N3377.70 it dietary groupps 5 and 3 respectively. This results differs with the range of 124.67 to N190.29 obtained by Sanusi et al (2015).

Conclusion and Recommendation

Birds on treatments 5, 4 and 2 performed better than those on treatments 1 and 3. And low feed cost/gain was recorded to be lowest in dietary treatment groups 2, 4 and 5 while dietary treatment groups 1 and 3 resulted highest feed cost/gain during the experiment. Diet 2, 4 and 5 are therefore recommended for production of 1.8 to 2.5kg broiler chickens for the period of day old to 42 days.

Table 1: Nutrient Composition of Experimental Diets

		Diets				
Age	**Nutrients**	**T1**	**T2**	**T3**	**T4**	**T5**
0-2	**SUPER STARTER PHASE**					
	Crude protein (%)	21.00	22.00	20.00	21.00	22.00
	Fat (%)	10.00	5.00	6.00	5.50	4.50
	Crude fibre (%)	10.00	5.00	3.00	1.10	5.00
	Metabolizable energy (MJ/kg)	12.90	12.50	12.10	12.50	12.50
3-4	**STARTER PHASE**					
	Crude protein (%)	18.00	21.00	19.00	20.00	21.00
	Fat (%)	10.00	4.00	5.00	4.50	5.00
	Crude fibre (%)	12.00	4.5.	3.00	5.00	5.00
	Metabolizable energy (MJ/kg)	12.50	12.50	11.70	12.30	12.90
5-6	**FINISHER PHASE**					
	Crude protein (%)	17.00	18.50	17.00	18.00	18.00
	Fat (%)	10.00	4.00	4.00	5.00	5.00
	Crude fibre (%)	15.00	6.00	3.50	5.00	5.00
	Metabolizable energy (MJ/kg)	12.50	12.90	12.10	12.50	13.30

Table 2: Growth Performance of Broiler Chickens fed Different Commercial Feeds Available in Bauchi, Bauchi State, Nigeria

	Diets					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Initial weight (g/b)	39.58	40.54	41.77	41.76	39.85	1.28^{NS}
Final weight (g/b)	1070.95^{c}	1392.59^{b}	772.70^{d}	1496.77^{b}	1730.32^{a}	81.09^{*}
Total feed intake (g/b)	2175.25^{b}	2503.84^{a}	1712.85^{c}	2633.74^{a}	2558.66^{a}	112.71^{*}
Daily feed intake (g/b/d)	62.15^{b}	71.87^{a}	48.93^{c}	75.25^{a}	73.10^{a}	3.27^{*}
Daily weight gain (g/b/d)	29.48^{b}	38.63^{a}	20.91^{c}	41.64^{a}	44.79^{a}	3.27^{*}
Feed conversion ratio	2.11^{a}	1.86^{bc}	2.36^{a}	1.82^{bc}	1.65^{c}	0.14^{*}
Mortality (number)	2.00	5.00	2.00	3.00	2.00	

Table 3: Carcass Characteristics of Broiler Chickens Fed Different CommercialFeeds inBauchi, Bauchi State, Nigeria

	Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Live weight (g)	1111.67^{c}	1283.33^{c}	875.67^{d}	1431.67^{b}	1738.33^{a}	57.44*
Pluck weight (g)	1027.00^{c}	1147.33^{c}	754.00^{d}	1296.17^{b}	1592.33^{a}	54.32*
Carcass weight (g)	712.00^{c}	832.83^{c}	503.67^{d}	996.17^{b}	1278.83^{a}	48.10*
Dressing %	69.19^{d}	72.40^{b}	66.37^{c}	76.77^{b}	80.10^{a}	0.84*
Heart (%)	0.89	0.876	0.93	0.72	0.80	0.89NS
Lungs (%)	1.03^{ab}	1.27^{a}	1.25^{a}	0.87^{b}	1.12^{ab}	0.16*
Head and Leg (%)	11.10^{abc}	12.73^{ab}	13.37^{a}	9.84^{c}	10.13^{bc}	1.13*
Spleen (%)	0.22	0.19	0.26	0.17	0.27	0.93
Gizzard (%)	1.81	1.82	2.60	1.90	2.20	0.37
Intestinal weight(%)	10.11^{ab}	7.05^{bc}	10.93^{a}	6.54^{c}	6.25^{c}	1.41*
Intestinal length (cm)	240.33	230.83	235.67	214.16	217.33	16.80NS
Liver (%)	2.13^{c}	3.10b^{c}	5.85^{a}	4.63^{ab}	4.41^{ab}	0.70*
Pancreas (%)	0.18	0.12	0.16	0.15	0.13	0.53NS
Ceacal length (cm)	21.83	17.67	17.67	18.50	21.83	2.15NS
Kidney (%)	1.40	1.13	0.88	0.68	1.04	0.31NS
Abdominal fat (%)	1.44^{b}	2.14^{ab}	2.45^{a}	1.83^{ab}	1.63^{ab}	0.40*

$^{abcd:}$ means within the same row bearing different superscripts are significantly different
*: ($P<0.05$)
NS: Not Significant
SEM: Standard Error of Mean

Table 4: Financial Benefits of Broiler Chickens Fed Different Commercial Feeds in Bauchi, Bauchi State, Nigeria

	Diets				
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**
Total feed intake (kg)	2.18	2.52	1.71	2.63	2.56
Feed cost (₦/kg)	148.00	148.00	161.00	148.00	160.00
Total feed cost (₦)	322.64	372.96	275.72	389.80	409.36
Total weight gain (kg)	1.03	1.35	0.73	1.46	1.57
Feed cost gain (₦/kg gain)	313.24	276.27	377.70	267.00	260.74

References

Bauchi State Diary (BSD), (2009). ABU/ICT-Centre database, http//:www.nigeriagalleria.com/Nigeria/statenigeria/bauchistate.

Doma, U.D., Muhammad, A.S., Bello, K.M. and Ugbeh, E. (2001). Performance of broiler chickens fed with local formulated feed and commercial feeds. *Nigerian Journal of Agriculture,***3**:82-86.

Gutierrez-Alamo, A. P., Perez D. A., Verstegen, M.W.A., Den Hartog, L.A And Villamide, M.J. (2008). Variability in wheat: factors affecting its Nutritional value. *World Poultry Science Journal.* 64 (**1**): 20-39.

Hossain, M. A., Roy, B. C., Islam, M. M. and Miah, M. Y. (2006). Performance of broiler fed with different commercial compound feeds of Bangladesh. Bangladesh journal of veterinary medicine, 4(2):97-101.

Loar, R. E, and Corzo, A. (2011). Effects of feed formulation on feed manufacturing and pellet quality characteristics of poultry diets. *World's Poultry Science Journal,* **67**: 19-28.

Sanusi, M., Rabi, A., Doma, U.D. and Haruna, J. (2015). Comparative effect of self-formulated and four commercial diets on the growth performance, carcass and haematological parameters of broiler finishers in the tropics. *SokotoJournal of Veterinary Sciences,* **13**(2):14-19

Uchegbu, M.C., Irechukwu, N.M., Omede, A.A., Nwaodu, C.H., Anyanwu, G.A., Okoli, I.C., and Udedibie, A.B.I. (2009) Comparative Evaluation of Three Commercial feeds on the performance of Broilers. *Report and opinion,* **1**(4):15-19

GROWTH PERFORMANCE OF FINISHED BROILER BIRDS AS INFLUENCED BY DIFFERENT DIETARY LEVELS OF TIGER NUT WASTE MEAL (CYPERUS ESCULENTUS)

[1]Nsa, E. E. and [2]Komolafe, P. L
[1]Department of Animal Science, University of Calabar, Calabar, Nigeria.
[2] Department of Animal Science, University of Ibadan
*Corresponding Author: essienkate@gmail.com

Abstract

A total of one hundred and fifty (150) four weeks old broiler birds were used to study the growth response to diets containing different levels of tigernut wastes meal (TNWM). The birds were randomly allotted to five dietary treatments of three replicates each containing 30 and 10 birds respectively. The treatment diets comprised 0, 25, 50, 75 and 100% of tiger nut waste meal (TNWM) as replacement for maize to form treatment diets 1 (control), 2, 3, 4 and 5 respectively. The control diet and Treatment 2 (25%TNWM) showed significantly (P<0.05) higher weight gain followed by treatment 3, 4 and 5 in that order. The feed intake showed a reversed trend as consumption significantly (P<0.05) increased with increasing dietary level of TNWM. The most favourable feed conversion ratio was obtained with birds in control and treatment 2 with values that were significantly (P<0.05) higher than birds in other treatment groups. The percentage reduction in feed cost per kilogram of diet showed a drastic reduction (P<0.05) as dietary TNWM increased in the diet. However, it did not correspond with percentage savings on feed cost which showed a negative trend as dietary as dietary TNWM increased. It is concluded that up to 25% level of maize could be replaced with TNWM without any adverse effect on performance but with favourable cost savings.

Key words: Tigernut waste, weight gain, feed conversion ratio, cost savings

Introduction

The search for lesser use and underutilized fedstufs, many of which are potentially valuable as animal feed has been intensified to maintain a balance between population growth and agricultural productivity, particularly in the tropical and sub-tropical areas of the world. In Nigeria, conventional feedstuffs especially energy sources like maize, wheat, millet and guinea corn are becoming increasingly costly. This has led to the search for alternative feedstuffs for use in animal production especially poultry species, which are the main sources of animal protein in Nigeria. Such alternative feed ingredients should of necessity be available all year round; easy to be procured and processed, if need be, into usable forms and must have a comparable cost advantage over the conventional feed stuffs (Oyebiyi *et al.*, 2007). Such feed stuffs must not be a staple item for human food (Okonkwo and Adikpe, 1988). At present in Nigeria, there are many agricultural and industrial by-products that have found their usefulness in livestock feeding (Togun and Oseni, 2005).

A species that can be exploited in this direction is *Cyperus esculentus* commonly called tigernut. It possesses as much agronomic and nutritional potential as the conventionally used energy sources. Tigernut is commonly known as earth almond, *chufa, chewfa* and *Zulu* nuts in Spain. It is known in Nigeria as *Aya* in Hausa, *Ofio* in Yoruba, Akihausa in Igbo and *Isip-Isong* in Efik where these varieties (black, brown and yellow) are cultivated. Among these, only two varieties, yellow and brown are readily available in the market. The yellow variety is preferred to all other varieties because of its inherent properties like bigger size, attractive colour and fleshier body. It also yields more milk upon extraction, contains lower fat, more protein and possesses less anti-nutritional factors especially polyphenols (Okafor *et al.,* 2003). Tigernut can be eaten raw, roasted, dried, baked or can be made into a refreshing beverage called *Horchata De Chufas* or tigernut milk. In Nigeria, it can be grown virtually everywhere. Residue after milk extraction is being discarded by the beverage industries as waste, even though it is said to have high energy content. The successful exploitation of this plant would add to the feed resources available to the livestock industry in Nigeria, and will contribute in solving the problem of scarcity and high cost of feed ingredients (maize, millet, guinea corn and so

on) in livestock feed industry. It will provide feed millers and poultry farmers with readily available high quality alternative feed ingredient that is relatively cheaper thereby reducing the cost of poultry production. This research therefore is to find out the actual level of replacement of maize with tigernut waste meal that can save cost without sacrificing growth performance parameters.

Materials and Methods

The study was carried out at the Poultry Unit of the Teaching and Research Farm of the University of Calabar, Nigeria. The tigernut waste was collected from Olam Agro- industry, which is located in Kaduna and Benue States, all in Nigeria. The waste was further sundried and preserved in jute bags for laboratory analyses and feed formulation. The dried tigernut waste and formulated diets were analysed for their proximate composition using AOAC, 2006 methods. The dried tigernut waste meal was used to replace maize in broiler chicken diets at 0, 25, 50, 75 and 100% levels, representing treatment diets 1, 2, 3, 4 and 5 respectively, The formulation was in line with the standard nutrient requirements as recommended by NRC (2013) for each phase of the poultry birds. One hundred and fifty (150) four weeks old broiler birds were distributed in a Completely Randomised Design to their respective experimental diets. Water and feed were administered *ad libitum* throughout the period of the experiment. Proper medication and vaccination were strictly followed. Feed intake was taken daily. Initial live weight was measured at the beginning of the study, thereafter done weekly. These help in computing their weight gain and feed gain ratio. All data collected was subjected to analysis of Variance (ANOVA) using SPSS, 2012.

Table 1: Ingredient composition of the experimental broiler finisher diets

	DIETS				
	1	2	3	4	5
Ingredient (%)	0%	25%	50%	75%	100%
Maize	61.00	45.75	30.50	15.25	0.00
Tigernut Waste meal	0.00	15.25	30.50	45.75	61.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Soybean meal	23.50	23.50	23.50	23.50	23.50
Fish meal	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Oyster shell meal	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
* Vitamin/mineral premix	0.25	0.25	0.25	0.25	0.25
Total (%)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated values					
Crude protein (%)	21.00	21.23	21.36	21.49	21.53
ME(Kcal/kg)	3102.50	3087.60	3080.17	3076.20	3085.90
Crude fibre (%)	5.32	6.54	6.69	6.82	7.31

* Vitamin/mineral premix containing the following per kg. Vitamin A, 8,000,000 IU; vitamin D3, 1,600000 IU; Vitamin E, 5,000 IU; Vitamin K, 2,000 mg; Thiamine, 1,500 mg; Riboflavin B2, 4,000 mg; Pyridoxine B6, 1,500 mg; Antioxidant, 125 g; Niacin, 1,500 mg; Vitamin B12, 10 mg; Pantothenic acids, 5,000 mg; Folic acid, 500 mg; Biotin, 20 mg; Choline chloride 200 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 12 g' Selenium, 200 mg; Cobalt, 200 mg.

Results and Discussion

The results of the performance of finished broiler birds fed the experimental diets are presented in Table 2. The feed intake improves (P<0.05) significantly with the dietary levels of TNWM. This suggests the absence of odour and toxic factors in the TNWM. It also indicates reduction in the energy density of the diets as shown in Table 1. Monogastric animals are expected to consume more of low energy diets to meet their energy requirement (Nsa et al., 2010).

The daily weight gain values of the birds in control diet and treatment 2 were numerically similar but significantly (P<0.05) higher than that of birds in other treatment diets which tended to depress (P>0.05) as the level of dietary TNWM increases in the diets. The poor energy density of the diet as the dietary TNWM increases in the diets may have also attributed to the poor weight gain of birds on higher levels of TNW diets.

The feed conversion ratio was most favourable with birds in diets 1 and 2 with statistically similar values. Beyond this level (25% TNWM), Feed conversion ratio significantly (P>0.05) depreciated as the level of inclusion of TNWM increased in the diets. This might be an indication that broiler finisher birds have poor ability of utilising high level of TNWM in their diets. TNWM is high in fibre as indicated in Table 1. Archibong et al., 2018 reported that broiler birds have poor tendency of utilising feeds with high fibre levels. This is also reflected in the protein efficiency values as it tended to significantly (P<0.05) depressed as the level of dietary TNWM exceeded 25% of maize replacement. There was cost savings associated with the use of TNWM up to 25% but beyond this level it is unwise to use it in feeds as it shows negative returns to investments.

Conclusion

The results of this study have shown that replacing maize with 25% could save cost of investment without sacrificing growth performance of finished broiler birds.

Table 2: Growth performance of finisher broiler birds as influenced by different dietary levels of Tiger nut waste

Treatments Parameters	T1	T2	T3	T4	T5	SEM
Initial live weight (g)	100.37	100.19	100.48	100.92	100.51	1.52
Daily weight gain(g/d/bird)	27.52^{a}	27.18^{a}	25.50^{b}	21.42^{c}	19.21^{d}	0.66
Daily feed intake(g/d/bird)	78.41^{d}	79.11^{d}	83.41^{c}	86.97^{b}	89.54^{a}	0.95
Feed conversion ratio	2.85^{d}	2.91^{d}	3.27^{c}	4.06^{b}	4.66^{a}	0.12
Daily protein intake(g/d/bird)	16.58	16.61	16.63	16.64	16.66	0.23
Protein efficiency ratio	1.66^{a}	1.64^{a}	1.53^{b}	1.29^{c}	1.15^{d}	0.23
Feed Cost (N/Kg)	106.22^{a}	101.06^{b}	98.21^{c}	95.18^{d}	92.08^{e}	2.58
Cost/Kg weight gain	302.64^{d}	294.14^{d}	321.24^{c}	386.45^{b}	429.20^{a}	3.89
Feed cost saving(%)	-	3^{a}	0.60^{b}	0.21^{b}	0.42^{b}	0.01

Means within the same row with different superscripts are significantly different (p<0.05).
SEM – Standard Error of Mean.
TNW= Tiger nut waste, T1=0%TNW, T2=25%TNW, T3=50%TNW, T4=75%TNW and T5=100TNW

References

AOAC, 2006. Oficial Methods of Analysis. Association of Official Analytical Chemists. 20th Edition. Washington DC.

Archibong ,E. E., Nsa, E. E. and Umoren, U. E. (2018). Nutritional Evaluation of tigernut (*Cyperus esculentus*) meal as a replacement for maize in broiler diets. *Nigerian Journal of Animal Production*. Vol. 46, pg. 90-98. ISSN 031-2064.

NRC, 2013. Nutrient requirements of domestic animals. Nutrient of poultry birds. (12th edition) National Academy of Sciences-National Research Council, Washington D.C.

Nsa, E. E., Ukachukwu, S. N., Akpan A. I. and Edet, G. D. (2010). Comparative study of maize, maize sievate and wheat offal based diets in growing rabbit diets. Proceedings of the 15th conference od Animal Science Association of Nigeria. 13th-15th September, University of Uyo.

Okafor, J. N. C., Mordi, J. I. Ozum,ba, A. U., Solomon, H. M. and Olattunji, O. 2003. Preliminary Studies on the Characteristics of contaminants in Tiger nut. Proceedings of 27th Conference of Nigerian Society of Animal Production. Nigerian Institute of Food Science and Technology (NIFEST) Nigeria. Oct., 13th-17th .

Okonkwo, A. C. and Adikpe, D. A. 1988. Leucacena lencocephala seed meal in the diets of laying birds and its effect on eggyolk pigmentation. Nigerian Journal of Animal production. 15:207-212.

Oyebiyi, O. O., Farinu, G. O., Togun, V. A., Akinlade, J. A. 2007. Studies on growth and haematological attributes of weaner rabbits fed graded levels of sundried cassava peel-blood meal mixture. Proceedingds of the 32nd annual conference of the Nigerian Socciety for Animal Production. 18th-23th March. University of Calabar.

SPSS, 2012. Statistical package for Microsoft windows. Release 6.0 Users manual.

Togun, V. A. & Oseni, B. A. (2005). Effect of low level of inclusion of biscuit dust in broiler finisher diet on pre-pubertal growth and some haematological parameters of unsexed broilers. *Research Communication in Animal Science*, 1(2): 10-14.

PERFORMANCE AND NUTRIENT DIGESTIBILITY OF BROILER BIRDS FED DIETS CONTAINING YEAST AND INORGANIC COPPER

*** [1]Ogwuegbu, M.C., [2]Oyeagu, C.E., [1]Edeh, H.O., [1]Ani A.O and [1]Okpala, C.R.**

[1]Department of Animal Science, University of Nigeria Nsukka, Nigeria

[2] Department of Livestock and Pasture Science, University of Forte Hare, Private Bag X1314, Alice 5700, South Africa

*Corresponding author

Email: mercy.ogwuegbu@unn.edu.ng; +2347068515325

Abstract

The study was conducted to investigate the response of broiler chicks to varying dietary levels of yeast and inorganic copper as growth promoters. A total of 120 day old Broiler birds were used for the study. The study lasted for eight weeks. The broiler chicks were randomly allocated to four treatment groups and fed diets containing four levels of copper and yeast been at constant level(0g Yeast + 0g Copper, 32.5g Yeast + 25.0g copper, 32.5g Yeast + 37.5g copper and 32.5g Yeast + 50g copper respectively per 25kg of diet.) Each group was replicated three times with 10birds per replicate in a Completely Randomized Design (CRD). The result showed that Significant (P<0.05) differences occurred among treatments in most of the parameters studied. Broiler birds fed 32.5g of yeast + 37.5g of inorganic copper per 25kg of feed performed better in the starter Phase with body weight gain (BWG) of 722.61g, feed conversion ratio(FCR) of 1.27g,cost© of ₦93.54, better CP and CF utilization when compared with other test groups. The result reveals that up to 32.5g of yeast + 37.5g of inorganic copper should be incorporated per 25kg of broiler diets as feed additive, to enhance growth and well-being of broiler birds.

Keywords: Broiler chicks, Yeast, inorganic copper

Introduction

Poultry is one of the most important sources of animal protein for human consumption. In Nigeria, the demand for poultry meat and egg has increased drastically, driven by the increase in population, income growth, and urbanization (Oladeebo *et al.,* 2007). For many years, antibiotic growth promoters (AGP) have been incorporated in the poultry diets due to their favorable effects on growth rate, feed consumption and feed efficiency (Goshen *et al.,* 2012). However, there are increasing concerns that the frequent feeding of AGP is leading to the rise of antibiotics resistance in many pathogenic and opportunistic bacteria (kana *et al.,* 2011). With the growing public concern about bacterial resistance, poultry scientists are researching on the AGP alternatives that can maintain intestinal health balance with antimicrobial properties as well as increased growth. Yeast (*Saccharomyces cerevisiae*) additives could be used as alternatives to the feed antibiotics due to their beneficial performance and health effects on monogastric animals (Dhama *et al.,* 2015). Copper is one of the most critical of the essential trace minerals required by poultry and can maintain proper body functions and obtain the optimal growth performance of poultry (Banks *et al.,* 2004). According to NRC (1994) the requirement for copper in broiler diets is 5-8mg/kg. Higher level of copper in broiler diet increases the intestinal lipase activity in young birds (Luo and Dove 1996) and also improves gut health by decreasing the intestinal crypt depth and lymphocytes leading to a better absorption of nutrients performance. Considering the importance of yeast and copper, the present study was designed to evaluate the potential effects of supplementation of yeast (*Saccharomyces cerevisiae*) and copper as a natural growth promoter on production performance of commercial broiler chicken.

Materials and Methods

The study was carried out at the Department of Animal Science Teaching and Research farm, University of Nigeria, Nsukka. One hundred and twenty (120) day old broilers (Anak strain) were randomly divided into four groups of thirty birds each. The groups were randomly assigned to four experimental diets containing 0g Yeast + 0g Copper, 32.5g Yeast + 25.0g copper, 37.5g Yeast + 25g copper and 50.0g Yeast + 25g copper respectively per 25kg of diet. The percentage of Starter and finisher feeds is shown in table 1. Each treatment was replicated three times with ten birds per replicate placed in a 2.6 x 3m deep litter pens with fresh wood shavings. Feed and water were offered *ad libitum* every morning from 7.00am -8.00am and the birds were properly vaccinated. The proximate analysis was carried out according to the procedure of AOAC (2006). Data collected were subjected to analysis of variance as described for Completely Randomized Design (Steel and Torrie, 1980) and differences between treatment means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Results and Discussion

Table 2 showed the growth performance of broiler birds fed diets containing yeast and inorganic Copper. Most of the parameters measured both at starter and finisher phase differed significantly ($p<0.05$) among the treatments on the (DWG), (FBW), (BWG), (FCR) and (PER). Birds fed diet 3 had a higher ($p<0.05$) Daily weight gain, Final body weight and Body weight gain compared to birds fed diets 2 and 4 but similar ($p>0.05$) to birds fed diet 1 (Control). Copper and yeast inclusion improved the FCR and reduced the feed cost per kg at 37.5g Yeast + 25g copper/ 25 kg diet. The results of Onwurah *et al.,* (2014) and Dat *et al*., (2010) agrees with the result of the present finding that yeast and substitution of inorganic copper improves body weight (BWG), and Feed conversion ratio (FCR). This indicates that yeast could be an alternative to antibiotic-growth promoter in feed for broiler chicken by maintaining normal intestinal micro-flora by competitive exclusion and antagonism altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production.

Table 3 shows the nutrient digestibility of broiler birds fed diets containing yeast and inorganic copper. There is significantly ($p<0.05$) difference in most of the parameters measured among the treatments. The Crude Fibre, Crude Protein, Ash, of birds fed diet 3 was increased ($p<0.05$) significantly compared with birds fed treatment diets 2 and 4 which had similar ($p>0.05$) CF and CP. The observed positive effect in the nutrient retention is in agreement with the result of Raju *et al*., (2006) and this confirms yeast and copper dietary inclusion increased nutrient digestibility especially that of protein. Also the significant retention value of crude fibre confirms yeast and copper as possessing the ability to degrade fibrous material in poultry feed.

Conclusion

The result of the study showed that up to 37.5g Yeast + 25g copper/ 25kg feed can be included in the broiler diets without any deleterious effect on the growth performance and Nutrient intake and utilization.

Recommendation

It is therefore recommended that yeast and inorganic copper can be used as an effective growth promoter in broiler diets for the improvement of performance and Nutrient utilization.

References

AOAC (2006). Association of Official Analytical Chemist. Official Methods of Analysis (21th edition). Washington D.CUSA.

Banks, K.M., Thompsom, k.l., Rush, J.K., and apple gate, T.J (2014). Effects of copper source on phosphorus retention in broiler chicks and laying hens.*Poultry science* 83:990-996.

Dhama, K.; Latheef, S. K.; Mani, S.; Abdul Samad, H.; Karthik, K.; Tiwari, R.; Ullah Khan, R.; Alagawany, M.; Farag, M. R.; Alam, G. M.; Laudadio, V. and Tufarelli, V. 2015. Multiple beneficial applications and modes of action of herbs in poultry health and production-A review. *International Journal of Pharmacology* 11*:*152-176.

Duncan, D.B., (1955). New Multiple Range Test, Biometrics 11 1-42

Ghosh, T.K., S. Haldar, M.R. Bedford, N. Muthusami, I. Samanta, 2012: Assessment of yeast cell wall as replacements for antibiotic growth promoters in broiler diets: effects on performance, intestinal histo-morphology and humoral immune responses. *J. Anim. Physiol. Anim. Nutr*. 96, 275-284.

Kana, J.R., A. Teguia, B.M. Mungfu, J. Tchoumboue, (2011) Growth performance and carcass characteristics of broiler chickens fed diets supplemented with graded levels of charcoal from maize cob or seed of Canariumschweinfurthii Engl. *Trop. Anim. Health Prod*. 43, 51-56.

Luo, X.G and Dove C.R. (1996). Effect of dietary copper and fat on nutrient utilization, digestive enzyme activities, and tissue mineral levels in weanling pigs *J. Anim Sci.* 1996 Aug;74(8):1888-96.

NRC, (1994). Nutrient Requirements of Poultry, 9th rev. ed. National Academy Press, Washington DC.

Oladeebo J.O, Ambe-Lamidi A.I, Jabaru MO (2007). Resource productivity and returns to scale in poultry egg production in Afijio Local Government Area, Oyo State. Proc. 32nd Ann. Conf. Nig. Soc. Anim. Prod., Calabar, March 18-2 1 2007. Pp: 399-401.

Onwurah, F.B., Amaefule, K.U. and Ahamefule, F.O. (2014) Effect of baker's yeast (Saccharomyces cerevisiae) inclusion in feed and in drinking water on performance of broiler birds. British *Journal of Applied Science and Technology*.,4 (1): 144-151.

Raju, M.V.L.N., Reddy, V.R Rama Rao S.V. and. Panda, A.K (2006). Yeast: A multifunctional feed supplement for poultry. A review of the benefits of yeast in poultry diets. Poult. Int., 45: 16-21.

Steel, R.G.D., and Torrie, J.H.N (1980). Principles and Procedures of statictics. A biometric Approach(2nd ed.). McGraw-Hill Publishers , New York.

Table 1: Percentage compositions of the experimental diets

Ingredients (%) Diets	**Starter(kg)**	**Finisher(kg)**
Maize	40.00	43.00
Soybean meal	33.6	22.00
Groundnut cake	24.00	16.00
Palm kernel cake	10.40	16.00
Fish meal	3.00	2.00
Fixed ingredients*	13.00	13.00
TOTAL	100	100
Calculated Composition:		
Crude protein (%)	23.36	20.12
Energy(Mcal/kg ME)	2.87	2.93
Crude fibre(%)	4.91	4.39

Fixed ingredients: 8% wheat offal, 4% bone meal, 0.25% iodized salt, 0.25% Vit-min Premix, 0.25% methionine, 0.25 lysine.

Table 2: Growth performance of broiler birds fed diets containing yeast and inorganic Copper

Treatments*	**T1**	**T2**	**T3**	**T4**	**SEM**
Parameters					
Daily Performance					
Daily feed intake (g)	58.97	58.49	58.32	58.87	0.07
Daily weight gain (g)	48.05^{b}	47.58^{b}	54.51^{a}	49.23^{b}	0.05
Starter Phase					
Total feed intake (g)	953.61^{a}	928.33^{ab}	920.42^{b}	945.69^{ab}	5.36
Initial body weight (g)	570.01	565.87	569.62	573.97	17.29
Final body weight (g)	1155.20^{b}	1133.20^{b}	1292.20^{a}	1107.50^{c}	10.16
Body weight gain (g)	585.16^{b}	567.37^{b}	722.61^{a}	533.50^{b}	23.47
Feed conversion ratio	1.63^{b}	1.64^{b}	1.27^{c}	1.77^{a}	0.07
Protein efficiency ratio	0.82^{ab}	0.89^{a}	0.83^{ab}	0.79^{b}	0.01
Finisher Phase					
Total feed intake (g)	2348.82	2347.08	2345.40	2350.94	8.67
Final body weight (g)	2691.00^{c}	2664.30^{c}	3052.70^{a}	2756.70^{b}	25.59
Body weight gain (g)	1535.80^{c}	1531.10^{c}	1760.50^{a}	1649.20^{b}	42.67
Feed conversion ratio	1.53^{a}	1.53^{a}	1.33^{c}	1.43^{b}	0.03
Protein efficiency ratio	1.25^{a}	1.22^{ab}	1.25^{a}	1.20^{b}	0.01
Feed cost per kg (₦)	98.47^{a}	99.78^{a}	93.54^{b}	96.18^{a}	1.26

Table 3: Nutrient Digestibility of broiler birds fed diets containing inorganic copper and yeast.

Treatment	**T1**	**T2**	**T3**	**T4**	**SEM**
Parameters					
Starter					
Moisture	35.22	35.98	36.00	35.88	0.03
Crude Fibre	14.44^{c}	21.82^{b}	29.12^{a}	22.50^{b}	0.01
Ash	16.00^{a}	17.37^{a}	13.26^{b}	16.67^{a}	0.02
Crude fat	56.67	54.55	59.54	58.33	0.31
Crude protein	55.61^{b}	58.01^{b}	68.77^{a}	47.64^{c}	0.28
Finisher					
Moisture	18.00	19.17	17.35	18.36	0.01
Crude Fibre	11.10^{c}	18.61^{b}	26.81^{a}	20.54^{b}	0.11
Ash	26.11^{ab}	25.38^{ab}	27.81^{a}	29.85^{a}	0.04
Crude fat	60.29	58.33	57.50	62.52	0.05
Crude protein	53.31^{c}	69.18^{b}	84.95^{a}	62.09^{b}	0.08

Hematological and Serum Biochemical Parameters of Broiler finisher Chickens fed yam and Sweet Potato Peel Meals as Replacement for Maize

[1]Osuagwu, F. M. and [2]George, O.S.

[1]Department of Animal Science, Rivers State University, Nkpolu- Oroworukwo, Port Harcourt, Nigeria.

[2]Department of Animal Science, University of Port Harcourt, Choba, Port Harcourt, Nigeria.

Corresponding author: George, O. S.; otokini.george@uniport.edu.ng

ABSTRACT

An experiment was conducted to for eight (8) weeks to determine the replacement effect of yam and sweet potato peels meals for maize in broiler finisher diets on haematological and serum biochemical parameters.One hundred and eighty (180) birds were randomly allotted to five (5) treatment diets in a completely randomized design and raised separately in different pens. There were 36 birds in each treatment with three replicate and 12 birds per replicate. Feed and water were provided adlibitum. Five experimental diets were formulated and designated as T_1 (control) containing 0% yam and sweet potato peels (Maize – based), while diets T_2, T_3, T_4 and T_5 contained 2.5%, 5%, 7.5%, and 10% each of yam and sweet potato peel meals respectively . Data were collected on haematologicaland biochemical profile of the birds at the end of the feeding period (29-56 days). The data collected were subjected to analysis of variance (ANONA) using SAS (2010) Software. Differences between treatment means were separated using Duncan's New Multiple Range Test of the same software.The result of hematological parameters revealed that there was no malnourishment and anemic condition in the experimental birds.The serum biochemical parameters obtained fall within the normal range of birds, indicating good nutritional and physiological quality of the test ingredients.

KEYWORDS: Haematology, serum Biochemistry, yam and sweet potato peel

INTRODUCTION

High cost of feeds and scarcity of essential raw materials have necessitated poultry farmers to look out for alternative sources which could help to identify feed ingredients of lower cost and sound biological values that can partly supplement the conventional protein and energy sources in broiler diets. Cost of feed from the total estimated price of production in poultry is about 75% in Nigeria (Atteh, 2002, George & Wariboko 2015).

The combination of yam peel meal and sweet potato is good because the Yam peel meal good protein source while the sweet potato peel meal is good .Although some researchers have been used singly to replace part of dietary maize, replacement (Eka, 1985; Ekenyen*et al*, 2006; Aladoku, *et al*, 2007 ; Akinmutimi and Onen, 2008) and some have used it as a combination (Etela and Ironkwe, 2008; Diarra*et al*, 2012)

There is paucity of information available on literature of the Hematological and Serum Biochemical Parametersof Broiler finisher Chickens fed yam and Sweet Potato Peel Meals as Replacement for Maize. This study investigates the effect of feeding yam-sweet potato peels combination on Hematological and Serum Biochemical Parametersof Broiler finisher Chickens

MATERIALSAND METHODS

Location and duration of the experiment

This study was conducted with one hundred and eighty (180) day-old Anak broiler at the Poultry Unit of Teaching and Research Farm of Archdeacon Brown Education Centre, Woji, Port Harcourt Rivers State and it lasted for 8 weeks.

Processing of Yam, Sweet Potato Peels and Experimental Diets

The yam and sweet potato peels were washed, sun dried and milled immediate after obtaining it from the school kitchen of Archdeacon Brown Education Centre in Woji, Port-Harcourt. Five experimental diets were formulated and designated as T_1(control) containing 0% yam and sweet potato peels (Maize – based), while diets T_2, T_3, T_4 and T_5 contained 2.5%, 5%, 7.5%, and 10% each of yam and sweet potato peel meals respectively (Table 1).

Experimental Birds and Management

They were brooded using kerosene stoves under metal hooves and electric bulbs as source of light in a deep –litter house. The house was a tropical one with dwarf walls. Both sides were open covered with wire gauze. All drugs and vaccines were given to the animal.

The one hundred and eighty (180) birds were randomly allotted to five (5) treatment diets in a completely randomized design and raised separately in different pens. There were 36 birds in each treatment with three replicate and 12 birds per replicate. Feed and water were provided *adlibitum*.

Data Collection

Blood Collection and Analysis

Blood samples were drawn from punctured wing vein to aspirate about 5ml of blood. About 2.5ml of the sample was collected in ethylene diamine tetra acetic acid (ETDA) for haematological analysis. The other 2.5ml was allowed to coagulate to produce serum for blood chemistry analysis. The blood samples were analyzed within 2 hours for packed cell volume, (PCV), haemoglobin, (Hb), red blood cell (RBC), white blood cell (WBC), Mean corpuscular haemoglobin concentration (MCHC), bilirubin, creatinine, SGOT and SGPT as described by Schalm (1965), while the coagulated blood was subjected to standard methods of serum separation and analysis while haematological indices were calculated.

Data Analysis

The data collected were subjected to analysis of variance (ANONA) using SAS (2010) Software. Differences between treatment means were separated using Duncan's New Multiple Range Test of the same software.

RESULTS AND DISCUSSION

Table 2 showed that the Hematological indices of broiler finishers fed yam and sweet potato peels. The result did not follow any definite pattern that may be attributed to the test ingredients. Among the

measured parameter which included PCV%, HB, RBC, WBC, MCH and MCHC% there were significant difference($p<0.05$) among all the treatments. However there was no significant difference between treatment T_1 and T_4 in terms of HB%. Also, no significant difference ($p>0.05$) between treatment T_1, T_4 and T_5. There is also, no significant difference between treatment 2 and 4 in terms of WBC.

Table 3 showed that the serum biochemical parameters of broilers fed yam and sweet potato peel meal diets. The result obtained revealed significant difference ($p<0.05$) among the treatments in all the parameters measured which included bilirubin, creatinine, SGOT and SPGT. However, it did not follow any definite pattern that may be attributed to the test ingredients. Also, there were no significant difference ($P>0.05$) between treatment 1 and 2 in terms of SGOT. Similarly, there was no significant difference between treatment 1 and 4 and treatment 2 and 5 in terms of SPGT. The values of the hematological parameters of broiler finishers fed yam and sweet potato peels showed significant differences ($p<0.05$). The result of the investigation revealed that there were no malnourishment and anemic condition in the experimental birds since the values obtained fall within the normal range of measured hematological parameters. In a recent study with 15% inclusion level of yam peel by Akinmutimi and Onen (2008) observed that, there were significant difference for albumin, alkaline phosphate and urea. Also in a recent study on the combination of sweet potato and yam peel diets to broiler finisher by Ilo*et a*l., (2010), the result also revealed that among the parameters, measured only the WBC showed significant ($p<0.05$) difference between the treatments with T_2 (10%>PM) having the least value of (19.00) than others; the highest value of (27.36) was obtained from T_1(control).

The serum biochemicals in broilers fed yam and sweet potato peel meal diets showed significant differences ($p<0.05$).Among the treatments the value obtained from SGOT and SGPT fall within the normal range value of chicken as reported by Baerjee (1998). This indicated no toxicity in the experimental feed (Ologhobo, 1992). Increase creatinine value in blood among other things signifies poor protein utilization by the animals Fasina *et al*.,l999).

Conclusion and Application

The result of hematological parameters revealed that there was no malnourishment and anemic condition in the experimental birds.

The serum biochemical parameters obtained fall within the normal range of birds, indicating good nutritional and physiological quality of the test ingredients.

REFERENCES

Akinmutimi, A.H and Onen, G.E. (2008), The Response of Broiler Finisher Birds fed Graded Levels of Yam Peel meal in place of Maize-Based diets. *International Journal of Poultry Science*, 7(5), 474-479.

Aladoku, O.A; Aderemi, F.A and Tewe, O.O (2007) Sweet potato as a feed resource for layer production in Nigeria. African crop science conf. proc. Vol. 8pp 585-588.

Atteh J.O. 2002. Principles and practice of livestock feed manufacturing, Adlek Printers 64, Sabo-line Ilorin.

Baerjee, E. C. (1998). *Animal Husbandry.*Thayu Printing Press Ltd, Oxford. Pp 835 – 37.

Diarra S. S., Igwebuike J. U., Kwari I. D., Sinodo S., Babangida A., Ahmadu U., Shettima S. And Jibrin M.(2012) Evaluation of Yam-Sweet Potato peels mixture as source of energy in broiler chickens diets. Arpn Journal of Agricultural and Biological Science, vol. 7, No. 7, PP 497-502

Eka, O.U. (1985). The chemical composition of yam tubers: Advance in yam research the biochemistry and technology of yam tubers. *Osiyin is ed. Pub. By Biochemical society of Nig.In collaboration with ASUTECH*, Enugu p. 51-75.

Ekenyen, B.U., Madubike, F.N; and Dike, O.F; (2006) Effect of partial replacement of yam peel meal *Dioscorea spp*. for maize meal *Zea mays* on performance and carcass characteristics of finisher Broiler chicks. *International Journal of Poultry Science* 5(10): 942-945

Etela, I. and Ironkwe, M.O. (2008). Utilization of sweet potato as feed resource for farm Animals a Review, Proceeding of 42nd ASN, Abakaliki. Nig.

Fasina, O.E; Ologhobo, A.D; Ayoode, E.O; Adeniran, E.A and Adeyemi, O.A (1999).Nutritional and toxicological assessment of amygdalia in nutrition of broiler chicks.Effects of performance on haematological and biochemical indices.*Proceedings of Annual Conference, Animal Science Association of Nigeria.*August 22nd 121-131.

George, O. S. and N. O. Wariboko (2015).Effects of Monkey Kola Nut *(Kola lepidota)* Meal on the Performance of Growing Rabbits.*International Journal of Livestock Research*, pp 66-71

Ilo, S.U; Anakebe O.C; Osuagwu, F.M, Onyekwere, M.U, Inyang. E.C, Olabode, D. Oggulumba, S.I; Akinyemi, I.E; Ozuo, U.K; Oyama, R.Z, and Samuel, M.V.(2010) Performance of Broiler Finishers Fed yam and sweet potato peel meal diets. *Proceedings of 44th Annual conference of Animal Science of Nigeria.LAUTECH*.

Ologhobo, A.D (1992). Nutritive values of some tropical (West African) legumes for poultry.*JournalApplied Animal production*, 2:93-94.

Table 1: Composition of the Experimental Diets

Ingredients	**T_1 (control)**	**T_2**	**T_3**	**T_4**	**T_5**
Maize	55	50	45	40	35
Yam peel	-	2.5	5	7.5	10
Sweet potato peel	-	2.5	5	7.5	10
GNC	25.6	25.6	25.6	25.6	25.6
P.K.C	6	6	6	6	6
Wheat offal	4	4	4	4	4
Fish meal	4	4	4	4	4
Oyster shell	2	2	2	2	2
Bone meal	2	2	2	2	2
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.50	0.50	0.50	0.50	0.50
Lysine	0.40	0.40	0.40	0.40	0.40
Total	100	100	100	100	100
Calculated Chemical Composition					
Crude protein (%)	21.67	21.43	21.27	21.67	21.77
Crude fiber	3.9	4.25	4.5	4.75	5.05
ME(Kcal/kg)	2,983	2,902	2,879	2,864	2,756
Fat(%)	5.47	5.05	4.95	4.53	4.05
Calcium (%)	1.57	1.57	1.56	1.57	1.57
Phosphorus(%)	0.82	0.78	0.78	0.78	0.78

Table 2: Hematological Parameters of Broiler finisher Chickens fed yam and Sweet Potato Peel Meals as Replacement for Maize

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
PCV (%	25.63^{d}	28.33^{b}	29.26^{a}	27.40^{c}	25.60^{d}	0.40
Hb (%)	8.91^{b}	9.55^{a}	9.65^{a}	8.83^{b}	7.91^{c}	0.20
RBC (10^6u/l)	2.32^{c}	2.69^{b}	2.92^{a}	2.40^{c}	2.38^{c}	0.06
WBC (10^3u/l)	29.42^{a}	26.62^{b}	24.62^{c}	20.65^{d}	27.42^{b}	0.80
MCV (fl)	11.05	10.53	10.02	11.41	10.76	1.39
MCH (mg)	36.36^{a}	33.40^{c}	34.11^{b}	33.33^{c}	33.30^{c}	0.30
MCHC(ml)	24.40^{e}	32.00^{a}	30.20^{b}	29.16^{c}	25.60^{d}	0.80

Means within the same rows having the same superscript a, b, c, d, e are not significantly different (p> 0.05).

Table 3: Serum Biochemical Parameters of Broiler finisher Chickens fed yam and Sweet Potato Peel Meals as Replacement for Maize

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Bilirubin (mol)	0.25^{c}	0.30^{b}	0.40^{a}	0.39^{a}	0.30^{b}	0.02
Creatinine (mg/L)	1.30^{c}	1.25^{e}	1.28^{d}	1.35^{b}	1.41^{a}	0.02
SGOT (Iu/L)	90.50^{d}	89.08^{d}	92.77^{c}	97.30^{b}	99.50^{a}	1.60
SPGT(Iu/	18.41^{b}	17.33^{c}	23.45^{a}	18.36^{b}	17.80^{c}	0.60

Means within the same rows having the same superscript a, b, c, d, e are not significantly different (p> 0.05).

EFFECTS OF REPLACING MAIZE WITH PROCESSED MANGO SEED KERNEL MEAL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF WEANER RABBITS

[1]Shuaibu, U. S., [1]Bello, K. M., [1]Mancha, Y. P., [1]Jatutu, S. S., [1]Shuaibu, B. and [2]Muazu, M. S.
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi,
[2]Department of Animal Production, Bauchi State Collage of Agriculture, Bauchi, Bauchi State, Nigeria.

Corresponding author email: umarlutiatbu@gmail.com

+ 2347065267274

ABSTRACT

This study was conducted to evaluate the effect of replacing maize with processed mango seed kernel meal (PMSKM) in the diets of weaner rabbit on performance and carcass characteristics. A total of thirty two (32) mongrel rabbits (8 rabbits per treatment, 2 per replicate) were randomly allotted to four experimental diets in which processed mango seed kernel meal replaced maize at 0, 20, 40 and 60% level designed as diets 1, 2, 3 and 4 respectively. The experiment lasted for eight weeks. The result showed that the Average initial weight (500.00-518.75), average final weight (1393.75-1412.50), average daily feed intake (52.98 55.05), average daily weight gain (15.74-16.19) and feed conversion ratio (3.29-3.48) obtained were not significantly (P<0.05) affected by the dietary levels of processed mango seed kernel meal. Most of the carcass traits showed no significant difference (P<0.05) among the treatment except for carcass weight, dressing %, Intestine and loin weight. Diet 2, 3 and 4 (20, 40 and 60% PMSKM) gave highest values for carcass weight, dressing% and intestine while also diet 1, 2 and 3 (0, 20 and 40%) gave higher value for loin weight. It was therefore concluded that processed mango seed kernel meal can replace maize at 60% level in the diet of weaner rabbit as an energy source without any negative effect on their performance and carcass parameters.

Keyword: Mango seed kernel, Maize, Performance, Carcass characteristics, Weaner rabbits

Introduction

There is a continuous rise in the cost of production of cattle, sheep, goats and poultry which has prompted people to explore other less common but potential sources of animal protein like rabbits. Taiwo *et al*., (2005) indicated several advantages of rabbits over other livestock species in the tropics and advocated for its increased production in Nigeria. However, cost of feeding rabbits is high and accounted for about 65.7% of the total cost of rabbit production in Nigeria. Therefore, there is a need for researchers to find cheap and readily available sources of rabbit feed in Nigeria.

The potential of rabbit meat as a quality or nutritious food stemmed from its higher protein content, lower fat, lower sodium and cholesterol content compared with other meat source such as beef, pork, mutton and chicken. The World Health Organization recommended 76g protein intake of which 34.0g should be of animal origin (Akintola *et al*., 1999). This has been difficult to achieve in most developing countries due to insufficient availability, high cost of conventional feed stuffs resulting from stiff competition between man and animal for the few available feedstuffs especially cereal and legume grains. Tewe (1988) observed that under the prevailing circumstances, it is unlikely that there will be surplus from conventional cereals and pulses upon which livestock production can develop: thus his suggestion of waste-to-wealth approach to solve the animal feed crisis.

Mango seed kernel meal (MSKM) has been reported to be a good non conventional ingredient. Faniyi (1997) reported its importance in poultry production while Arogba (1997) provided the physical, chemical and functional properties of Nigerian mango *(Mangifera indica)* kernel and it processed flour. Chemical analysis and metabolizable energy of mango seed kernel meal as determined by Arogba (1997) revealed that it contains Tannin an astringent compound, thus necessitate processing the seed before it could be safely fed to animals. The nutrient composition of Mango seed kernel on dry matter basis was estimated in Nigeria to be 6.16% crude protein, 13.63% ether extract, 2.23% ash and 73.35% nitrogen free extract (Farinu *et al.* 1999) while EI-Alaily *et al.* (1996) reported that the gross energy is 4.7Kcal/g. This study was designed to evaluate the growth performance and carcass characteristics of weaner rabbits fed diets containing processed mango seed kernel meal.

Materials and Methods

Experimental Site:

The experiment was conducted at the Rabbitery Unit of Bauchi State College of Agriculture Teaching and Research farm, Bauchi State. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East.

Collection and Processing of Mango Seed into Mango Seed Kernel Meal

Mango seeds were collected from various dumping sites of major markets within Bauchi town. They are readily available in the area of study. The collection was done during the months of April and May which represents the peak of the mango season in Bauchi town. The kernel were obtained by cutting the seed coat using a knife or crushed with a stone. The Mango Seed Kernel (MSK) obtained was then processed through soaking and boiling.

Mango Seed Kernel was soaked in water for 24 hours at the rate of 100g per liter of water in containers. The water was changed at regular intervals of 8 hours for a day. The Mango Seed Kernels were thereafter boiled for 30 minutes, drained and sundried. Thereafter milled before incorporation into the diets.

Experimental Design and Management of Rabbits

A total of thirty two weaner rabbits were used for the experiment. They were randomly assigned into four dietary treatment groups of 8 rabbits per group in a completely randomized design (CRD) consisting of four replicates of 2 rabbits each. Feed and water were provided *ad libitum*.

Experimental Diets

Four diets were compounded manually. The diets contain 0, 20, 40, and 60% replacement level of proceed mango seed kernel meal for maize coded diets 1, 2. 3 and 4 respectively. The feed were prepared by mixing the various ingredient together at Abubakar Tafawa Balewa University feed mill.

Carcass Characteristics

At the end of the experiment four rabbits (one per replicate, were randomly selected from each treatment and slaughtered for carcass analysis, carcass and internal organ's weight were measured using a sensitive balance.

Determination of the Proximate Composition of Mango Seed Kernel

The proximate composition (Table 2) was obtained by analyzing the different samples of Mango seeds kernel according to the methods described by AOAC(1990).

Results and Discussions

The proximate composition of the test ingredients is presented in Table 2. The PMSKM used in the study contained 89.61, 2.23, 5.39, 9.62 and 3.87% for dry matter, ash, crude protein, ether extract and crude fibre respectively. These values were lower compared to the values reported by Faniyi (1997) and El-Alail *et al*. (1996). It could be due the varietal differences.

The results of performance of weaner rabbits fed processed mango seed kernel meal (PMSKM) as replacement for maize were presented in table 3. The performance characteristics in this experiment revealed that the replacement of maize by processed mango seed kernel meal at 0, 20, 40 and 60% recorded on average daily feed consumption of 52.98, 53.06, 54.45 and 55.05 (g) for treatment 1, 2, 3 and 4 respectively. There was no significant different amongst the treatment means. This agrees with the finding of Saleh *et al*., (2015) and Shitu *et al*., (2013). They reported that the average daily feed intake were not significantly different ($P<0.05$) for weaner rabbit fed mango seed kernel meal and for growing crossbreed rabbit fed PMSK meal respectively. The result also revealed that there was no significant different ($P>0.05$) in the average daily weight gain of rabbits fed PMSKM as replacement for maize. The values ranged from 15.74-16.19g obtained in this study is higher than 10.1g reported by Adama and Nma (2002) when groundnut leaves were fed to rabbits. This also confirms the report of (Saleh *et. al*., 2015) and (Fayeye and Joseph, 2004). Shitu *et.al*; (2013) reported no significant effect on growing crossbreed rabbits fed processed mango seed kernel meal. The non significant effect of processed mango seed kernel meal based diets on feed conversion ratio among the treatments means contradicts the findings of Diarra *et.al*; (2004) but similar to the finding of Saleh *et al*., (2015).

Table 4 showed the result for carcass analysis of weaner rabbits fed PMSKM base diets. For carcass analysis it also revealed that there was no significant ($P<0.05$) difference in the live weight, heart,

lung, kidney, stomach and liver which agrees with the findings of Shitu *et.al*; (2013) they reported non significant different between the control diet and the mango seed kernel meal based diet in rabbits. There was a significant difference in the carcass weight and dressing percentage among the treatment means, the significant effects of mango seed kernel meal based diet on carcass weight and dressing percentage among the treatment means contradict the finding of Fayeye and Joseph (2004) who reported non significant difference across the dietary treatments. The weight of stomach also shows significant difference between the control diet and the mango seed kernel meal based diet in rabbits. The weight of head, skin, tail, shoulder and thigh also did not show significant different across the dietary treatments.

Conclusion and Recommendation

It can be concluded that processed mango seed kernel meal can be use to replace maize in the diet of weaner rabbits as an energy source without any negative effect on their performance and carcass values, thereby reducing competition and improving consumer access to animal protein. Thus the use of mango seed kernel meal is there by advocated at up to 60% replacement.

Table 1: Ingredients and Percentage Composition of Experimental Diets

Parameters	**Diets** T_1 **(0%)**	T_2 **(20%)**	T_3 **(40%)**	T_4 **(60%)**
Maize	31.32	25.06	18.79	12.53
Soya bean	17.98	17.98	17.98	17.98
MSKM	0.00	6.26	12.53	18.79
Maize brand	25.00	25.00	25.00	25.00
Groundnut hay	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100
Calculated composition (%)				
Crude protein	18.00	17.85	17.69	17.55
Crude fiber	9.33	9.46	9.49	9.57
ME (kcal/kg)	2552.66	2542.84	2532.99	2523.16

Table 2: The Proximate Composition of Mango Seed Kernel Meal

Parameters (%)	Mango Seed Kernel Meal
Dry matter	89.61
Ash	2.23
Crude protein	5.39
Ether extracts	9.62
Crude fibre	3.87

Table 3: Performance of Weaner Rabbit Fed Processed Mango Seed Kernel Meal Based Diets

	Dietary treatment					
Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**	**SEM**	**LOS**
Average initial weight (g)	500.00	500.00	512.50	518.7	61.18	NS
Average final weight (g)	1393.75	1400.00	1412.5	1406.25	21.35	NS
Total weight gained (g)	893.75	900.00	900.00	887.50	20.40	NS
Average daily feed intake (g)	52.98	53.06	54.45	55.05	1.57	NS
Average daily weight gain (g)	15.74	15.96	16.07	16.19	0.75	NS
Feed conversion ratio	3.66	3.33	3.39	3.40	4.51	NS

LOS: Level of significance
NS: Non significance difference (P<0.05)

Table 4: Carcass Characteristics of Weaner Rabbits Fed Processed Mango Seed Kernel Meal Based Diets

	Dietary Treatments					
Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**	**SEM**	**LOS**
Live Weight	1361.25	1378.75	1385.00	1355.00	22.95	NS
Slaughter weight	1323.75	1330.00	1332.50	1307.50	20.43	NS
Carcass weight	765.50^{b}	882.50^{a}	880.00^{a}	830.00^{ab}	30.89	*
Dressing %	56.22^{b}	64.01^{a}	63.53^{a}	61.23^{a}	1.74	*
Heart	0.46	0.43	0.45	0.41	0.10	NS
Lung	0.78	0.81	0.73	0.71	0.11	NS
Liver	3.90	4.40	4.10	3.56	0.49	NS
Kidney	1.19	1.30	1.38	1.25	0.26	NS
Stomach	1.80	1.62	1.75	1.68	0.14	NS
Intestine	14.80^{b}	20.45^{a}	21.48^{a}	20.18^{a}	1.34	*
Head	11.07	12.41	11.90	12.13	0.59	NS
Skin	11.65	12.48	12.40	12.35	0.64	NS
Tail	1.21	1.49	1.22	1.15	0.17	NS
Shoulder	26.68	25.80	26.60	25.78	0.45	NS
Loin	22.80^{ab}	23.60^{a}	22.70^{ab}	22.10^{b}	0.42	*
Thigh	27.35	26.62	27.43	26.37	40.77	NS

^{abc}: means within the same row bearing different superscript are significantly different (P<0.05)
LOS: Level of significance
NS: Non significance difference (P<0.05)

Reference

Adama, T.Z. and Nma Y.B. (2002). An evaluation of feeding value of five types of forages fed to growing rabbits. *Journal of sustainable Tropical Agricultural Resources*. **4**: 45-49.

Arogba, S.S. (1997). Physical chemical and functional properties of Nigerian Mango *(Mangifera indica)* kernel and its processed flour. J SL: Food Agric. **73**: 321-328.

Akintola, E. O., Kehinde. A. S., Abu O. A. and Tewe O.O. (1999). Performance and Economy of Production of Growing Pigs Fed Whole Cassava Plant Based Diet in the Tropics. *Journal of Tropical Animal Production Investigation* **2**: 181-186.

AOAC (1990). Official Methods of Analysis (15th Edition). Association of official analytical chemist,Washington D.C, USA.

Diarra, S.S., Saleh, B., Kwari, I.D and Igwebuike, J. U. (2004). Evaluation of boiled mango kernel as energy source by broiler chickens in the semi-arid zone of Nigeria. *International Journal of Science and Nature* **2**(2): 270-274

El Alaily, H. A., Anwar, A., El Banna, I. (1996). Mango seed kernel as an energy source for chicks. *Broiler Poultry Science*. **17**:129-133.

Faniyi, G. F. (1997). Effect of Including rarrciled mango seed kernel meal in broiler starter. *Journal of Proffesional Teacher trainers*. **2** (1): 62-68.

Farinu, G. O, Odunsi A. A. and Togun V.A. (1999). Effect of varying levels of mango-seed kernel meal on growth performance, nutrient digestibility and blood components of weaner Rabbits. *Tropical Journal of animal science*. **3**: 119-125.

Fayeye, T. R. and Joseph, K. (2004). Effect of Dietary Dehulled, Sundried Mango kernel meal on Growth and Carcass Characteristics of Fryer Rabbit. *Journal of Agricultural Research and Development* **3**: 129-137

Saleh, N., Bello K. M., and Muhammad A. S. (2015). Effects of Replacing Maize with Mango Seed Kernel Meal on Performance, Carcass Characteristics and Economic of Production of Weaner Rabbits. *International Journal of Geology, Agriculture and Environmental Sciences*.3:

Shittu , M. D., Olabanji R. O., Ojebiyi O. O., Amao O.A. and Ademola S.G. (2013). Nutritional Evaluation of Processed Mango *(Mangifera Indica* - Kent) Seed Kernel Meal as Replacement for Maize in the Diet of Growing Cross bred Rabbits. *Online Journal of Animal and Feed Research.* **5**: 210-215

Taiwo, A. A., Adejuyigbe, A.O, Asebowale, A.E., Oshotan, J.S. and David O.O. (2005). Performance and Nutrient digestibility of weaned rabbits fed forage supplemented with concentrate. *Nigeria Journal of Animal Production* **32** (1):74 – 78

Tewe, O. O (1988). Recent Trend in the Utilization of Agro-Industrial By-Products and Crop Residues in Non-Ruminant Feeding. The Green (*Akinbote, H.L. Chief Ed*). **6**: 9-12.

THE EFFECT OF PARTIAL REPLACEMENT OF MAIZE WITH ACHA (*Digitaria exilis)* OFFAL ON PERFORMANCE OF BROILER CHICKENS

[1]Sudik, S. D., [1]Bagudu, I. A., [1]Maidala, A., [1]Lawan, A., 2Agbede, J. O., and [2]Igbasan, F. A.
[1]Department of Animal Science, Federal University, Gashua, Yobe State, Nigeria
[2]Department of Animal Production and Health, Federal University of Technology, Akure, Ondo State, Nigeria
Corresponding author: davidsudik@fugashua.edu.ng Mobile No: +2348065633451

Abstract
An experiment was conducted to determine the performance of broiler chickens fed diets with acha offal (AO) replacing maize. A total of two hundred and forty (240) day-old broilers were randomly allotted into six dietary treatments with AO at 0%, 5%, 7.5%, 10%, 12.5% and 15% with forty birds per treatment. Each treatment had four replicates with 10 birds each in a completely randomized design. Feed and drinking water were served ad libitum throughout the experiment which lasted for 42 days. The results showed that at the starter phase only feed conversion ratio (FCR) was significantly (p<0.05) affected by treatment while others parameters were not significantly different from each other. Chicks fed 12.5% AO had best FCR (1.59) while those fed 0%, 5%, 7.5%, 10% and 15% AO had poor (2.05, 2.08, 2.03 and 2.02, respectively). At finisher phase, final weight (FW), total weight change (TWC), daily weight gain (DWG) and FCR were significantly (p<0.05) affected by treatment. Chickens fed 7.5% - 15% AO had higher FW, TWC and ADG than 0% AO while birds fed 5% AO had lower compared with those fed 0% AO. However, those fed 15% AO had best FCR (2.26) while those fed 0% and 5% had poor (2.46 and 2.33, respectively). It can be concluded that AO can replace maize in broilers' diets by 12.5% at starter phase and 15.0% at finisher phase without adverse effect on performance.

Keywords: Broiler, Acha offal, Maize, Feed intake, Performance,

Introduction

Globally, the aim of any poultry farmer is to have flock with efficient feed utilization, uniform growth rate, and low cost of production. This can be achieved in parts through the use of standard feed produced from low cost ingredients (NRC, 1994). In developing countries, where competition on conventional feedstuff between man and livestock exist, a careful selection of agro industrial by-products stand as means of reducing cost of feed (Makinde *et al*., 2014). Many agro industrial by-products including brewers dried grains, broken rice, cottonseed cake, groundnut cake, maize bran, millet hulls, oat hulls, palm kernel cake, peanut hulls, rapeseed hulls, sunflower meal, rice bran, rice hulls, sesame hulls, soybean hull, wheat bran have been well reported as alternative ingredients (Mottet *et al*., 2017). However, many others are yet to be exploited, one of which is acha offals.

Acha (also called white fonio) is a small annual, herbaceous plant that belongs to the family *Poaceae* and the genus *Digitaria* (Cruz *et al*., 2016). It grows to the height of 30-80 cm (Cruz *et al*., 2016). It is grown in the Central Zone of Nigeria and many West African countries as staple food (Cruz *et al*., 2016). Acha offal (AO) is a by-product obtained from dehulling acha grains by pounding with a pestle in a mortar to crack the hulls or using machines (NRC, 1996). A 100g of AO contains 5.74% total ash, 10.16% crude protein, 4.70% crude fat, 7.82% crude fibre, 2.65g/16N methionine and 2.89g/16N lysine (Sudik, 2016). By implication AO is rich in essential nutrients. The objective of this study is to determine the effect of partial replacement of maize with acha (*Digitaria exilis)* offal on performance of broiler chickens.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm Federal University of Technology Akure, Nigeria. Akure lies on latitude 7^0 15' N and longitude 5^0 12' 0" E and within the rainforest zone of Nigeria. Its annual average rainfall is usually1524 mm, average atmospheric temperatures ranges between 28^0C and 31^0C, and mean annual relative humidity is usually about 80% (Ajibefun, 2011).

The acha (*Digitaria exilis*) offal was purchased in Bokkos local Government Area of Plateau State, Nigeria. Maize grains and other ingredients were purchased from a feed miller in Akure town, Ondo

State, Nigeria. A basal diet (0% AO) that meets nutrient requirements of broiler chickens (NRC, 1994) was formulated. Thereafter, 5 other diets with 23% CP (Starter) and 20% CP (Finisher) were formulated with AO replacing maize at 5%, 7.5%, 10.0%, 12.5% and 15% (Table 1 and 2).

Table 1: Gross composition and calculated values of starter

Ingredients	**Diet 1 0%AO**	**Diet 2 5%AO**	**Diet 3 7.5%AO**	**Diet 4 10%AO**	**Diet 5 12.5%AO**	**Diet 6 15%AO**
Maize	50.00	47.50	46.25	45.00	43.75	42.50
Acha offal	0.00	2.50	3.75	5.00	6.25	7.50
Soybean meal	27.00	27.00	27.00	27.00	27.00	27.00
Groundnut cake	10.10	10.10	10.10	10.10	10.10	10.10
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Dicalcium phosphate	3.10	3.10	3.10	3.10	3.10	3.10
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Soy oil	4.00	4.00	4.00	4.00	4.00	4.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated						
Crude protein	23.00	23.00	23.10	23.10	23.20	23.20
Crude fibre	3.18	3.28	3.38	3.47	3.57	3.66
ME (kcal/kg)	2967.51	2960.22	2943.18	2921.43	2881.56	2816.15
Calcium	1.10	1.10	1.10	1.10	1.10	1.10
Average phosphorus	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	1.14	1.14	1.15	1.15	1.16	1.16
Methionine	0.54	0.54	0.55	0.55	0.56	0.56

AO = Acha offal

Two hundred and forty (240) day-old Abor-Acre broiler chicks were purchased from Chi Farm, Ibadan, Nigeria. They were randomly allotted to six dietary treatments. Each treatment had forty birds and four replicates with ten birds per replicate in a completely randomized design (CRD). The birds were raised on deep litter and heat was provided by charcoal and electricity. Feed and water were provided *ad libitum* throughout the 42 days of the experiment. Gumboro disease vaccine 1st and 2nd dose was administered on day 7th and 21st, respectively while Newcastle disease vaccine on day 14th and 28th and routine management practices were strictly adhered to.

At the start of the experiment, the birds were weighed to determine initial weight thereafter, on weekly basis to determine the body weight chance (BWC) and daily weight gain (DWG) was calculated by dividing the cumulative weights by number of days considered. The left over feed of each diet was subtracted from supply to determine the feed consumed. Dividing the cumulative total feed intake (TFI) by number of day under consideration gave daily feed intake (DFI). Feed conversion ratio (FCR) was calculated as feed intake/weight gain.

Table 2: Gross composition and calculated values of finisher diets

Ingredients	Diet 1 0%AO	Diet 2 5%AO	Diet 3 7.5%AO	Diet 4 10%AO	Diet 5 12.5%AO	Diet 6 15%AO
Maize	58.00	55.10	53.65	52.20	50.75	49.30
Acha offal	0.00	2.90	4.35	5.80	7.25	8.70
Soybean meal	20.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	12.20	12.20	12.20	12.20	12.20	12.20
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Dicalcium phosphate	2.50	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Soy oil	3.00	3.00	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated						
Crude protein	20.00	20.30	20.30	20.40	20.40	20.40
Crude fibre	4.31	2.28	3.42	3.46	3.49	3.53
Metabolizable energy (kcal/kg)	3021.12	3001.34	2989.08	2909.27	2887.16	2857.57
Calcium	1.04	1.04	1.04	1.05	1.05	1.05
Average phosphorus	0.78	0.78	0.78	0.78	0.78	0.78
Lysine	1.03	1.03	1.05	1.05	1.06	1.06
Methionine	0.41	0.41	0.41	0.42	0.42	0.43

AO = Acha offal

Data generated were subjected to Analysis of Variance (ANOVA) using the computer software SAS (2010). Significant means were separated with Duncan multiple range test at 5% level of probability.

Results

Feed conversion ratio (FCR) was only significantly ($p<0.05$) affected at 21-day (Table 3). Birds fed 12.5% AO had better FCR (1.59) than those on 0% AO (2.05) while birds fed 5%-10% and 15% AO had poor FCR (2.08, 2.03, 2.03 and 2.02, respectively) comparable to those fed 0% AO. At the finisher phase FW, BWC, DWG and FCR were significantly ($p<0.05$) affected (Table 4). Birds fed 7.5% - 15% had higher FW (2057.50 g, 2070.00 g, 2093.75 g and 2132.50 g, respectively), BWC (2016.25 g, 2028.50 g, 2052.00 g, and 2091.25 g, respectively) and DWG (48.01 g, 48.30 g, 48.86 g and 49.79 g, respectively) than those fed 0% AO (FW (1906.76 g), BWC (1865.26 g) and DWG (44.41 g)) while those fed 5% AO had lower (FW (1863.75 g), BWC (1822.25 g) and DWG (43.39 g)) compared with 0% AO. The birds fed 15% had better FCR (2.26) while those fed 0% and 5% AO had poor (2.46 and 2.33, respectively).

Discussion

The better FCR observed in birds fed 12.5% AO indicates that the optimum level to use AO for younger birds is at 12.5% and their high performance over those fed control means that the diet might have contained nutrients probably deficient in the control. The decline in FCR at 15% AO demonstrates that the birds could not tolerate AO beyond 12.5% probably due to high fibre because high fibre in diet interferes with the nutrients availability. This observation confirms the results of Makinde *et al*. (2014) that high fibre content in diet limit nutrients available for birds to grow.

At the finisher stage the higher gain and better FCR in birds fed diets with 7.5% -15% AO means that AO can be tolerated by older birds up to 15% which probably might have not interfered with the nutrients availability. This finding confirms the results of Ezieshi *et al*. (2011) that older birds tolerate fibre diet at certain levels than young ones.

In comparison with other offals the optimum level recorded for AO in this experiment is in agreement with 15% rice offal reported by Maikano (2007) for broilers. However, Makinde *et al*. (2014) reported that higher levels of 20-30% rice offal could be used with enzyme supplementation.

Table 3: Performance of broiler chickens fed diets with acha offal (21 days of age)

Parameters	Diet 1 0%AO	Diet 2 5%AO	Diet 3 7.5%AO	Diet 4 10%AO	Diet 5 12.5%AO	Diet 6 15%AO	±SEM
Initial weight	41.50	41.50	41.25	41.50	41.75	41.25	0.03
Final weight	765.00	758.75	778.75	785.00	790.25	799.00	8.84
Body weight change	723.50	717.25	737.50	743.50	749.50	757.75	8.84
Daily weight gain	34.45	34.16	35.12	35.40	45.61	36.08	0.42
Total feed intake	1483.65	1493.52	1498.56	1507.80	1520.61	1528.38	1.08
Daily feed intake	70.65	71.12	71.36	71.80	72.41	72.78	0.24
Feed conversion ratio	2.05[a]	2.08[a]	2.03[a]	2.03[a]	1.59[b]	2.02[a]	0.05

Values are average of 40 birds, AO = Acha offal, ±SEM = Standard Error of Mean,
Means with differing superscripts in the same columns are significantly ($p<0.05$) different.

Table 4: Performance of broiler chickens fed diets with acha (42 days of age)

Parameters	Diet 1 0%AO	Diet 2 5%AO	Diet 3 7.5%AO	Diet 4 10%AO	Diet 5 12.5%AO	Diet 6 15%AO	±SEM
Initial weight	41.50	41.50	41.25	41.50	41.75	41.25	0.03
Final weight	1906.76[b]	1863.75[b]	2057.50[a]	2070.00[a]	2093.75[a]	2132.50[a]	22.85
Body weight change	1865.26[b]	1822.25[b]	2016.25[a]	2028.50[a]	2052.00[a]	2091.25[a]	23.00
Daily weight gain	44.41[b]	43.39[b]	48.01[a]	48.30[a]	48.86[a]	49.79[a]	0.55
Total feed intake	4584.72	4638.30	4683.32	4697.26	4701.00	4729.66	89.19
Daily feed intake	109.16	110.44	111.51	111.84	111.93	112.61	4.50
Feed conversion ratio	2.46[a]	2.55[a]	2.32[b]	2.32[b]	2.29[c]	2.26[c]	0.13

Values are average of 40 birds, AO = Acha offal ±SEM = Standard Error of Mean,
Means with differing superscripts in the same columns are significantly ($p<0.05$) different.

Conclusion and Recommendation

It can be concluded that birds fed 12.5% AO at the starter phase and 15.0% AO at the finisher phase had outstanding performance over those fed 0% AO. Therefore, 12.5% AO and 15.0% AO are recommended for starter and finisher broiler chickens, respectively.

References

Ajibefun, I. (2011). Akure City Profile. www.wikipedia.org/wiki/Akure . Retrieved 5th May, 2011.

Cruz, J.-F. ; Béavogui, F. ; Dramé, D. ; Diallo, T. A. (2016). Fonio, an African cereal. Cirad, Montpellier, France, 154 p.

Ezieshi, E. V., Obazele, M. O. and Olomu, J. M. (2011). Performance and energy metabolism by broiler chickens fed maize and millet offals at different dietary levels. *Journal of Agriculture and Social Research (JASR)*, 11(1) 2011.

Maikano, A. (2007). Utilization of rice offal in practical ration of broilers. *The Zoologist-AJOL* 5:1-7.

Makinde, O. J., Enyigwe, P. C., Babajide, S. E., Atsumbe, J. A., Ibe, E. A. and Samuel, I. (2014). Growth performance and carcass characteristics of finisher broiler fed rice offal based diets supplemented with exogenous enzyme. *Greener Journal of Agriculture Sciences*, 4(4)6-15.

Mottet, A., de Haan, C., Falcuccia, A., Tempio, G., Opio, C. and Gerber, P. (2017). Livestock: On our plates or eating at our table? A new analysis of the feed/ food debate. Global Food Security, 14: 1-8 https://dx.doi.org/10.1016/j.gfs.2017.01.001

NRC (1994): The National Academies. Component of poultry diets. Nutrient requirements of Poultry. Ninth revised edition. The National Academies Press Openbook.

NRC (1996). Lost Crops of Africa. Volume I Grains. National Research Council, Washington DC

SAS Institute (2010). SAS User's Guide Statistics Version 5 SAS Institute Inc. Releigh North Califonia, USA. 96.

Sudik, S. D. (2016). Nutrient distributions and biochemical studies of acha (*digitaria spp*) in infant weaning foods and poultry diets. Ph. D Thesis, Federal University of Technology, Akure, Nigeria.

EFFECT OF REPLACING WHEAT OFFAL WITH RICE BRAN ON GROWTH PERFORMANCE OF BROILER CHICKENS

[1]Usman, Y., [2]Egbo, L.M., [2]Abdulkarim, M.,[2]Doma, U.D.
[1]Department of Animal Health Technology, College of Agriculture Bauchi, Nigeria
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Abstract
A feeding trial was carried out to evaluate the effect of replacing wheat offal with rice bran on growth performance of broiler chickens. Five (5) diets were formulated in which rice bran replaced wheat offal at 0, 25, 50, 75 and 100% levels, designated as diets 1, 2, 3, 4 and 5 respectively. Two hundred (200) day-old broiler chicks weighing between 158.98 – 169.02 g were randomly allotted to five diets in replicates of three containing 13 birds each in a completely randomized design. Feed and water were providedad libitum and the experiment lasted for eight (8) weeks. Results showed that there was no significant influence of diet on all performance parameters during the starter, finisher and overall phases. It was therefore concluded that rice bran can completely replace wheat offal in broiler chicken diets without compromising growth performance.

***Keywords**: Wheat offal, Rice bran, Broiler chickens, Growth performance*

***CorrespondingAuthor**: yakubuusman320@gmail.com; Phone no: 07039368989*

Introduction
The growth of Nigerian poultry industry is constrained by persistent scarcity and high cost of conventional feed ingredients such as maize and soya bean. To stem this problem and ensure that the sector expresses its full potentials of making animal protein available at affordable rate, the need for use of relatively cheap and readily available unconventional feedstuff becomes necessary. This will also reduce feed cost which stands at about 75 - 80 % of the total cost of broiler chicken production (Ani *et al.*, 2012). Previous research findings have shown that diets formulated with some alternative fibre sources such as rice offal can replace wheat offal in broiler diets (Amaefule *et al.*, 2006). Rice offal has a CP content of 5.09% and 30.39% crude fibre. The inclusion of rice offal at up to 15% level in broiler chicken diets, did not negatively affect performance and carcass yield (Makinde *et al.*, 2014). Okpanachi *et al.*, (2015) reported that, when treated with urea, rice offal can be included in broiler diets at up to 15 and 10% levels respectively without reduction in performance. This study was therefore aimed at investigating the performance of broiler chickens fed graded levels of rice bran as replacement of wheat offal in the study area.

Materials and methods
The experiment was carried out at the Poultry Teaching and Research Farm, College of Agriculture, Bauchi, Bauchi State. Five experimental diets were formulated in which rice bran replaced wheat offal at 0, 25, 50, 75 and 100% levels, designated as diets 1, 2, 3, 4 and 5 respectively. The percentage composition and calculated analysis of experimental diets for both the starter and finisher phases are presented in Tables 1 and 2. A total of 200 day-old chicks were allotted to five experimental diets in three replicates of 13 birds each in a completely randomized design. The study lasted for 56 days. Data was collected for feed intake, weight gain, feed conversion ratio and mortality. All data collected were subjected to ANOVA.L.S.D. was used for mean separation.

Table1: Ingredients and Percent Composition of Rice Bran as Replacement for Wheat Offal Fed to Broiler Chickens at the Starter Phase (1-4 weeks)

	Diets				
Ingredients	**1**	**2**	**3**	**4**	**5**
Yellow sorghum	52.46	52.46	52.46	52.46	52.46
Soya bean	18.14	18.14	18.14	18.14	18.14
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Wheat offal	10.00	7.50	5.00	2.50	0.00
Rice bran	0.00	2.50	5.00	7.50	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis (%)					
Crude protein	23.00	222.93	22.85	22.78	22.70
ME (kcal/kg)	2780.70	2767.90	2754.20	2725.35	2789.70
Crude fibre	4.78	4.78	4.45	4.97	4.96
Ether extract	3.83	4.07	4.29	4.51	4.73
Ash	3.89	3.98	4.07	4.16	3.89
Lysine	0.89	0.89	0.88	0.87	0.86
Methionine	0.33	0.33	0.33	0.34	0.34
Calcium	1.35	1.55	1.53	1.54	1.53
Phosphorus	0.58	0.59	0.60	0.60	0.60

Table 2: Ingredients and Percent Composition of Rice Bran as Replacement for Wheat Offal Fed to Broiler Chickens at the Finisher Phase (5-8 weeks)

	Diets				
Ingredients	**1**	**2**	**3**	**4**	**5**
Yellow sorghum	55.40	55.40	55.40	55.40	55.40
Soya bean	13.20	13.20	13.20	13.20	13.20
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fishmeal	2.00	2.00	2.00	2.00	2.00
Wheat offal	15.00	11.25	7.50	3.75	0.00
Rice bran	0.00	3.75	7.5	11.25	15.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis (%)					
Crude protein	20.00	19.89	19.78	19.67	19.55
ME(kcal/kg)	2736.10	2747.00	2765.00	2762.00	2736.10
Crude fibre	4.20	3.52	4.84	4.52	4.20
Ether extract	3.65	3.99	4.33	4.65	3.63
Ash	348	3.42	3.75	3.89	4.02
Lysine	1.33	1.32	1.31	1.30	1.29
Methionine	0.25	0.26	0.44	0.26	0.26
Calcium	1.45	1.45	1.46	1.45	1.44
Phosphorus	0.67	0.67	0.66	0.66	0.64

Results and discussion

Results for growth performance of broiler chickens (Table 3) revealed that no parameter was significantly influenced by diet during study phases. During the starter phase, birds at 4th week weighed between 606.32g on diet 5 and 714.10g on diet 3, daily feed intake, 43.29g (diet 3) to 50.44g (diet 1), daily weight gain, 15.89g (diet 5) to 20.10g (diet 2) while feed conversion ranged from 2.22 (diet 3) to 2.73 (diet 1). This agrees with Onuh *et al.* (2015), Similar performance was recorded during the finisher phase. Final weight of birds ranged from 1322.70g (diet 3) to 1564.70g (diet 2), daily feed intake, 91.69g (diet 3) to 101.10g (diet 1), daily weight gain, 31.74g (diet 3) to 42.33g (diet 2) and feed conversion ratio from 2.29 to 2.89 on diets 2 and 3 respectively. This contradicts Akpet and Ibekwe (2018). The overall phase showed that total feed intake of birds ranged from 3779.64 to 4243.12g, total weight gain, 1400.08 – 1747.96g, daily feed intake, 67.49 – 75.77g, daily weight gain, 25.00 – 31.21g and feed conversion ratio from 2.27 to 2.83.

Table 4: Performance of Broiler Chickens Fed Varying Levels of Rice Bran (1-8 weeks)

	Diets					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
Starter phase (1-4 weeks)						
Initial Weight(g)	169.02	158.98	161.54	163.46	161.19	6.26^{NS}
Week 4 weight	695.98	721.70	712.10	648.98	606.19	39.21^{NS}
Daily Feed intake (g)	50.44	43.88	43.30	44.45	45.03	1.58^{NS}
Daily weight gain (g)	18.82	20.10	19.66	17.34	15.89	0.26^{NS}
Feed Conversion ratio	2.73	2.25	2.22	2.57	2.84	0.33^{NS}
Mortality (%)	1	0	0	1	1	-
Finisher phase (5-8 weeks)						
Final Weight (g)	1495.5	1564.7	1383.1	1353.3	1322.7	100.23^{NS}
Daily Feed Intake (g)	101.1	97.09	91.69	93.25	95.87	5.63^{NS}
Daily Weigh Gain (g)	38.05	42.33	31.74	33.52	34.11	3.42^{NS}
Feed Conversion Ratio	2.58	2.29	2.89	2.84	2.82	0.25^{NS}
Mortality (%)	1	1	1	1	1	-
Overall phase (1-8weeks)						
Total feed intake (g)	4243.12	3947.16	3779.64	3855.60	3945.28	160.49^{NS}
Total weight gain (g)	1592.36	1747.96	1439.28	1424.08	1400.08	121.38^{NS}
Final Weight (g)	1761.38	1906.94	1600.82	1587.54	1561.27	119.20^{NS}
Daily Feed Intake (g)	75.77	70.49	67.49	68.85	70.45	3.65^{NS}
Daily Weigh Gain (g)	28.44	31.21	25.70	25.43	25.00	2.47^{NS}
Feed Conversion Ratio	2.66	2.27	2.56	2.70	2.83	0.23^{NS}
Mortality (%)	2	1	1	2	2	-

SEM = Standard error of the mean, NS = Not significant

Conclusion

Rice bran can completely (100%) replace wheat offal in broiler chicken diets without compromising growth performance.

References

Akpet, S. O. And Ibekwe, H. A. (2018). Performance, haematological and serum characteristics of broiler chicks fed diets with graded levels of rice offal. *International Journal of Food Science and Nutrition,* **3** (6): 61 – 67.

Amaefule, K. U., Iheukwumere, F. C., Lawal, A. S. and Ezekwonna, A. A. (2006). The effect of treated rice milling waste on performance, nutrient retention, carcass and organ characteristics of finisher broilers. *International Journal of Poultry Science*, **5**(1):50-55

Ani, A. O., Oguwuowo, L. C., Omeje, O. D. (2012). Growth performance of broiler chicks fed diets containing raw bambara nut (Vigna subterranean L.) waste and supplementary enzymes. *African Journal of Biotechnology*, **11** (56): 11991 – 11997.

Makinde, O. J., Enyigwe, P. C,, Babajide, S. E., Atsumbe, J. A., Ibe, E. A. and Samuel, I. (2014). Growth performance and carcass characteristics of finisher broilers fed rice offal based diets supplemented with exogenous enzymes. *Greener Journal of Agricultural Sciences,* **4** (4): 144 - 149.

Okpanachi, U., Boyi, P. U., Egbu, C. F. and Oyibo, A. (2015). Performance and internal organ characteristics of broiler chickens fed urea-treated and untreated rice milling waste. *International Journal of Animal Biology*, **1** (4): 130 – 135.

GROWTH PERFORMANCE AND ECONOMY OF FEED CONVERSION OF BROILER CHICKENS FED DIETS CONTAINIING COWPEA MILLING WASTE AND PLANTAIN PEEL MEAL MIXTURE

A. A. MALIK*, Y. S. KUDU, M. A. HAMZAH, M. A. WORU, S. Y. EZRA AND O. E. ADEYEMI

Department of Animal Production, Federal University of Technology, Minna, Niger State
**Corresponding author's e-mail: delemalik@gmail.com*
Phone: 08030637763

Abstract
144 day-old Arbor Acre chicks were used to investigate the effect of feeding diets containing cowpea milling waste and plantain peel meal mixture (CMWPPM) on the growth performance and economy of feed conversion of broiler chickens. The birds were randomly allotted to four dietary treatments in a completely randomized design model, and consisted of 0, 10, 20 and 30 % dietary inclusion levels of CMWPPM. Each treatment was replicated three times with 12 chicks per replicate, making a total of 36 chicks per treatment. The experiment lasted for eight weeks. Results showed that at the starter phase, birds on CMWPPM 0 % had significantly (P<0.05) higher feed intake, while birds on CMMPPM 20 % had significantly (P<0.05) lower feed intake than birds on the other treatments. The cost of feed and total cost of feed intake were significantly (P<0.05) higher for CMWPPM 30 % and significantly lower for CMWPPM 20 % than for the other treatments; while feed cost per kg weight gain had no significant difference across the treatments. At the finisher phase, there were no significant differences in all the growth performance parameters measured across the treatment groups. However, total cost of feed intake was significantly (P<0.05) higher for CMWPPM 10 % and significantly (P<0.05) lower for CMWPPM 20 %. The feed cost per kg weight gain was significantly (P<0.05) higher for CMWPPM 10 % and significantly (P<0.05) lower for CMWPPM 20 % and 30 % diets. Therefore, it is concluded that the inclusion level of CMWPPM in the diet of broiler chickens should not exceed 20 % for optimum economy of feed conversion at the starter phase; whereas birds can be fed diets containing 30 % dietary inclusion level of CMWPPM with good economy of feed conversion at the finisher phase.

Keywords: *Cowpea milling waste, plantain peel meal, growth performance, broiler chickens*.

Introduction

The poultry industry has not been a very lucrative enterprise because of high cost of conventional feedstuffs, which most times are competed for by both human beings and the livestock industry (Ironkwe and Oruwari, 2012). Nigeria, like many other developing countries of the world, is currently faced with shortage and high cost of conventional feedstuffs for poultry production (Duwa *et al*., 2014). This high cost and low availability of conventional poultry feedstuffs frequently demand consideration of by-products, even if efficiency of utilization is low, for poultry feeding (Negesse *et al*., 2009). It is important to utilize inexpensive materials not only to sustain the market of animal products but also to search for new sources of animal feed by recycling underutilized wastes (Ulloa *et al*., 2004). It is therefore necessary now for animal nutritionists to look for non-conventional feedstuffs that are readily available and cheaper in order to cut down on the feed cost, which constitute about 65-70 % of the total cost of production. Reports have shown that there are large numbers of feedstuffs with enormous potentials in Nigeria and one of such is plantain peel meal and cowpea milling waste.

Plantain peels are mostly regarded as wastes which constitute environmental pollution especially in urban areas where goats and sheep are not allowed to roam about (Ajasin *et al*., 2004; Ighodaro, 2012). Plantain peel is reported to have some nutritional values. It is a source of energy which compares favourably with maize, except for its crude fibre and ether extract content. Plantain peel is a good source of energy containing 12 % crude protein, 6 % crude fibre and 2700 Kcal/kg metabolizable energy on dry matter basis (Omole *et al*., 2008). It also contains higher levels of minerals such as calcium, iron and phosphorous (Nsa *et al*., 2010). Cowpea milling waste is a by-product obtained from cowpea. It contains 24 % crude protein and its nutrients can easily be utilized by livestock (Maidala and Bello, 2016). Research have shown that cowpea milling waste meal can be

fed to cockerel chicks up to 40 % inclusion level with no adverse effect on their growth performance (Raheem, 2016); while plantain peel meal can replace maize in broiler diets up to 75 % (Agubosi *et al*., 2019) or constitute as much as 50 % of a broiler diet (Nsa *et al,* .2010).
Although, cowpea (*Vigna unguiculata*) milling waste and plantain (*Musa paradisiaca*) peel meal have been used individually for feeding livestock, however, there are no reports on the use of cowpea milling waste and plantain peel mixture for feeding broiler chickens in Nigeria. Hence, this research study was designed to evaluate the growth performance and economy of feed conversion of broiler chickens fed diets containing cowpea milling waste and plantain peel meal mixture.

Materials and Methods

This research study was carried out at the Poultry Unit of the Department of Animal Production Teaching and Research Farm, Federal University of Technology, Minna, Niger State. This lies within the Guinea Savannah zone of Nigeria (latitude 9°37' North and longitude 6°33' East). Cowpea milling waste and plantain peel meal mixture were obtained from Kitchen Friendly, an agro–industrial company located in Gurara area of Minna. It was obtained as a by-product of cowpea and plantain processing, and used to compound four treatment diets as follows: T1 (without cowpea milling waste and plantain peel meal), T2 (with 10 % cowpea milling waste and plantain peel meal), T3 (with 20 % cowpea milling waste and plantain peel meal) and T4 (with 30 % cowpea milling waste and plantain peel meal) for the starter and finisher phases respectively (Tables 1). A total of one hundred and forty-four (144) day-old Arbor Acre broiler chicks were purchased from Damas Farm, Ibadan, Oyo State, Nigeria. Before the arrivals of the birds, the walls and floors of the pens were sanitized using Germicide (Izal®) solution, after thoroughly washing with detergent and water. The pens were then allowed to dry completely and litter materials made of wood shavings were spread on the floor of the pen. Newspapers were spread on the floor for the first one week of the experiment. Germ free feeders and drinkers were also made available with proper label of treatment and replicates for easy identification. Local pots and charcoal were made available during the brooding process to produce warmth for the chicks. The day old chicks upon arrival were made to acclimatize for one week after which the experimental diets were introduced to them. The birds were randomly allotted to four treatments in a completely randomized design (CRD) lay-out. Each of the treatment had three replicates made up of 12 birds per replicate. The experiment was carried out under an intensive management system with feed and water supplied *ad-libitum,* and it lasted for eight weeks. Vaccines were administered to the birds based on the recommendations of the Nigerian Institute of Animal Science (NIAS) for the region. Data were collected on feed intake, weekly weight gain and feed conversion ratio. Efficiency of feed conversion was determined based on the following parameters: feed cost per kg (₦), total cost of feed intake per bird (₦), and feed cost per kg body weight gain (₦/kg). Data collected were subjected to one-way analysis of variance using SPSS (2007) version 16.00. Where means were significantly different ($P<0.05$), they were separated using the Duncan Multiple Range Test as contained in the Package.

Table 1: Ingredient composition of the experimental diets at both the starter and finisher phases

Ingredient	Starter Phase				Finisher Phase			
	CMWPPM 0 %	CMWPPM 10 %	CMWPPM 20 %	CMWPPM 30 %	CMWPPM 0 %	CMWPPM 10 %	CMWPPM 20 %	CMWPPM 30 %
Maize	50.00	45.00	37.00	32.00	62.00	55.00	48.50	41.50
Maize offal	5.00	3.00	4.00	2.00	0.00	10.00	20.00	30.00
CMWPPM	0.00	10.00	20.00	30.00	20.50	17.50	14.00	11.00
Soyabean cake	26.00	23.00	20.00	17.00	10.00	10.00	10.00	10.00
Full fat soya	10.00	10.00	10.00	10.00	3.00	3.00	3.00	3.00
Fishmeal	3.00	3.00	3.00	3.00	1.00	1.00	1.00	1.00
Limestone	1.00	1.00	1.00	1.00	2.50	2.50	2.50	2.50
Bonemeal	3.50	3.50	3.50	3.50	0.25	0.25	0.25	0.25
Lysine	0.50	0.50	0.50	0.50	0.25	0.25	0.25	0.25
Methionine	0.50	0.50	0.50	0.50	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	100	100	100	100
TOTAL	100	100	100	100	62.00	55.00	48.50	41.50
CALCULATED ANALYSIS								
Crude protein (%)	23.17	23.01	23.10	23.02	19.84	19.94	19.87	20.01
ME (Kcal /kg)	2896	2883	2852	2839	2975	2962	2951	2930
Crude fibre (%)	4.45	4.75	5.35	5.64	3.80	3.78	3.72	3.68
Ether extract (%)	5.88	6.35	6.84	7.31	5.31	5.44	5.60	5.76
Calcium (%)	1.86	1.85	1.85	1.84	1.48	1.40	1.83	1.33
Available phosphorus (%)	0.78	0.79	0.78	0.78	0.74	0.78	0.77	0.78
Lysine (%)	1.20	1.21	1.40	1.46	1.25	1.28	1.30	1.33
Methionine (%)	1.15	1.15	1.10	1.07	0.60	0.60	0.61	0.62

*0.25kg of the premix contained: Vitamin A 1,000,00 IU, Vitamin D_3 200,000 IU, Vitamin E 2300 mg, Vitamin K_3 200.00 mg, Vitamin B_1 180 mg, Vitamin B_2 550 mg, Niacin 2,750 mg, Pantothenic acid 750 mg, Vitamin B_6, Vitamin B_{12} 1.5 mg, Folic acid 75 mg, Biotin 6mg, Choline chloride 30,000 mg, Cobalt 20 mg, Copper 300 mg, Iodine 100 mg, Iron 2000 mg, Manganese 4,000 mg, Selenium 20 mg, Zinc 3000 mg, Antioxidant 125 mg..

CMWPPM = Cowpea milling waste and plantain peel meal mixture ME = Metabolizable energy

Results and Discussion

The proximate composition of cowpea milling waste and plantain peel meal mixture (CMWPPM) is presented in Table 2. Dry matter, crude protein, ether extract, ash, crude fibre, and nitrogen free extract content were 83.40, 19.25, 9.50, 6.00, 9.00, 39.65 % respectively. This result shows that cowpea (*Vigna unguiculata*) milling waste and plantain (*Musa paradisiaca*) peel meal mixture has high crude protein and low crude fibre content, hence, the mixture can serve as a non-conventional protein feedstuff for broiler chicken.

Table 2: Proximate composition of cowpea milling waste and plantain peel meal mixture

Parameters (%)	Percentage composition (%)
Dry matter	83.40
Crude protein	19.25
Crude fibre	9.00
Ash	6.00
Ether extract	9.50
Nitrogen free extract	39.65

At the starter phase, birds on CMWPPM 0 % had significantly ($P<0.05$) higher feed intake, while birds on CMMPPM 20 % had significantly ($P<0.05$) lower feed intake than birds on the other treatments (Table 3). This result contradicts the findings of Abdon *et al* (2013) who reported that different dietary levels of cowpea seed had no significant ($P>0.05$) effect on feed intake in broiler chicken. The observed difference in feed intake in this study might be due to plantain peel meal inclusion in the diets which affected feed palatability and acceptability, and hence feed intake. There were no significant differences in all the growth performance parameters of the birds fed different dietary levels of CMWPPM at the finisher phase. This differs from the findings of Akanji *et al.* (2015) who reported that cowpea based diets had effect on broiler performance because feed consumed and growth response were extremely ($P<0.05$) declined in chicks fed unprocessed cowpea and dehulled cowpea diets respectively.

The results of the economy of feed conversion at the starter phase showed that as the level of cowpea milling waste and plantain peel meal mixture increased, cost of feed per kg decreased (which was not the case at the finisher phase). This is similar to the findings of Adama *et al.* (2007) when they fed sorghum dried brewers' grain to broiler chicken and reported that feed cost was significantly ($P<0.05$) lower when fed at 40 % dietary inclusion level. At the finisher phase, feed cost per kg weight gain was significantly ($P<0.05$) higher for CMWPPM 10 % and significantly ($P<0.05$) lower for CMWPPM 20 % and 30 % diets; whereas, there were no significant differences in feed cost per kg weight gain among the birds fed the different dietary treatments at the starter phase.

Conclusion and Recommendations

From the results of this research study, it is concluded that the inclusion of CMWPPM in the diets of broiler chickens should not exceed 20 % for optimum economy of feed conversion at the starter phase; whereas birds can be fed diets containing 30 % dietary inclusion level of CMWPPM with good economy of feed conversion at the finisher phase.

References

Abdon, T. Y. K., Khadig, A. A., Bakheit, M. D., Hind, A. A. E., Huwaida, E. E. M. and Khalid, M. E. (2013). Effect of treated cowpea seeds on broiler chicken. *Global Journal of Animal Scientific Research*, 1(1):53-60.

Adama, T. Z., Ogunbajo, S. A. and Mambo, M. (2007). Feed intake, growth performance and nutrient digestibility of broiler chicks fed diets containing varying levels of sorghum dried brewers' grains. *International Journal of Poultry Science*, 6(8): 592-598.

Agubosi, O.C.P., Oluwafemi, R. A. and Ibrahim, T. U. (2019). Performance of broiler chickens fed graded levels of ripe plantain peel meal as replacement for maize. *Journal of Agricultural Science and Practice*, 4(1): 1-3.

Ajasin, F.O., Omole, A. J., Oluokun, J. A., Obi, O.O. and Owosibo, A. (2004). Performance characteristics of weaned rabbits fed plantain peel as replacement for maize. *World Journal of Zoology, 1: (1) 30-32.*

Akanji, A., Fasina, O. and Ogungbesan, A. (2015). Growth and heamatologcal profile of broiler chickens fed raw and processed cowpea based diets. ISSN 2224-3208 (Paper). ISSN 2225-093X (Online). *Journal of Biology, Agriculture and Healthcare*, volume number 6.

Duwa, H., Saleh, B., Lamido, M. and Saidu, A. (2014). Growth, haematological and serum biochemical indices of broiler chickens fed banana peel meal as replacement for maize in the semi-arid zone of Nigeria. *Journal of Animal Feed Research, 4: 121-126.*

Ighodaro, O. M. (2012). Evaluation study on Nigerian species of *Musa Paradisiaca* peels: Phytochemical screening, proximate analysis, mineral composition and anti-microbial xctivities. *Researcher*, 4(8): 17-20.

Ironkwe, M. O. and Oruwari, B. M. (2012). Effects of replacement levels of maize with plantain peel in broiler finisher diet. *Bulletin of Environment, Pharmocology and Life Sciences, I (4): 39-42.*

Maidala, A., and Bello, I. B. (2016). Nutritional evaluation of cowpea shell as a source of fibre in the diets of broiler chickens. *International Journal of Agriculture and Earth Science, volume 2, No. 1, pp 21-30.*

Negesse, T., Makkar, H. P. S. and Becker, K. (2009). Nutritive value of some non-conventional feed resources of Ethiopia determined by chemical analyses and an *in vitro* gas method. *Animal Feed Science and Technology, 154: 204–217.*

Nsa, E. E., Okon, B., Anya, M. I. and Essien, O. E. (2010). Effect of replacement levels of wheat offal with brewers' dried grain in broiler finisher diets. *Proceedings of the 35th Annual Conference of the Nigerian Society for Animal Production (NSAP), University of Ibadan, Nigeria, March 14th-17th, 2010. Eds: Babayemi, O. J., Abu, O. A. and Ewuola, E. O., pp. 14-17.*

Omole, A. J., Ajasin, F. O., Oluokun, J. A., Obi, O. O. and Owosibo, A. (2008). *Performance characteristics of weaned rabbits fed plantain peel as replacement for maize* (Review): Emerald Group Publishing Ltd., Nigeria.

Raheem, K. I., (2016). Growth performance and economic characteristics of cockerel chicken fed diets containing varying levels of cowpea (*Vigna unguiculata)* milling waste meal. B.Tech Agric. Thesis, Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna Niger State.

Ulloa, J. B., Weerd, V. J. H., Huisman, E. A., and Verreth, J. A. (2004). Tropical agricultural residues and their potential uses in fish feeds: The Costa Rican situation. *Waste Management, 24: 87–97.*

Table 3: Growth performance and economy of feed conversion of broiler chickens fed diets containing cowpea milling waste and plantain peel meal mixture

Parameter	Starter Phase						Finisher Phase					
	CMWPP M 0 %	CMWPP M 10 %	CMWPP M 20 %	CMWPP M 30 %	SEM	P-VALUE	CMWPP M 0 %	CMWPP M 10 %	CMWPP M 20 %	CMWPP M 30 %	SEM	P-VALUE
GROWTH PERFORMANCE												
INI WT(g)	64.93	65.30	64.96	64.69	0.50	0.94	459.70	440.73	430.56	463.33	22.40	0.80
FIN WT(g)	459.70	440.73	430.56	463.33	17.40	0.80	1013.3	966.80	975.00	975.26	22.58	0.92
TFI(g)	1023.7^{a}	838.40^{b}	750.56^{c}	834.63^{b}	43.05	0.13	1524.03	1545.43	1205.76	1218.76	69.45	0.13
AFI(g)	36.56^{a}	29.94^{b}	26.80^{c}	29.81^{b}	1.53	0.13	54.42	55.18	43.06	43.52	2.48	0.13
TBWG(g)	394.76	375.43	365.60	398.66	17.30	0.84	553.63	526.06	544.43	511.93	28.77	0.89
ABWG(g)	14.10	13.40	13.05	19.69	1.30	0.24	19.77	18.78	19.44	18.28	1.67	0.89
FCR	2.60	2.25	2.05	1.67	0.15	0.22	2.82	2.94	2.24	2.38	0.14	0.30
MOR %	8.33^{b}	19.00^{a}	0.00^{c}	0.00^{c}	3.01	0.05	13.90^{a}	19.64^{a}	0.00^{b}	0.00^{b}	3.07	0.02
ECONOMY OF FEED CONVERSION												
COF (₦/kg)	181.45^{a}	151.45^{ab}	121.17^{c}	155.94^{ab}	8.44	0.06	254.58	262.79	208.05	213.95	11.30	0.18
TCOF intake (₦)	192.49^{a}	127.23^{b}	91.26^{c}	130.20^{b}	16.00	0.15	330.48^{ab}	409.24^{a}	251.06^{c}	260.76^{c}	24.05	0.037
COF/kgWG (₦)	493.55	343.81	248.80	334.14	42.60	0.25	616.04^{ab}	775.36^{a}	468.62^{c}	510.80^{c}	46.44	0.057

^{abc}Means in the same row with different superscripts were significantly ($p<0.05$) different.

CMWPPM = Cowpea milling waste and plantain peel meal mixture SEM = Standard error of mean

P-value = Probability value

INI WT = Initial body weight FIN WT = Final body weight

TFI = Total feed intake AFI = Average feed intake

TBWG = Total body weight gain ABWG = Average body weight gain FCR = Feed conversion ratio

MOR % = Percentage mortality

COF = Cost of feed TCOF = Total cost of feed intake

COF/kgWG = Cost of feed per kg weight gain

CARCASS YIELD AND ECONOMICS OF PRODUCTION OF GROWING RABBITS (*Oryctolagus cunniculus*) FED DIFFERENT TYPES AND LEVELS OF RUMEN CONTENT

[1*]ABDULLAHI, A. M., [1]MAIDALA, A., [2]DOMA, U.D., [1]LAWAN, A., [1]ABDULLAHI, U., [1]CHANA, I. M., [1]MAKINDE, O., [3]OYAWOYE, E., & [4]TAMBURAWA, M. S.

[1]Department of Animal science, Faculty of Agriculture, Federal University Gashua, Yobe State
[2]Department of Animal Production, Abubakar Tafawa Balewa University, P.M.B. 248. Bauchi State
[3]Department of Animal Production, Landmark University, Omu Aran. Kwara state
[4]Department of Animal Production, Kano State University, Wudil. Kano State
Corresponding author: alhajimusaabdullahigadaka@mail.com+2348024991014
**Presenting author*

Abstract
An experiment was conducted to investigate the carcass yield and the economics of rabbit production. Rabbit were fed different types and levels of rumen content. Forty-eight (48) mongrel rabbits were randomly allotted to six diets containing rumen content of *caprine*, *ovine* and *bovine* each had 30 and 40% levels of inclusion in 3x2 factorial arrangements completely randomized design (CRD). Results showed that the interaction effect did not affect live weight (1075.00-1487.50g), carcass weight (456.25-775.00g) and dressed weight (38.36-52.86%). There were significant different (P>0.05) in the grow performance of rabbit fed different levels of rumen content. Most of the organs were not affected by the interaction effect (P<0.05) except the lungs (0.42-0.63%), head (7.72-9.25%) and small intestine (3.50-4.38%) which were affected by the interaction effects (P<0.05). Most of the parameters assessed were not affected by the main effect (P>0.05) of types of rumen contents except the kidney (0.15-0.64%), stomach (1.2-1.58%) and small intestine (0.93-1.19%) which were affected (P<0.05). The economics of production showed that feed cost per kg decreased slightly at higher levels of inclusion for the three types of rumen content. The feed cost per kg gain also decreased as the level of rumen content increase. Therefore rumen content should be included at higher levels in the diet of rabbits for enhanced carcass yield and reduce cost of production

Keywords: Rumen content, Carcass yield, Caprine, Ovine, Bovine

Introduction

The dietary protein intake in Nigeria is 4.5g grossly short of the recommended 35g of animal protein intake per person per day (FAO, 2001). This observed low animal protein intake may be attributed to the declining animal production occasioned by the high cost of feeds which usually accounts for 70-85% of total cost of production (Sanni and Ogundipe, 2005). Possible and most appropriate measure for shortage of animal protein for human consumption lies in the production of fast growing animals like rabbits. This is because livestock like cattle, camels, sheep, goats and pigs take longer time to mature. Rabbits as potential animal with short generation interval, high prolificacy, easy management strategy, ability to utilize waste and other unconventional feed sources for maximum weight gain (efficient feed conversion) to good high quality and quantity animal protein and the ability to thrive on forage with little concentrate will reduced the shortage of protein from animal sources. Rabbit meat is also known to be low in sodium, cholesterol and higher proportion of polyunsaturated linoleic and linolenic fatty acids. All these attributes in addition to less fed cost of production, make rabbit desirable livestock that can help increase and improve protein intake of an average income earning in Nigeria (Mohammed, *et al.,* 2011)

There is an urgent need for low cost feed ingredient especially locally available and cheap agro-industrial products particularly those that do not attract competition in consumption between humans and livestock or have no direct relevance in human food channel. Rumen digesta is one of these wastes that pose a problem to the environment. It is an abattoir by-product obtained from cattle, sheep and goat as well as camel (Maigandi *et al*., 2004). Magaindi and Tukur (2002) reported the proximate analysis of rumen content for camel, cattle sheep and goat slaughtered at the Sokoto abattoir. In their studies, camel rumen content was reported to have 8.39% crude protein (CP), 11.98% ether extract (EE), and 36.74% (CF) while 8.18% CP, 2.68 EE and 33.31% CF were documented for cattle. Sheep rumen digesta had 9.18% CP, 5.57% EE and 33.31% CF while 8.03 % CP, 5.57% EE and 30.83% CF were values for goat. Sun-dried rumen content of various ruminants animal by-product which is found mostly in abattoirs when the rumen of the animals is cut open after slaughter. The rumen is a unique organ. Its content (rumen content or digesta) is very heterogeneous. It is made up of digested feed at different stages of degradation, saliva (making up the rumen liquor) micro-organisms and the products of their metabolic activities such as proteins, peptides, amino acids, lipids, vitamins and Volatile Fatty Acids (VFA). The aim of this research work is to ascertain higher inclusion levels of rumen content of cattle, sheep and goats on carcass characteristics and economics of production of rabbits.

Materials and Methods

Experimental Site

The experiment was conducted in Katagum Local Government Area of Bauchi State, Nigeria. It is located between latitudes 11^0 42' and 11^0 40^0 and longitude 10^0 31' and 10^0 11' east (Anon, 2009). It shares common boundary with Itas/Gadau local government in north-west, Jama'are to the west, Dambam to the east, Misau to the south-west, Giade to the south and Shira to the southwest (Azare, 2013). It has a landmass of 1,120 square kilometres (NPC, 2009). The climate of the study area is controlled by the intertropical convergent zone (ITCZ) which is marked by the rainy and dry season. The major climate elements that influence the weathe of the study area and affecting the farming system were temperature and precipitation (rainfall), the annual temperature ranged between 22-33^{0}C from April to May (Bashir *et al*., 2001). The mean annual rainfall ranged between 615.6-985mm with peak between July-Augusts.

Sources and feed Processed

Different rumen contents inclusion from caprin, ovine and bovine were obtained from Azare Abattoir and suns dried by constant raking at an intervals of 2hours until dry materials were obtained. Other feed ingredients were procured at Azare main market. The rabbits used in this study were mongrels obtained from the rabbit farmers in Azare. The three types of rumen content were used for formulation of six diets each at 30 and 40% levels. The percentage composition of the experimental diet was shown in table 2. Forty-eight mongrel rabbits were randomly allotted to the six experimental diets. There were eight rabbits per treatment and replicated 4 times (two rabbits per replicate) in a completely randomized design (CRD) using 3x2 factorial arrangements.

Proximate composition of different types of rumen content

The samples of different types of rumen content were taken to biochemistry laboratory, School of Agriculture and Agricultural Technology of Abubakar Tafawa Balewa University Bauchi for proximate analysis. Samples were analyzed for crude protein (CP), crude fibre (CF), ash, crude fat (ether extract) and nitrogen free extract (NFE) accurate to the procedures of AOAC (1990).

Carcass evaluation

At the end of the feeding trial, 4 rabbits were randomly sampled from each treatment, weighed, starved overnight and slaughtered by severing the jugular vein. During evisceration, the internal organs and other gut contents were removed and weight, the dressed carcass and internal organs were weight and expressed as percentage of the live weight.

$$\text{Dressing \%} = \frac{\text{Dressed carcass weight}}{\text{Live weight}} \times 100$$

The economics of production was based on the prevailing market price at Azare as of the time of the experiment. The experiment lasted for six weeks and both the interaction effects as well as main effects were tested. The data set generated was analyzed according to Steel and Torrie 1980 using the Minitab Statistical software. LSD was used to separate the means.

Results and Discussion

Table1 showed the percentage composition of the different types of rumen content fed to rabbits. The crude protein, crude fibre and ash content ranged of 16.00%-16.06%, 8.34%-17.83% and 3.56%-7.93% were adequate for growing rabbits in the tropics (Aduku, 2004). The proximate composition of different types of rumen content shown in table 2, results showed variation in different types of rumen content for caprine, ovine and bovine CP 15.93%, 12.29% and 11.23%, CF 32.58%, 33.56% and 34.61%, EE 0.86%, 1.15% and 1.23%, Ash 11.21%, 13.42% and 12.54% and NFE 40.85%, 34.42% and 35.59% respectively. The results were similar to those reported by Abubakar (1998), and Dairo (2005). The high CP in caprine rumen content can be attributed to grazing habits of goat which prepare to browse of young shoot, twigs and flowers which are more nutritious than the mature plant. Similarly Mohammed *et al*. (2008) showed a wide variation between rumen content of cattle, camel, sheep and Goat. The effect of interaction of carcass of rabbits fed rumen content is shown in Table 3, results showed that final live weight, carcass weight and dressed weight were not affected by the types and levels of rumen content ($P>0.05$), and this findings partly concord with the findings of Ani *et al*. (2015) who reported non-significant difference in rabbits fed dehydrated rumen content. Most of the gut content of different rumen content fed to rabbits were not affected by the types and levels of rumen content except the head, and small intestine which were affected by interaction effect ($P<0.05$). Olabanji *et al*., (2007) reported a significant difference in small intestine of rabbits fed rumen content. Similarly Esonu *et a*l., (2006) reported that there were no significant differences in organs of rabbits fed rumen content. The main effects of different types of rumen content are shown in Table 4. Results showed that most of the carcass parameters were not affected by the types of rumen content ($P>0.05$), this results partly agrees with the findings of Okpanchi *et al*., (2010) who reported that there was no significant difference between carcass yield and organs of rabbits fed sun dried rumen content. The economics of production of rabbits fed different rumen content is shown in table 5. Results showed that the feed cost per kg steadily declines from 30-40% level. Similarly the feed cost per kg gain decreased from 30-40% for the three types of rumen content and this is in line with the earlier reports of Mohammed *et al*., (2011) who reported decline in cost per kg gain of rabbits fed bovine rumen content. The highest fed cost per kg gain was observed in caprine rumen content (₦181.60) while the lowest fed cost was observed in 40% rumen content of bovine (₦137.75)

Conclusion

Rumen content of cattle sheep and goat can be included up to 40% level in the diet of growing rabbits without adverse effect on carcass characteristics with reduction in cost of production.

References

Abubakar, M.M.(1998). Utilization of unconventional feedstuff for sustainable livestock production. Abubakar Tafawa Balewa University, Bauchi, Inaugural lectures series NO.9, 44pp

Aduku, A. O. (2004). **Animal Nutrition in the Tropics.** Davcon and Business bureau, Samaru, Zaria, Nigeria

Ani, A. O., Udeh, F. U., Uzochukwu, I.E. and Onuora, S.I. (2015). Haematological indices, carcass and organ characteristics of crossbred weaner rabbits fed dehydrated bovine rumen digesta. Proc. 40th Ann. Conf. Nigerian Society for Animal Production, 15-19th march, 2015, NAPRI/ABU, Zaria

Association of Official Analytical Chemists (AOAC), (1990). Official Methods of Analysis, Washington D.C. USA.

Anonymous (2009). Mapsofworld. Com. Available at http://www.mapsofworld.com /Nigeria/cities/azare/html mapXL inc. 10s third street Suite 310 San Jose.

Azare, I.M. (2013).Evaluation of farmers response strategies to climate change in Katagum local government area of Bauchi state. *Journal of Environment Technology and Sustainable Agriculture* **2** (10):26-33

Bashir, M.M., Bala, A., Mohammed, I.T., Isa, H.J., Adamu, M.B., Hamisu, M.S., and Abdullahi, A.(2001).Request for the creation of Katagum state out of the present Bauchi state of Nigeria. A memorandum submitted to the speakers, house of representatives, national assembly, Abuja, Nigeria pp 1-28.

Cheeke, P.R. (1987) Rabbits feeding and nutrition. Academy Press Inc. London pp 41-51.

Esonu, B.O., Ogbonna, U.D., Anyanuwn, G.A., Emenalom, O.O., Uchegbu, M.C., Etux, E.B. and Udedibie, A.B.I. (2006) Evaluation of performance, Organs characteristics and Economic Analysis of Broiler finisher fed Dried Rumen Digesta. Inter. J. Poult. Sci. 5(12): 1116 – 1118.

Dairo, F.A.S. and Aina, O.O, (2000) Ruminal content as a protein source in diet of growing rabbits. Paper presented at the 25th Annual Conference of the Nigerian Society for Animal Production, Michael Okpara University of Agriculture, March 2000

Maigandi, S.A. Adebiyi, B.Z. and Manga, S.B. (2004).Chemical composition of Ensiled Forestomach digesta (FSD) from Animals slaughter at Sokoto abattoir *Proceedings. of the 29th Annual conference of Nigeria Society of Animal Production*, 29:149-151.

Maigandi, S. A. and Tukur, H.M. (2002). Potentials of fore-stomach Digesta as an unconventional feed ingredients.*Journal Agriculture and Enviroment.* 3(1): 55-64.

Mohammed, G., Igwebuike J.U. Ubosi, C.O. and Alade, N.K. (2008). Comparative study of the nutrient composition, Amino acid profile and microbial Assay of fresh and dry cattle, camel, sheep, and goat, rumen contents. Proc. of the 13 Ann. Conf. of .Anim.sci.Assoc. of Nig. (ASAN) Sep 15-19, 2008. p-518-520

Mohammed, G., Igwebuike, J.U and Alade, N.K. (2011). Performance of growing rabbits fed graded levels of bovine blood-rumen content mixture. Agriculture and Biology Journal of North America 2(4):720.723

Okpanachi, U., Aribido, S.O. and Daikwo, S.I. (2010). Growth and heamatological response of growing rabbits to diets containing graded levels of Sundried Bovine Rumen content. *Africa Journal of Food and Agriculture Nutrition and Development.* 10(11): 4444 – 4457

National Population Commission (NPC, 2006).National Population Commission Bulletin. Printed and published by federal government printers, Abuja. FGP

Olabanji, R. O., Farinu, G. O., Akinlade, J. A. and Ojebiyi, O. O. (2007). Growth Performance, Organ Characteristics and Carcass Quality of Weaner Rabbits Fed Different Levels of Wild Sunflower (*Tithonia diversifolia* Hemsl A. Gray) Leaf-Blood Meal Mixture. *International Journal of Agricultural Research,* 2: 1014-1021.

Sanni, S.A. and Ogundipe, S.O. (2005). Economics of some modules of poultry production inKaduna state. *Nigerian Journal of Animal Production,* 32(1):102-107.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of Statistics: A biometric Approach New York: McGraw Hill

Table 1: Percentage composition of rumen content fed rabbits

Parameters	Goat rumen content		Sheep rumen content		Cattle rumen content	
	30%	40%	30%	40%	30%	40%
Maize	42.33	34.33	38.33	29.00	35.33	25.00
Rumen content	30.00	40.00	30.00	40.00	30.00	40.00
Soybean	14.67	12.66	18.67	18.00	21.67	22.00
Maize offal	10.00	10.00	10.00	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis (%)						
Crude protein	16.01	16.07	16.01	16.00	16.01	16.00
Crude fibre	8.34	13.63	13.63	16.97	14.30	17.83
Ether extract	6.05	7.93	5.78	7.40	3.56	4.48
Ash	6.14	7.93	5.78	7.40	3.56	4.48

Premix supply the following per 2.5 contain vitamin of 15.000.000 I.U., Vitamin D_3 3,000,000 I.U, Vitamin E 30,000.000, Vitamin K_2 500mg, Thiamine B_1 2000mg, Riboflavin B_2 6000mg, Pyridoxine B_6 400mg, Niacin 40,000mg, Pantothenic acid 10,000mg, Folic acid 1000mg, Biotin 80mg, Choline chloride 500mg, Biotin 80mg, antioxidant 125g, Manganese, 96g, Zink 60g, Iodine 1.4g, Selenium 240g, Cobalt 24mg.

Table 2: Proximate composition of the different types of rumen content

Types of rumen content	**Parameters**					
	DM	**CP**	**CF**	**EE**	**Ash**	**NFE**
Caprine	95.43	15.93	32.58	0.86	11.21	40.85
Ovine	95.23	12.29	33.56	1.15	13.42	34.42
Bovine	96.51	11.23	34.61	1.23	12.54	35.59

Table 3: Types and level interaction effect on carcass, organs and gut characteristics (% body weight) of rabbits

Parameters	Diets							
	Caprine		*Ovine*		*Bovine*			
	30%	40%	30%	40%	30%	40%	SEM	LSD
Final live weight (g)	1293.30	1200.00	1075.00	1130.00	1368.80	1487.50	126.74	NS
Carcass weight (g)	593.75	456.25	531.25	668.75	718.75	775.00	64.13	NS
Dressed weight %	44.97	38.36	50.08	51.75	52.25	52.86	3.17	NS
Liver %	2.52	2.50	3.25	2.35	2.29	2.77	0.31	NS
Lungs %	0.63[b]	0.54[b]	1.34[a]	0.51[b]	0.42[b]	0.60	0.19	0.46
Heart %	0.21	0.13	0.19	0.17	0.15	0.13	0.03	NS
Kidney %	0.53	0.56	0.59	0.50	0.16	0.67	0.25	NS
Abdominal fat %	0.53	0.56	0.59	0.50	0.16	0.67	0.25	NS
Head %	8.23[b]	8.48[b]	9.25[a]	7.73[b]	7.72[b]	7.95[b]	0.38	0.90
Feet %	2.19	2.57	2.66	2.12	2.06	1.93	0.19	NS
Pelt %	7.29	6.15	6.68	6.87	5.92	5.80	0.48	NS
Stomach %	1.39	1.60	1.87	1.62	1.48	1.36	0.12	NS
Small intestine %	3.88	3.50	5.42	3.50	4.35	4.38	0.36	NS
Large intestine %	0.96	0.89	1.13	0.77	1.05	1.32	0.23	NS
Caecum %	2.75	2.32	3.04	2.75	2.50	2.26	0.24	NS

Note: Means bearing different superscripts are statistically different (P<0.05), NS= Not significant

Table 4: Main effects of rumen content type and levels on carcass, organs and gut characteristics (% body weight) of rabbits

Parameter	Diets			LSD	30%	40%	LSD
	Caprine	Ovine	Bovine				
Final live weight (g)	1246.90	1187.50	1428.10	NS	1245.80	1329.20	NS
Carcass weight (g)	525.00	600.00	746.87	157.60**	614.58	633.33	NS
Dressed weight %	41.67[a]	50.92 [b]	52.55 [c]	7.76**	49.10	47.66	NS
Liver %	2.51	2.80	2.54	NS	2.69	2.54	NS
Lungs %	0.59	0.93	0.53	NS	0.79	0.56	NS
Heart %	0.17	0.18	0.14	NS	0.18	0.14	NS
Kidney %	0.44 [a]	0.64 [c]	0.48 [b]	0.15	0.57	0.49	*
Abdominal fat %	0.45	0.55	0.41	NS	0.43	0.51	NS
Head %	8.35	8.49	7.83	NS	8.39	8.05	NS
Feet %	2.88	2.39	1.99	NS	2.31	2.21	NS
Pelt %	6.72	6.78	5.86	NS	6.63	6.27	NS
Stomach %	1.49	1.75	1.42	NS	1.58	1.53	*
Small intestine %	3.69	4.46	4.36	NS	4.57	3.79	*
Large intestine %	0.93	0.95	1.19	NS	1.05	0.99	NS
Caecum %	2.54	2.89	2.38	NS	2.76	2.44	NS

Note: Means bearing different superscripts are statistically different (P<0.05), NS= Not significant

Table 5: Economics of production of rabbits fed rumen content based diet

Parameters	Diets					
	Caprine		Ovine		Bovine	
	30%	40%	30%	40%	30%	40%
Total feed intake (kg)	2.59	3.29	2.52	2.75	2.64	2.57
Feed cost (₦/kg)	24.54	21.23	25.77	22.87	26.61	24.12
Total feed cost (₦)	63.68	69.85	64.94	62.89	70.25	61.99
Total weight gain (kg)	0.35	0.45	0.37	0.39	0.42	0.45
Feed cost (₦/kg) gain	181.60	155.22	175.51	161..26	167.26	137.75

EFFECTS OF RUMEN EPITHELIAL SCRAPINGS INCLUSION IN DIETS FOR GROWER RABBITS

Adedoyin A. A.

Department of Agricultural Education, Biotechnology Unit.
The College of Education, Lanlate, Oyo State, Nigeria. (Former Emmanueal Alayande College of Education, Oyo, Lanlate Campus).
E-mail: akintundedoyin@yahoo.com or adedayoakintude1@gmail.com
Gsm: 08139396741

Abstract
Twenty-five (25) Crossbred grower rabbits were used to assess the effects of Rumen Epithelial Scrapings (RES) inclusion in the diets for rabbits. The five treatment groups consisting of five replicates of one rabbit per replicate in a Completely Randomized Design (CRD). The dietary treatments comprised graded levels of RES at 0, 2.5, 5, 7.5 and 10% in T_1, T_2, T_3, T_4 and T_5 diets respectively. Total feed offered was 100g/rabbit/day. Feed intakes were similar ($P<0.05$) across the dietary treatments, 1, 2, 3, and 4. Daily weight gain and feed to gain ratio were not affected ($P<0.05$) by increasing rumen epithelial scrapings except in T5 (10% RES) that recorded (10.01) and (8.51) respectively. Lower feed cost/kg significantly reduced ($P<0.05$) the cost/kg gain (₦) in diets 2 (₦444.4), 3 (₦447.7) and 4 (₦449.5) compared with the control diet 1(₦450). Conclusively, grower rabbits can utilize up to 7.5% rumen epithelial scrapings based diets without any adverse effect on performance.

Keywords: Grower rabbits, rumen epithelial scrapings, feed to gain ratio, cost/kg gain, inclusion

Introduction
There is an increasing interest in rabbit production in the developing countries, as a means of producing meat from forages and agricultural by-products in the tropics (Babayemi *et al.,* 2014; Adedoyin and Bamimore, 2018). Rabbits are especially well adapted to backyard rearing systems, with little capital and fodder resources which are usually limiting factors in animal production. Rabbits reared according to the techniques appropriate to the environment can do much to improve the family diet of many of the neediest rural families, while at the sametime supplying them with a source of income. With more advance bio-technology rabbit production can also help to supply big City meat markets. It has infact been stated that hindgut digestion which takes place in the rabbit is a superior adaption for dealing with wide varieties of feed staffs (Iyeghe-Erakpotobor and Esiero, 2010). However, to ensure sustainability in livestock production there is a need to optimize usage of the by-products of the abattoir as sources of nutrients for farm animals (Abubakar, 1998). A number of slaughterhouse byproducts are presently being wasted, such as rumen epithelial scrapings, blood, meat scraps, etc. Rumen contents can be prepared as a few material either by sun-drying involves spreading the material on any heat absorbing surface and constantly raking it to facilitate uniform drying. Ensiling involves mixing rumen contents with other ingredients such as molasses and packing the mixture tightly in silos or other suitable containers under anaerobic conditions (Adedoyin *et al.,* 2013). Abubakar (1998) opined that rumen contents are a good source of vitamins, especially the B vitamins. And that the dried material contains 15.43% crude protein, 1.91% ether extract, 39.08% crude fibre, and 31.71 Nitrogen free extract (NFE). Thus, the objectives of this study is to evaluate the nutritional values of rumen epithelial scrapings based diets for grower rabbits.

Materials and Methods
A total of twenty-five, four to five weeks old crossbred rabbits of mixed breeds (New Zealand white and Chinchinlla) and sexes, obtained from I.A.R.T, Ibadan, Oyo State were randomly assigned to treatment (n = 5 rabbits per treatment). The rabbits of average initial weight of 450g were individually housed and maintained in battery cages in an open sided house. Rumen Epithetical Scrapings (RES) were obtained from Bodija market abattoir, Ibadan. The RES are then dried and grounded separately to a fine powder and replaced with groundnut meal at 0, 2.5, 5, 7.5, and 10% w/w in treatment 1(control), 2, 3, 4 and 5 respectively (Table 2). Body weight and feed intakes were determined weekly

while feed to gain ratio was estimated as outlined by Olomu (2011). Feeding was done in the morning at 08:00 hours in earthen flat bottom pots. The concentrate and forage were offered to give a total of 100g feed/rabbit/day. Feed wastage and/left over were measured daily before the morning feeding so as to determined the total feed intake for eight weeks, water was provided ad libitum in plastic drinkers (Iyeghe-Erakpotobor, 2012). Mortality ratio were also calculated as percentage of total Number of rabbits per group. Data collected were subjected to the analysis of variance test, (2007). Means of significant result was compared by Duncan's. Proximate analysis of the rumen epithelial scrapings were analyzed according to the procedures described by AOAC (1990).

Table 1: Proximate Composition(%) of Rumen Epithelial Scrapings and Groundnut meal.

Nutrients %	Rumen Epithelial	Groundnut Meal
Moisture	3.99	7.32
Crude Protein	66.14	43.12
Crude Fiber	1.66	5.9
Ether	4.33	12.01
Ash	4.01	4.48
Nitrogen Free Extract	9.98	11.12

Table 2: Composition of Concentrate Diets fed Grower Rabbits

Ingredient	Replacement levels of Rumen Epithelial Scrapings (RES)				
	T_1 (0%RES)	T_2 (2.5%RES)	T_3 (5%RES)	T_4 (7.5%RES)	T_5 (10%RES)
Maize	45.0	45.0	45.0	45.0	45.0
Groundnut meal	36.50	34.0	31.5	29.0	26.5
Rumen Epithelial	-	2.5	5.0	7.5	10.0
Maize offal	15.00	15.00	15.00	15.00	15.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin/Mineral Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analyzed Composition					
Crude Protein	18.10	18.31	18.55	18.67	18.97
Crude Fibre	9.80	9.14	8.80	8.16	8.50
Met. Energy(Kcal/ME/kg)	2450	2403	2389	2400	2409

Table 3: Performance of Grower Rabbits fed Rumen Epithelial Scrapings Based Diets

Parameter	Replacement levels of Rumen Epithelial Scrapings (RES)					
	T_1 (0%RES)	T_2 (2.5%RES)	T_3 (5%RES)	T_4 (7.5%RES)	T_5 (10%RES)	SEM
Initial Weight (g)	449	450	449	451	450	0.05
Final Weight (g)	1039	1049	1031	1028	1011	0.72
Feed intake	75.3^{bc}	78.01^{b}	79.11^{ab}	81.80^{ab}	85.2^{a}	10.9
Weight Gain	10.53^{a}	10.69^{a}	10.39^{b}	10.30^{b}	10.01^{c}	0.5
Feed to Gain	7.15^{bc}	7.29^{b}	7.61^{b}	7.94^{b}	8.51^{a}	0.99
Cost/kg-Feed(₦)	630^{a}	609^{b}	588^{c}	566^{d}	545^{c}	0.04
Cost/kg-gain(₦)	450.5	444.4	447.7	449.5	463.8	-

abc… means with different superscripts along rows the significantly different (P>0.05)
SEM – Standard Error of Mean

RESULTS AND DISCUSSION

Performance of grower rabbits fed different levels of rumen epithelial scrapings (RES) is shown in Table 3. Feed intakes were similar with a slight increase with an increasing levels of Rumen Epithelial Scrapings (RES) from 2.5 to 7.5% in the diets 2, 3, and 4. Similar intakes observed in the diets 2 (78.01), 3 (79.11) and 4 (81.8) for grower rabbits fed 2.5 to 7.5% RES could indicate a threshold of intake which might have been approached as the forage level increased. This could probably also suggests, an inability of the rabbits to further increase their gastrointestinal tract capacity to accommodate any further increase in feed intake as RES level increased from 2.5 to 7.5% level as also suggested (Iyeghe-Evakpotobor *et al.,* 2012). Daily weight gain and feed to gain ratio were not affected (P>0.05) by increasing RES except in T5 (10% RES) that recorded (10.01) and (8.51) respectively. A significant lower weight gains of grower rabbits fed diet 5 (10% RES) in this study compared to others (diets 1, 2, 3, and 4) could be as a result of the depressing effect of increasing rumen epithelial scrapings (RES) in the diet. Also, that possibly an increased level of RES brought about on rich bacteria protein a drastic changes in the biological functions of grower rabbits, poor feed efficiency and utilization, disturbances in metabolism of energy, mineral and vitamin balances, and enzymatic reactions with an impaired fermentative mechanisms in the cecum (NAP, 1991; Nwagu and Iyeghe-Erakpotobor, 2012; Adedoyin *et al.,* 2013) Lower feed cost/kg gain obtained with increasing level of RES up to 7.5% in the diet indicates the potential of reducing cost of producing rabbits by increasing the level of rumen epithelial scrapings in the diet of grower rabbits.

CONCLUSION

It is concluded from this study that grower rabbits can utilize up to 7.5% rumen epithelial scrapings diet based without any adverse effect on performance. Also, that lower feed cost and cost/kg weight gain were obtained.

REFERENCES

A.O.A.C. (1990). Official Methods of Analysis 13th Edition *Association of Analytical Chemists Washington DC*

Abubakar, M. M. (1998) Slaughterhouse by-products for sustainable livestock production in the tropics. *In: Strategies and Tactics of Sustainable Agriculture in the Tropics (STASAT) Vol. 1* (Eds. M. A. Badejo and A. O. Togun (1998) College Press, Ibadan and Enpract Consultants, Lagos, Nigeria.

Adedoyin, A. A. and Bamimore, I. A. (2018). A guide to selected mini-livestock farming. *In: Introduction to Agricultural System: Principles and Practices. Department of Agricultural Education, The College of Education, Lanlate, Oyo State, Nigeria. Pg 78- 91*

Adedoyin, A. A. Onilude, A. A., Tewe, O. O. and Mosobalaje, M. A. (2013). Nutritional Enhancement of whole Cassava Starch Residue by biodegradation with Fungi Spp. *Elixir Inter. Journal of Biotechnology 60:16064-16068*

Babayemi, O.J. ,Abu O.A. and Opakunbi A (2014). Integrated Animal Husbandry for Schools and Colleges. *Positive Press, Ibadan, Nigeria 299pp.*

Iyeghe-Erakpotobor, G.T., Tudunwada, I.K. Tijjani, A. Muhammad, I. R. and Bello, N. (2012). Influence of level of groundnut haulms and feeding systems on performance of growing rabbits. *Nigerian Journal of Animal Production. Vol 39(1) pp. 64-73*

Nwagu, F. O. and Iyeghe-Erakpotobor, G. T. (2012). Protein and Energy partitioning for growth by rabbits fed soybean cheese waste diet and lablab hay. *Nigerian Journal of Animal Production. Vol. 39 (1) pp. 54-63*

Olowu, J. M. (2011). Monogastric Animal Nutrition: Principles and Practice. *2nd Edition St. Jackson Publishing. Benin City Nigeria.*

SAS Institute (2007). SAS Users' Guide Statistics *Version 6.12 Edition SAS Institute. Inc. Carry, NC.*

The National Academics Press (1991). Micro Livestock: Little-Known Small Animals with a promising Economic Future. *National Academy of Sciences. xx 448 pp.*

REPLACEMENT VALUE OF SESAME SEED MEAL (*Sesamum Indicum*) FOR SOYBEAN MEAL ON PERFORMANCE OF STARTER BROILERS

Adedoyin, A.A.

Department of Agricultural Education, The College of Education, Lanlate, Oyo State. Formerly Emmanuel AlayandeCollege of Education, Oyo, Lanlate Campus
email-akintundedoyin@yahoo.com or adedayoakintunde1@gmail.com

GSM: 08139396741.

Abstract
One hundred (100) Anak strain day-old broiler chicks were used to evaluate the replacement value of Sesame Seed Meal (SSM) (Sesamum indicum) for soybean meal (SBM) on growth response of broilers starter. Chicks were randomly allotted to four treatment groups consisting of five replicates of five chicks per replicate in a completely randomized design. The dietary treatments were sesame seed meal (SSM) replaced for soybean meal at 0, 5, 10 and 15% w/w in T_1 (control), T2, T3, and T4 diets respectively. For four weeks, data were collected on feed intake, weight gain, feed to gain ratio and mortality. Results revealed that all the parameters were similar ($P<0.05$) across the dietary treatments except feed to gain ratio which was significantly ($P<0.05$) better in T_2 (5% SSM replacement) (1.60) compared to control T1 (0% SSM replacement) (1.61) respectively. It can be concluded that sesame seed meal (SSM) has a potential to replace at least 5% soybean meal (SBM) without any negative effect

Key words: Replacement value, growth response, feed to gain ratio, potential, mortality.

Introduction

Nigeria still remains among the least animal protein consumers in Africa. For instance, the average animal protein intake for Africa is 11g/head/day while the average value for Nigeria is 7.5g/head/day. This has been attributed to high and rising cost of some feedstocks which are not always accessible to rural farmers' accounts for 60 – 75% cost of raising commercial poultry (Adedoyin, 2014), Similarly, with the insufficient production of soybean meal (SBM) in Nigeria has led to permission being given for an import of this product from other countries such as Brazil, Austria etc. However, today the price is considerably still high due to government policy which also on the other hand has to encourage soybean growers in Nigeria. Searching for alternative vegetable protein sources, which are cheap and locally available, has become increasingly urgent subject to poultry nutritionists in the country. One of the vegetable plant sources that can replace soybean is sesame seed. Sesame (*Sesamum indicum-L*) seed is a drought, tolerant crop adapted to many soil types (Rahimian *et al*., 2013). Sesame meal is the by-product of oil extraction from sesame seed. It has a crude protein content of about 46% and medium energy value (Olomu, 2011). Full fat sesame seed and the meal after oil extraction are not only excellent sources of edible nutrients (45 to 50% lipid, 15 to 20% protein, and 10 to 15% carbohydrate and 47.1 to 52.9% crude protein respectively (Deyab *et al*., 2007). The amino acid composition of the protein is similar to that of soybean meal with the exception of lower lysine and higher methionine in sesame. The fiber content of the seed ranges from 2.7 to 6.7% (Ralf and Knoietzny, 2016). Sesame seeds are also good sources of minerals and vitamins such as manganese, copper, calcium, vitamin B_1 and Vitame E and in addition to the highly absorbable spectrum of vitamin E, they increase its bioactivity in the body (Yakubu and Alfred, 2014) Many studies have showed sesame seed meal replacement of soybean meal at 25 – 75% in broilers diet. Therefore the objective of this preliminary study is to evaluate the replacement value of sesame meal for soybean meal based diets for broilers starter.

Materials and Methods

100 day old unsexed Anak strain broiler chicks were randomly allotted into four treatments groups in a completely randomized design. Each treatment group was replicated five times with five birds per replicate. Sesame seed meal purchased from Maya market in Ibarapa Area, Oyo State was dried and then grounded separately to a fine powder and replaced with soybean meal at 0, 5, 10, and 15% w/w

in treatments 1 (control), 2, 3 and 4 respectively (Table 2). Body weight and feed intakes were determined weekly while feed to gain ratio was estimated as outlined by Olomu (2011). The birds were fed the experimental diets and clean drinking water ad libitum for a period of 4 weeks. Mortality ratio were also calculated as percentage of total number of birds per group. All data collected were subjected to analysis of variance technique (SAS 2007). Means of significant result was compared by Duncan's. Proximate analysis of the sesame seed were analyzed according to the procedures described by AOAC (1990).

Table 1: Proximate Composition of Sesame Seed Meal and Soybean Meal

Nutrient%	**Soybean**	**Sesame**
Moisture	6.89	6.11
Crude protein	46.66	43.10
Crude fiber	6.11	9.03
Either extract	18.38	23.49
Ash	5.02	4,87
Nitrogen free extract	14.99	10.83

Table 2: Gross Composition of Experimental Starter Diets

		Replacement levels of sesame seed meal (SSM)		
Ingredients	**T_1**	**T_2 (5%SSM)**	**T_3 (10%SSM)**	**T_4 (15%SSM)**
Maize	56.0	56.0	56.0	56.0
Soybean meal	39.0	34.0	29.0	24.0
Sesame meal	-	5.0	10.0	15.0
Bone meal	2.90	2.90	2.90	2.90
Oyster shell	1.10	1.10	1.10	1.10
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Common salt	0.30	0.30	0.30	0.30
Premix	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**

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Calculated composition				
Crude protein (%)	23.08	22.89	22.69	22.58
Crude fibre (%)	3.08	3.66	3.73	3.98
Metabolizable energy (Kcal/kg)	2981.76	3006.4	3089.3	3100.1

Table 3: Growth Response of Broiler Chicks fed Sesame Seed Meal (SSM) and Soybean Meal (SBM) based diets

Parameters	$T_{1(0\%)}$	T_2 (5%)	T_3 (10)	T_4 (15%)	SEM
Initial body weight (g/bird)	39.86	39.98	39.79	39.88	1.8
Final body weight (g/bird)	842.83_b	870.8^a	839.44^{bc}	840.01^b	2.8
Daily weight gain (g/bird)	30.10^{ab}	31.11^a	29.98^{bc}	30.0^{ab}	1.2
Daily feed intake (g/bird)	48.63^{ab}	49.93^{ab}	50.63^a	51.11^a	2.6
Feed to gain ratio	1.61^c	1.60^{bc}	1.68^{ab}	1.70^a	0.19
Mortality(%)	4	4	4	4	00.1

abc…indicate in the same row with different subscripts are significant (P < 0.05) different.

SEM = Standard Error of Mean

Results and Discussion

The nutrients composition of the test diets indicated an optimum crude protein value of approximately 23% as suggested by Olomu (2011). The growth performance of the starter broilers fed sesame seed meal (SSM) and soybean meal (SBM) based diets are presented in Table 3. At the starter phase, the results show that all parameters were similar (P> 0.05) across the dietary treatments. However, numerical higher values of 870. 8, 31.1 and 1.60 respectively were recorded for final body weight, daily weight gain and feed to gain ratio of birds fed T_2 (5% SSM) replacement of soybean meal. Also, there was a decrease in average final body weight and daily weight gain with increased level of sesame seed meal in the diets T_3 (10% SSM replacement) and T_4 (15% SSM replacement). This results is in agreement with the reports of Agbulu et al (2010) and Diarra and Usman (2008) that reported slight decrease in weight gain of broilers fed high graded levels of soaked sesame seed meal as a source of methionine in broiler chickens.This could be attributed to the presence of phytic and oxalic acid content of sesame seed meal and its subsequent inhibiting the nutrients utilization in the diet. Hossain and Jauncey (1998) suggested that the high phytic acid content of SSM is a possible reason for its lower apparent protein digestibility. Also, it was stated that being a lignanin plant which may interferes the absorption of minerals and vitamins in the diet and also led to poor feed to gain ratio observed as the level of sesame meal increased. Although, birds fed T_2 (5% SSM replacement) diet had better fed to gain ratio compared with the control. It agrees with Olomu (2011) that sesame

seed meal which has a higher content of methionine than most plant protein supplement when used in the right proportion together with soybean meal which also has a higher content of lysine, will result in balanced diet of lysine and methionine, which might play a crucial role in digestion as observed in this study.

Conclusion: It can be concluded that sesame seed meal has a potential as a feed resource to replace soybean meal at 5% in broiler diets without any negative effect. Also, its contents phytate and oxalate still possess some limitations to its use as a feed resource.

References

A.O.A.C (1990) Official Methods of Analysis 13th Edition. *Association of Analytical Chemists, Washington DC.*

Adedoyin, A.A (2014) Fungal biodegradation and exogenous enzyme supplementation of cassava starch residue for broiler production. *Ph.D Thesis submitted to the Department of Animal science, Faculty of Agriculture and Forestry. University of Ibadan, Ibadan XIV 152.pp.*

Agbulu, A.O., Gyau, A. M and Abakura J.B (2010). Effect of the replacement of sesame seed for methionine in broiler production in middle Belt Region- Nigeria. *Journal of emerging trends in educational research and policy studies (JETERAPS)1:16-21*

Deyab, D.M., El-Saidy, S., samy, H.M., Mostafa, A.E and Hayam, D. T (2007) Nutrition evaluation of sesame seed meal (Sesamum indicm-L) as alternative protein source in diets of Juvenile mono sex nile tilapia (Oreochromisniloticus). *Egypt J. AquatBiol and fish 13(1) 93 – 106*

Diara, S.S. and Usman, B.A (2008) Performance of laying hens fed graded levels of soaked sesame (Sesamum indicum) seed meal as a source of methionine.*Inter. Journal of poultry science 7:323 – 327.*

Hossain, M.A and Jauncey, K.(1998) Nutritional evaluation of some banglandeshi oil seed meals as partial subsitutes for fish meal in the diet of common carp, cyprinascarpiol. *Aqual.culturefisheringmanagement 20:155 – 268.*

Olomu, J.M (2011) Monogastric Animal Nutrition: *Principles and practice 2nd Edition St Jackson Publishing. Bening City Nigeria.*

Rahimian Y, Noor Aldin T. Valiollahi, M.R. Toghiani M., Kheiri, F., Rafiee, A. Zamani, F and Miri, Y (2013). Effect of use cumulative levels of sesame (*Sesamum indicum –L*) meal with phytase enzyme on performance of broiler chicks. *Scholarly Journal of Agricultural Science Vol. 3(12) pp 526 – 534. ISSN 2276 – 7118*

Ralf, G. and konietzny U. (2016) Phytase for food application. *Food Technology Biotechnology, 44:125 – 140*

SAS Instiute (2007) SAS User's Guide statistice version 6.12 Edition SAS Institute. Inc. Cary, NC.

Yakubu, B. and Alfred, B. (2014) Nutritional Evaluation of Toasted white sesame seed meal *(Sesamum indicum)* as a source of Methionine on growth performance, carcass characteristic, Haematological and Biochemical indices of finisher broiler chickens.*10SR J. of Agriculture and veterinary science Vol (7) 1: 46 – 52*

EFFECTS OF AFRICAN WALNUT (*Tetracarpidium conophorum*) LEAF AND ITS EXTRACT ON GROWTH PERFORMANCE OF BROILER CHICKENS AT STARTER AND FINISHER PHASES

Adejola Y.A[1], Tiamiyu D.O[1], Jinadu K.B[2], Odetola M.O[2] and Adekanbi A.O[2]

*Affiliation: [1]Federal College of Agriculture, P.M.B 5029, Moor Plantation, Ibadan, Oyo State, Nigeria, [2]Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Oyo State, Nigeria. Corresponding author: *Adejola Y.A, E mail address: adejolayusuf@fcaib.edu.ng, Phone number: +2348032471968*

Abstract

The main objective of this study was to evaluate the effects of African walnut (Tetracarpidium conophorum) leaf and its extract on the growth performance of broiler chickens. Five experimental diets were formulated with the inclusion of Tetracarpidium conophorum Leaf Powder (TCLP) and its Extract (TCLE). The diets were made as followings: (T1) control and basal diet; (T2) T1 + 250mg TCLP kg/diet; (T3) T1 + 500mg TCLP kg/diet; (T4) T1 + 25mg TCLE kg/diet; (T5) T1 + 50mg TCLE kg/diet. This study was conducted from 7 to 49 days of age. A total of 135 seven days old, unsexed broiler chickens were used. They were individually weighed and randomly distributed into five dietary treatments; each treatment included three replicates each with a total of nine birds per replicate on the basis of their weight. Data were collected on growth performance and subjected to one way of analysis of variance in a Completely Randomized Design. At the starter phase, birds fed the control diet had significantly ($p<0.05$) greater average weight gain (420.55g), average feed intake (2201.45g) and lower feed conversion ratio (2.86) compared to other treatment groups. At the finisher phase, no significant ($p>0.05$) difference was observed on growth performance across the dietary treatments. Based on the results, it is therefore concluded that growth performance of the broiler chickens both at starter and finisher phases were not influenced by Tetracarpidium conophorum leaf powder and its extract.

Keywords: African Walnut leaf, broiler chickens, and growth performance

Introduction

Antibiotics have been utilized as growth promoters and to prevent outbreak of diseases (Phillips *et al.*, 2004). However, the benefit of the use of antibiotics as growth promoters has some disadvantages; these include drug toxicity, residual effects and development of bacteria resistance (Ogbe and John, 2012). These problems have led to the ban on the use of antibiotics as growth promoters by the European Union (Catalá-Gregori *et al.*, 2008). Thus, attention to safe and natural alternatives such as plants to replace antibiotics (phytobiotics) is on the increase. Therefore, for a long time antibiotics have been supplemented to animal diets to allow animals to cope better with these harsh conditions. This led to the ban of antibiotics in animal diets in the European Union in 2006. As a result, many substances belonging to the groups of prebiotics, probiotics, organic acids, enzymes, silicates and herbs and spices have been tested for their potential to replace AGPs in animal diets, also for poultry.

African walnut (*Tetracarpidium conophorum*), like many plants in Africa and other parts of the world has been proven to have nutritive, medicinal, agricultural and industrial values over the years. Phytochemical analysis of Africa walnut indicates that it contains bioactive compounds such as oxalates, phytates, tannins, saponins and alkaloids which partly show the use of the seeds, leaves and roots in herbal medicine (Ayoola *et al.* 2011. Studies have shown that *T. conophorum* possesses some properties that are required for wound healing like antibacterial and antioxidant activities (Amaeze *et al.*, 2011) and immuno stimulating activities (Animashaun *et al.* 1994).

Extracts of *T. conophorum* leaves have been shown to possess good antibacterial activities especially against Gram positive organisms. Results from a study conducted by Onwuli *et al.* (2014) suggested that *T. conophorum* nuts have antihyperglycaemic and antimicrobial activities. A research conducted by Okon *et al.* (2014) discovered that albino wistar rat fed with a standard, commercial diet (control group) or a diet *containing T. conophorum* seeds for 60 days reduced the level of cholesterol and triglyceride in the rats compared with the control group fed with standard diets.

Based on the aforementioned bioactive compounds and properties of (*Tetracarpidium conophorum*) the plant, there is need to know whether (*Tetracarpidium conophorum*) leaf and its extracts could be used as feed additives for broiler chickens in producing safe and cost effective meat. Therefore, the

objective of the present study is to evaluate the effects of African walnut (*Tetracarpidium conophorum*) leaf and its extracts on the growth performance of broiler chickens.

Materials and methods

Experimental Site

This experiment was carried out at the poultry unit, Federal College of Agriculture, Moor Plantation, Ibadan, Nigeria.

Sourcing and Processing of Test Ingredients

Tetracarpidium conophorum leaves were obtained from a farm in Omi adio, Ibadan. They were washed with clean water and allowed to air dry under shade and thereafter were ground into powder and stored in the dark in airtight plastic bags at ambient temperature. The Proximate analysis of the test ingredient was analyzed in the laboratory according to AOAC (1999). The *Tetracarpidium conophorum* leaf extract was obtained by soaking the *T. Conophorum* powder in ethanol (as an extracting solvent) for 48 hours. The ratio of ethanol volume (mL) and sample weight (g) was 40:1. Then, the extract solution was concentrated at a temperature of 50°C using a rotary evaporator. The leaf and seed extracts were stored in separate dark airtight plastic bags at ambient temperature.

Experimental Diet

Five experimental diets were formulated with the inclusion of *Tetracarpidium conophorum* Leaf Powder (TCLP) and *Tetracarpidium conophorum* Leaf Extracts (TCLE). The diets were made as followings:

(1) T1, control and basal diet; (2) T2, T1 + 250mg TCLP kg/diet, (3) T3, T1 + 500mg TCLP kg/diet (4) T4, T1 + 25mg TCLE kg/diet and (5) T5, T1 + 50mg TCLE kg/diet

Experimental Design and Management

This study was conducted from 7 to 49 days of age. A total of 135 day old, unsexed broiler chickens were purchased from a commercial hatchery in Oluyole, Ibadan, Nigeria. On arrival, all chickens were fed a commercial broiler starter for 7 days. Then, at 7 days of age, they were individually weighed and randomly distributed into five (5) dietary treatments; each treatment included three (3) replicates each with a total of nine (9) birds per replicate on the basis of their weight. Routine managements, vaccinations and medications were duly followed throughout the course of the study and the experiment lasted for six (6) weeks.

Data collection

Chemical Analysis: Proximate analysis of the test ingredient was carried out according to the method of AOAC. (1990).

Growth Performance Evaluation: Records of live weight (g), feed intake (g), weight gain (g) and feed conversion ratio (FCR) were determined on weekly basis.

Statistical analysis: All data were analyzed using one way analysis of variance (ANOVA) and means was compared by the Duncan's multiple range test when ANOVA analysis is significant (SPSS 16).

Results and Discussion

Table 2 shows the effect of varying levels of Africa walnut leaf Powder and its extract on growth performance of broiler chickens at starter phase. Birds fed the control diet (T1) had significantly ($p<0.05$) greater final weight, weight gain and feed intake than other treatment groups. The final weight (FW) values ranged between 503.89g and 555.78g with the highest value for the bird fed the control diet (T1) and least value for the bird fed 250mg TCLP kg/diet (T2). The inclusions did not increase the growth performance. Table 3 shows the effect of varying levels of African walnut leaf Powder and its extract on growth performance of broiler chickens at finisher phase. No significant ($p>0.05$) differences in final weight, average weight gain, average feed intake and feed conversion ratio observed in broilers fed *Tetracarphidium conophorum* leaf powder and its extract at finisher phase. These results are in accordance with the reports of Botsoglu *et al.,* (2002) and Lee *et al.,* (2004) who found that dietary supplementation of oregano essential oil (100 and 50 mg/kg, respectively) did not affect the broilers' performance. Likewise, supplemental PFA containing turmeric extract, citrus extract, grape seed extract, Chinese cinnamon essential oil, Chilean boldo leaves, and fenugreek seeds had no effect on growth performance of broilers (Fascina *et al.,* 2012).

Table 1: Composition of the basal diet of broiler chickens

Items	Starter Phase 7-21days	Finisher Phase 22-49 days
Ingredients (%)		
Maize	58.00	63.00
Soybean Meal	37.00	32.00
Limestone	2.50	2.50
Dicalcium Phosphate	1.50	1.50
Dl-Methionine	0.20	0.20
Lysine	0.30	0.30
Mineral Premix	0.25	0.25
Salt	0.25	0.25
Total	100	100
Calculated analysis		
Crude Protein	23.00	20.00
Metabolisable energy (kcal/kg)	3000	3200
Lysine (%)	1.30	1.00
Methionine (%)	0.52	0.38
Calcium (%)	1.00	0.90
Phosphorus (%)	0.80	0.75

*****Premix to provide the following: Vitamin A 12,000,000I.U; Vitamin D3 3,000.000I.U; Vitamin E 30,000mg;Vitamin K 2,500mg; folic acid 1,000mg; Niacin 40, 000mg; Cal Pan 10,000mg; Vitamin B12 20mg; Vitamin B12,000mg; Vitamin B6 3,500mg; Biotin 80mg; Antioxidant 125,000mg; Cobalt 250mg; Selenium 250mg; Iodine1,200mg; Iron 40,000mg; Manganese 70,000mg; Copper 8,000mg; Zinc 60,000mg; Chlorine 200,000mg.

Table 2: Effect of African walnut (*Tetracarpidium conophorum*) leaf powder and its extract on growth performance of broiler chickens at starter phase (7-28 days)

Parameters	T1	T2	T3	T4	T5	±SEM
IW (g/bird)	135.26	134.85	135.07	135.59	135.70	±0.25
FW (g/bird)	555.78^{a}	503.89^{b}	548.29^{ab}	522.00^{ab}	524.28^{ab}	±7.34
AWG (g/bird)	420.55^{a}	369.04^{b}	413.22^{ab}	386.41^{ab}	388.58^{ab}	±7.34
AFI (g/bird)	1201.45^{a}	1172.98^{ab}	1195.26^{a}	1095.98^{b}	1166.76^{ab}	±14.21
FCR	2.86	3.18	2.90	2.87	3.00	±0.06

^{a,b} means along the same row with different superscripts are significantly different (P<0.05)
IW- Initial Weight, FW- Final Weight, AWG- Average Weight Gain, AFI- Average Feed Intake,
FCR- Feed Conversion Ratio, SEM: Standard Error of Mean

Table 3: Effect of African walnut (*Tetracarpidium conophorum*) leaf powder and its extract on growth performance of broiler chickens at finisher phase (28-49 days)

Parameters	TI	T2	T3	T4	T5	±SEM
IW (g/bird)	555.78^{a}	503.89^{b}	548.29^{ab}	522.00^{ab}	524.28^{ab}	±7.34
FW (g/bird)	1534.03	1464.00	1531.36	1408.11	1518.63	±24.67
AWG (g/bird)	978.25	960.11	983.06	960.11	994.34	±22.73
AFI (g/bird)	2246.41	2206.01	2387.79	2291.92	2377.65	±65.16
FCR	2.30	2.31	2.44	2.59	2.38	±0.06

^{a,b} means along the same row with different superscripts are significantly different (P<0.05)
IW- Initial Weight, FW- Final Weight, AWG- Average Weight Gain, AFI- Average Feed Intake
FCR- Feed Conversion Ratio, SEM: Standard Error of Mean

References

1. Amaeze, U.O, Ayoola, G.A, Sodiya, M.O, Adepoju-Bello, A.A, Adegoke, A.O and Coker, H.A(2011) "Evaluation of anti-oxidant activity of *Tetracarpidium conophorum* (Mull.Arg) Hutch and Dalziel leaves", *Oxidative Med Cell Long*., 13: 1 –7.
2. Animashun, T, Togun, R.A and Hughes, C.R. (1994) "Character-ization of isolectins in *Tetracarpidium conophorum* seeds (Nigerian walnut)", Glycoconjugation J., 11: 299 –303, 1994.
3. Ayoola, P.B, O.O Onawumi and O.P, Faboya (2011). "Chemical evaluation and nutritive values of *Tetracarpidium conophorum* (Nigerian walnut) seeds". *Journal of Pharmaceutical and Biomedical Sciences. 11 (11): 1–4.*
4. Botsoglou, N. A., P. Florou-Paneri, E. Christaki, D. J. Fletouris, and A. B. Spais. (2002). Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. *British Poultry Science* 43:223–230.
5. Catalá-Gregori P, Mallet S, Travel A and Lessire M (2008). Efficiency of a prebiotic and a plant extract on broiler performance and intestinal physiology. Proceedings of the 16th European Symposium on Poultry Nutrition; *World Poultry Science Association*, Strasbourg. France.
6. Fascina V.B., Sartori J.R., Gonzales E., de Carvalho F.B., de Souza I.M.G.P., Polycarpo G.D., Stradiotti A.C., Pelicia V.C. (2012): Phytogenic additives and organic acids in broiler chicken diets. *Revista Brasileira de Zootecnia,* 41, 2189–2197.
7. Lee KW., Everts H., & Beynen AC. (2004). Essential oils in broiler nutrition. *International Journal of Poultry Science*. 3:738–752.
8. Ogbe AO and John PA (2012). Proximate study, Mineral and anti-nutrient composition of *Moringa oleifera*leaves harvested from Lafia Nigeria potential in poultry nutrition and health. *Journal of Microbiology Biotechnology and Food Science*; 1(3)296-308.
9. Okon, U. and Atai, A. A. (2014).Aqueous Extract of *Tetracarpidium conophorum* Increases FSH and LH Plasma Indices in Albino Wistar Rats. *International Journal of Biomedical Research*, 10:7439-7444.
10. Onwuli, D.O, Brown, H. and Ozoani, H.A. (2014) "Antihypergly-caemic effect of *Tetracarpidium conophorum* nuts in allox-an induced diabetic female albino rats", *ISRN Endocrinol* : 1-4. article ID .
11. Phillips I, Mark C, Tony C, Brad DG, Christian FRJ, Nightingale C (2004). Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data. *Journal of Antimicrobial Chemotherapy;* 53:28-52.

PERFORMANCE AND SERUM BIOCHEMISTRY OF BROILER CHICKEN FED *CANARIUM SCHWEINFURTHII* SEED MEAL DIET WITH PHYTASE ENZYME

[*1]Adelowo, O.V., [2]Etop, S., [1]Garba, S. I., [1]Isah, S. A., and [1]Joel, Y. P.
[1]Department of Animal Production, Federal College of Animal Health and Production Technology, N.V.R.I., Vom, Plateau State
[2]Department of Animal Science, Faculty of Agriculture, University of Ibadan, Oyo State
[*]Corresponding author:olufisayo71@gmail.com (08030426283)

Abstract
The study was conducted for six weeks to investigate the effect of Canarium schweinfurthii seed meal on performance and serum biochemistry of broiler chickens. One hundred and twenty arbo acre two weeks old broiler chicken were randomly allotted to four dietary treatments (T1 to T4) of 0%, 5%, 7.5% and 10% inclusion levels of Canarium schweinfurthii seed meal (CSSM) with three replicate of ten birds each in a completely randomized design. The parameters measured are performance (weight (g), average weight gain (g), feed intake (g), and feed conversion ratio (FCR) was calculated), serum biochemical indices (total protein (g/L), albumin (g/L), globulin (g/L), creatine (g/d) and cholesterol (mmol/L). The results showed significant variation ($p<0.05$) in average weight gain, average feed intake and final weight across the treatments while the FCR were not significantly different ($p>0.05$). The serum biochemical indices were significantly different ($p<0.05$) across the treatments. Therefore, Canarium schweinfurthii seed meal with phytase enzyme can be included in the diets of broiler chickens without having a negative effect on the growth performance and biochemical indices of the birds.

Key words: *Canarium schweinfurthii*, broiler chickens, performance, serum, phytase

Introduction
In developing countries like Nigeria, the supply of animal protein is grossly inadequate. It is established that an average Nigerian consumes only 8.6g of animal protein per day as against 53.3g by the inhabitants of developed countries (Ojo, 2003). Sanni and Ogundipe (2005) reported that poultry industry occupies a major position in livestock production as birds reproduce much quicker to produce meats and eggs for human consumption. According to FAO (2006) poultry is considered to be a means of livelihood and a way of achieving a certain level of economic independence. Nutrition is perhaps the most important consideration in livestock management. Therefore, the major interest of the farmer is to reduce the feed cost, which accounts for 60 to 70 % of the total cost of production (Igwebuike *et al*., 2001 and Ogundipe, *et al*; 2003). Research efforts are geared towards evaluating alternative feed ingredient that are less costly and yet efficient for poultry. In essence, to overcome the problem of feed shortage in the poultry industry, the recent trend is the usage of non-conventional feedstuff that is readily available, cheap and nutritionally safe in poultry feed formulation. One of such non-conventional feedstuffs with great potential is *Canarium schweinfurthii* seed. *Canarium schweinfurthii* is a suitable source of edible oil which can also serve as alternative source of energy with valuable minerals such as calcium, potassium, magnesium, sodium, phosphorous, iron, zinc and copper (Adelowo *et al*., 2019a). Adelowo *et al*., (2019b) in their findings reported that, the inclusion of roasted *Canarium schweinfurthii* seed meal up to 7.5% significantly improve the final weight, weight gain and feed intake of broiler chickens. Hence, this study evaluates the growth performance and serum biochemistry of broiler chickens fed graded level of *Canarium schweinfurthii* seed meal with phytase enzyme.

Materials and methods
The study was carried out at the Poultry Department of the National Veterinary Research Institute (N.V.R.I.), Vom, Plateau State. One hundred and twenty day-old broiler Arbo acre chicks were acquired from a local hatchery. The chicks were brooded for 14 days (at a density of 20 chicks/$m^{2)}$ using a commercial feed and thereafter the experimental diets were introduced. The chicks were weighed at the beginning of the experiment to obtain the initial weight. The 120 broiler chicks of fourteen days old were randomly allotted in a completely randomized design to 4 dietary treatments 0% (T1), 5% (T2), 7.5% (T3) and 10% (T4) inclusion levels of *Canarium schweinfurthii* seed meal (CSSM). Each dietary treatment had 30 chicks with 3 replicates of 10 birds. *Canarium schweinfurthii*

seeds were sourced in a local market from Pankshin L.G.A., Plateau state, dried, grounded and mixed with other ingredients in the experimental diets. Thirty grams of phytase enzyme was weighed and added to the dietary treatments; the composition and calculated analysis of the experimental diets are presented in Table 1. The diets were isonitrogenous and isocaloric to meet the recommended crude protein and Metabolisable energy requirements as stated by NRC (1994). Feeds and water were given *ad libitum.* The parameters were measured weekly: the performance data taken include feed intake, initial and final weight, body weight gain while the feed conversion ratio (FCR) was calculated weekly. Daily feed consumption was recorded as the difference between feed offered and the left over. The birds were raised on deep litter standard management and hygiene, the recommended vaccines for broilers were administered accordingly. The duration of the experiment was six weeks. At the end of the six weeks study, 2 birds from each treatment were randomly selected and blood samples were collected for serum biochemistry analysis. For each chicken, 2ml of blood was collected with a syringe via the wing vein and transferred into an anti-coagulant free bottle. Meanwhile, after centrifugation, blood free from anticoagulant, serum was collected and preserved at -20^{0}C for the evaluation of serum biochemical parameters (Total protein, Albumin, Globulin, Total cholesterol and Creatinine) using a colorimetric method as prescribed by the commercial kits (Chronolab® kits).

Statistical Analysis

Data obtained from the experiment were analysed using the statistical analysis of variance (ANOVA) procedure of SAS (2010) and significant level of p=0.05 was used. The treatment means were compared using the New Duncan Multiple Range test of the same software.

Table 1: Composition of the experimental diets

Ingredient	T1 (0%)	T2 (5%)	T3 (7.5%)	T4 (10%)
Maize	50.00	44.00	40.00	40.00
Soybean cake	20.00	17.00	17.00	16.50
Wheat offal	8.00	13.00	13.0	11.0
Groundnut cake	17.30	15.30	15.80	15.80
Atili (CSSM)	0.00	5.00	7.5	10
Bone meal	2.00	2.00	2.00	2.00
Vegetable oil	2.00	3.00	4.0	4.0
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Premix	0.15	0.15	0.15	0.15
Salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00

Nutrient Analysis				
Crude P. %	22.44	20.50	20.32	19.75
Energy(M.E.kcal/kg)	2999.40	2835.90	2792.90	2742.00
Calcium	0.80	0.80	0.80	0.79
Average phosphorus	0.59	0.62	0.62	0.59
Lysine	1.11	1.00	1.00	0.98
Methionine	0.52	0.49	0.49	0.48
Fibre	3.85	3.86	3.80	3.60

CSSM= *Canarium schweinfurthii* seed meal, P=Phosphorous, ME = Metabolisable energy,

Table 2: Proximate composition of *Canarium schweinfurthii* seed

Parameter	g/100g
Protein	4.55
Fat	3.14
Moisture content	13.20
Ash	3.96
Crude fibre	3.62
Energy(M.E.kcal/kg)	2448.81

Results and Discussion

Table 3: Growth performances of broiler chickens fed *Canarium schweinfurthii* seed meal

Parameters	Treatments				
	T1 (0%)	T2 (5%)	T3 (7.5%)	T4 (10%)	SEM
Initial weight(g\bird)	235.00	235.00	232.00	230.00	0.12
Average Feed intake (g\bird)	970.00^{a}	893.50^{b}	842.50^{b}	768.00^{c}	14.8
Average weight gain (g\bird\week)	294.00^{b}	323.50^{a}	314.00^{a}	295.00^{b}	9.4
Final weight (g\bird)	1999.00^{b}	2271.00^{a}	2150.00^{ab}	2000.00^{ab}	65.0
FCR	3.29	2.76	2.68	2.90	0.37

abc Means along the same row with different superscripts are significantly different ($p<0.05$)
SEM =Standard Error of Mean

In Table 3, it was observed that final weight/bird, average weight gain/bird/week and average feed intake/bird increased significantly ($P<0.05$) across the treatments. The final weight/bird values ranges from highest 2271.00g (T2), to lowest 1999.00g (T1) respectively. The average weight gained/bird increases from 294g (T1), 295g (T4), 314g (T3) to 323.50g (T2) and the average feed intake/bird

decreases from 970g (T1), 893g (T2), and 842g (T3) to 768g (T4) respectively. The FCR values were not significantly different ($p>0.05$) across the treatments. The final weight value was higher in birds fed diet with 5% and 7.5% CSSM compared to those fed with the control diet (T1) this result agree with the findings of Adelowo *et al*., (2019) that broiler chickens can tolerate roasted *Canarium schweinfurthii* seed meal up to 7.5% without affecting their performance. The introduction of phytase enzyme in T2 to T4 had positive effect on the FCR which agree with the report in the findings of Agboola *et al*. (2015) that enzymes addition to diet had positive effect on broiler growth. The average weight gain and final weight of the broiler chickens were significantly different. Hence, CSSM can be included in broiler diet up to 10% because the seed contained appreciable amount of nutritionally valuable minerals such as calcium, potassium, magnesium, sodium, phosphorous, iron, zinc and copper while glutamic and aspartic acids dominated the amino acid profile also appreciable amount of essential amino acids which was more than fifty percent of total amino acid contents (Aigade *et, al.* (2017). Table 4 shows the effect of feeding different levels of *Canarium schweinfurthii* seed meal on serum biochemical indices of broiler chickens is shown in Table 3. The total protein levels were 52.50g/L, 58.50g/L , 47.00g/L, and 48.00g/L respectively. The albumin levels were 28.00g/L, 30.00g/L, 25.00g/L and 25.00g/L respectively. The globulin were 25.00g/L, 28.50g/L, 22.00g/L and 23.00g/L respectively, the creatinine levels were 1.95mg/dL, 1.65mg/dL, 2.15mg/dL and 1.55mg/dL respectively while the cholesterol levels were 2.80mmol/L, 1.75mmol/L, 2.30mmol/L and 2.25mmol/L from T1 to T4 respectively. There were significantly variations ($p<0.05$) in all the biochemical indices measured in this study across the treatments. Although, the total protein, albumin and globulin were not statistically different for treatments T1 and T2.

Table 4: The Serum biochemistry of broiler chickens fed *Canarium schweinfurthii* seed meal

Parameters	Treatments				
	T1 (0%)	T2 (5%)	T3 (7.5%)	T4 (10%)	SEM
Total protein (g/L)	52.50^{ab}	58.50^{a}	47.00^{b}	48.00^{b}	1.68
Albumin (g/L)	28.00^{ab}	30.00^{a}	25.00^{b}	25.00^{b}	0.78
Globulin (g/L)	25.00^{a}	28.50^{a}	22.00^{b}	23.00^{b}	1.12
Cholesterol (mmol/L)	2.80^{a}	1.75^{b}	2.30^{ab}	2.25^{ab}	0.15
Creatine (mg/dL)	1.95^{a}	1.65^{b}	2.15^{a}	1.55^{b}	0.08

abc Means along the same row with different superscripts are significantly different ($p<0.05$)
SEM =Standard Error of Mean

Conclusion and Recommendation

Canarium schweinfurthii seed is readily available with little or no economic value and its inclusion in diets of broiler chickens up to 10% without adverse effects on performance will reduce the cost of production of broiler chickens especially for farmers in the rural areas. It can also serve as cheap income for farmers who produces *Canarium schweinfurthii* olive oil from the fruits where the seeds serve as waste products.

References

Adelowo, O.V., Oshibanjo, D.O., and Gowal, D.P (2019b). Effects of Feeding Roasted *Canarium schweifurthii* Seed Meal on Performance of Broiler Chickens. *Proceedings of the 8th ASAN-NIAS Joint Annual Meeting*, Umuahia. 2019 Pg: 638-641. ISSN-9783477722

Adelowo, O. V., Oshibanjo, D. O. and Tangshwan, L. S. (2019a). Proximate Composition of Raw-Dried and Heat Treated *Canarium Schweifurthii* (Atili) Fruit As Non-Convention Ingredient In Broiler Diet. In *Proceedings Nigeria Society for Animal Production* 44th Annual Conference Abuja 2019. Page 284-287. ISSN: 1596-5570

Agboola, A. F., Odu, O., Omidiwura, B. R. O. and Iyayi, E. A. (2015). Effect of Probiotic, Carbohydrase Enzyme and Their Combination on the Performance, Histomorphology and Gut Microbiota in Broilers Fed Wheat-based Diets. In *American Journal of Experimental Agriculture* 8(5): 307-319, 2015, Article no.AJEA.2015.174 ISSN: 2231-0606 SCIENCEDOMAIN international www.sciencedomain.org

Aigade, G. W1, Amoo, I. A1, Jabar, J.M1, Ojo A.M and Maduawuchi, C.O. (2017). Proximate, Minerals and Amino Acid Profile of (*CanariumSchweinfurthii*) Seed Pulp. *International Journal of Science and Technology Volume 6 No. 1*

FAO (2006). Food and Agricultural Organistion of the United Nations. Village chicken production systems in Rural African House, Food security (ed ns). Agricultural Department, FAO Corporate Document Repository, 9-11.

Igwebuike, J.U., Kwari, I.D., Ubosi, C.O. and Alade, N.K. (2001). Replacement Value of Spent Sorghum Grains for Maize in Broiler Finisher Diets. *Journal of Sustainable Agricultural Environment*, 3:224-233.

NRC. (1994). Nutrient requirements of poultry 9th revised edition. Nutritional Academic Press. Washington D.C. USA.

Ogundipe, S. O., Abeke, F. O; Sekoni, A.A., Dafwang, I.I., and Adeyinka, A. I. (2003). Effect of duration of cooking in the utilization of lab lab purpureus by pullet chicks. In; *Processing of the 28th Annual conference of the Nigerian*, 233-235.

Ojo, S.O. (2003). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. *International Journal of Poultry Science*, 2:459-464.

Sanni, S.A. and Ogundipe, S.O. (2005). Economics of some modules of poultry production in Kaduna State Nigeria. *Nigerian Journal of Animal Production*, 32 (1): 102-107.

SAS. 2010. SAS/STAT User's Guide: Version 9.2. SAS Institute Inc., Cary. NC., USA; 2010.

GROWTH PERFORMANCE OF BROILER CHICKENS FED DIETS WITH GRADED LEVELS OF BITTER LEAF (*VERNONIA AMYGDALINA*) MEAL

Adelowo, O. V[1]., Oshibanjo, D.O[2]., Olaiya, O. D[1]., Emmanuel, N. Y[1]., and Joseph, N[1].
[1]Department of Animal Production, Federal College of Animal Health and Production Technology, N.V.R.I., Vom, Plateau State,
[2]Department of Animal Production, Faculty of Agriculture, University of Jos, Jos, Plateau State
Corresonding author: olufisayo71@gmail.com, 08030426283

Abstract
This study evaluate the growth performance of broiler chickens fed diet with graded levels of Vernonia amygdalina leaf meal. One hundred and twenty 2 weeks-old Arbo acre broiler chicks were weighed at the beginning of the experiment to obtain the initial weight and randomly allotted in a completely randomized design to 4 dietary treatments of 0% (T1), 5% (T2), 7.5% (T3) and 10% (T4) graded levels of Vernonia amygdalina leaf meal (VALM). Each dietary treatment had 30 chicks with 3 replicates of 10 birds. The duration of the experiment was six weeks. Data collected are initial weight, final weight, feed intake, weight gained and feed conversion ratio. Data obtained from the experiment were analysed using the statistical analysis of variance (ANOVA) procedure of SAS (2010) and significant level of p=0.05 was used. The treatment means were compared using the New Duncan multiple range test of the same software. The initial weight of the birds was significantly the same. Significant different was observed in final weight, feed intake, weight gained and feed conversion ratio. Treatment 4 containing 10% graded levels of Vernonia amygdalina leaf meal (VALM) was significantly higher in final weight compared to other treatments. Similar, trend was observed for feed intake and weight gained with least feed conversion ratio. In conclusion Vernonia amygdalina leaf meal (VALM) could be added to broiler chickens diet up to 10% inclusion level.

Keywords: *Vernonia amygdalina* leaf meal (VALM), growth performance, broiler chickens, feed conversion ratio.

Introduction

One of the profitable agro industries which can effectively tackle the problem of unemployment in the rural areas is the poultry sector (sings 2010). Poultry can be adopted under a wide range of climatic conditions and can generally combine conveniently with other farm enterprises. It is a common knowledge that feed constitute the greatest and most costly input in livestock production especially poultry. Thus, any significant reduction in the cost of feeds will definitely reduce the overall cost of production and increase the profit margin (Owen and Amakiri, 2011). Due to high cost of conventional protein ingredient like fish meal, groundnut cake and soya bean, the trust of nutritional research is toward identifying non-conventional sources that are locally available with low human demands (owen et al 2009). One of such non-conventional feed sources in livestock diet is bitter leaf (*Vernonia amygdalina*) meal. *Vernonia amygdalina* is a shrub or small tree that grows throughout tropical Africa. The leaves contain a considerable amount of anti-nutritive factors like tunic acid and saponin and according to Akwaowo *et al.,* (2000), the young leaves contain higher cyanide (60.1 mg 100^{-1}g DM) and tannin (40.6mg 100^{-1} g DM) than older ones. The Proximate composition of *Vernonia amygdalina* (V.A.) leaf showed a chemical composition of 527.83 ME Kcal/kg, 86.40% DM, 21.50%CP, 13.10% CF, 6.80% EE,11.05% Ash, and the result on mineral calcium, 0.40% magnesium, 0.03% phosphorus 0.06, 6% iron,0.33% potassium, and 0.05% sodium (Owen,2011). Furthermore, *Vernonia amygdalina* has also been fed to broilers, where it was able to replace 300g/kg^{-1} of maize-based diet without negative effect on feed intake, body weight gain and feed efficiency (Bonsi et al, 1995). Research also showed that *V. amygdalina* had some beneficial effects in disease management of poultry (Dakpogan, 2006) such as anti-coccidiosis, anti-bacterial and anti-parasitic (Gbolade, 2009; Tadesse et al,1993), anti- oxidant (Erasto et al, 2007) and as a growth promoter by enhancing the gastro intestinal enzymes thus increasing feed conversions efficiency (Huffman et al,1996; Olobatoke and Oloniruha,2009). This study therefore evaluate the growth performance of broiler chickens fed diet with graded levels of *Vernonia amygdalina* leaf meal.

Materials and Methods

The study was carried out at the Poultry Department of the National Veterinary Research Institute (N.V.R.I.), Vom, Plateau State. One hundred and twenty 2 weeks-old Arbo acre broiler chicks were weighed at the beginning of the experiment to obtain the initial weight and randomly allotted in a completely randomized design to 4 dietary treatments of 0% (T1), 5% (T2), 7.5% (T3) and 10% (T4) graded levels of *Vernonia amygdalina* leaf meal (VALM). Each dietary treatment had 30 chicks with 3 replicates of 10 birds. The composition and calculated analysis of the experimental diets are presented in Table 1. The diets were isonitrogenous and isocaloric to meet the recommended crude protein and Metabolisable energy requirements as stated by NRC (1994). Feeds were provided in the various troughs daily and water were given *ad libitum.* The parameters were measured weekly: the performance data taken include feed intake, initial and final weight, body weight gain while the feed conversion ratio (FCR) was calculated weekly. Daily feed consumption was recorded as the difference between feed offered and the left over. The birds were raised on deep litter standard management and hygiene, the recommended vaccines for broilers were administered accordingly. The duration of the experiment was six weeks.

Statistical Analysis

Data obtained from the experiment were analysed using the statistical analysis of variance (ANOVA) procedure of SAS (2010) and significant level of p=0.05 was used. The treatment means were compared using the New Duncan multiple range test of the same software.

Table 1: Composition of the experimental diet

Ingredient	T1	T2	T3	T4
Maize	50	48	45.0	47.3
Wheat offal	6.3	6.3	6.8	4.0
Soya beans meal	20	18.0	18.0	17.0
Groundnut cake	19	18.0	18.0	17.0
Vegetable oil	2.0	2.0	2.0	2.0
Bitter leaves	__	5	7.5	10
Bone meal	2.0	2.0	2.0	2.0
Premix*	0.15	0.15	0.15	0.15
Methionine	0.2	0.2	0.2	0.2
Lysine	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated Nutrient Analysis				
Crude Protein	22.95	21.45	21.25	20.16
Energy(M.E.Kcal/kg)	3011.81	2863.81	2771.16	2744.00
Calcium	0.80	0.79	0.79	0.78
Available Phosphorus	0.57	0.55	0.56	0.52
Lysine	1.13	1.45	1.04	0.99
Methionine	0.53	0.50	0.50	0.49
Fibre	3.79	3.57	3.50	3.24

ME = Metabolisable energy *Composition of premix per kg of diet: vitamin A:(12,000,000 i.u) ; vitamin D3 (2,500,000 i.u) ; vitamin E (30,000 mg); vitamin K3 (2,000 mg); vitamin B1 (2250 mg); vitamin B2 (6000 mg); vitamin B6 (4,500 mg); vitamin B12 (15 mcg); niacin (40,000 mg); pantothenic acid (15,000 mg); folic acid (1,500 mg); biotin (50 mcg); choline chloride (300,000 mcg); manganese (80,000 mg); zinc (50,000 mg); iron (20,000 mg); copper (5,000 mg); iodine (1,000 mg); selenium (200 mg); cobalt (500 mg); antioxidant (125,000 mg)

(T1)= 0% graded levels of *Vernonia amygdalina* leaf meal (VALM)

(T2)= 5% graded levels of *Vernonia amygdalina* leaf meal (VALM)

(T3) =7.5% graded levels of *Vernonia amygdalina* leaf meal (VALM)

(T4) 10% graded levels of *Vernonia amygdalina* leaf meal (VALM)

Results and Discussion

The results of the initial weight and performance of the broiler chickens fed diets with *Vernonia amygdalina* leaf meal is shown in Figure 1 and Table 2. The initial weight of the birds was significantly the same. It was observed that the weight gain and the final weight of the birds fed with VALM increased significantly ($p<0.05$) across the treatments from 1924.50g (T1) to 2175.00g (T4) and 1924.50g (T1) to 2175.00g (T4) while the weight gains are 253.50g (T1), 254.00g (T2), 268.g (T3) and 319.50g (T4), respectively. The feed intake and the feed conversion ratio also increased significantly ($p<0.05$) across the treatments. The values for the feed intake are 949.5g (T1), 918.0g (T2), 962.5g (T3), and 979.0g (T4) while the FCR are 3.75 (T1), 3.70 (T2), 3.60 (T3), and 3.15 (T4), respectively.

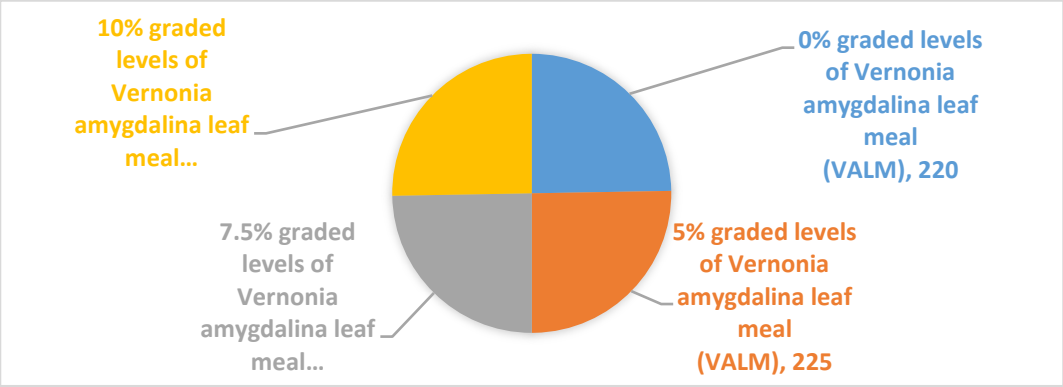


Figure 1: Initial weight of the experimental birds in grams

Table 2: Growth performance of broiler chickens fed Bitter leaf meal

Parameters	T1	T2	T3	T4	SEM
Final weight (g)	1924.50^{ab}	1897.00^{b}	1930.00^{ab}	2175.00^{a}	45.5
Feed intake (g)	949.50^{b}	918.00^{c}	962.50^{ab}	979.00^{a}	10.68
Weight gain (g)	253.50^{b}	254.00^{b}	268.50^{b}	319.50^{a}	9.59
Feed conversion ratio	3.75^{a}	3.70^{a}	3.60^{a}	3.15^{b}	2.12

^{abc} Means on the same row with different superscripts are significantly different ($p<0.05$)
(T1)= 0% graded levels of *Vernonia amygdalina* leaf meal (VALM)
(T2)= 5% graded levels of *Vernonia amygdalina* leaf meal (VALM)
(T3) =7.5% graded levels of *Vernonia amygdalina* leaf meal (VALM)
(T4)= 10% graded levels of *Vernonia amygdalina* leaf meal (VALM)
SEM= Standard error mean

Similar result was obtained by Chiemela *et al.* (2016). The result for FCR in this study is in line with the findings of Olobotoke and Oloniruha (2009) who reported that inclusion of *VA* powder in cockerels feed significantly improved FCR. This could be associated with its effect on enhancing the gastro intestinal enzyme thereby improving digestion and assimilation of nutrients (Adaramoye *et al.*, 2008). The findings by Windisch (2007) also reported improved growth performance of animals fed *VA*. Furthermore, the report of Mohammed and Zakariya (2012) supported the observations made by Abubakar *et al*., (2010) that phytogenic feed additives are often associated to the improvement of flavor and palatability of feed, thus bitter leaf extract enhances production performance of birds. However, the observations made by Mohammed and Zakariya (2012) pertaining improvement of weight gain and FCR in broilers are in contrary with the present result.

Conclusion

In conclusion *Vernonia amygdalina* leaf meal (VALM) could be added to broiler chickens diet up to 10% inclusion level.

References

Abubakar, A.L., Malik, O.O., Bashar, Y.A., & Muffau, M. (2010). Growth Performance of broiler finishers fed Garlic (*Allium salivium*) supplemented diets. *Proc. 35th conf. Nig. Soc. for Anim. Prod.* 14th-17th March; 372-374.

Adaramonye, O.A., Akintayo, O., Achem, J., & Fatunso, M.A. (2008). Lipid lowering effects of methanolic extracts of vernonia amygdalina leaves in rats fed on high cholesterol diet. Vasc. Health Risk Management; 4:236-241.

Akwaowo, E.U., Ndon, B.A., & Etuk. (2000). Minerals and antinutrients in fluted pumpkin (*Telfaria accidentalis* Hook f.). Food Chem; 70: 235-240.

Bamgbose, A.M., Oyewoye, E.O., Apata-Olakulehin, H.O., Mohammed, A.S., & Musa, A.M. Utilization of Roasted full-fat Soyabean in diets for Broiler Chickens. *NSAP proc.,* Abeokuta; 176-177

Bonsi, M.L.K., Osuji, P.O., Tuah, A.K., & Umunna, N.N. (1995). Vernonia amygdalina as a supplement to teff straw (*Eragrostis tef*) fed to Menz sheep. Agrofor.Syst ; 31:229-241.

Dakpogan, H.B. (2006). Free range chick survivability in improved conditions and the effect of 3 medicinal plants on Eimeria tenella. M.Sc. Thesis, Department of Veterinary Pathobiology, The Royal Veterinary and Agricultural University, Denmark.

Ekpo, A., Eseyin, O.A., Ikpeme, A.O., & Edoho, E.J. (2007). Studies on Some Biochemical Effects of *Vernonia Amygdalina* In Rats.Asia Journal of Biochemistry; 2(3): 193-197.

Chiemela P.N., Nwakpu E.P., Oyeagu C.E AND Obi C.L Effect of *Vernonia amygdalina* (Bitter Leaf) Extract on Growth Performance, Carcass Quality and Economics of Production of Broiler Chickens. International Journal of Agriculture and Earth Science Vol. 2 No.1 Pg 58 – 65 ISSN 2489-0081 2016 .

Erasto, P., Grierson, D.S., & Afolayan, A.J. (2007). Evaluation of Antioxidant activity and the fatty acid profile of the leaves of *Vernonia amygdalina* growing in South Africa. Food Chem; 104:636-642.

Gbolade, A.A. (2009). Inventory of antidiabetic plants in selected districts of Lagos State, Nigeria. J. Ethnopharmacol; 121:135-139.

Mohammed, I., & Zakariya, R. (2012). Bitter leave (*VA)* as a feed additive in broiler diets. Journal of animal science, Usman Danfodiyo University, Sokoto, Nigeria.

NRC (1994). Nutrient requirements of poultry 9th revised edition. Nutritional Academic Press. Washington D.C. USA.

Olobatoke, R.Y., & Oloniruha, J.A. (2009). Haematological assessment of bitter leaf (*Vernonia amygdalina)* efficiency in reducing infections in cockerels. Proceedings of the World Congress on Medicinal and Aromatic Plants, November 9-14, 2008, Cape Town, South Africa; 472-473.

Oluyemi, J.A., & Roberts, F.A. (2000). Poultry production in warm wet climate. Macmillian Press Ltd. 2nd Edition, Spectrum Books Ltd. Ibadan, Nigeria.

Owen, O.J. (2011). Proximate Composition, Energy Content and Mineral Profile of *Vernonia Amygdalina* (Bitter Leaf) Meal Advance In Food and Energy Security; 1:36-39.

Owen, O.J., Amakiri, A.O., David, E.U., Nyeche, V.N., & Ndor, L. (2009). Proximate composition, energy content and mineral profile of Vernonia amygdalina (Bitter Leaf) meal. Proceedings 14th Annual Conference Animal Science Association of Nigeria (ASAN), 14th-17th September, Ogbomoso, Oyo State; 173-176.

Owen, O.J., & Amakiri, A.O. (2011). Serological and haematological profile of broiler finishers fed graded levels of bitter leaf (*Vernonia amygdalina*) meal. Adv. Agric. Biotechnology; 1: 77-81.

Singh, V.P. (2010). Poultry farming in Punjab. An economic evaluation competitiveness. Ph.D. dissertation (unpublished), Punjab Agricultural University, Ludhiana, 1:115.

SAS. 2010. SAS/STAT User's Guide: Version 9.2. SAS Institute Inc., Cary. NC., USA; 2010.

Tadesse, A.A., Gebie-Hiwot, K., Asres, M., & Djote, F.D. (1993). The *in vitro* activity of *Vernonia amygdalina* on *Leishmania aethiopica*. Ethiop. Med. J; 31: 183-189.

Tarek, M., Shafey, I.M., & Al-Ruqaei, S.I.A. (2013). Effect of feeding olive leave extract (oleuropein) on the performance, Nutrient utilization, small intestine and carcass characteristics of broiler chickens. Department of Animal production, college of food and Agriculture science, king Saudi university, Riyadh, Saudi Arabia.

Windisch, W., Schedle, K., Plitzer, C., & Kroismayr, A. (2007). Use of phytogenic products as feed additives for swine and poultry. *J. Anim. Sci*; 86:140-148.

AN APPRAISAL OF THE PERFORMANCE OF WEANER AND GROWER PIGS FED FROM DIFFERENT FEEDING TROUGHS: CONCRETE FEEDING TROUGH, SEMI-AUTOMATIC FEEDER AND THEIR COMBINATION

Adesehinwa* A. O. K., Makanjuola B. A., Ajayi E., Ogunyemi D. J.[1], Boladuro B. A., Sorunke A. O. and Abiola J. O.[2]

Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan
[1]Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife
[2]Department of Veterinary Medicine, University of Ibadan, Ibadan. Nigeria.
*Corresponding Author: aokadesehinwa@yahoo.com

Abstract

Performance of weaned and growing pigs fed from concrete feeding trough, semi-automatic feeder and its combination was examined for eight weeks. Sixty weaned cross bred (Large white × Landrace) pigs of average initial weight of 9.04 ±0.31 kg were used for the weaner phase. The animals were distributed into three treatments (T1; concrete feeding trough, T2: concrete feeding trough and semi-automatic feeder and T3; semi-automatic feeder), with four replicates of five pigs per replicate. Ninety growing pigs with average initial weight of 18.19±0.31 kg were allocated to three experimental treatments with five replicates of six pigs per replicate. The experimental design was completely randomized design. Feed and water were supplied unrestrictedly. Weekly feed intake and weight were monitored. Performance and economic variables were evaluated. There was no significant (P>0.05) effect of different feeders on all the performance and economic variables across the treatments for the weaner phase. The total cost of feeding (₦) ranged from 7170.4 to 7687.80. During the growing phase, the average daily weight gain (g) ranged from 428.57 to 448.74. The highest and lowest average daily weight gain was observed in pigs fed from the combined feeders and the semi-automatic feeder respectively. The total cost of feeding (₦) and average cost of feed per day (₦) were significantly (P<0.05) different among the treatments. The pigs that fed from the combined feeders (T2) had highest total cost of feeding (₦) while the total cost of feeding for the pigs that fed from concrete feeding trough (T1) and semi-automatic feeder were comparable.

Keywords: Concrete feeding trough, Semi-automatic feeder, Performance, Weaner and grower pigs,

Introduction

The quest for strategies to address the issue of body weight variability among pigs of the same age has gained attention recently in pig industry. The use of strategies that are commercially relevant, easy to implement and acceptable, such as feeder space and feeding management are among those strategies (López-Vergé *et al.*, 2018). Feeder space and design has been considered to be one of the possible ways to reduce body weight variability experience in pig production. Feeder has been described as a tool used for pigs to correctly access the diets (Gonyou and Lou, 2000) and act as the interface used for pigs to potentially meet their maximum growth. Feed intake is essential for a correct performance. Limiting feed intake due to poor access to feed directly affects growth potential and affects metabolism and health status in pigs (Dong and Pluske, 2007). Therefore, a correct access to feed is fundamental to allow pigs to meet their nutrient requirements (Gonyou and Lou, 2000). Quite a number of feeders for pigs have been identified in the market, and all of them were designed for similar goals; to maximize feed intake and minimizing feed wastage in order to optimize pig performance. The feeder, then, may affect the performance, growth and homogeneity of pigs (López-Vergé *et al.*, 2018). Therefore, the objective of this study was to evaluate effect of different feeders on growth performance and economic analysis of weaned and growing pigs.

Materials and methods

The experiment was conducted at AK Research farms located at Eleyele, Ibadan, Oyo state, Nigeria and it lasted for 56 days. Two studies were run concurrently using weaner and grower pigs. Experimental diets (Table 1) were formulated using the nutrient requirement recommendations of National Research Council (1998) for weaned and growing pigs. Sixty weaned cross bred (Large white × Landrace) pigs of average initial weight of 9.04 ±0.31 kg were used. The animals were distributed into three treatments (T1; concrete feeding trough, T2: concrete feeding trough and semi-automatic feeder and T3; semi-automatic feeder as shown in Figures 1-3), with four replicates of five

pigs per replicate. Ninety growing pigs with average initial weight of of 18.19±0.31 kg were allocated to three experimental treatments (as in the weaner study) with five replicates of six pigs per replicate. The experimental design was completely randomized design. The pigs were kept in Pens (234cm L × 216cm W) which had concrete floors with no litter in groups (same sex) based on body weight. Each pen had a concrete feeder (97cm L × 33cm W) and a concrete drinker (97cm L × 33cm W)**.** Semi-automatic feeder used had a guard that prevents feed wastage by the animals and provided a total of 56.0cm. × 25.0cm. (length × width) of trough space per feeder. All pigs in weaner and grower phases were fed a common weaner and grower diets respectively. Pigs were allowed *ad libitum* access to the diets and water served in concrete watering trough. Data were collected on daily feed intake and body weight gain. Daily weight gain, feed conversion ratio and indices for economic analysis were evaluated. All the data were subjected to analysis of variance using General Linear Model of SAS (2002) and the means were separated using Duncan Multiple Range test.

Results and Discussion

The growth performance and economic analysis of both weaner and growing pigs fed from different feeding troughs are presented in Table 2. There was no significant (P>0.05) effect of different feeders on final weight, daily weight gain, average daily feed intake and feed conversion ratios across the treatments for the weaner phase. The final weight (kg) ranged from 27.32 to 29.35 with the pigs that fed from concrete feeding trough (T1) and the combined troughs (T2) having the lowest and highest respectively. The pigs fed from both feeders had improved daily weight gain (369.71 g) and best feed conversion ratio (2.99). The highest feed intake (1021.14 g) was also observed in pigs fed from the combined feeders (T2). The economic analysis showed no significant (P>0.05) difference among the variables measured. The total cost of feeding (₦) ranged from 7170.4 to 7687.80. The pigs that fed from the combined feeders (T2) had the highest total cost of feeding while the lowest was observed in pigs that fed from concrete feeding trough (T1). The feed cost/Kg live weight gain (₦/Kg) ranged from 401.99 to 444.14. The best feed cost/Kg live weight gain (401.99 ₦/Kg) was observed in pigs fed from combined feeders while the worst feed cost/Kg live weight gain (444.14 ₦/Kg) was observed in pigs fed from semi-automatic feeder. During the growing phase, no significant (P>0.05) difference was observed in all the performance parameters except average daily feed intake that was significantly (P<0.05) different across the treatments. The average daily weight (g) ranged from 428.57 to 448.74. The highest and lowest average daily weight gain was observed in pigs fed from the combined feeders and the semi-automatic feeder respectively. The average daily feed intake (1579.03 g) of pigs fed from concrete feeding trough (T1) and that (1558.61 g) of those fed from semi-automatic feeder (T3) were similar. However, the feed intake (1666.56 g) of the pigs fed from combined feeders (T2) was significantly (P<0.05) higher. The total cost of feeding (₦) and average cost of feed per day (₦) were significantly (P<0.05) different among the treatments. The pigs that fed from the combined feeders (T2) had highest total cost of feeding (165.95) while the total cost of feeding for the pigs that fed from concrete feeding trough (T1) and semi-automatic feeder were comparable. No significant (P>0.05) difference exists in feed cost/Kg live weight gain (₦/Kg) across the treatments. The values ranged from 380.89 to 407.34 with the pigs fed from concrete feeding trough and the combined feeders having the highest and the lowest value respectively. The results showed a better performance in terms of final body weight and daily weight gain for pigs allocated to both semi-automatic feeder and concrete feeding trough during the weaner and grower phases. This is in agreement with the earlier results of He *et al*. (2016), the authors suggested that more feeder spaces to pigs could lead to a better feeding motivation with a consequent increase in growth. The improved growth performance observed in pigs fed with combined feeders (T2) reinforced the claims by several authors that feeders affect performance of pigs. This probably explained by a higher feed intake and minimal feed wastage. This also corroborates the earlier findings of Bergstrom *et al*. (2009) who reported improved growth performance in pigs fed with wet-dry feeders compared with pigs fed with conventional dry feeders. However, Bergstrom *et al*. (2009) reported no difference in feed intake, which is in line with the findings of this study. Lack of significant difference in many of the parameters also supports the earlier findings of Brumm and Gonyou (2001) who reported no significant difference in growth performance but improved performance in pigs fed with wet-dry feeders when compared with conventional dry feeders.

Conclusions

It could be concluded from the studies that the combination of concrete feeding trough and semi-automatic feeders improved the average daily weight gain and average daily feed intake of weaner and grower pigs compared with the individual use of the feeders. However, the total cost of feeding of the pigs fed from the combination of the feeders increased for the grower pigs compared to the use of either the concrete feeding trough or the semi-automatic feeder.

References

Bergstrom J. R., Tokach M. D., Dritz S. S., Nelssen J. L., DeRouchey J. M. and Goodband R. D. (2009). The effects of feeder design on growth performance and carcass characteristics of finishing pigs. *Journal of Animal Science* 87 (Supplement 2): 183 (Abstract.)

Bergstrom, J. R. Nelssen, J. L., Edwards, L. N, Tokach, M. D., Dritz, S. S. Goodband, R. D. and DeRouchey J. M. (2015**).** Effects of feeder design and changing source of water to a location separate from the wet-dry feeder at 4 or 8 weeks before harvest on growth, feeding behavior, and carcass characteristics of finishing pigs, *American Journal of Animal Science* 90:4567–4575

Brumm M. C. and Gonyou H. W. (2001). Effects of facility design on behavior and feed and water intake. In Swine Nutrition 2nd edition. pp 499-518.

Dong G. Z. and Pluske J. R. (2007). The low feed intake in newly-weaned pigs: problems and possible solutions. *Asian Journal of Animal Science* 20:440-452.

Gonyou H. W. and Lou Z. (2000). Effects of eating space and availability in feeders on productivity and eating behavior of grower/finisher pigs. *Journal of Animal Science* 78 (4): 865–870

He Y., Cui S., Deen J., Shurson G. C. and Li Y. (2016). Effects of feeder space allowance on behavior of slow-growing pigs during the nursery period. *Journal of Animal Science* 94(Supplement 2):4

López-Vergé, S., Gasa J., Temple D., Bonet J., Coma J. and Solà-Oriol D. (2018). Strategies to improve the growth and homogeneity of growing-finishing pigs: feeder space and feeding management *Porcine Health Management* 4:14

National Research Council (1998). Nutrient requirements of swine. 10th revised edition. National Academy Press, Washington, DC.

SAS (2002). Statistical Analysis software, Version 9.0. SAS Institute Incorporation, Cary, NC, USA.

Table 1. Ingredient Composition of the Experimental Diets

Ingredients (%)	**Weaner phase**	**Grower phase**
Maize	45	28.7
Ground nut cake	24	25
Palm Kernel cake	7.34	20
Rice bran	-	10
Wheat offal	10	-
High quality cassava peel	5	10
Fish meal	3	-
Bone meal	1.6	1.4
Limestone	0.8	0.7
Palm oil	2	3
Lysine	0.48	0.45
Methionine	0.03	-
Premix	0.25	0.25
Salt	0.5	0.5
Total	**100**	**100**
Calculated values		
Crude protein	20.83	19.72
Metabolizable energy (Kcal/kg)	2939.21	2921.84
Crude fibre	4.27	6.28

Table 2: Growth Performance and Economic Analysis of Pigs Fed from Different Feeders

Parameters	T1	T2	T3	Pvalue	SEM
Weaner's phase					
Initial weight (kg)	8.73	8.64	9.75	0.17	0.31
Final weight (kg)	27.32	29.35	28.06	0.72	1.03
Daily weight gain (g)	331.94	369.71	326.87	0.54	15.15
Average daily feed intake (g)	952.41	1021.14	988.51	0.61	27.86
Feed conversion ratio	3.06	2.99	3.30	0.60	0.13
Grower' phase					
Initial weight (kg)	18.40	18.03	18.08	0.86	0.31
Final weight (kg)	42.93	43.16	42.08	0.86	0.81
Average daily weight gain (g)	438.08	448.74	428.57	0.82	12.19
Average daily feed intake (g)	1579.03[b]	1666.56[a]	1558.61[b]	0.01	14.04
Feed conversion ratio	3.83	4.09	4.03	0.67	0.13
Economic analysis					
Weaner's phase					
Total cost of feeding (₦)	7170.4	7687.80	7442.2	0.61	209.79
Average cost of feed per day (₦)	128.04	137.28	132.90	0.61	3.75
Feed Cost/kg Weight Gain (₦/Kg)	411.05	401.99	444.14	0.60	17.71
Grower' phase					
Total cost of feeding (₦)	8805.40[b]	9293.40[a]	8691.50[b]	0.01	78.31
Average cost of feed per day (₦)	157.24[b]	165.95[a]	155.21[b]	0.01	1.40
Feed Cost/kg live weight gain (₦/Kg)	380.89	407.34	401.71	0.68	13.17

[ab] Means within the same row with different superscripts are significantly different ($p<0.05$), SEM: standard error of mean



Fig. 1: Concrete Feeding trough



Fig. 2: Combination of feeding troughs



Fig. 3. Semi-Automatic Feeder

EFFECTS OF RESTRICTED FEEDING AT THE CHICK AND GROWING PHASES ON LAYING PERFORMANCE AND EGG QUALITY PARAMETERS OF ISA BROWN CHICKENS

Adewole F. A[1], L.T. Egbeyale[2] O. A. Adeyemi[2], O. M. Sogunle[2] and D. Eruvbetine[3]

[1]*Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta*

[2]*Department of Animal Production and Health, Federal University of Agriculture, Abeokuta*

[3]*Department of Animal Nutrition, Federal University of Agriculture, Abeokuta*

*adewolefaith@yahoo.com *Phone no: +2348027170579*

Abstracts

Two hundred and seventy (270) pullet chicks were reared in a group for one week. At day 8, the chicks were randomly allotted into 3 treatments such that each treatment had three replicates of 30 chicks each. The chicks in experimental group R_0 were fed ad-libitum, R_1 were fed six days weekly while R_2 received full feeding for five days weekly. After the first 8 weeks, the three groups of birds used in the first experiment were each sub divided into three groups of ad libitum (r_0), one-day feed restriction (r_1) and two days feed restriction (r_2), resulting finally in nine experimental groups. Laying performance, internal and external qualities of eggs were determined. There were no significant difference ($p>0.05$) in the weights of first egg, egg weight and shell thickness across the treatments. However, R_0r_0 birds has the highest ($p<0.05$) value for henday (68.33%) and percentage yolk weight (23.56%) while R_2r_1 and R_2r_0 birds had the least ($p<0.05$) values; 53.41% and 21.26%, recorded for above parameters respectively. The albumen percentage is however significantly ($p<0.05$) higher in R_2r_0 birds than R_0r_0 birds. It could be concluded that starter-restricted Isa Brown layers (R_2) had poor laying performance and egg quality with the exception of the albumen percentage. Mild starter-restriction (R_1) is recommended as it gave effects similar to ad libitum feeding.

Keywords: feed restriction, laying performance, egg quality

Introduction

Poultry products has been recognized as the cheapest source of animal protein in the developing countries (Ajayi, 2010). Egg production is of great economic importance and the success of this enterprise hinges on the total number of eggs produced from management inputs (Ojepapo *et al*., 2009). The qualities of egg which include egg weight, shell thickness, and shell index are very important due to their economic importance in the egg production industry (Savegnago *et al*., 2011; Blanco *et al.*, 2014). The high cost of feed inputs in poultry farming means that feed management is the key profit index in poultry production (Achi *et al.*, 2007). Feed, according to Sanni and Ogundipe (2003) constitutes a major cost input in egg production enterprise. Any savings in feed consumption will increase the profit margin. Feed restriction is one major way of ensuring efficient utilization of feed and feed cost reduction.

Different methods of feed restriction programmes are applied in practice. These include: reduced nutrient intake by means of diet dilution (Camacho-Fernandez *et al.*, 2002), appetite suppressant (Oyawoye and Krueger, 1990), limiting the time of feed access as in skip-a-day feeding (Khajali *et al*., 2007), meal feeding (Susbilla *et al.*, 2003) and limiting the quantity of feed offered to the birds daily (Ocak and Sivri, 2008). This research is designed to determine the effect of restricted feeding at the chick and growing phases on laying performance and egg quality parameters of Isa Brown chickens.

Material and methods

The research was carried out in the Poultry Unit, Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State. Two hundred and seventy (270) pullet chicks were purchased from a reputable hatchery. At day 8, the chicks were randomly allotted into 3 treatment groups such that each treatment had 3 replicates of 30 chicks each in dimensions of 2.5m x 3m. The chicks in experimental group R_0 were fed *ad-libitum* at chick phase and served as control. Groups R_1 and R_2 were restricted one-day and two-day per week respectively. After the first 8 weeks, the three groups of birds used in the first experiment were each sub divided into three groups of *ad libitum* (r_0), one-day,(r_1) and two days (r_2) weekly feed restriction, resulting finally in nine experimental groups. The birds were fed with chicks mash, grower mash and layers mash at chick, growing and laying phases respectively. At 20 weeks, the number of pullets per replicate was

reallocated in the battery cage to have equal number of eight birds per replicate. The production of egg and egg weights of all egg were measured daily and calculated periodically (every 30 days) from 20 to 68weeks of age. Haugh unit scores were calculated by the procedure of Haugh (1937) in the formula; $HU = 100\log(H + 7.5W^{0.37})$, Where H = Albumen height in mm; W = Egg weight in grams. Hen day egg production was the average of daily egg production of the 3 replicates (8 birds per replicate). Percentage albumen weight and Yolk weight were calculated as the percentage of the albumen weight and yolk weight to the egg weight respectively. Shell thickness: The thickness of individual air-dried shells was measured to the nearest 0.01mm using micrometer screw gauge. Albumen height: The eggs were gently broken and the maximum albumen height was measured with tripod micrometer. Egg shape Index (ESI) calculated using the formula ESI = $\text{Width of egg (mm)}/\text{Length of egg (mm)}$

Statistical Analysis

Data collected were subjected to analyses of variance for a Completely Randomised Design in 3x3 factorial arrangements of treatments. Duncan Multiple Range test was utilized to separate significant means (SAS Version, 2012).

Result

The effects of main restriction and sub-restriction on the laying performance and egg quality parameters are shown in Table 2. In the main restriction, there was significant difference ($p<0.05$) in the body weight at lay (BWL). Birds maintained on R_1 have the highest value (1419.75 g) of BWL which was not significantly different ($p>0.05$) from R_0 birds but significantly different ($p<0.05$) from birds in R_2. In the main restriction, R_0 birds have the highest values of henday and yolk weight percentage while R_2 birds have the least values of henday, albumin height, yolk weight, and Haugh unit. The interaction of main feed restriction and sub-restriction is presented in Table 3. The result showed that the age at first lay of birds maintained on R_0r_0 was earlier than other treatments, while birds in R_0r_2 has the highest (140 days) age at first lay. The birds maintained R_0r_1 has the highest body weight (1483.89g) at first lay while the least (1240.19g) was recorded in R_2r_0 birds. There was no significant ($p>0.05$) difference in the weight of first egg across the treatments. However, R_0r_1 birds has the highest egg weight value (43.67g) while R_1r_2 has the least value (38.77g). Layers on R_0r_0 has the highest value (68.33%) of hen day which was not significantly different ($p>0.05$) from other treatments except R_2r_1 birds with the least value (53.41). The highest values of egg length were recorded in R_1r_0 birds. R_2r_0 birds had the significantly ($p<0.05$) highest values of albumen percentage.

Discussion

The average age at first lay of Isa brown in this study ranges between 127.33 days and 140days. The birds on *ad libitum* feeding both at chick and growing phases (R_0r_0) came to lay earlier than all other groups. All restriction groups were delayed at least by 3 days or more when compared to the *ad-libitum* group. The range of age at first lay in this study is earlier than the observed age at lay by Roll *et al.*, (2008) who reported an onset of lay for Isa brown hens at 21 weeks. Lala *et al*., (2016) reported an age at first lay of 153 days (21.86 weeks) for same strain of birds. The difference might be due to methods of rearing which is an important factor in poultry production (Ojedapo, 2013). The body weight at sexual maturity was significantly higher in *ad-libitum* and one day restriction groups (with the exception R_0r_0 group) than the two days restriction groups. Sandoral and Gernat (1996) found 3-5 days delay in sexual maturity age and partially an increase in body weight due to fee restriction.

Restricted feeding effects were significantly found on the henday, albumen percentage, albumen height, yolk percentage and Haugh unit. The *ad libitum* (R_0) and mildly restricted (R_1) performed better in all parameters mentioned above than the severely restricted birds (R_2), with the exception of albumen percentage. This result may be due to severity and length of feed restriction programme for birds (Mahmood *et al.*, 2007). The performance of the bird group on more severe restriction (R_2) programme performed low compared with birds on *ad libitum* feeding and one day restriction programme. The lower values of egg length were recorded in R_0r_0 and R_1r_2 birds. The remaining groups recorded higher and similar values.

In conclusion, age at first lay may be delay and body weight at sexual maturity reduced due to severe starter restricted feeding. However, henday and most egg qualities parameters are negatively affected due to severe feed restriction.

Table 2: Main effects of main restriction and sub-restriction on Egg production records and egg quality traits of Isa Brown layers

	Main restriction				Sub-restriction			
	R_0	R_1	R_2	SEM	r_0	r_1	r_2	SEM
Age first lay (days)	135.67	133.78	133.11	1.15	131.33	136.78	134.44	1.15
Body weight at 1st lay (g)	1398.94 [a]	1419.75 [a]	1285.23 [b]	20.68	1318.5	1398.63	1386.79	20.68
Weight of 1st egg (g)	42.54	41.05	41.74	0.66	42.12	43.03	40.18	0.66
Henday (%)	63.56 [a]	60.86 [ab]	55.07 [b]	1.44	60.52	60.99	57.97	1.44
Egg Weight(g)	64.44	64.36	64.99	0.39	64.72	64.71	64.36	0.39
Egg length (mm)	57.8	57.68	58.2	0.19	57.98	58.01	57.7	0.19
Egg width (mm)	35.37	34.82	35.12	1.56	35.03	35.38	34.9	1.56
Shell (%)	10.09	10.1	9.96	0.06	10	10.11	10.03	0.06
Shell thickness(mm)	0.51	0.5	0.51	0.00	0.5	0.51	0.51	0.00
Egg shape Index	0.61	0.61	0.6	0.03	0.6	0.61	0.6	0.03
Yolk Weight %	23.15 [a]	22.18 [b]	21.64 [b]	0.20	22.21	22.42	22.34	0.20
Albumin %	66.76 [b]	67.72 [ab]	68.4 [a]	0.21	67.79	67.47	67.63	0.21
Albumen height (mm)	9.3 [ab]	9.54 [a]	9.08 [b]	0.08	9.21	9.34	9.37	0.08
Haugh Unit	95.62 [ab]	96.77 [a]	94.28 [b]	0.41	95.1	95.66	95.9	0.41

Table 3: **Interaction of main restriction and sub-restriction on egg production records and egg quality traits of layers**

Main restriction	R_0			R_1			R_2			
Sub-restriction	r_0	r_1	r_2	r_0	r_1	r_2	r_0	r_1	r_2	SEM
Age at first lay (days)	127.33 ^{b}	139.67 ^{a}	140 ^{a}	134.67 ^{ab}	134 ^{ab}	132.67 ^{ab}	132 ^{ab}	136.67 ^{ab}	130.67 ^{ab}	1.15
Body weight at 1st lay (g)	1273.75 ^{b}	1483.89 ^{a}	1439.17 ^{a}	1441.56 ^{a}	1430.51 ^{a}	1387.19 ^{ab}	1240.19 ^{b}	1281.48 ^{b}	1334.02 ^{ab}	20.68
Weight of 1st egg (g)	41.46	43.67	42.5	42.13	42.23	38.77	42.75	43.2	39.26	0.66
Henday (%)	68.33 ^{a}	65.94 ^{ab}	56.4 ^{ab}	57.97 ^{ab}	63.63 ^{ab}	60.97 ^{ab}	55.26 ^{ab}	53.41 ^{b}	56.54 ^{ab}	1.44
Egg Weight(g)	0.61	0.61	0.61	0.6	0.62	0.6	0.6	0.6	0.61	0.03
Egg length (mm)	63.01	65.2	65.11	65.71	64.64	62.72	65.45	64.28	65.26	0.39
Egg width (mm)	56.84 ^{b}	58.22 ^{ab}	58.35 ^{ab}	58.77 ^{a}	57.49 ^{ab}	56.79 ^{b}	58.32 ^{ab}	58.31 ^{ab}	57.97 ^{ab}	0.19
Shell %	34.89	35.65	35.57	35.1	35.44	33.92	35.09	35.04	35.22	1.56
Shell thickness(mm)	6.44	6.48	6.55	6.47	6.61	6.37	6.47	6.51	6.42	0.04
Egg shape Index	10.22	9.96	10.08	9.89	10.23	10.18	9.89	10.15	9.85	0.06
Yolk Weight %	0.5	0.51	0.5	0.5	0.5	0.51	0.51	0.52	0.5	0.00
Albumin %	23.56 ^{a}	22.73 ^{abc}	23.15 ^{ab}	21.82 ^{abc}	22.4 ^{abc}	22.32 ^{abc}	21.26 ^{c}	22.13 ^{abc}	21.53 ^{bc}	0.20
Albumen height (mm)	66.22 ^{c}	67.31 ^{abc}	66.77 ^{bc}	68.29 ^{ab}	67.37 ^{abc}	67.5 ^{abc}	68.85 ^{a}	67.73 ^{abc}	68.62 ^{ab}	0.21
Body weight at 1st lay (g)	8.87	9.55	9.47	9.66	9.56	9.41	9.09	8.91	9.23	0.08
Haugh Unit	93.89	96.66	96.3	97.11	96.78	96.43	94.3	93.55	94.99	0.41

References

Achi, M., A. Adelanwa and A. B. Ahmed (2007). Performance of broiler chickens fed on lima bean, groundnut and soyabean diets. Science World Journal 2 (2): 13-16.

Ajayi, F. O. (2010). Nigerian indigenous chicken: A valuable genetic resources for meat and egg production. Asian Journal of Poultry Science. 4: 164-172.

Blanco AE, Icken W, Ould-Ali D, Cavero D, Schmutz M. 2014. Genetic parameters of egg quality traits on different pedigree layers with special focus on dynamic stiffness. Poultry Science 2014;93(10):2457–2463.

Camacho-Fernandez, D., Lopez,C., Avila, E. and Arce, J. 2002. Evaluation of different dietary treatments to reduce a scites syndrome and their effects on corporal characteristics in broiler chickens. *J. Applied Poult.* Res.11:164-174.

Haugh, R.R. 1937. The Haugh unit for measuring egg quality. US. Poult. Mag., 43: 552-555. Gous, R.M., Bradford, G.D., Johnston, S.A. and Morris, T.R. 2000. Effect of age of release from light or food restriction on age at sexual maturity and egg production of laying pullets. *Brit. Poult. Sci.*, 41: 263-271

Khajali, F., Zamani-Moghaddam, A. and Asadi-Khoshoei, E. 2007. Application of an early skip-a-day feed restrictionon physiological parameters, carcass traits and development of ascites in male broilers reared under regular or cold temperatures at high altitude. *Anim. Sci. J.*, 78:159-163

Lala, A.O., N. Okwelum, K. O. Bello, N. A. Famakinde, M. O. Alamu. 2016. Comparative study between Isa brown and Fulani Ecotype Chickens supplemented with Humic acid. Slovak J. Anim. Sci., 49, 2016 (2): 68–75.

Mahmood, S., Mehmood, S., Ahmad, F., Masood, A. and Kausar, R. 2007. Effects of feed restriction during starter phase on subsequent growth performance, dressing percentage, relative organ weights and immune response of broilers. Pakistan *J. Vet., 27(3): 137-141.*

Ocak, N. and Sivri, F. 2008. Liver coloration as well as performance and digestive tract characteristics of broilers may change as influenced by stage and schedule of feed restriction. *J. Anim. Physio. Anim. Nutr.* 92: 546-553.

Ojedapo, L. O. (2013). Effect of two housing systems (cages vs deep litter) on external and internal egg characteristics of a commercial laying birds reared in derived savanna zone of Nigeria. Transitional Journal of Science and Technology 3 (7): 25-34.

Ojepapo, L.O., Adedeji, T.A., Ameen, S.A., Olayeni, T.B., Amao, S.R., Ige, A.O., Rafiu, T.A., Ojediran, T.A. and Akinniran, T.N. 2009. Effect of strain and age on egg quality characteristics of two different strains of layer chicken kept in cages in Derived savannah zone of Nigeria. Proc. Of the 14th Annual Conf. of the Anim. Sci. Association of Nig. 14th-17th September., 2009, LAUTECH, Ogbomoso, Oyo State, Nig. Pp. 41-43.

Oyawoye, E.O. and Krueger, W.F. 1990. Potential of chemical regulation of food intake and body weight of broiler breeder chicks. *Br. Poultry Sci.*, 31: 735-742.

Roll, V.F.B., G.A.M. Levrino, R.C. Briz, and T. Buil (2008). Ethological parameters and performance of Hy Line W-98 and ISA Brown hens when housed in furnished cages. Arq. Bras. Med. Vet. Zootec., v.60, n.3, p.749-754, 2008

Sandoral, D. M. and Gernat, A. G. 1996. Evaluation of early feed restriction on egg size and hen performance. *Poult. Sci.,* 75: 311-314.

Sanni, S. A. and Ogundipe, S. O. 2003. Economics of four modules of poultry production in Northern Nigeria. Proceedings of 28th Annual Conference of Nigerian Society for Animal Production. 28: 436-439.

SAS Institute, Inc. 1999. JMP statistics and graphics Guide. SAS Institute, Inc., Cary, NC.

Savegnaga, R.P., Caetano S. L., Ramos, S. B., Nascimento, G. B., Schmidt, G. S. and Ledur, M. C. 2011. Estimates of genetic parameters, and cluster and principal components analyses of breeding values related to egg production traits in a White Leghorn population. Poultry Science 2011;90(10):2174–2188.

Susbilla, J. P., Tarvid, I., Gow, C. B. and Frankel, T. L. 2003.Quantitative feed restriction or meal-feeding of broiler chickens alters functional development of enzymes for protein digestion. *Br. Poultry Sc*, 44: 698-709.

COST BENEFIT ANALYSIS OF PREGNANT RABBIT DOES SUBJECTED TO DIFFERENT LEVELS AND PERIODS OF CONCENTRATE FEED RESTRICTION

Adeyemo A. A.,[1*] Adeyemi O. A.,[1] Sogunle, O. M.,[1] and Bamgbose, A. M [2]
[1]*Department of Animal Production and Health, Federal University of Agriculture, Abeokuta*
[2]*Department of Animal Nutrition, Federal University of Agriculture, Abeokuta*

** Corresponding author: arkeens25@gmail.com.*

Abstract
There has been increased interest in studying feed restriction in rabbits as a means of reducing the cost of production. This study evaluated the cost benefit of restrictive feeding on pregnant rabbit does reared in south-western Nigeria. A total of forty three (43) rabbits consisting of thirty six (36) 20 weeks old doe rabbits of mixed breeds with initial live weight of 1.7-2.0 kg and seven (7) mature bucks with live weight of 2.0-2.5 kg were used for the study. The does were divided into three groups of twelve rabbits each after balancing for weight. The does were placed on three levels of quantitative feed restriction (0, 15, 30 %) at three periods of gestation (15-19 days, 20-24 days and 25-29 days). Data collected were arranged in a 3 × 3 factorial layout. The interactive effect showed that there was no significant difference (p>0.05) in the cost of feed across the dietary treatments. Highest (p>0.05) feed cost was obtained for rabbit does on 30% restriction at 25-29days of gestation. However, 15% restriction at 25-29 days of gestation resulted into increased (p>0.05) average litter size at birth which competed favourably with the ad libitum groups. Therefore it can be concluded from the result obtained that feed restriction of pregnant does at 15% restriction at 25-29days is cost effective, as this period resulted in increase in average litter size at birth compared to others.

Keywords: Maternal restriction, restriction periods and Cost benefit

Introduction

Feed restriction could be exploited in the feeding regimen of rabbits, especially in periods of inadequate supply of concentrates and forages (Yakubu *et al.,* 2007). The cost of feeding rabbits is however very high, a condition that also prevails for other Nigerian livestock species (Adeyemi *et al*., 2008). Young rabbit does fed *ad libitum* diets often show parturition problems, (dystocia and abnormal presentation) with subsequent reduction of the number of kits per kindling, linked to excessive fat accumulation (Fortun-Lamothe and Lebas, 1996). In order to reduce the excessive fat in young does, restricted feeding during pregnancy is frequently applied to obtain uniformity in their body weights and to avoid high mortalities during kindling (Rommers *et al.,* 2001) and to allow a long productive life of these does (Partridge *et al.,* 1986).Therefore, feed restriction could be a useful tool to improve economic performance of rabbit does (Tůmová *et al.,* 2006b), which in turn consequently reduces the costs of production (Yakubu *et al.,* 2007). Several studies demonstrated that, after a restricted feeding, the appetite of rabbits improves and a sharp increase of voluntary feed intake occurs (Rommers *et al*., 1999). Moreover, rabbit can be used as an experimental model to elucidate the effects of anorexia during pregnancy on embryo-foetal development (Matsuoka *et al.,* 2006). Several studies have been done on cost of restrictive feeding in growing rabbits. However, details of the cost of restricted feeding on pregnant does are still obscure; hence, this study aims to examine the cost benefit analysis of restricted on pregnant rabbit does in south-western Nigeria.

Experimental Site

The experiment was carried out at the Rabbitary Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State. The site is located in the rain forest vegetation zone of South-Western Nigeria on latitude 7° 13' 49.46'' N, longitude 3° 26 11.98E and altitude 76m above the sea level (Google Earth, 2018).

Experimental Animals and Management

A total of forty three (43) rabbits consisting of thirty six (36) 20 weeks old doe rabbits of mixed breeds with initial live weight of 1.7-2.0 kg and seven (7) mature bucks with live weight of 2.0-2.5 kg were used for the study. The does were divided into three groups of twelve rabbits each after balancing for weight.

Experimental Design

Treatments consist of three (3) levels of concentrate feed restriction fed at three (3) different periods during the latter half of the pregnancy period after ascertaining pregnancy by palpation. Percentage composition of concentrate diet consist of Maize 47.50; Fish meal 2.00; Soyabean meal 3.00; Wheat offal 23.00; Groundnut cake 12.00; Rice husk 7.00; Bone meal 3.00; Oyster shell 2.00; Salt 0.25; Vitamin and Mineral premix 0.25. The feeding regimen included: 0% Restriction (control) was fed (100 g/rabbit/day), 15% Restriction was fed (85 g/rabbit/day), 30% Restriction was fed (70 g/rabbit/day). Experimental animals were offered forage (100grams of wilted *Tridax procumbens*) once in a week across the dietary treatment.

Statistical Analysis

Data obtained were arranged in a 3×3 factorial experimental layout using (SAS, 1999). Significantly ($p<0.05$) different means were separated using Duncan's Multiple Range Test of the same statistical package.

Results and Discussion

The main effect of level of feed restriction and period of feed restriction on cost benefit of raising gestating does is shown on Table 1. There were no significant ($p>0.05$) difference in the cost of feed/kg and total cost of feed consumed. Gestating does on 30% level of feed restriction recorded the highest cost (₦204.07) for feed consumed numerically, while gestating does on 0% level of feed restriction recorded the lowest cost (₦199.91) for feed consumed numerically. The highest feed cost recorded for rabbit does on 30% restriction can be attributed to highest feed intake compared to others during the period of realimentation. The results corroborates with the findings of Rommers *et al* (1999) who reported increase in voluntary intake of rabbits at the end of feed restriction.

The periods of feed restriction had no significant ($p>0.05$) effect on the total cost of feed consumed and cost of feed per weight gain. Gestating does between 25-29 days period of feed restriction had the highest (₦205.06) cost. Higher cost obtained for does on 25-29days of gestation could be attributed to longer periods of days before the restriction started while, gestating does between 20-24 days period of feed restriction had the lowest (₦196.89) cost.

Table 2 shows the interactive effect between level and periods of feed restriction on cost benefit of raising gestating does. There was no significant ($p>0.05$) difference on the total cost of feed consumed per gestating doe. Gestating does on 30% level of feed restriction between 25-29 days had the highest cost (₦218.98) while gestating does on 30% level of feed restriction between 20-24 days recorded the lowest cost of feed consumed (₦195.44). Highest cost obtained for does on 30% restriction corroborates with the findings of Rommers *et al*. (1999) who reported that after a restricted feeding, the appetite of rabbits improves and a sharp increase in voluntary feed intake occurs. Moreover, leptin a key hormone involved in the regulation of body weight either suppressing appetite or increasing metabolic rate can also be attributed to the increase in feed intake which will in turn increase feed cost (Friedman and Halaas, 1998).

Conclusion: Based on the results of this study it can be concluded that 15% level of feed restriction of pregnant does at 25-29 days of gestation is cost effective because it was at this level better cost of feed to weight was achieved likewise higher average litter size was obtained for the does compared to the control groups.

REFERENCES

Adeyemi, O. A., Sobayo, R. A., Aluko, F. A. and Oke, D. B. 2008. Utilization of rumen filtrate fermented corn-cobs by weaner rabbits. *Nigerian Journal of Animal Production*. 35(1): 69 – 75.

Fortun-Lamothe, L. and Lebas, F., 1996. Effects of dietary energy level and source on foetal development and energy balance in concurrently pregnant and lactating primiparous rabbit does. *Journal of Animal Science*, 62(3): 615–620.

Google Earth. 2018. http//www.google.earth.

Matsuoka, T, Mizoguchi Y. Serizawa K., Ishikura T., Mizuguchi H. and Asano Y., 2006. Effects of stage and degree of restricted feeding on pregnancy out come in rabbits. *Journal Toxicology Science, 31(2), 166-175.*

Partridge, G.G., Daniels Y. and Fordyce, R.A., 1986. The effects of energy intake during pregnancy in doe rabbits on pup birth weight, milk output and maternal body composition change in the ensuring lactation. *Journal of Agricultural Science*, volume.107, pp. 697–708.

Rommers, J. M., Kemp, B., Meijerhof, R. and Noordhuizen, J. P. T. M., 2001a. The effect of litter size before weaning on subsequent body development, feed intake, and reproductive performance of young rabbit does. *Journal of Animal Science 79:1973-1982.*

Rommers, J. M., Meijerhof R., Noordhuizen, J. P. T. M. and Kemp, B., 2001b. Effect of different feeding levels during rearing and age at first insemination on body development, body composition, and puberty characteristics of rabbit does. *World Rabbit Science. 9 (3):101-108.*

Rommers, J.M., Kemp, B., Meijerhof, R., Noordhuizen, J.P.T.M., 1999. Rearing management of rabbit does. A review *World Rabbit Science, 7, 125–138.*

SAS Institute Inc. 2000. SAS/E-miner 3.0 program. SAS Institute Inc., Cary, North Carolina.

Tůmova, E., Zita L., Skřivanova V., Fučikova A., Skřivan M., Burešova M., (2006 a): Digestibility of nutrients, organ development and blood picture in restricted and *ad libitum* fed broiler rabbits. *Arch. Geflűgelkde, 70.*

Tümová, E., Zita, L. and Stolc, L., 2006b. Carcass quality in restricted and *ad libitum* fed rabbits. *Czech Journal of Animal Science*, v.51, p.214-219.

Yakubu, A., Salako, A.E., Ladokun, A.O., Adua, M.M. and Bature, T.U.K., 2007. Effects of feed restriction on performance, carcass yield, relative organ weights and some linear body measurements of weaner rabbits. *Pakistan Journal of Nutrition* 6(4): 391–396

Table 1: Main effect of level and period of feed restriction during breeding on cost benefit of raising gestating does

	Level of feed restriction				Period of feed restriction			
Parameters	0%	15%	30%	SEM	15-19 days	20-24 days	25-29 days	SEM
Total feed intake (g)	2379.96	2395.96	2429.42	45.24	2420.16	2343.94	2441.25	46.50
Cost of feed/kg (₦)	84	84	84	_	84	84	84	_
Total cost of feed consumed (₦)	199.91	201.26	204.07	3.88	203.29	196.89	205.06	7.04
Weight gain (g)	397.67^{c}	530.00^{a}	410.00^{b}	23.06	447.50	455.00	435.16	42.31
Cost of feed/weight gain (₦)	0.50^{a}	0.37^{b}	0.49^{a}	0.02	0.45	0.43	0.47	0.06
Gestation Length (Days)	29.00^{c}	30.00^{b}	31.08^{a}	0.48	29.66	29.66	30.75	0.28
Average litter size at birth/doe	5.50	5.16	4.83	0.37	5.00	5.33	5.25	0.40

$^{a, b, c}$:Means in the same row with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

Table 2: Interaction between level and period of feed restriction during breeding on cost benefit of raising gestating does

Level of feed restriction		0%			15%			30%		SEM
Period of feed restriction	15-19 days	20-24 days	25-29 days	15-19 days	20-24 days	25-29 days	15-19 days	20-24 days	25-29 days	
Parameters										
Total feed intake (g)	2442.63^{ab}	2347.38^{b}	2349.88^{b}	2463.22^{ab}	2357.72^{b}	2366.96^{ab}	2354.64^{b}	2326.72^{b}	2606.91^{a}	53.40
Cost of feed/kg (₦)	84	84	84	84	84	84	84	84	84	_
Total cost of feed consumed (₦)/rabbit	205.18	197.71	197.38	206.91	198.04	198.82	197.78	195.44	218.98	7.89
Weight gain(g)	395.00^{ab}	400.00^{ab}	398.00^{ab}	545.00^{a}	555.00^{a}	490.00^{a}	402.50^{ab}	410.00^{ab}	417.50^{ab}	55.21
Cost of feed/weight (₦)	0.51^{a}	0.49^{a}	0.49^{a}	0.37^{c}	0.35^{c}	0.40^{b}	0.49^{a}	0.47^{a}	0.52^{a}	0.09
Gestation Length(days)	29.00^{c}	29.00^{c}	29.00^{c}	30.00^{b}	30.00^{b}	30.00^{b}	30.00^{b}	30.00^{b}	33.25^{a}	1.61
Average litter size at birth	5.50	5.50	5.50	4.75	5.25	5.50	4.50	5.25	4.75	0.77

$^{a, b, c}$:Means in the same row with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

EFFECT OF DIETARY INCLUSION OF PROCESSED WILD SUNFLOWER (*Tithonia diversifolia*) AND GOAT WEED *(Ageratum conyzoides*) LEAF MEALS ON MEAT QUALITY OF BROILER CHICKENS

Adeyeye, S.A[*], Oloruntola, O.D[¶] Ayodele, S.O[€], Fadiyimu, A.A[*], Agbede, J.O[†], and Aletor, V.A[†]

[*]*Department of Animal Health and Production, Federal College of Agriculture, Akure, Nigeria*

[¶]*Department of Animal Science, Adekunle Ajasin University, Akungba Akoko. Nigeria*

[€] *Department of Agricultural Technology, The Federal Polytechnic, Ado Ekiti. Nigeria*

[†]*Department of Animal Production and Health, The Federal University of Technology, Akure, Nigeria*

**Corresponding author: Adeyeye S.A, samwaleadeyeye@gmail.com*

Abstract

This study evaluated the effects of wild sunflower and goat weed composite leaf meal mix (CLM) on the meat of 42-day old broiler chicken. Three hundred day-old Arbor-acre broiler chicks were used for the experiment. The chicks were randomly assigned into five experimental groups at sixty chicks per treatment and ten chicks per replicate. The experimental diets were supplemented with CLM at various inclusion levels: diet 1 (0%), diet 2 (0.11% Oxytetracycline supplementation), diet 3 (0.4% CLM supplementation), diet 4 (0.80% CLM supplementation), and diet 5 (1.20% CLM supplementation). Feed and water were giving ad-libitum and routine management strictly observed. The meat cholesterol level of the broiler chickens fed OXY supplemented diet (diet 2) was lower (P<0.05) to those that were fed the control diet. However, further significant (P<0.05) decrease were recorded in the birds fed the CLM supplemented diets (diets 3, 4 and 5) such that the least cholesterol content was recorded in 0.8 CLM supplemented-diet. The broiler meat glutathione peroxidase content recorded in the birds fed the 0.8% and 1.2% CLM supplemented diets were lower (P<0.05) compare to those birds fed the control diet; OXY and 0.4% CLM supplemented diets. However, the lipid oxidation of the broiler meat fed the OXY and CLM supplemented diets (diets 2, 3, 4 and 5) were (P<0.05) lower than those birds fed the control diet. In conclusion, 0.8% and 1.2% dietary supplementation of the broiler chicken diets reduced the meat cholesterol content and the glutathione. The phyto-additives reduced the meat lipid oxidation.

Keywords: Antioxidants, Cholesterol, Meat quality, Phyto-additives

Introduction

Phyto feed additives are plant-based feed additives or botanicals that are used in natural substances in poultry nutrition. They are derived from herbs, spices, other plants and their extracts, like essential oils. Phytogenics or phyto-additives are natural, less toxic, residue-free and ideal feed additives for poultry when compared to synthetic antibiotics. Phyto feed additives have antimicrobial, antifungal, antiviral, antioxygenic, antiparasitic and insecticidal properties. The benefits of using phyto- feed additives in poultry nutrition include increased feed intake, stimulation of digestion, increased growth performance, reduced incidence of disease, improved reproductive parameters, feed efficiency, profitability and reducing poultry house emissions (Windisch *et al*., 2008). The proximate composition (20.6% crude protein, 18.90 crude fibre, 4.00% ether extract, 42.5% carbohydrate and 14.00% ash) and Phyto-constituents (79.1 mg/100g phytin, 0.39 mg/100g tannin, 1.76 mg/100g oxalate, 2.36 mg/100g saponin, 1.23 mg/100g alkaloid and 0.87 mg/100g flavonoid) of wild sunflower leaf meal was reported by Fasuyi *et al*., (2010). The proximate analysis has shown that goat weed (*Ageratum conyzoides*) contains 11.93% crude protein (Gbolade, 1999). According to Okunade (2002), the extract of goat weed has anti-inflammatory, antipyretic and analgesic activities in mice and rats while the oil has antibacterial and antifungal activity. Verma *et al*., (2013) reported that the phytochemical investigation of the plant extract of goat weed shows a high concentration of phenolic compounds and flavonoids, for protection against disorders associated with an excess of free radicals or reactive oxygen species. The goat weed was reported to play a significant role in the eradication of Enteropathogenic microorganism causing inflammation of the intestine (Ram *et al*.,

2008). Little attention has been given to the effects of herbal mixture on poultry physiology when compared to other animals. There could be an interaction of the bioactive compounds in these botanicals (Oloruntola *et al*., 2018). Therefore, the study aimed at assessing the effects of dietary composite leaf meal mix of wild sunflower and goat weed leaf meals on broiler meat quality.

Materials and methods

The experiment was carried out at the Teaching and Research Farm of the Federal College of Agriculture (FECA), Akure, Nigeria. Fresh goat weed and wild sunflower leaves were plucked within the campus of FECA, Akure. The leaves were washed in running tap water, suspended on tray under shade for 20 minutes to ensure proper water drainage and chopped into small pieces with the sharp stainless knife, thereafter spread lightly on tarpaulin under the shed to air-drying for about 14 days and then after milled (100 µ size) to produce goat weed and sunflower leaves meals. Thereafter, equal portion of goat weed meal (GLM) and wild sunflower meal (WLM) were mixed to form wild sunflower and goat weed composite leaf mix (CLM) and analysed for proximate analysis, *terpenoid* (Ferguson, 1956), *saponin* (Shad *et al*, 2013), *flavonoid* (Shad *et al*, 2013), ferric reducing antioxidant property (FRAP) (Pulido *et al*, 2002) and 2,2-diphenyl-1- picrylhydrazyl hydrate (DPPH) (Gyamfi *et al*, 1999). Two basal diets were formulated for the starter (1 to 21 days) and finisher phase (days 22 to 42) (Table 1) to meet the minimum requirement of broiler chicken (NRC, 1994). At each phase, the basal diets were divided into five (5) equal portions and labeled diets 1 to 5. Diet 1 contained 0g/kg of CLM supplement, diet 2 was supplemented with 0.11% Oxytetracycline while Diets, 3, 4 and 5 were supplemented with 0.40%, 0.80% and 1.20% of g/kg CLM, respectively. Three hundred a-day old Arbor acre broiler chicks were distributed to five (5) dietary treatments (60 birds/treatments: 10 birds per replicate) in a complete randomize design. Feed and water were provided *ad-libitum* throughout the 42 days of the experiment.

Results and Discussion

Table 2 shows the proximate composition of phytochemical and antioxidant properties of WLM, GLM, and CLM. The crude protein and crude fibre contents of CLM was higher than the crude protein of WLM but lower than that of GLM. The phenol and flavonoid content of CLM was 6.07 mg/g and 9.56 mg/g, respectively. Saponin (68.91 mg/g) and terpenoid (56.02 mg/g) were also detected in CLM. The antioxidant properties determination shows that CLM has 65.59% DPPH and 1.70 mg/g FRAP. The CLM phytochemical and antioxidant parameter profiles recorded shows that the phyto-additive used in this study has phytochemicals of pharmacological importance. Earlier reports show that phytogenic feed additives usually possess phytochemicals that can be of benefits to the health (Maisarah *et al*., 2014, Oloruntola *et al*., 2018a,b). The effects of phyto-additives on meat analysis of broiler chickens are shown in table 3. The cholesterol content of the meat of the broiler chickens fed OXY supplemented diet (diet 2) was lower ($P<0.05$) to those that were fed the control diet. However, further significant ($P<0.05$) decrease were recorded in the birds fed the CLM supplemented diets (diets 3, 4 and 5) such that the least cholesterol content was recorded in 0.8 CLM supplemented-diet. This observed reduced meat cholesterol in the birds fed the phyto-additive supplemented diets in this study may be a result of activities of phytochemicals such as saponin in CLM which impaired and reduced the uptake of cholesterol in the gut (Oloruntola *et al*., 2019). The broiler meat glutathione peroxidase content recorded in the birds fed the 0.8% and 1.2% CLM supplemented diets were lower ($P<0.05$) compare to those birds fed the control diet; OXY and 0.4% CLM supplemented diets. However, the lipid oxidation of the broiler meat fed the OXY and CLM supplemented diets (diets 2, 3, 4 and 5) were ($P<0.05$) lower than those birds fed the control diet. In conclusion, 0.8% and 1.2% dietary supplementation of the broiler chicken diets reduced the meat cholesterol content and the glutathione. The phyto-additives reduced the meat lipid oxidation.

Table 1: Composition and Nutrient Contents of Experimental Basal Diets

Ingredients (g/kg)	Starter (1 to 21 days)	Finisher(22 to 42 days)
Maize	426.60	485.60
Wheat offal	121.00	101.00
Soybean meal	386.90	347.90
Vegetable oil	22.00	23.00
Di-calcium phosphate	18.00	17.00
Limestone	14.00	14.00
Premix	3.00	3.00
Methionine	3.00	3.00
Lysine	2.50	2.50
Salt	3.00	3.00
Analysis (g/kg DM)		
Crude protein	220.00	205.60
Crude fibre	45.30	43.80
Metabolizable energy (kcal/kg)	2955.88	3 000.24
Calcium	10.20	9.30
Available Phosphorus	6.00	5.50
Methionine	6.30	3.80
Lysine	11.50	10.30

Table 2: Composition of leaf meals and their composite mix

Composition	WLM	GLM	CLM
Proximate composition (%)			
Crude protein	8.05±0.70	11.79±0.13	9.83±0.41
Crude fibre	13.29±0.27	15.80±0.24	14.28±0.25
Ether extract	6.02±0.01	4.97±0.20	5.59±0.13
Ash	14.79±0.14	13.71±0.09	14.28±0.16
Nitrogen free extract	48.54±0.63	45.87±0.51	47.14±0.47
Phytochemicals (mg/g)			
Phenol	6.27±0.01	5.87±0.16	6.07±0.09
Flavonoid	10.25±0.04	8.52±0.13	9.56±0.16
Saponin	60.11±0.15	81.15±0.06	68.91±1.75
Terpenoid	57.85±0.05	53.73±0.27	56.02±0.14
Antioxidant properties			
DPPH (%)	77.85±0.43	48.13±0.07	65.59±2.24
FRAP (mg/g)	1.44±0.01	2.01±0.15	1.70±0.09

CLM: Wild sunflower and goat weed composite leaf mix; WLM: Wild sunflower leaf meal; GLM: Goat weed leaf meal

Table 3: Effects of phyto-additives on meat analysis of broiler chickens

Parameters	Diet 1 Control	Diet 2 OXY	Diet 3 0.4% CLM	Diet 4 0.8% CLM	Diet 5 1.2% CLM	SEM	P value
CHOL (mg/dl)	123.71[a]	60.10[b]	40.16[c]	10.66[e]	30.59[d]	10.37	0.00
GPx (µg/g)	60.12[b]	60.71[a]	60.27[ab]	31.07[d]	40.23[c]	3.32	0.00
LO (mgMDA/g)	1.55[a]	0.83[b]	0.75[b]	0.89[b]	0.94[b]	0.09	0.02

Means within a row with different superscripts are significantly different (P<0.05), OXY: Oxytetracycline, CLM: Composite leaf mix (WLM+GLM 1:1), CHOL: Cholesterol, GPx: Glutathione peroxidase, LO: Lipid oxidation, SEM: Standard error of the mean.

References

Fasuyi, A.O., Dairo, F.A.S and Ibitayo, F.J (2010). Ensiling wild sunflower (*Tithonia diversifolia*) leaves with sugar cane molasses. *Livestock Research for Rural Development*. **22**(3).

Ferguson, N.M. (1956): **A Textbook of Pharmacology**. *Macmillan Company, New Delhi*. Pg.191.

Gbolade, T.E. (1999): Sunflower Cake as a substitute for groundnut cake in Commercial broiler Chicks diets. *Pakistan Journal of Nutrition*, **7**(6); 782-784 **http://dx.doi.org/10.3923/** Pjn.2008.782.784.

Gryamfi, M.A., Yonamine, M. and Aaniya, Y. (1999). Free radical scavenging action of medicinal herbs From Ghana: *Thoniagia Sanguins* on experimentally induced liver injuries. *Giroval Pharmacology*, **32**:661-667. **https://doi.org/10.102/jf9913458**.

Maisarah, AM, Asmah, R, Fauziah, O (2014). Proximate analysis, antioxidant and antiproliferative activities of different parts of *Carica papaya. J. Nutr. Food Sci*. **4**:267.

NRC, (1994): **Nutritional Requirements Council**. 9th Revised ed. *National Academy Press*, Washington D.C.

Okunade, A.L. (2002). Ageratum conyzoides Asteraceae. *Fitoterapia*. **73**: 1-16.

Oloruntola, O.D, Agbede, J.O, Ayodele, S.O, and Oloruntola, D.A (2018a). Neem, pawpaw, and bamboo leaf meal dietary supplementation in broiler chickens: Effect on performance and health status. *Journal of Food Biochemistry.* Vol. **43** Issue 2 e12723. **https://doi.org/10.1111/jfbc.12723**

Oloruntola, O.D., Ayodele, S.O., Adeyeye, S.A., Jimoh, A.O., Oloruntola, D.A. and Omoniyi, S.I. (2019). Pawpaw leaf and seed meals composite mix dietary supplementation: effects on broiler chicken's performance, caecum microflora and blood analysis. *Agroforestry Syst.* DOI:10.1007/s10457-019-00424-1.

Oloruntola, O.D., Ayodele, S.O., Adeyeye, S.A., Ogunsipe, M.H., Daramola, O.T., Ayedun, E.S. (2018b). Effect of pawpaw leaf meal and multi-enzyme supplementation in the diet on performance, digestibility and oxidative enzyme status of rabbits. *J Basic Appl Zool* .**79**:26.

Pulido, R., Bravo, L., and Suara-Calixto, F. (2002): Antioxidant activity of dietary polyphenols as determined by a modified ferric reducing antioxidant assay. *Journal Agric. Food Chem*. **48**: 3396-3402. https//doi.org/10.102/jf9913.

Ram, P.K., Crump, J.A., Gupta, S.K., Miller, M.A., Mintz, E.D. (2008). Part ii. Analysis of data gaps pertaining to Shigella infections in low and medium development index countries, 1984-2005. *Epidemiology and Infection.* **136**:577-603.

Shad, M.A., Nawaz, H., Rehma, T. and Ikrah, M. (2013): Determination of Biochemicals, Phytochemicals and antioxidants properties of different plants of *Cichorium intybus* L: A comparative study. The *J. Animal Plant Sci*. **23**:1060-1066

Verma, A.R., Vijayakumar, M., Mathela, C.S and Rao, C.V. (2009): *In vitro* and *in vivo* antioxidant properties of different fractions of *Moringa oleifera* leaves. Food and Chemical Technology, **47**, 2196-2201. *Vet Adv* 9:2565-2570.

Verma, P.K., Raina, R., Sultana, M., Prawez, S., Jamwal, N. (2013). Hepatoprotective mechanisms of Ageratum conyzoides on oxidative damage induced by acetaminophen in Wistar rats. *Free Radicals and Antioxidants*. **3**: 73-76.

Windisch, W., Schedle, K., Plitzner, C. and Kroismayr, A. (2008). Use of phytogenic products as feed additives for swine and poultry. *J Anim Sci* **86** (E. Suppl.), E140-E148.

EVALUATION OF THE OPTIMUM LEVEL OF COMMERCIAL BLENDED ORGANIC ACIDS (BIOTRONIC® TOP FORTE) AS A REPLACEMENT FOR ANTIBIOTIC GROWTH PROMOTER ON THE PERFORMANCE OF GROWER PULLETS

Agbai, K.N., Omage, J.J., Sekoni, A.A., and Afolayan, M.

Ahmadu Bello University Zaria Kaduna State, Nigeria

Corresponding author: nellyhelen89@gmail.com; +234 8038685777

Abstract

This study was conducted to evaluate the efficacy of combined organic acids and their salts (Biotronic® Top Forte) as alternatives to the conventional antibiotics used in poultry production on the performance of growing pullets. Six hundred and nine (609) grower pullets were used for the study and were intensively managed. The pullets were randomly assigned into seven treatment groups in a complete randomized design and administered as 0,100,200,300,400,500g of Biotronic® Top Forte, oxytetracycline as positive control and defined as T1, T2, T3, T4, T5, T6 and T7 respectively. Results showed a significant ($p<0.05$) influence of Biotronic® Top Forte on weight gain, feed intake, feed/gain ratio, feed cost/kg gain age at 1st lay, weight of 1st egg and age at 10% lay. Birds on 500g inclusion of Biotronic® Top Forte had better weight gain (1359.83g), feed/gain ratio (3.71) and feed cost/Kg gain (₦364.92) when compared with birds on 0 inclusions, oxytetracycline and birds on other treatments. Haematological indices measured were within the normal range for healthy birds in all treatment groups. There was no mortality recorded in this study. It was concluded that Biotronic® Top Forte inclusion at 500g enhanced growth performance growing pullet from 9 weeks to 18weeks compared to birds on 0 inclusion diets, birds on oxytetracycline diets and birds on other treatments. Inclusion of of Biotronic® Top Forte at 100, 200, 300, 400 and 500g reduced the cost of production by 6.41, 8.36, 3.27, 0.00 and 12.45% respectively.

Keywords: organic acids, Biotronic® Top Forte, oxytetracycline, pullet and Haematological.

Introduction

High levels of production and efficient feed conversion are the need of the modern poultry industry, which to a certain extent could be achieved by the use of specific feed additives. Antibiotic feed additives as growth promoters have long been supplemented to poultry feed to stabilize the intestinal microbial flora, improve the general performances and prevent some specific intestinal pathology (Hassan *et al*., 2010). Young animals are highly susceptible to various stressors, including bacterial diseases, resulting in compromised growth performance and high mortality (Barton, 2000). Antibiotics have long been used at sub-therapeutical levels in swine, poultry, aquaculture and ruminant diets for better growth performance (Randrianarivelo *et al* 2010; Allen *et al.*, 2012). However, due to the emergence of microbes resistant to antibiotics which are used to treat human and animal infections, the European Commission (EC) decided to phase out, and ultimately ban (1 January 2006), the marketing and use of antibiotics as growth promoters in feed (EC Regulation No.1831/2003). There have been a significantly increased number of studies focused on searching for alternatives to antibiotics with similar antimicrobial and growth-promoting effects without inducing bacterial resistance and potential side effects to animals. Organic acids (Eckel *et al.*, 1992; De Lange *et al.*, 2010), enzymes (Bedford and Cowieson, 2012), prebiotics (Gibson *et al.*, 2004), probiotics (Musa *et al.*, 2009), antimicrobial peptide (Choi *et al*., 2013) and phytogenic compounds (Yang *et al.*, 2007; Windisch *et al.*, 2008; Randrianarivelo *et al.*, 2010; Gong *et al.*, 2014) have been widely recognized as potential alternatives to antibiotics in feed. Among these alternatives, dietary organic acids have gained greater attention because of their antimicrobial activity against pathogenic bacteria and the fact that these compounds can induce a pH reduction in the gastrointestinal tract (GIT), which can improve nutrient utilization in poultry diets (Eidelsburger *et al.*, 1992).

Organic acid treatments composed of individual acids and blends of several acids have been found to perform antimicrobial activities similar to those of antibiotics (Wang *et al*., 2009).

The European Union allowed the use of organic acids and their salts in poultry production because these are generally considered safe (Adil *et al*., 2010). The Biotronic® Top Forte combines selected organic acids and their salts with a phytochemical and the unique Biomin® Permeabilizing Complex fully utilizing a unique synergism in their mode of action. The Biomin® Permeabilizing

Complex boosts the activity of the active ingredients (the organic acids and the phytochemical) and facilitates their entry by permeating the outer membrane of Gram-negative bacteria (Biomin, 2018). Increasing worldwide concentration and growing competition in the poultry industry requires efficient pullets to satisfy specific market requirements. Lohmann Tierzucht offers a wide range of high quality pullet strain "bred in Germany" to meet these demand. Lohmann brown-classic is well known for their efficient production of quality brown eggs (Lohmann brown-lite management guide, 2018) Body weight and body conformation are the two important parameters for measuring growth in chickens, as growth and reproduction is the most important aspect of poultry production (Addisu, 2013).

The aim of this work therefore is to evaluate optimum inclusion levels of Biotronic® Top Forte (commercial blended organic acid) on grower pullets performance.

Materials and Methods

This study was carried out at the Poultry Unit, Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Six hundred and nine (609) grower pullets were allocated to seven dietary treatments with 3 replicates of 29 birds each in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practices. Feed and water were provided *ad libitum* for the 12 weeks period of the experiment. Left over feed was weighed to calculate feed intake. Birds were weighed at the beginning and end of experiment, to calculate weight gain. Birds were cared for according to guidelines established by the University Animal Care Committee. Seven diets were formulated. Table 1 shows the proximate composition of the common diet used. The Biotronic® Top Forte was added as non-inclusive part of the diets. Diet 1: (Control diet) – without Biotronic® Top Forte and oxytetracycline, Diet 2: 100g of Biotronic® Top Forte /100 Kg diet, Diet 3: 200g of Biotronic® Top Forte /100 Kg diet, Diet 4: 300g of Biotronic® Top Forte /100 Kg diet, Diet 5: 400g of Biotronic® Top Forte /100 Kg diet, Diet 6: 500g of Biotronic® Top Forte /100 Kg diet, Diet 7: Oxytetracycline at 0.8g/100Kg diet (as recommended by manufacturer). Recommended dosage for Biotronic® Top Forte is 1.85 – 4.50 kg/tonne of feed. Proximate analysis of the sample of experimental diets was done at the Biochemical Laboratory, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria according to methods described by A.O.A.C. (2005) At the end of 18 weeks of the feeding trial, 2mls of blood sample were collected from each of the three birds per treatment (that is one bird per replicate) via the wing veins into sterile tubes containing an anticoagulant (ethylene diamine tetra acetic acid, EDTA) for the determination of some haematological parameters. This was carried out at the Clinical Pathology Laboratory, Ahmadu Bello University Zaria. All data obtained were statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems (SAS, 2002). Significant difference between treatments means were separated using Dunnett's test in the SAS package.

Results and Discussion

Table 2 shows the growth performance characteristics of grower pullet fed diets containing graded levels of Biotronic® Top Forte (9-18weeks) to replace antibiotic as growth promoter. There were significant ($P < 0.05$) differences in final weight, weight gain, feed intake and feed/gain ratio. No mortality was recorded. Significant ($P < 0.05$) difference in final weight, weight gain, feed intake, feed/gain ratio, feed cost/gain, age at 1st lay, weight of 1st egg and age at 10% lay was as a result of the organic acid (Biotronic® Top Forte) used to enhance effectiveness of nutrients and improved growth performance through establishment of low gastro intestinal tract (GIT) pH condition by supporting endogenous digestive enzymes, reducing undesired gut micro-organisms and exert their effects in the gut or on the gut wall cells of the bird. This is an indication that the birds effectively utilized their feed components. Acidifiers constitute an important component of modern feeding strategies without antibiotics. This result agrees with the report of Van Immerseel *et al.*, 2006 and Naseri *et al.*, 2012, that addition of organic acids in diet can have a beneficial effect on the performance of poultry by decreasing pathogenic bacteria. Higher organic acid inclusion resulted to lower feed intake, higher weight gain, better feed to gain ratio because the organic acids aid in the effective feed utilization in the gut which resulted in better growth performance thereby reducing amount of feed consumed and reduce cost of production. This agrees with the study of Patten and Waldroup, (1988) who reported reduction in feed intake and increased body weight due

to higher acid concentration. No mortality was recorded, is an indication that the birds effectively utilized the feed nutrient because of the organic acid included in the feed which help to lower the pH of the feed, gut and microbial cytoplasm thereby inhibiting the growth of pathogenic intestinal microflora. This agrees with the report of Avitech, 2004 that the inhibition of the growth of pathogenic intestinal microflora by the inclusion of organic acid reduces the microflora competing for the host nutrient and result in better growth and performance of the birds. Inclusion of Biotronic® Top Forte in the diets of grower pullets at 100, 200, 300, 400 and 500g reduced the cost of raising grower pullets by 6.41, 8.36, 3.27 and 12.45% respectively. The result of haematological indices of grower pullets (9-18 weeks) fed diets containing graded levels of Biotronic® Top Forte is shown in Table 3. Haematological indices are essential in monitoring feed toxicity especially with feed constituents that affect the formation of blood (Aro and Akinmoyegun,2012). Significant differences were observed on haematological values obtained among treatment groups, though significantly different, their values fell within the normal range of Pollack *et al.*(2005);Cray, (2000); Jain, 1986 and Simraks *et al* 2004 which defines that the birds were in complete normal state of health.

Table 1: Proximate Composition of Experimental Diets for Grower Pullets (9 – 18weeks)

Parameters (%)	Composition
Dry matter	93.12
Crude protein	22.28
Ash	8.14
Crude fibre	6.41
Ether Extract	2.01
Nitrogen free Extract	61.16

Table 2: Growth Performance of Grower Pullets Fed Diets Containing Different Levels of Biotronic® Top Forte Grower (9 – 18 weeks)

	Levels of Biotronic® Top Forte (g)							
Parameters	**0**	**100**	**200**	**300**	**400**	**500**	**Oxytet**	**SEM**
Initial Weight (g/bird)	719.78	711.17	726.15	708.91	722.20	701.04	719.43	13.09
Final Weight (g/bird)	1919.67^{ab}	1984.41^{ab}	2042.72^{a}	1926.51^{ab}	1881.11^{b}	2060.87^{a}	1937.78^{ab}	81.84
Total Weight Gain (g/bird)	1199.67^{ab}	1273.24^{ab}	1316.57^{a}	1217.60^{ab}	1158.91^{b}	1359.83^{a}	1218.35^{ab}	81.87
Total Feed intake (g/bird)	5077.82^{a}	5044.83^{a}	5068.05^{a}	4968.16^{b}	5040.00^{a}	4971.03^{b}	5040.34^{a}	47.48
Feed/Gain Ratio	4.24^{b}	3.96^{ab}	3.88^{ab}	4.10^{b}	4.43^{b}	3.71^{a}	4.15b	0.28
Feed Cost/Kg Gain	416.79	390.08	381.96	403.15	435.60	364.92	414.09	27.44
Cost of Total feed intake (g/bird/₦)	499.74^{b}	496.51^{b}	488.97^{a}	488.97^{a}	496.05^{b}	489.27^{a}	502.51^{c}	4.69
Age at 1st Lay (days)	116.67^{b}	116.67^{b}	114.33^{b}	116.33^{b}	115.67^{b}	112.00^{a}	117.33^{c}	1.77
Weight of 1st egg (g)	38.92^{ab}	28.31^{c}	41.71^{a}	33.17^{b}	38.99^{a}	43.68^{a}	43.68^{a}	4.18
Age at 10% Lay (days)	124.00^{c}	123.67^{b}	121.33^{a}	123.00^{b}	122.67^{b}	118.67^{a}	124.00^{c}	1.65

^{abc} = means with different superscripts on the same row differ significantly (P<0.05), Oxytet:Oxytetracycline.
SEM: Standard Error of Means

Table 3: Haematological Indices of Grower Pullets Fed Diets Containing Different Levels of Biotronic® Top Forte (9- 20weeks)

	Levels of Biotronic® Top Forte (g)								
Parameters	**0**	**100**	**200**	**300**	**400**	**500**	**Oxytet**	**SEM**	**REF. V**
PCV (%)	20.00[b]	39.80[a]	39.80[a]	26.10[b]	47.60[a]	28.20[b]	49.50[a]	3.94	23.00–55.00[+]
Hb (g/dL)	8.00[d]	10.00[c]	13.10[a]	7.30[d]	10.00[b]	7.80[d]	9.50[c]	0.47	7.0 – 18.60[+]
RBC (x10^6 /uL)	2.45[b]	3.70[a]	2.47[b]	2.35[c]	3.70[a]	2.48[b]	1.19[d]	0.05	1.30 -4.50[+]
WBC (x10^3 /uL)	0.98[d]	1.12[a]	1.01[c]	0.91[e]	1.01[c]	1.07[b]	0.91[e]	0.01	0.90 – 3.20[+]
Heterophils (%)	9.10[c]	12.10[a]	7.20[e]	5.17[f]	11.10[b]	4.10[g]	8.10[d]	0.15	15.00–50.00[+]
Lymphocytes (%)	90.30[a]	77.80[d]	84.20[b]	90.30[a]	80.20[c]	92.30[a]	77.90[e]	0.09	40.00–100[++]
Monocytes (%)	0.60[f]	6.80[b]	5.60[c]	3.50[d]	5.57[c]	2.80[e]	7.90[a]	0.04	0 – 7.00[+]
Eosinophils (%)	0.00[f]	2.50[b]	2.10[c]	1.20[d]	2.10[c]	0.70[e]	4.20[a]	0.07	0 – 16.00[+]

[abcdefg] = means with different superscripts on the same row differ significantly (P<0.05),Oxytet: Oxytetracycline; SEM: Standard Error of Means. Ref.v: Reference values: [+]Pollack *et al.*,(2005), [+]Cray, (2000), [++]Jain 1986, [+++] Simarak et al.,(2004).

CONCLUSION AND RECOMMENDATION

Birds on 500g Biotronic® Top Forte inclusion significantly lowered the cost of production than the 0 inclusion and the AGPs treatments to 12.45%.

It can be finally concluded that the addition of the balanced acidifier product Biotronic® Top Forte, containing an organic acid blend of formic acid, propionic acid and its salts based on an inorganic carrier, increases in the absence of anti-biotic growth promoters the performance grower pullets chicken.

Farmers can use Biotronic® Top Forte feed additives as replacement for antibiotic in grower pullets production at 500g/100kg diets to improve growth, early laying performance and profitability

REFERENCES

A.O.A.C (2005). Official methods of analysis, *Association of official analytical chemistist 17th Edition*, Washington D.C, USA.

Addisu, H. (2013). Phenotypic Characterization of Indigenous Chicken Ecotypes in Northwolle, Amhara Regional State, Ethiopia. A master's thesis. Page 87

Adil, S., Tufail, B., Gulam, A. B., Masood, S. and Manzoor, R. (2010). Effect of dietary supplementation of organic acids on performance, intestinal histomorphology, and serum biochemistry of broiler chicken. *Veterinary Medicine International.* 2010:1–7. Article ID 479485.

Allen, H.K., Levine U.Y., Looft T., Bandrick M, and Casey T.A. (2012) Treatment, promotion, commotion: Antibiotic alternatives in food-producing animals. *Trends Microbiology*, 21:114–119. doi: 10.1016/j.tim.2012.11.001.

Aro, S.O and Akinmoyegun, M.B (2012). Haematology Red Blood Cell Osmotic Stability of Pigs fed Graded Levels of Fermented Cassava Peel – Based diets. *Proceedings of the 17th Annual conference of Animal Science Association of Nigeria. Held at International conference center, Opposite Radio House, Area 8, Abuja between 9th – 13th September,2012. Editors: Akpan, G.N., Dairo, F.A., Bawa, G.S., Solomon, I. P., Amaefuele*, K.U., *Odunsi, A.A. and ladokun, A. O., 152 – 155.*

Avitech technical bulletin (2004). The Role of Acidifers in Poultry Nutrition. Animal Health PVT Limited.

Barton, M.D. (2000). Antibiotic use in animal feed and its impact on human health. *Nutrition research Reviews*, 13:279-299. doi: 10.1079/095442200108729106.

Bedford, M.R. and Cowieson A..J. (2012). Exogenous enzymes and their effects on intestinal microbiology. *Animal Feed Science. Technology*, 173:76–85

Biomin, (2018). Biomin GmbH. Erber campus 1, 3131 Getzersdorf, Austria.

Choi, S.C., Ingale, S.L., Kim, J.S., Park, Y.K., Kwon, I.K. and Chae, B.J. (2013). An antimicrobial peptide-A3: Effects on growth performance, nutrient retention, intestinal and faecal microflora and intestinal morphology of broilers. *British Poultry Science*, 54:738–746. doi: 10.1080/00071668.2013.838746.

Cray, C. (2000). Blood and Chemistry Tables. In: Olsen G, Orosz S.(eds), *Manual of Avian Medicine.* St. Louis, MO: Mosby

De Lange, C.F.M., Pluske J.R., Gong J. and Nyachoti C.M. (2010). Strategic use of feed ingredients and feed additives to stimulate gut health and development in young pigs. *Livestock Sciences*, 134:124–134.

Eckel, B., Kirchgessner M. and Roth F.X. (1992). Influence of formic acid on daily weight gain, feed intake, feed conversion rate and digestibility. *Journal of Animal Physiology and Animal Nutrition*; 67:93–100. doi: 10.1111/j.1439-0396.1992.tb00588.x.

Eidelsburger, U., Kirchgessner, M. and Roth, F. X. (1992). Influence of formic acid, calcium formate and sodium bicarbonate on pH, concentration of carbonic acids and ammonia in different segments of the gastrointestinal tract: 8 liberation. Nutritive value of organic acids in piglet rearing. *Journal of Animal Physiology*, 68:20-32.

European Commission (EC), (2006), the marketing and use of antibiotics as growth promoters in feed. EC Regulation No.1831/2003 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:268:0029:0043:EN:PDF).

Gibson G.R., Probert H.M., Loo J.V., Rastall R.A. and Roberfroid M.B.(2004). Dietary modulation of the human colonic microbiota: Updating the concept of prebiotics. *Nutrition. Reserve. Revised.*,17:259–275. doi: 10.1079/NRR200479.

Gong, J., Yin, F., Hou, Y. and Yin, Y. (2014). Chinese herbs as alternatives to antibiotics in feed for swine and poultry production: Potential and challenges in application. *Canadian Journal of Animal Sciences*, 94:223–241. doi: 10.4141/cjas2013-144.

Hassan, H.M.A., Mohamed, M.A., Youssef, A.W. and Hassan, E.R. (2010). Effect of usin organic acids to substitute antibiotic growth promoters on performance and intestinal microflora of broilers. *Asian-Australian Journal of Animal Science*. 23(10):1348– 1353.

Jain, N.C. (1986). Schalm Veterinary Haematology. 4th edition Philadelphia, Lea and Ferbinger. *Journal of Applied Poultry Research*, volume 5, p. 203-209

Lohmann brown-lite management guide, (2018) LOHMANN TIERZUCHT GmbH. Am Seedeich 9-11/27472 Cuxhaven/ GERMANY.

Musa, H.H., Wu, S.L., Zhu, C.H., Seri, H.I. and Zhu, G.Q. (2009). The potential benefits of probiotics in animal production and health. *Journal Animal Veterinary Advances*, 8:313–321.

Naseri, K.G, Rahimi, S. and Khaki, P. (2012). Comparison of the effects of probiotic, organic acid and medicinal plant on Campylobacter jejuni challenged broiler chickens. *Journal of Agricultural Science and Technology*. 14:1485–1496.

Patten, J.D. and Waldroup, P.W. (1988). Use of organic acids in broiler diets. *Journal of Poultry Science:* 67:1178-1182.

Pollack, C., Carpenter, J.W. and Antinoff, N. (2005). Birds In: Carpenter Journal (ed.), *Exotic Animal Formulary.* 3rd edition. St. Lousi, MO: Elsevier Saunders.

Randrianarivelo, R.., Danthu P., Benoit C., Ruez P., Raherimandimby M., Starter S.(2010). Novel alternative to antibiotics in shrimp hatchery: Effects of the essential oil of Cinnamosma fragrans on survival and bacterial concentration of Penaeus monodon larvae. *Journal of Applied Microbiology*, 109:642–650.

S.A.S. (2002). Statistical Analysis System Institute, User's Guide. Version 9 for Windows. North Carolina, U.S.A.

Simaraks, S., Chinrasri, O. and Aengwanich, S. (2004). Hematological, electrolyte and serum biochememical values of the Thai indigenous chickens (*gallus domesticus)* in northern Thailand Songklanakarin. *Journal of Science and Technology, 26(3): 425-430.*

Van Immerseel, F., Russell, J.B., Flythe, M.D., Gantois, I., Timbermont, L., Pasmans, F., Haesebrouck, F. and Ducatelle, R. (2006). The use of organic acids to combat Salmonella in poultry: A mechanistic explanation of the efficacy. *Avian Pathology*. 35:182–188.

Wang, J.P., Yoo, J.S., Lee, J.H., Zhou, T.X, Jang, H.D., Kim, H.J. and Kim, I.H. (2009). Effects of phenyllactic acid on production performance, egg quality parameters, and blood characteristics in laying hens. *Journal of Applied Poultry Research*. 18:203–209.

Windisch, W., Schedle, K., Plitzer, C. and Kroismayr, A. (2008). Use of phytogenic products as feed additives for swine and poultry. *Journal of Animal Sciences*; 86:140–148. doi: 10.2527/jas.2007-0459.

Yang, W.Z., Benchaar, C., Ametaj, B.N., Chaves, A.V., He, M.L. and McAllister, T.A. (2007). Effect of garlic and juniper berry essential oils on ruminal fermentation and on the site and extent of digestion in lactating cows. *Journal of Dairy Sciences*, 90:5671–5678. doi: 10.3168/jds.2007-0369.

GROWTH RESPONSE AND BLOOD PROFILE OF PULLET FED DIETS SUPPLEMENTED WITH TURMERIC

Agbalaya K. K., Onigemo M. A., Oso Y. A. A., Anjola A.O. J., Tijani L. A., Agunbiade M. A.,

Agbaye P. F., Ishola O. J. Asafa A. R., Oladipupo C. P. and Ademoye A. D.

Department of Animal Production Technology, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria.

maonigemo@gmail.com.

Abstract

Sixty-three Isa brown growing pullets of 11-weeks old with average weight of 849.44±2.16g were used in a completely randomized design to evaluate the growth response and blood profile of pullet fed diets supplemented with turmeric. Three experimental diets were formulated and supplemented with turmeric powder at 0g/Kg in diet 1(control), 10g/Kg in diet 2, and 20g/Kg in diet 3. Data were collected on weight gain, feed intake, haematological and serum biochemical indices. There was no significant (P>0.05) differences in the growth parameters except in feed intake. The highest significant feed intake of 88.57g/bird/day was observed in diet 1 followed by 81.61g/bird/day in diet 2 and least in diet 3 80.89g/bird/day. Pullets fed 20g/kg turmeric had the highest weight gain of 5.03g/bird/day. Mean values of haematological parameters measured differed significantly except the Packed Cell Volume (PCV). The haemoglobin (Hb), red blood cell (RBC) and white blood cell (WBC) of birds fed turmeric supplemented diets were significantly (P<0.05) higher than those fed the control diets. The serum biochemical indices were significantly (P<0.05) affected by the diets except for creatinine (CR mg/dl) but diet 1(control) was similar to diet 2 in all the parameters measured except for total protein (PRO) and cholesterol (CHOL). In conclusion, pullets' diet can be supplemented with turmeric up to 10g/Kg without adverse effect on their growth performance and blood profile.

Keywords: Turmeric powder, Pullets, Haematology and Serum biochemistry

Introduction

Medicinal plants, herbs and spices have prospect in livestock sector due to their bioactive compounds that have been in use in treating ailments (Labban, 2010) and also to improve performance when added to animal feed (Hussein, 2013). The focus on alternative to replace antibiotics in animal feed has gained significant interest and recently the use of herbs as feed additives has shown encouraging results. Adomeh and Eguaoje (2019) reported enhanced growth performance of birds fed ginger and garlic mixture at 2% while Olabode *et al.,* (2018) recommended 1.5% safe use of turmeric as a phyto-additive in starter broiler. Herbal feed additives like ginger, garlic and turmeric have received more attention due to their potential to improve nutritive value, boost immune system and enhance performance (Zhang *et al.*, 2009). Similarly, Lee *et al.*, (2004) reported that the antimicrobial activity of the phytochemical components in herbs may provide beneficial effects on poultry performance. Phytochemicals in turmeric are known to be natural, residual free and are thought to be ideal as feed additives in livestock diets (Wang *et al.*, 1998). Curcumin the main active compound furnishes turmeric with its characteristics yellow colour and is recognized as being responsible for most of it therapeutic effects such as antibacterial, antifungal, antiprotozoal, antiviral, antioxidant, anti-inflammatory and hypocholesterolemic activities (Chattopadhyay *et al.*, 2004). Supplementation of dietary turmeric reduced serum cholesterol in laying hens (Kermanshahi and Riasi, 2006), rabbits (Quiles *et al.*, 1998), and rats (Dixis *et al.*, 1998). The objective of this study was to determine the growth response and blood profile of pullet fed diets supplemented turmeric.

Materials and Methods

The study was conducted in the Poultry Unit of the Teaching and Research Farm of Lagos State Polytechnic, Ikorodu, Lagos State. Sixty-three (63) eleven-week old pullet chickens were randomly distributed into three groups with twenty-one chickens per group and each group was replicated thrice in a completely randomized design experiment. Turmeric rhizome were thoroughly washed with clean

water, sun dried for three days then oven dried for 30 minutes thereafter milled into powdery form and added as supplement into basal experimental diet comprising 42% maize, 22% PKC, 10% GNC, 20% wheat offal, 2%SBM, 2% bone meal, 1.5% limestone, 0.25% premix and 0.25% salt at the rate of 0g/Kg (control, T1), 10g/Kg T2 and 20g/Kg T3 turmeric supplementation. The determined crude proteins (g/Kg) are 185.5, 183.0 and 181.0 while gross energy (Kcal/Kg) are 3351.7, 3530.8 and 3477.9 for T1, T2 and T3 respectively. The pullets were raised in battery cage system during which feed and water were provided *ad libitum* for thirteen weeks. At the end of the trial about 2 mls of blood was collected from each bird using needle and syringe through the jugular vein from two birds per replicate into labeled heparin bottle and Ethylene-diaminetetraacetic acid (EDTA) bottle for analyses. Data were collected on weight gain, feed intake, haematological and serum biochemical indices. All data were subjected to analysis of variance using the Assistat-statistical Assistance 7.6 beta software developed by Silva and Azevedo, (2016) and differences between treatment means were separated using Duncan Multiple Range Test of the same software.

Results and Discussion

Growth performance of pullets fed diet supplemented with turmeric

The growth performances of growing pullets fed diet supplemented with turmeric are presented in Table 1. Statistical analysis showed that turmeric had no significant (P>0.05) influence on the growth parameters except for the feed intake (FI). The highest FI (88.57g/bird/day) was observed in T1 (control treatment) followed by T2 (81.61g/bird/day) and the lowest in T3 (80.89g/bird/day). The lowest feed intake might be attributed to the aroma in turmeric which probably affects the birds' appetite and also the level of inclusion of turmeric in the diet. Turmeric has been reported to reduced feed intake in bird (Durrani *et al.*, 2006; Olabode *et al.*, 2018). The weight gain, specific growth rate and feed conversion ratio of the experimental birds were similar (P> 0.05).

Table 1: Growth Performance of Pullets fed diet supplemented with turmeric

Variables	Levels of supplementation (g/kg feed)			SEM±
	T1 (0%)	T2 (1%)	T3 (2%)	
Average initial weight (g)	846.98	851.05	849.44	2.16
Weight gain (g/bird/day)	4.39	4.29	5.03	0.231
Feed intake (g/bird/day)	88.57[a]	81.61[b]	80.89[b]	2.448
Specific growth rate	1.13	1.24	1.25	0.038
Feed conversion ratio	20.18	19.02	16.08	1.22

[ab] mean with the same superscript on the same row are not significantly different (P>0.05),
SEM –Standard error of means

Haematological parameters of pullets fed diet supplemented with turmeric

Table 2 shows the haematological parameters of pullet fed different levels of turmeric based diets. The haematological parameters of growing pullets fed turmeric supplementation were significantly (P<0.05) higher than those on control diet except PCV. The haemoglobin observed ranged from 7.7 in T1 to 9 in T2. The Hb values were within the normal range of 7-14 reported by earlier workers (Mitruka and Rawnsley 1977; Esmail 2004; Sugiharto *et al.*, 2011; Iheukwumere and Herbert 2012; Campbell 2013). PCV values ranged from 27 in T3 to 29 in T2. The birds fed diets 10g/Kg of turmeric had the highest PCV of 29% though the values in all the treatments appeared to be within the normal range of 22.0-35.0% reported in literature (Jain 1986; Campbell 2013) The highest red blood cell (RBC) count ($3.77X10^{12}$/L) was recorded in T2 while the lowest value was observed in birds fed control diet (T1 $3.00X10^{12}$/L). The higher RBC counts of birds fed turmeric supplemented diets compared with the birds fed control diet might be attributed to the fact that turmeric in iron which probably resulted in increased production of haemoglobin and consequently increased RBC

concentration. Hence, turmeric positively influences blood formation and reduces anaemic condition (Sharma, 2003; Olabode *et al.,* 2018). Birds fed turmeric supplemented diets had significantly higher WBC values when compared to the control diet probably due to fact that the turmeric in the diets activates immune response and disease resistant (Zhang *et al.,* 2009). The improvement in haematological constituents in this study is in accordance with previous researchers' reports (Sugiharto *et al.,* 2011; Sodamola *et al.,* 2016; Olabode *et al.,* 2018).

Table 2: Haematological parameters of pullets fed diet supplemented with turmeric

Variables	Experimental diets			SEM±
	T1 (0%)	T2 (1%)	T3 (2%)	
Haemoglobin (g/d1)	7.7[b]	8.5[a]	9.0[a]	0.38
Packed cell volume (%)	28	29	27	0.58
Red Blood Cell ($X10^{12}$/L)	3.00[b]	3.77[a]	3.55[a]	0.23
White Blood Cell ($X10^{9}$/L)	4960[b]	7200[a]	7040[a]	721.48

[ab]mean with the same superscript on the same row are not

Serum biochemistry parameters of pullets fed diet supplemented with turmeric

Serum biochemistry parameter of pullet chickens fed turmeric-supplemented diet is shown in the Table 3. Statistical analysis revealed that serum biochemical parameters of pullets fed turmeric-supplemented diet differs significantly (P<0.05) except creatinine (CR mg/dl).

Table 3: Serum biochemistry parameters of pullets fed diet supplemented with turmeric

Variables	Experimental diets			SEM±
	T1 (0%)	T2 (1%)	T3 (2%)	
Protein (g/d1)	59.28[a]	48.59[b]	45.55[b]	12.49
Glucose (mg/dl)	141.90[a]	143.00[a]	126.50[b]	15.98
Cholesterol (mg/dl)	128.13[b]	171.23[a]	163.08[a]	39.67
Triglycerides (mg/dl)	74.64[a]	84.90[a]	70.91[b]	12.55
Albumin (g/dl)	1.26[a]	1.13[a]	1.08[b]	0.16
Alkaline phosphatase (u/l)	99.36[a]	118.68[a]	82.80[b]	31.1
Creatine (mg/dl)	0.82	1.1	0.64	0.4
Urea (mg/dl)	23.40[a]	34.22[a]	20.51[b]	12.52

[ab]mean with the same superscript on the same row are not significantly different (P>0.05)

The highest value of glucose was recorded in T2 (143.00mg/dl) while the lowest value was obtained in T3 (126.50mg/dl), the values of glucose recorded in this study is below the normal reference value (192-299mg/dl) reported by church *et al.,* (1984). Cheesebrought (1999) reported that high serum glucose indicates pancreatic or liver disease. The highest serum protein was recorded in T1 (59.28g/dl) while the lowest value was recorded in T3 (45.55g/dl). The protein value obtained from this study is above the normal reference value (3.0-4.9g/dl) reported by Church *et al.,* (1984) and also within the range of 39.45-55.53g/dl reported by Ochefu (2006). The highest value for Cholesterol was recorded in T2 (171.23mg/dl) and the lowest value was obtained from T1 (128.13mg/dl) the Cholesterol value of this study is within the normal reference value (129-297mg/dl) reported by Church *et al.,* (1984). The highest value of Triglycerides was obtained in T2 (84.90mg/dl) while the lowest value was recorded in T3 (70.91mg/dl). Numerically T2 had the highest value of Creatine while the lowest value was recorded in T3. Alkaline phosphatase and urea had their highest values in T2 and their lowest value was obtained in T3. T1 had the highest value for ALB while the lowest value was reported in T3.

Conclusions and Recommendation

The dietary inclusion of turmeric powder at 10g/kg and 20g/kg did not show significant difference except in the feed intake. However, chickens fed diet 2 (10g/kg) had the highest values for weight gain, feed intake, feed conversion ratio and specific growth rate except for protein efficiency ratio. The turmeric had no adverse effect on the haematological and serum biochemistry indices of the experimental birds. In conclusion, the results of the study indicated that up to 20g/kg dietary inclusion of turmeric could be recommended for beneficial effects on pullet chickens performance.

References

Adomeh, E.E. and Eguaoje A.S. (2019). Performance and organoleptic qualities of broiler chickens fed and raised with varying levels of ginger and garlic mixture. *Nigerian J. Anim Sci.* 21(2): 310 – 318.

Campbell, T. W. (2013). Processing the avian haematological sample. *Avian haematology*. P 8-9.

Chattopadhyay, I., Biswas, K., Bandyopadhyay, U., and Banerjee, R. K, 2004. Turmeric and curcumin: Biological actions and medicinal applications. *Curr Sci.* 87:44-53.

Cheesebrought, M., (1999). District Laboratory Practice in Tropical Countries. 1999 edition. Cambridge University Press, Cambright, UK.

Church, J. P., Judd, J. T., Young, C.W., Kebay, J. L. and Kim, W.W. (1984). Relationships among diet constituents and specific serum clinical components of subjects eating self-selected diets. *Aric. J. Clin. Nutr*. 40: 1338-1344.

Dixit, V.P., Jain, P. and Joshi, S. C. (1988). Hypolipidaemic effects of *Curcuma longa* L and Nardostachysjatamansi DC in triton-induced hyperlipidaemic rats. *Indian Journal of Physiology Pharmacology*, 32, 299–304.

Durrani, F.R., Mohammad, I.., Asad, S., Suhail, S. M, Naila, C. and Durrani, Z. (2006). Effect of different levels of feed added turmeric on the on the performance of broiler chicks. *Journal of Agricultural Biology Science.* 1; 9-11.

Esmail, S. H. M. (2004). Flavouring poultry feeds can be beneficial. In: world poultry J. 20(5): 14-15.

Hussein, S. N. (2013). Effect of Turmeric (*Curcuma longa*) powder on growth performance, carcass traits, meat quality, and serum biochemical parameters in broilers. *Journal of Advanced Biomedical and Pathobiology Research,* 3 (2): 25-32.

Iheukwumere, F.C. and Herbert, U. (2012). Physiological responses of broiler chickens to quantitative water restrictions: haematology and biochemistry. *J. Poult. Sci.* 2:117- 119.

Jain, N. S. (1986). Schalms veterinary haematology (4thedn). Lea and Febiger, Philadelphia, USA.

Kermanshahi, H., and Riasi, A. (2006). Effect of Turmeric Rhizome Powder (*Curcuma longa*) and Soluble NSP Degrading Enzyme of Some Blood Parameters of Laying Hens. *International Journal of Poultry Science* 5 (5): 494-498.

Labban, L (2010). Medicinal and pharmacological properties of turmeric (*Curcuma longa*); A review. *Int. J. Pharma. Biomed Sci*. 5(1): 17 – 23.

Lee, K. W., Everts, H., and Beynen, A.C. (2004). Essential oils in broiler nutrition. *International Journal of Poultry Science*; 3:738-752.

Mitruka, B.M. and Rawnsley, H.M. (1977). Clinical, Biochemical and Haematological reference value in Normal Experimental Animal. Mason publishing company, New York, pp 35 – 50.

Ochefu, J., 2006. The effects of Kapok (Ceiba pentandra) seed meal-based diet on growth, carcass yield and blood chemistry of weaner rabbit. M.SC. thesis. Department of Aninmal breeding and physiology, University of Agriculture, Markudi.

Olabode, A. D., Adetutu, I. S., Agu, C. I., Ugwuowo, I. C., Ojuoloruntaye, T. J. and Okelola, O. E. (2018). Growth performance and haematological characteristics of starter broilers fed diets supplemented with turmeric (*Curcuma longa*) meal. *Nig. J. Anim Prod.* 45(5):79 – 83.

Quiles, J. L., Aguilera, C. and Mesa, M. D. (1998). An ethanolic-aqueous extract of *Curcuma longa* decreases the susceptibility of liver microsomes and mitochondria to lipids peroxidation in atherosclerotic rabbits. *Biofactors*;8 (1-2):51-57.

Ross, J.G., G. Christie, W.G. Halliday and R.M. Jones, (1978). Haematological and chemistry comparison values for chemical pathology in poultry. *Vet. Res.*, 102: 29-31.

Sharma, K.K. (2003). Improving bioavailability of Iron in Indian diets through food-based approaches for the control of iron deficiency anemia. *Food Nutrition and Agriculture*, 32, 51–61.

Silva, F. and Azevedo, C. A. V. de. (2016). The Assistat Software Version 7.7 and its use in the Analysis of Experimental Data. *African Journal of Agric. Research.* 11 (39):3733 - 3740.

Sodamola, M. O, Jimoh, W. A, Adejola, Y. A, Akinbola, D. D, Olanrewaju, A. and Apiakason E. 2016. Effect of Turmeric (*Curcuma longa*) Root Powder (TRP) on the Growth Performance, Hematology and Serum Biochemistry of African Catfish (*Clarias gariepinus*) *Academia Journal of Agricultural Research* 4(9): 593-596.

Sugiharto, I., E. Widiastuti and N. S. Prabowo (2011). Effect of Turmeric Extract on Blood Parameters, Feed Efficiency and Abdominal Fat Content in Broilers. *J. Indonesian Trop. Anim. Agric*. 36(1): 23 – 26.

Wang, R., Li, D., and Bourne S. (1998). Can 2000 years of herbal medicine history help us solve problems in the year 2000. In Lyons, T. P., Jacques, K.A. eds. Biotechnology in the Feed Industry. Proceedings of Alltech's 14th Annual Symposium, Nottingham (UK): Nottingham University Press. Pp. 273-291.

Zhang, G.F., Yang, Z.B., Wang, Y., Yang, W.R., Jiang, S.Z. and Gai, G.S. (2009). Effects of ginger root (*Zingiber officinale*) processed to different particle sizes on growth performance, antioxidant status and serum metabolites of broiler chickens. *J. Poult. Sci.* 88, 2159-2166.

GROWTH PERFORMANCE, DIETARY SELECTIVITY AND NUTRIENTS PROFILE OF BROILER CHICKENS ON A CAFETERIA FEEDING REGIME

***AJETUNMOBI, A.W.; + OLOGHOBO, A.D. AND ++EGUAOJE, S.A.**
**Agric., Edu Dept. Adeniran Ogunsanya Coll. of Edu., Lagos.*
+ Dept. of Animal Science, University of Ibadan, Ibadan.
++ Dept. of Animal Science, University of Benin, Benin City.

Abstract
The study was conducted to determine growth performance, dietary selectivity of feed ingredients and nutrient profile of broiler chickens at 42 days of rearing. Two hundred and eighty-eight (288) unsexed day-old FUNAAB ALPHA Strain broiler chicks raised in battery cages were randomly distributed in a completely randomized design into 5 cafeteria dietary treatments and a basal dietary treatment groups of 6 replicate each containing 20% crude protein and 300kcal MC/kg. The results showed significant differences (P<0.01) among the treatment for all production variables except for feed: water radio. Weight gains were better (P>0.01) in broiler fed Red sorghum-soyabean meal-concentrate and Red sorghum-millet-soyabean meal-groundnut cake-concentrate. The feed conversion ratio showed similar trends with the weight gains and final body weights. The co-efficient of preference (%) indicated higher values (74g 5%) for millet in millet-soyabean concentrate diet compared to 67.43% for red sorghum in Red sorghum-soyabean meal- concentrate diet. Nutrient profile of the cafeteria dietary treatments showed similar trends with other measured variables. It was shown that Red sorghum and millet can nutritionally and suitably be used with soyabean meal for cafeteria-fed broilers that can select and consumed feedstuffs to meet energy, protein and mineral needs for growth and production.

Keywords: Cafeteria, coefficient of preference, dietary selectivity, nutrient profile, growth indices.

Introduction
Birds' performance and their products are affected by nutrition and feeding systems. Poultry can be managed under different feeding systems.Feed intake is influenced by the interface between nutrition, management and animal responses (Church and Pond, 1988; Leeson and Summer, 2005). About 86.2 percent of the poultry are managed under traditional husbandry systems (Tewe, 1998). Cafeteria system could be an option to *ad libitum* complete diet feeding. It allows the animals to select their own diet (Forbes and Shariatmadari, 1994; Forbes and Covasa, 1995). Cafeteria feeding has recently not received considerable research attention to meet the current needs of the poultry industry. Cafeteria study will serve as a basis for establishing semi intensive system for rural small-scale poultry production. The objective of the study was to evaluate the production response, dietary selectivity and nutrient profile of broiler chickens on a cafeteria feeding system.

Materials and Methods
The experiment was conducted at the poultry unit, Teaching and Research Farm, Agricultural Education Department, Adeniran Ogunsanya College of Education, Otto/Ijanikin, Lagos. Two Hundred and Eighty-eight unsexed day-old broiler chicks obtained from the hatchery of the Federal University of Agriculture, Abeokuta were randomly allotted to six experimental diets with six replicates of 48 broiler chicks each in a completely randomized design and raised in constructed cage system. The dietary treatments are presented in Table 1.

Table 1: Gross and Nutrient Composition of Test Finisher Diets

	COMPOSITION, %					
Ingredients	***Ma-SBM-C***	***S-SBM-C***	***S-GNC-C***	***Mi-SBM-C***	***Mi-GNC-C***	***S-Mi-SBM-GNC-C***
Maize	58.60	-	-	-	-	-
Sorghum	-	62.00	52.00	-	-	31.00
Millet	-	-	-	61.20	50.50	25.25
Soyabean meal	19.40	16.00	-	16.80	-	8.40
Groundnut cake	-	-	26.00	-	27.50	13.;75
Brewer's Dried Grain	5.00	5.00	5.00	5.00	5.00	5.00
Palm kernel cake	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	6.00	6.00	6.00	6.00	6.00	6.00
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00
Dicalcium phosphate	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.25	0.25	0.25	0.25	0.25	0.25
*Vitamin/Mineral premix	0.25.	0.25	0.25	0.25	0.25	0.25
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis	20.00	20.00	20.01	19.97	19.56	20.02
Crude Protein, %	4.34	4.19	4.25	7.90	7.33	5.78
Crude Fibre, %	3.95	3.35	4.05	3.97	4.60	3.99
Fat, %	157.56	150.01	152.49	150.79	153.63	154.92
Calorie:Protein ratio	3151.28	3001.10	3051.38	3011.20	3005.10	3101.50
ME,Kcal/kg						

**Contain per kg of diet: 10,000 iuVit. A, 2000 iuVit. D_3 51 iuVit. E, 2.24mg Vit. K, 5.5mg riboflavin, 10mg Vit. B_{12}, 25mg Niacin, 1mg Folic Acid, 250mg Choline, 8mg pantothenate, 54mg, Mn, 48mg Zn, 10mg Cu, 20mg Fe, 2.25mg Cobalt and BHT antioxidant*.

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The feeds were presented in a mash form with 3 - compartment feeding troughs to separate the sources of energy, protein and concentrate with the exception of 5 - compartment feeder for treatment containing all the energies and protein sources.

The following parameters were measured; weight gain, feed intake, feed conversion ratio, feed/gain ratio, water consumption, feed to water ration co-efficient of preference and nutrient profile. The data obtained were subjected to analysis of variance using the General Linear model procedure (SAS Institute, 2012).

Result and Discussion

The results of the growth performance, co-efficient of preference and the nutrient profile of the broiler chicken at the finisher stage (22-42 days) are presented in Tables 2, 3 and 4 respectively.

Table 2: Growth Performance of Broiler Chickens at the Finisher Phase (22-42days)

PARAMETERS	Ma-SBM-C	S-SBM-C	S-GNC-C	Mi-SBM-C	Mi-GNC-C	S-Mi-SBM-GNC-C	P-Value
MBW, g/bird	183.8±10.5^{a}	181.8±17.8^{ab}	98.1±9.3^{c}	163.8±14.6^{c}	118.5±14.6^{c}	171.5±15.1^{ab}	<0.001
MBW @ day 42, g/bird	1158.7±20.6^{a}	1020±95.41^{b}	311.6±122.5^{c}	858.5±55.1^{b}	428.2±139.2^{c}	1001±99.9^{b}	<0.001
Total Feed intake, g	2256.6±120.5^{bc}	2436.4±343.7^{ab}	895.8±211.2^{d}	1941.9±245.9^{c}	1185.4±186.2^{d}	2162.5±110.7^{bc}	<0.001
Feed Intake , g/b/d	376.1±15.5^{bc}	406.1±57.2^{ab}	149.3±35.2^{d}	323.6±40.9^{c}	197.5±31.03^{d}	360.4±18.4^{bc}	<0.001
Weight gain, g	974.8±61.8^{b}	838.2±81.8^{b}	213.5±113.2^{c}	694.7±59.4^{b}	309.8±130.9^{c}	829.5±109.5^{b}	<0.001
Weight gain, g/bird	162.4±13.5^{a}	139.7±13.8^{b}	35.5±4.3^{d}	115.7±12.3^{c}	51.6±9.57^{d}	138.2±11.3^{b}	<0.001
Feed Conversion Ratio	2.31±0.03^{a}	2.89±0.19^{b}	5.05±2.43^{a}	2.80±0.32^{b}	4.09±0.96^{ab}	2.64±0.37^{b}	0.089
Feed Efficiency	0.43±0.16^{a}	0.35±0.02^{ab}	0.22±0.10^{c}	0.36±0.04^{ab}	0.25±0.06^{bc}	0.38±0.05^{a}	0.029
Mean total water intake (ml)	4563.8±360.4^{a}	4747±1502.9^{a}	1736.3±625.7^{b}	3975.1±204.1^{a}	2111.4±776.8^{b}	4511.7±435.3^{a}	0.001
Mean water intake (ml/b/d)	126.7±4.8^{a}	138.2±43.6^{a}	48.7±18.5^{b}	113.4±5.7^{a}	60.2±21.8^{b}	128.7±12.5^{a}	0.009
Feed: Water ratio	0.49±0.06	0.53±0.11	0.53±0.06	0.49±0.06	0.61±0.22	0.48±0.03	0.709

MBW=Mean Body weight
a, b, c, d Means with different superscripts in the same row are significantly different

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

There were significant differences (P<0.01) among the treatments for all variables except for feed to water ratio. Feed intake was greater in broilers on cafeteria feeding of red sorghum - soya bean meal - concentrate differing significantly (P<0.01) from birds on free-choice feeding of sorghum-GNC-concentrate and millet-GNC concentrate. Feed intake was not statistically different (P>0.01) among the treatments of red sorghum-soyabean meal concentrate, millet-soyabean meal- concentrate and millet- red sorghum-soyabean-GNC-concentrate.

Table 3: Co-efficient of Preference and Proportion (%) of each Ingredient consumed by Broiler chicken at Finisher Phase (22-42 days)

INGREDIENTS	TREATMENTS					
	Ma-SBM-C	S-SBM-C	S-GNC-C	Mi-SBM-C	Mi-GNC-C	Mi-S-SBM-GNC-C
Maize (Ma)	74.20±3.49	-	-	-	-	-
Sorghum (S)	-	67.43±2.45	60.59±9.81	-	-	7.47±2.89
SBM	22.85±1.52	30.69±2.14	-	23.14±4.31	-	19.90±2.61
Millet (Mi)	-	-	-	74.95±4.49	66.22±5.59	53.26±7.13
GNC	-	-	37.17±9.89	-	32.28±6.07	16.28±6.06
*Conc (C)	2.95±0.68	1.87±0.68	2.24±0.27	1.91±0.77	1.50±0.25	2.55±0.65

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The result indicated higher preferences for millet, red sorghum and soyabean meal as good sources of energy and protein for better performance. Birds consumed less groundnut cake probably due to its low protein quality, poor palatability and unattractiveness compared to soyabean meal.

Table 4: Nutrient Profile of Broiler Chickens at Finisher Phase (22-42 days)

Parameters	TREATMENTS							
	Ma-Soy-C	S-Soy-C	S-GNC-C	Mi-Soy-C	Mi-GNC-C	S-Mi-SBM-GNC-C	SEM	P – Value
Feed Intake, g/b/d	376.1±15.5^{bc}	406.1±57.2^{ab}	149.3±35.2^{d}	323.6±40.9^{c}	197.6±31.1^{d}	360.4±18.4^{bc}	-	<0.001
Weight gain, g/bird	162.4±13.6^{a}	139.7±13.8^{b}	35.5±4.35^{d}	115.7±12.3^{c}	51.6±9.5^{d}	138.2±11.3^{b}	-	<0.001
ME intake, Kcal/Kg	1135.2^{c}	8032.1^{a}	2334.3^{bc}	6471.4^{a}	3749.6^{b}	7272.7^{a}	292.94	<0.0001
Energy conversion	7.3^{c}	13.3^{b}	15.56^{a}	13.24^{b}	19.41^{a}	11.99^{b}	3.40	<0.0001
CP intake, g/bird	75.2^{d}	643.5^{a}	168.8^{cd}	447.7^{b}	248.9^{c}	577.1^{ab}	29.1	<0.0001
Protein conversion	0.46^{b}	1.07^{a}	1.13^{a}	0.92^{a}	1.26^{a}	0.96^{a}	0.24	0.0001
Calorie: Protein ratio	15.7^{ab}	12.6^{c}	14.1^{bc}	14.4^{bc}	15.4^{ab}	12.7^{c}	0.6	0.005

ME - Metabolisable Energy CP - Crude Protein
a, b, c, d, Means with different superscripts in the same row are significantly different.
SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The birds utilized the nutrient in feedstuffs according to their choice to meet their nutritional needs. Poultry has been reported to adjust voluntary intake of feeds with different energy and protein densities (*Cruz et al, 2005; Rose, 1997).*

Conclusion and Recommendations

Red sorghum and millet as energy sources can adequately be utilized in combination with soya bean meal as the broilers on the diets containing these ingredients presented better growth performance, dietary selectivity and nutrient profile than when groundnut cake was used. This therefore will provide a guide for the improvement of feeding and nutrition of the rural poultry system, which will ultimately improve smallholder poultry production in a sustainable and economic manner for higher animal protein intake.

References

Church, D.C and Pond W.G. (1988). **Basic Animal Nutrition and Feeding**. Third Edition. U.S.A; John Wiley & Sons, Inc.

Cruz, V.C., Pezzato, A.C., Pinheiro, D.F., Goncalves and Sartori, J.R., (2005). Effect of Free-choice feeding on the performance and Ileal Digestibility of Nutrients in Broilers. *Brazilian Journal of Poultry Science* 7**(3)**:143-150.

Forbes, J.M. and Shariatmadari, F., (1994). Diet Selection for Protein by Poultry. *World's Poultry Science Journal* **50**: 7-24

Forbes, J.M and Covasa, M., (1995). Application of diet selection by poultry with particular reference to whole cereals. *World's Poultry Science Journal **51**: 149-165*

Leeson, S and Summers, J.D. (2005). **Commercial Poultry Nutrition.** 3rd Edition. England: Nottingham University Press.

SAS Institute. (2012). SAS/STAT® User's Guide. SAS Institute Inc. Cary, NC

Tewe. O.O., (1998). Sustainability and Development: Paradigms from Nigeria's livestock industry, Ibadan. Inaugural Lecture, 1996 – 1997. University of Ibadan, 42pp.

GUT CHARACTERISTICS AND ILEA DIGESTIBILITY OF BROILERS FED PELLET AND MASH FEED FORMS

Akande T.O., Olakanmi O. F., Okunlola P.F. and Owolabi E.O.
Obafemi Awolowo University, Ile-Ife, Osun State
yakandetaiwo@yahoo.com

ABSTRACT
A study was conducted to evaluate performance, gut characteristics and nutrient digestibility of broilers fed pellet and mash feed forms. 100 Cobb-500 one-day old broilers used were randomly grouped into two treatments of five replicates and 10 birds per replicate in a deep litter system. The birds were fed with 2mm and 4mm die size pelletized feed at the starter and finisher phase respectively while commercial mash feed grade was applied at starter and finisher phase. The experiment lasted 7 weeks. Five days to the end of the experiment, two birds per replicate were separated into metabolic compartment for ilea digestibility trial and they were offered feed treated with chromic oxide at 0.2% for the five days. On the 6th day, the birds were slaughtered and the ilea content of the gut was collected for the proximate and chromic content determination. The morphometric measurement of the internal organs and intestinal components of the birds were taken and sample collected for histological assessment. The result showed significant difference (p<0.05) in the performance parameters measured with the birds fed pellet having higher feed intake, body weight gained and superior feed conversion ratio. There was no significant difference (p>0.05) in the length of the duodenum, jejunum and ileum and weight of the heart and liver between the two treatments while the gizzard weight was higher (P<0.05) in birds fed mash feed form. Ilea nutrient digestibility for ether extract was higher in birds on pellet. It was deduced from the result of the experiment that pellet feed form performed better than mash counterpart and with significant influence on the gut physiology and overall better nutrient utilization.
Key words: broilers, feed forms, ilea digestibility, gut morphology,

INTRODUCTION
Feed composition, feed structure and feed form are most important factors that determines the efficiency of feed utilization by animals particularly poultry because of the simple nature of their stomach (Choct *et al*., 2004; Ball *et al*., 2015). Modern meat type chicken have high appetite for feed which translate to increased live production costs claiming about 60-70% of total cost (Aliakbarpour *et al*.,2013; Willems *et al*., 2003). Therefore, broilers' feed consumption and utilization should be well studied to ensure optimum performance of the birds so as to offset maximum and substantial profit.

The growth and development of the gastrointestinal tract is equally vital for broiler chickens as it helps to effectively utilize nutrients in their diet (Jacobs *et al.,* 2010). Feeds fed to broiler can assume different forms such as pellets, mash and crumble due to difference in processing method during feed formulation. Mash is a form of a complete feed that is finely ground and mixed so that birds cannot easily separate out ingredients; crumble also is a type of feed prepared at the mill by pelleting of the mixed ingredients and then crushing the pellet to a consistency coarser than mash; while pellet is a feed form that is small (using different dies depending on the desired size) rounded and compressed in to a mass of substance. Ilea digestibility which collects digesta from part of the ileum is a more complex method of measuring digestibility but tactically eliminates some confounding factors such as urine and microbial contributions into the excreta which may produce overestimation of nutrient utilization. The objective of the study is to determine the comparative effect of two feed forms (i.e. mash and pellet) on the performance of broiler chicken, some gut characteristics and the ilea digestibility of the birds.

MATERIALS AND METHODOLOGY
Experimental station and Birds Management.
The experiment was conducted at Obafemi Awolowo Teaching and Research Farm, Ile-Ife, Osun State Nigeria. One hundred day old Cobb 500 were obtained from a reputable farm and were brooded in a floor litter system for two weeks but the birds were together for the first week after which they were distributed randomly to their various experimental pen at the beginning of the second week. The birds were offered a starter compounded ration 23%CP and 3000kcal/kg ME and

a finisher diet 21%CP, 3000kcal/kg at the onset of the fourth. Water and feed were offered *ad-libitum* while other routine management was performed as appropriate.

Experimental diets

The ingredients used for the feed formulation were purchased from a reputable commercial feed ingredient seller in Ile- Ife while the milling, mixing and pelleting were carried out at OAU Teaching and Research Farm. The gross compositions of the experimental diets are as shown in Table 1

Table1: Gross composition of the experimental diets

Feed Ingredients	Starter	Finisher
Maize	56.0	58.0
Soya bean meal	15.0	15.0
Groundnut cake	16.0	12.5
Palm kernel cake	4.50	8.00
Fish meal	4.0	2.0
*Other feed ingredients	4.5	4.5
Calculated analysis		
Crude Protein	23.1	20.30
Crude fibre	3.53	3.93
Metabolizable Energy	2993	2957

*Other feed ingredients: bone meal=2.5, 0yster shell=1.0, Methionine=0.3. Lysine=0.3, Pre.=0.2, salt=0.2

Data collections and Analysis

The initial weight of the birds was taken by end of first week using a digital scale while feed intake was obtained on weekly basis. At the end of the feeding trial which lasted 7 weeks, two birds from each replicate were randomly selected and transferred into metabolic cage. The birds were fed with chromic oxide supplemented diet at 0.2% concentration for 5 days and after which they were sacrificed to recover the ilea content. The sampling of the ilea segment of the intestine was standardized by collecting from the region between 30 mm before the ileo-cecal junction and 30 mm after Meckel's diverticulum, in order to avoid contamination of the cecal and jejunal flow, respectively. Contents from the ileum of each bird were collected by gentle finger-stripping directly into a jar, homogenized and oven dried (80 C) for 48 h, ground (0.5mm screen), and stored in air tight labelled bags for subsequent analysis. Sample of the diets and dried ilea content were taken to laboratory for determination of chromic oxide concentration and proximate contents according to the procedure of AOAC (2009).

The length of the duodenum, jejunum and ileum were taken using a measuring tape while small portion of the duodenum and jejunum were cut and preserved in 10% formalin. Samples were later prepared on slide for micrographs. The data generated were analyzed using student T-test of SAS 2009 statistical package.

RESULT AND DISCUSSION

Production performance of broiler fed mash and pellet feed forms

Data on performance indices are as presented in Table 2. The result shows that all performance parameters were significantly different ($p< 0.05$) across the treatments. The finding aligned with earlier reports on numerous advantages associated with pelleting which include enhancement of feed intake and growth of animals as a result of the reduction in feed wastage, decreasing of energy used

for consumption, improving palatability, and the reduction of dustiness of feed (Abdollahi *et al.*, 2013). However, a marginal increase in cost is expected with bird on pellet because of extra cost accrued from pelleting as indicated by Jahan *et al.* (2006).

Table 2: Performance characteristics of broiler chicken

Treatment	Control (mash)	Pellet	P value
Initial body weight (g)	152.52±0.8869	152.16±1.0348	0.80
Final body weight (g)	2473.7±29667[a]	2992.3±91.167[b]	0.01
Body weight gain (g)	2321.1±29.873[a]	2840.2±91.31[b]	0.03
Daily weight gain (g)	55.265±0.7113[a]	67.263±2.1743[b]	0.04
Total feed intake (g)	4964±70.62[a]	5533±102.8[b]	0.01
Feed conversion ratio	2.1388±0.0229[a]	1.9517±0.06[b]	0.049

**ab means in the same column followed by different letter are significantly different. P<0.05

Gut morphology and Ilea digestibility of broiler fed mash and pellet feed form.

The result of the organ, intestinal and micrographs of the duodenum and jejunum are given in Table 3. Digestion and absorption of feed takes place majorly in the duodenum and the jejunum and partially in the ileum aided by the presence of the villus and crypt. Any changes observed in the villus and crypt may influence the rate of digestion and absorption as these components increase the surface area of the intestine and expose the feed to proper enzymatic reaction. The result in the Table 3 shows that the villus height of the duodenum and jejunum of birds fed pellet was significantly higher (P< 0.5) than birds on mash feed. The higher feed intake observed in birds fed pellet increased the activity of the villus in the intestine and may have resultant effect in their length being longer. The increased villus height may increase total luminal villus absorptive area and subsequently result in greater digestive enzyme action and enhanced transport of nutrients at the villus surface (Naderinejad *et al*., 2016). These higher value of the villus height of duodenum and jejunum and higher value of the crypt depth of jejunum observed in birds fed pellets may be responsible for the better performance observed. Although, there were marginal rise in nutrient digestibility of birds on pellet only ether extract was significantly different (P<0.05).

Table 3: Organ and intestinal measurement of broiler chickens

Treatment	**Control (mash)**	**Pellet**
Duodenum(cm)	36.00±3.03	46.00±6.02
Jejunum (cm)	85.50±6.364	80.50±3.500
Ileum(cm)	78.00±10	93.00±2.887
Gizzard (g)	57.00±2.000[a]	38.50±0.500[b]
Liver(g)	23.00±2.000	23.500±4.500
Heart(g)	12.00±2.000	14.00±100
Villus height duodenum(µm)	1829.30±78.760[b]	2349.9±65.539[a]
Villus height jejunum(µm)	664.56±46.709[b]	1443.50±27.839[a]
Crypt height duodenum (µm)	520.95±14.738[a]	304.95±16.689[b]
Crypt height jejunum (µm)	256.05±20.509[b]	441.77±18.333[a]

**ab means in the same column followed by different letter are significantly different. P<0.05

CONCLUSION

It was concluded that pellet feed form significantly improved feed conversion, influenced some gut changes and translated to better overall nutrient utilization in Cobb-500 broilers. Hence, farmers are advised to opt for pellet feed form for broiler chickens.

REFERENCES

A.O.A.C. (2009). Official Methods of Analysis of the Association Analytical Chemistry revised Edition. 13th Edition Washington D.C. United States of America. Pg 1094

Abdollahi M.R., Ravindran V., Svihus B. (2013). Influence of grain type and feed form on performance, apparent metabolisable energy and ileal digestibility of nitrogen, starch, fat, calcium and phosphorus in broiler starters. *Anim Feed Sci Technol* 186: 193-203.

Aliakbarpour H.R., Chamani M., Rahimi G., Sadeghi A.A., Qujeq D. (2013). Inter-mittent feeding programme and addition of Bacillus subtilis based probiotics to the diet of growing broiler chickens: influence on growth, hepatic enzymes and serum lipid metabolites profile. *Arch Anim Breed* 56: 410-422.

Ball M.E,E,, Magowan E,, McCracken K.J., Beattie V.E., Bradford R., *et al*. (2015). An investigation into the effect of dietary particle size and pelleting of diets for finishing pigs. *Livest Sci* 173: 48-54

Choct M., Selby E.A.D., Cadogan D.J., Campbell R.G. (2004). Effect of particle size, processing, and dry or liquid feeding on performance of piglets. *Aust J Agric Res* 55: 237-245.

Jacobs CM, Utterback PL, Parsons CM (2010) Effect of corn particle size on growth performance and nutrient utilisation in young chicks. *Poult Sci* 89: 539-544

Jahan M. S, Asaduzzaman M and Sarkar A . K (2006) Performance of Broiler Fed on Mash, Pellet and Crumble. International Journal of Poultry Science 5 (3): 265-270.

Naderinejad S., Zaefarian F., Abdollahi M.R., Hassanabadi A., Kermanshahi H., Ravindran V. (2016). Influence of feed form and particle size on performance nutrient utilisation, and gastrointestinal tract development and morphometry in broiler starters fed maize-based diets. *Anim Feed Sci Technol 215: 92-104.*

S.A.S. (2009). SAS User's guide, version 9.1 for windows, Statistical Analysis Systems Institute, Inc.,Cary, NC, U. S. A.

Willems O.W., Miller S.P., Wood B.J. (2003). Aspects of selection for feed efficiency in meat producing poultry. *World Poult Sci J* 69: 77-88.

GROWTH PERFORMANCE AND SERUM METABOLITES OF GROWING PIGS FED MICROBIAL DEGRADED CASSAVA PEEL-LEAF MEAL DIET

Akinola, O.S.[a*], Ayansola, E. I[a]., Williams[a], G.A.[b], Oso, A.O.[b], Egbeyale, L T.[a]

[a] *Department of Animal Production and Health, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta PMB 2240, Nigeria*

[b]*Department of Animal Nutrition, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta PMB 2240, Nigeria*

[a*] *Email address:bayomiola@gmail.com*

Abstract

This study was aimed to evaluate the effect of microbial degraded cassava peel-leaf blend on the growth performance and blood serum biochemistry of growing pigs. Eighteen intact male growing pigs (Landrace), weighing 44.6kg, were housed in a concrete cubicle with six pigs per treatment for six weeks. Pigs were fed ad libitum feed and water. Experimental diets were: control, microbial treated cassava peel and leaf blend and untreated cassava peel and leaf blend diets. The Cassava peel-leaf blend replaced maize at 100%. Cassava peel and leaf were mixed at ratio 5:1, allowed to ferment using Aspergilus tamari at 10.5 x 10^8 spurs/gram for five days, after which the mass was sundried to form microbial degraded cassava peel-leaf (MCPL). While the untreated cassava peel and leaf blend was tagged UCPL. Daily feed intake recorded and body weight was recorded for each treatment weekly. At the end of the experiment, blood samples were collected for serum biochemical indices. The results showed that pigs fed MCPL marginally gained more weight compared to pigs on the UCPL and control diets; and that the FCR of pig on MCPL was marginally better than those on other diets. The inclusion of cassava peel-leaf blend with or without microbial degradation had no significant (P>0.05) effect on the serum biochemical indices. It may be concluded that, feeding of microbial degraded cassava peel-leaf blend caused marginal improvement in the growth of pigs with no effect on blood serum biochemical indices.

Key Words: Pigs, microbial degraded, Growth performance, Serum metabolites, cassava peel-leaf blend

Introduction

The pig industry depends to a large extent on the availability of good quality pig feeds in sufficient quantity and at affordable price. In non-ruminant animals, such as pigs and poultry, greater proportion of cost is expended on feeding, feed representing 65-70% of total cost in intensive production system, in Nigeria and many developing countries (Apata and Babalola, 2012). As a result, alternate and cheap ingredients have been advocate, especially in the feeding of pigs. In general, the factors limiting the optimal use of alternate ingredients for monogastric animals include low palatability, often due to high levels of anti-nutritional factors (e.g. in cassava), low dry matter content (e.g. in duckweed) or high fibre content (e.g. in banana leaves and stem) and the low biological value of the protein (Khieu, 2014).

Cassava root is a rich source of energy but with low protein. Its by-products include: cassava peel, cassava leaf, cassava flour, cassava chaff and sievate. Major limitations in using cassava root is it low crude protein and presence of hydrocyanic acid (HCN). Several reports have shown that cassava leaf is high in protein, rich in lysine but low in some sulphur amino acids (Gomez and Valdivieso 1985).

Here in Nigeria, cassava peels and leaves are agricultural by product mostly discarded or fed to the local goat and sheep after the main content of the cassava product has been collected for further processing. However, their importance has not been discovered by both the local and commercial farmers in the Nigeria agro-industry (Aro *et al*., 2010; Adebayo, 2008). As such the combine use of

cassava peel and leaf in feeding of non-ruminant will assist in improving the utilization of these by-products and assist the farmer's economy.

Recent studies show that the biodegradation of by-products increase it nutritive content and reduces anti-nutritional content (Hawashi et al. 2019; Chebaibi et al. 2019). Augmenting cassava peel with other plant materials high in protein have been recommended to improve it use (Oni, 2010). Sun-drying and fermentation have been reported to reduce HCN or other anti-nutrients to tolerable level in diets (Ajagbonna et al., 1999). Therefore, this study is focused on evaluating the response of growing pig fed microbial degraded cassava peel and leaf blend diet.

Materials and Methods

The experiment was carried out at the piggery unit of the Directorate of University Farms, (DUFARMS) and at the College of Animal Science and Livestock Production Farm, Federal University of Agriculture, Abeokuta, Alabata, Ogun State, Nigeria. The site is situated in the derived savanna zone of the Southwestern Nigeria on Latitude $7^0$9' 39N and $3^0$20' 54E and 76m above sea level. The Mean Annual Rainfall is 1040mm and occurs from March to October, temperature average is 34.0C throughout the year.

Cassava root peels was collected from a reliable local cassava processing factory in Abeokuta and cassava leaves without petioles were sourced, sun dried. The two by-products were mixed at ratio 5:1 of cassava peel to leaves; degraded using microbial action *(Aspergilus tamari*) under anaerobic condition in a closed PVC nylon and container for 5 days; and then sun-dried. Table 1 show the gross composition of the experimental diet. Eighteen Male Land race pigs, weighing 44.6kgwere used Each treatment was allotted six pigs and given *ad libitum* feed and water six weeks. Daily feed intake and weekly weight of each pig, in each treatment, were recorded. Blood for serum biochemistry was collected at the end of the study and put in plane tube and analysed for Total protein, Albumin, Globulin, Cholesterol, Urea, Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), Alkaline Phosphatase (ALP) and Creatinine. Data were subjected to one-way analysis of variance in a completely randomized design using MINITAB 17. The difference among means was separated using Tukey krammer mean comparism procedure.

Results and Discussion

The effect of microbial degraded blend cassava peel-leaf meal on growth performance of growing pigs is shown (Table 2). The final weight gained of pigs fed MCPL was not significantly ($P>0.05$) improved compared to those on UCPL and the control diets. The feed conversion ratio of pigs on MCPL diet was not significantly ($P>0.05$) improved above those on other diets. Adeyemi et al. (2014) obtained similarity in values for all indices of performance for maize based diet and diet containing 50% replacement of maize with naturally fermented cassava peel and leaf meal for rabbit.

Table 1: Gross composition of experimental diet

Ingredients (g/kg)	Control	MCPLF	UCPLF
Maize	40.00	0.00	0.00
Microbial degraded Cassava Peel and leaf blend	00.00	40.00	0.00
Untreated Cassava Peel and leaf blend	00.00	0.00	40.00
Palm kernel Oil	1.00	4.50	3.50
Soyabean meal	17.00	18.00	19.00
Groundnut Cake	8.00	10.00	11.00
Palm Kernel Cake	11.00	10.00	10.00
Wheat offal	18.00	12.50	11.50
Bonemeal	3.00	3.00	3.00
Limestone	1.00	1.00	1.00
Salt (NaCl)	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Total	**100**	**100**	**100**
Nutrients Composition			
Metabolisable energy (Kcal/kg)	2588.00	2516.00	2588.25
Crude protein (%)	19.16	19.68	19.29
Ether extract (%)	3.88	2.97	3.83
Fibre (%)	4.90	9.26	7.68

Microbial diet has 10.5 X 10^8 spurs/gram of *Aspergilus tamari* and untreated diet contains no inoculum culture.

Table 2: Growth performance of pigs fed microbial degraded cassava peel leaf meal diet.

Parameters	Control	MCPL	UCPL	SEM	P VALUE
Initial weight (kg)	44.00	43.50	45.00	3.970^{NS}	0.983
Final weight (kg)	65.83	67.17	66.83	1.890^{NS}	0.944
Weight gain per day(kg)	0.45	0.48	0.45	0.011^{NS}	0.274
Feed intake per day (kg)	2.18	2.14	2.20	0.118^{NS}	0.923
Feed Conversion Ratio	4.25	3.79	4.28	0.289^{NS}	0.408

SEM = Standard Error of mean; NS = Not Significant

Slight increase in final weight and weight gain observed with pigs fed diet containing MCPL. Solid state fermentation has been reported to enhance the nutrient content of foods through the biosynthesis of vitamins, essential amino acids and proteins by improving protein quality and fibre digestibility (Achinewhu et al., 1998). The slightly reduced feed intake can be explained by the higher water holding capacity of cassava peel-leaf by-product (Ngoc et al., 2013), which invariably increases the bulk density of the feed (Kyriazakis and Emmans, 1995). Fermented by-products may add some probiotic effects, which contributed to the improved FCR (Hong et al. 2016). Giang et al. (2010) reported that dietary supplementation of a lactic acid bacteria complex together with *Bacillus* and *Saccharomyces* to growing-finishing pigs improved FCR.

The effect of microbial degraded cassava peel, leaf meal on the serum biochemical parameters of growing pigs is shown on Table 3. The result revealed that there was no significant (P>0.05) effect of diets on the on serum biochemical parameters of pigs. Blood total protein ranged from 7.4 – 7.8 g/dl, Aspartate amino transferase (AST) value ranges from 36-38 U/L and Alanine amino transferase (ALT) 33-38 U/L.

Table 3: Effect of microbial degraded cassava peel leaf on the blood serum

Parameters	Control	MCPLF	UCPLF	SEM	P VALUE
Total protein (g/dl)	7.42	7.89	7.54	0.724^{NS}	0.897
Albumin (g/dl)	3.86	4.48	4.88	1.090^{NS}	0.809
Globulin (g/dl)	3.56	3.41	2.66	0.698^{NS}	0.642
Cholesterol (g/dl)	76.10	110.20	84.50	12.40^{NS}	0.207
Urea (mg/dl)	3.24	5.10	3.48	1.110^{NS}	0.483
AST (U/L)	38.00	36.33	38.00	5.620^{NS}	0.971
ALT (U/L)	38.67	39.00	33.00	3.910^{NS}	0.514
ALP (U/L)	51.33	39.67	40.00	5.600^{NS}	0.316
Creatinine	0.65	0.75	0.57	0.495^{NS}	0.119

Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), Alkaline Phosphatase (ALP)

SEM= Standard Error of Mean; NS = Not Significant

The serum total protein and albumin of the growing pigs in this study were not affected by the diets in the three treatments. Gouache *et al.* (1991) reported albumin to be specifically influenced by protein shortage.

No significant (P>0.05) effect was observed in serum creatinine value with the imposed treatment. Ehebha and Eguaoje (2018) reported no significant difference in creatinine values of broiler fed varying dietary levels of sundried cassava peel meal supplemented with enzyme (Maxigrain). This indicate that no muscular wastage result from the use of cassava peel-leaf blend.

Conclusion and Recommendation

Microbial degradation caused marginal improvement of all growth performance parameter measured, except slight decrease in feed intake. All Serum indices measured indicated no adverse effect of microbial degraded cassava peel-leaf on the availability of nutrient for normal function of the growing pigs.

It is recommended that the utilization of cassava peel-leaf meal can be improve the adoption of microbial degradation.

REFERENCES

Achinewhu, S.C., Barber, L.I., Ijeoma, I.O., 1998. Physicochemical properties and garification (gari yield) of selected cassava cultivars in Rivers State, Nigeria. Plant Food Hum. Nutr. 52(2), 133-140.

Adebayo, A. O., 2008. Using cassava waste to raise goats. Project 2008-4345. World Bank Development Marketplace

Adeyemi, O.A., Adesanya , P.A., Eniolorunda , O.O., Sogunle , O.M., Egbeyale , L.T., Njoku, C.P., 2014. Performance of growing rabbits fed diets containing fermented and unfermented cassava leaf: peel meal mix as replacement for maize. Mal. J. Anim. Sci. 17(1), 61-72.

Ajagbonna, O. P., Onifade, K. I., Suleman, U., 1999. Haematological and Biochemical Changes in Rats Given Extracts of Calotropis procera. Sokoto J. Vet. Sci. 1, 36-42.

Apata, D. F., Babalola, T. O. 2012. The Use of Cassava, Sweet Potato and Cocoyam, and Their By-Products by Non – Ruminants. *International Journal of Food Science and Nutrition Engineering* 2012; 2(4): 54-62

Aro, S.O., Aletor, V. A., Tewe, O. O., Agbede, J. O., 2010. Nutritional potentials of cassava tuber wastes: A case study of a cassava starch processing factory in south-western Nigeria. Livest. Res. Rural Dev., 22 (11)

Chebaibi Salima, Grandchamp-Leriche Mathilde, Clément Tiphaine, Burgé Grégoire, Allais Florent and Laziri, Fatiha (2019). Improvement of protein content and decrease of anti-nutritional factors in olive cake by solid-state fermentation: A way to valorize this industrial by-product in animal feed. Journal of Bioscience and Bioengineering. 128. 10.1016/j.jbiosc.2019.03.010.

Ehebha, E. T. E., Eguaoje, A. S., 2018. Haematological and serum biochemical indices of broiler chickens fed varying dietary levels of sundried cassava (manihot esculenta) peel meal supplemented with enzyme (MAXIGRAIN®). Asian J. Res. Anim. Vet. Sci. 1(4), 1-9.

Giang, H.H., 2010. Impact of bacteria and yeast with probiotic properties on performance, digestibility, health status and gut environment of growing pigs in Vietnam. Doctoral thesis, Swedish, University of Agricultural Sciences, Uppsala, Sweden.

Gomez, G.; Valdivieso, M., 1985. Cassava foliage: chemical composition, cyanide content and effect of drying on cyanide elimination. J. Sci. Food Agric., 36 (6): 433-441.

Gouache, P., Lemoullac, B., Bleiberg- Daniel, F. Aubert, R., Flament, C., 1991. Changes in rat plasma apolipoproteins and lipoproteins during moderate protein deficiency: Potential use in the assessment of nutritional status. J. Nutr. 121(5), 653-662.

Hong, T. T. T., Van An, Le, Be, P. T., Lindberg, J. E., 2016. Effect of Fermented Rice Bran and Cassava Waste on Growth Performance and Meat Quality of Crossbred Pigs. World J. Agric. Res. 4(5), 132-138

Kyriazakis, I., Emmans, G.C., 1995. Voluntary intake of pigs given feeds based on wheat bran, dried citrus pulp and grass meal in relation to measurement of feed bulk. Br. J. Nutr. 73, 191-207.

Hawashi, M., Widjaja, T. and Gunawan, S. (June 25th 2019). Solid-State Fermentation of Cassava Products for Degradation of Anti-Nutritional Value and Enrichment of Nutritional Value [Online First], IntechOpen, DOI: 10.5772/intechopen.87160.

Ngoc, T.T.B., Len, N.T., Lindberg, J.E., 2013. Impact of fibre intake and fibre source on digestibility, gut development, retention time and growth performance of indigenous and exotic pigs. Animal. 7, 736-745.

Oni, A.O., Arigbede, O.M., Oni, O.O., Onwuka, C.F.I., Anele, U.Y., Oduguwa, B.O., Yusuf, K.O. 2010. Effects of feeding different levels of dried cassava leaves (Manihot esculenta Crantz) based concentrates with Panicum maximum basal on the performance of West African Dwarf goats. Livestock Science, 129, 24–30.

EFFECTS OF BAMBARA NUT OFFAL FED AS A REPLACEMENT FOR WHEAT OFFAL ON GROWTH PERFORMANCE AND CARCASS YIELD OF WEANER RABBITS

[*]Amaefule, V.D.,[*]Fasasi, M.O, [*]Bamgbose, A. M., [*]Oso, A.O., [**]Olayemi, W.A, Oladigbolu, F.D., [*]Ogunsola, I. A., [***]Raji, M.O, and [****]Safiyu, K.K

[*]Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

***Department of Agricultural Technology, Yaba College of Technology, Yaba, Lagos, Nigeria*

****Department of Animal health and Production Technology, Oyo State College of Agriculture and Technology, Igboora, Oyo State, Nigeria*

***** Department of Animal Production and Livestock Management, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria*

** Correspondence: mukhulisololade@gmail.com, +2348136314270*

Abstract

To evaluate the effect of Bambara nut offal (BNO) fed as a replacement for wheat offal (WO) on growth performance and carcass yield of weaner rabbits, a total of 24 mixed breed unsexed weaner rabbits were purchased, weighed and randomly grouped into four dietary treatments of 6 replicates each. The four dietary treatments were made up of varying ratios (in percentages) of BNO and WO at 0:100, 25:75, 50:50 and 75:25 respectively. Initial and final body weights, feed intake and feed conversion ratio (FCR) of the rabbits were taken on a weekly basis and the carcass yield was determined at the end of the study. The experiment was laid out in a completely randomized design and data obtained were subjected to one-way analysis of variance. The study showed that replacement of WO with BNO did not significantly influence ($p>0.05$) growth performance of rabbits across replacement ratios. Increasing the ratio of BNO to WO produced carcass yield closer to that of rabbits on 100% WO. Also, no significant differences ($p>0.05$) were recorded for carcass parts of commercial importance across treatments aside from tail where rabbits on 25%BNO recorded value (0.45g) significantly higher ($p<0.05$) than others on higher BNO levels but all are similar in weights to that of rabbits on 100%WO. Replacing WO with BNO in weaner rabbits' diets is therefore recommended as it produced similar results on growth performance and carcass yields.

Keywords: Weaner rabbits, Bambara nut offal, Wheat offal, Carcass yield, Growth performance

Introduction

Nigerians have been reported to be consuming about 7g of protein per day which is lower than 28g/head/day recommended by FAO (Uchegbu *et al.*, 2007). Rabbit is among the new livestock being explored to beef up the shortage in animal protein supply due to their short maturity period and overall acceptability when compared to major livestock such as cattle, sheep, goat and chickens (Yusuf *et al*., 2009). However, high cost of conventional feedstuffs which accounts up to 70% of the total production (Ijaiya, 2013) is a major challenge in animal production. Bambara nut offal is a cheap and commonly available fibrous waste gotten from processing of Bambara seed into flour used in preparing a delicacy called 'Okpa' in Southeastern part of Nigeria. Therefore, this study evaluated the effects of Bambara nut offal as a replacement for wheat offal on growth performance and carcass yield of weaner rabbits.

Materials and Methods

Preparation of the test ingredient

Bambara nut offal used for this experiment was sourced from Okpa processing centers in Igbo communities around Abeokuta, Ogun State. The offal was gotten after Bambara seed was washed, dried at 60°C for 8 hours, milled into flour and sieved. The dried Bambara nut offal collected was packed inside clean sacks, sundried to moisture content below 10% and taken to feed mill.

Experimental animals and management

A total number of 24 mixed breed unsexed weaner rabbits aged 6-7 weeks and weight range of 600-650g, were purchased from a reputable rabbit farm at Apata, Ibadan, Oyo state. On arrival, the initial weight of the rabbits were taken and randomly allotted into 4 experimental treatments of 6 replicates each. The animals were kept inside clean and disinfected wooden hutches and subjected to standard routine managements. Feed and water were provided to the animals *ad libitum* throughout the experimental period which lasted for eight weeks.

Experimental diets and design

Four different diets were formulated such that the control treatment groups were fed diet containing 0% inclusion of Bambara nut offal (BNO) as a replacement for wheat offal while experimental birds in the second, third and fourth treatment groups received diets containing 25%, 50% and 75% BNO as replacements for wheat offal. The experiment was laid out in a completely randomized design. The gross composition of the experimental diets is shown on Table 1.

Table 1: Gross composition (%) of the experimental diets for weaner rabbits.

Ingredients	**Control**	**25%BNO**	**50%BNO**	**75%BNO**
Maize	38.00	38.00	38.00	38.00
Soybean meal	17.00	17.00	17.00	17.00
Wheat offal	40.00	30.00	20.00	10.00
BNO	-	10.00	20.00	30.00
Fish meal (72%)	0.50	0.50	0.50	0.50
Bone meal	2.50	2.50	2.50	2.50
Limestone	1.48	1.48	1.48	1.48
Premix starter	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Toxin binder	0.02	0.02	0.02	0.02
Total	**100.00**	**100.00**	**100.00**	**100.00**
Determined analysis				
Metabolizable energy (Kcal/g)	2.52	2.53	2.55	2.56
Crude protein (%)	18.3	18.25	18.16	18.09
Crude fibre (%)	10.0	10.5	11.0	11.5

BNO- Bambara nut offal

Data collection

Growth performance

Weekly data was collected for growth parameter indices using the following formula:

$$\text{Weight gain per rabbit (g)} = \frac{\text{Final weight (g)} - \textit{Initial weight (g)}}{\text{Number of rabbits}}$$

$$\text{Feed intake per rabbit (g)} = \frac{\text{Feed supplied (g)} - \text{Feed leftover (g)}}{\text{Number of rabbits}}$$

$$\text{Feed conversion ratio} = \frac{\text{Amount of feed consumed (g)}}{\text{Weight gain (g)}}$$

Carcass yield

At the end of the experiment, 4 rabbits were randomly selected from each treatment, stunned with chloroform and slaughtered by cutting the jugular vein. The slaughtered rabbits were scalded with naked fire and eviscerated. Live weight, hot carcass weight, empty carcass weight and carcass dressing percentage were determined and recorded. The carcass was cut into retail parts and internal organs which were weighed using sensitive electronic scale and expressed as percentage of live weight.

$$Carcass\ dressing\ percentage = \frac{Empty\ carcass\ weight}{Live\ weight}\ X\ 100$$

Statistical Analysis

The data obtained were subjected into One-way Analysis of Variance (ANOVA) in a Completely Randomized Design using the GLM procedure of statistical analysis software SAS® version 2003. Significant ($p<0.05$) differences among treatment means were determined using Duncan Multiple Range Test (DMRT) as contained in the SAS® software.

Results and Discussion

The result of growth performance of weaner rabbits fed Bambara nut offal (BNO) as a replacement for wheat offal (WO) as shown on Table 2 below showed no significant difference ($p>0.05$) across the dietary treatments. However, the range of values recorded in this study for final weight gain (1433.30 – 1583.00g) is higher than the values (1200.00-1375.50g) reported by Igwebuike *et al*., (2013) who replaced wheat offal with sorghum offal but lower than values(1213.20-1690.70g) reported by Oni *et al*. (2015). Also, the values obtained for feed conversion ratio (FCR) (3.50-4.75) is lower than values (3.49-7.77) reported by by Igwebuike *et al*., (2013). This result suggests that Bambara nut offal is low in antinutritional factors such as tannin which has been reported to reduce feed utilization and growth (Helsper *et al*., 1993).

As also presented in Table 2, hot carcass weight, empty carcass weight and carcass length were not significantly affected ($p>0.05$) with the inclusion of BNO as a replacement for wheat offal aside from carcass dressing percentage which is relatively higher in rabbits fed 75%BNO (69.61%) and similar to the rabbits on control diet (66.71%). More so, carcass cut parts of economic importance and internal organs were not significantly different ($p>0.05$) in rabbits fed feed BNO containing diets and those fed 100%WO (control). The observation in this study is in conformity with what Igwebuike *et al*., (2013) reported when weaner rabbits were fed sorghum offal as a replacement for wheat offal. However, significant differences recorded for weight of tails could be attributed to the different breeds of rabbits used in the experiment.

Table 2: Growth performance and carcass yield of weaner rabbits fed Bambara nut offal as a replacement for wheat offal.

Parameters	Control	25%BNO	50%BNO	75%BNO	SEM	P-value
GROWTH PERFORMANCE						
Initial body weight (g)	646.67	650.00	653.33	650.00	21.13	0.902
Final body weight (g)	1466.70	1433.30	1500.00	1583.00	65.56	0.859
Total feed intake (g)	3419.20	3339.80	3349.60	3253.00	38.10	0.556
Feed conversion ratio (FCR)	4.75	4.26	4.37	3.50	0.38	0.766
CARCASS						
MEASUREMENTS						
Live weight (g)	1480.00	1350.00	1600.00	1600	60.77	0.461
Hot carcass weight (g)	1416.70	1123.30	1500.00	1516.70	71.26	0.171
Empty carcass weight (g)	1016.70	696.70	900.00	1116.70	70.89	0.177
Carcass dressing percentage (%)	66.71^{ab}	51.59^{c}	56.26^{bc}	69.61^{a}	2.65	0.017
Carcass length (cm)	44.67	44.83	45.17	44.97	0.15	0.751
Cut parts (%LW)						
Head	10.38	7.57	8.21	9.10	0.53	0.287
Neck	0.87	092	1.16	0.83	0.05	0.072
Ribs	12.75	9.84	8.96	11.18	0.67	0.211
Shoulders	8.96	7.06	8.70	7.88	0.42	0.427
Thighs	12.17	12.56	10.40	10.62	0.57	0.485
Loin	12.85	10.60	13.85	11.19	0.65	0.295
Rump	7.24	3.71	4.90	4.63	0.54	0.103
Tail	0.35^{ab}	0.45^{a}	0.23^{b}	0.27^{b}	0.03	0.011

Limbs	6.79	6.03	6.87	6.03	0.30	0.685
Internal Organs (%LW)						
Liver	2.92	2.39	2.95	2.52	0.15	0.472
Heart	0.31	0.21	0.24	0.28	0.02	0.184
Kidney	0.88	0.65	0.82	0.64	0.05	0.167
Lung	0.47	0.57	0.55	0.49	0.02	0.413
Spleen	0.06	0.04	0.04	0.05	0.004	0.671
GIT	20.12	17.42	19.50	17.67	0.89	0.704

Means on the same column having different superscript differ significantly at p< 0.05
BNO- Bambara nut offal
SEM- Standard error of mean

Conclusion and Recommendation

As observed from the results of this study, replacement of wheat offal with Bambara nut offal in weaner rabbits diets at levels of 25-75% produced results similar to that of rabbit fed 100% wheat offal for growth performance and carcass yield. Therefore, Bambara nut offal should be used as a replacement for wheat offal at up to 75% replacement level for proper growth, carcass yields and feeding cost saving.

References

- Helsper, J.P., Hoongendigk, J.M., Van Norel, A. and Burger-meyer. 1993. Anti-nutritional factors in faba beans (*Vicia faba* L.) as affected by breeding towards the absence of condensed tannin. *Journal of Agriculture and Food Chemistry* 41:1058-1061.
- Igwebuike, J.U., Augustine, C., Moses, J.D. and Bitrus, B. 2013. Effects of replacement of wheal offal with sorghum offal on performance of growing rabbits and cost benefit of replacing wheat offal with sorghum. *International Journal of IT, Engineering and Applied Sciences Research* 2(8):14-19.
- Ijaiya A. T. 2013. Haematology and serum biochemical indices of broilers chicken fed rumen filtrate fermented palm kernel. *Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria (ASAN)*, 8th-12th September, 2013, Abuja: 329
- Oni, O.O., Idowu, O.M.O., Olanite, J.A and Bambgose, A.M. 2015. Nutrient intake, growth performance and carcass yield of weaner rabbits fed graded levels of dried citrus (*C. sinensis*) pulp. *Journal of Agricultural Science and Environment* 15(1):60-68.
- SAS, 2003. Institute Inc. SAS Technical Report Package 2234 SAS/STAT Software. The GEMOD Procedure. Release 6.09. SAS Institute Inc. Cary, NC. USA
- Uchegbu, M. C., Ikechukwu, N. M., Omede, A. A., Nwaodu, C. H., Anyanwu, G. A., Okoli, I. C., and Udedibie, A. B. I. 2007. Comparative evaluation of three commercial feeds on the performance of broilers. *Proceedings of Agricultural Society's 41st Conference*, Zaria, Nigeria. Pp. 359-363.
- Yusuf, A. M., Garba, M. H., Olafadeham, O. A. and Okafor, C. I., 2009. Evaluation of the feeding potentials of *Vitellaria paradoxum, Nauclea latifolia* and *Terminalia macroptera* foliage as supplements to concentrate feed for weaner rabbits. *Proceedings of the 34th Annual Conference of Nigerian Society for Animal Production (NSAP)*, 15th-18th March, 2009, Uyo: 306- 308.

EFFECT OF VARYING INCLUSION LEVELS OF ACID SOAKED CAJANUS CAJAN SEED ON CARCASS CHARACTERISTICS OF BROILER FINISHER

AMUSA, H. O[1]., OGUNGBENRO, S. D[1]., ADEBISI, I. A[1]., EGBINOLA, O. O[1]., ADAM, T. O[1]., OSENI, T. A[1]., ADEOTI, T. M[2] AND AMUSA, F. L[3]

[1]Department of Animal Health and Production Technology, Faculty of Animal and Fisheries Technology. Oyo State College of Agriculture and Technology, Igboora Oyo State, Nigeria

[2]Department of Animal Health and Production Technology, School of Science, Oke-ogun Polytechnic Saki Oyo State Nigeria

[3]Department of pure and applied Chemistry, Ladoke Akintola University of Technology Ogbomoso, Nigeria, Oyo State.

Corresponding Authors E- Mail: hammed4dtop@yahoo.com

Phone number: 08054146259

Abstract

A total of ninety (90) day old broiler were used for the study to determine the carcass characteristics of broiler finisher fed acid soaked Cajanus cajan seed meal diet. The birds were randomly assigned into 3 dietary treatments of 30 birds consisting of 3 replicate of (10) birds per replicates in a completely randomized design experiment. The seeds used were purchased from Towobowo Market in Igboora. The raw pigeon pea seeds were pre-treated by soaking at the rate of 1kg/3L of water for 12 hours after which the soaked seeds were soaked at the rate of 1kg/3L of raw pap water filtrate for 24 hours, initial and final pH was taken. The sample was sundried for 3days, milled and then included in the diet accordingly. Birds on T1 received the control diet, T2 received 20% level of pigeon pea, while T3 received 40% level of pigeon pea. The experiment lasted for eight weeks. At the end of the 8 weeks three (3) birds per treatment were sacrificed for carcass analysis. Results showed that there were significant (P>0.05) difference in the live weight, dress weight, plucked weight, dress, neck, wing, shank, thigh muscle, drum stick, breast muscle, and back, while there was no significant (P<0.05) difference in the head. However, birds on T2 recorded the highest value of the live weight (2130.70g), dress weight (1924.30g), plucked weight (206.30g), neck (4.30g) and drum stick (11.34%) while T3 recorded the lowest value of live weight (1865.70g), dress weight (1682.30g), plucked weight (183.30g), dress % (90.20%), thigh muscle (10.67%), drum stick (10.61%), breast muscle % (24.67%), and back % (10.90%). Birds on T1 recorded the highest value of dress percentage (91.10%), shank (4.96%), thigh muscle (11.46%) and breast muscle (25.90%) however, bird on T1 recorded the lowest value of back (10.68%). It can be concluded that pigeon pea soaked in acidic medium can be fed to birds at 20% inclusion level without having any adverse effects on the birds.

Key word: Carcass, Broiler, Replicate, Pigeon pea.

Introduction

Poultry production is an important rapid growing money making industry. However, one of the major problems of poultry producers is the high cost of feed, which arises mainly from the competition between man and animal for conventional feedstuffs like maize, groundnut cake, soybean meal and fish meal (Amaefule and Obioha, 2005). Competition for these feed items (especially protein feeds such as soya bean) increases the price, leading to high cost of production and hence poultry products. Soya bean is an oil seed legume, high in protein (44-47% crude protein) and forms the major source of plant protein for non-ruminants mainly poultry, constituting 20-30% in poultry ration (Opara and Okorie, 2015). The over dependence on soyabean as major protein source for monogastric animal feeding and industrial purposes has increased its scarcity and consequent high cost of production. There is need to investigate into some other legume seeds that are rich in protein and have the potential to either partially or wholly replace soyabean in poultry ration

One of such unconventional legumes capable of substitution expensive soyabean is pigeon pea. Pigeon pea has a protein content of between 20- 29% however the seeds like other legume seeds contain Anti-Nutritional Factors (ANFs) such as protease trypsin and chymotrypsin inhibitors and haemaglutinins (Carlini and Udedibie, 1997). However several processing methods such as boiling,

toasting, roasting, soaking (Akintunde *et al*., 2010) had been used to inactivate these antinutritional factors

Materials and Methods

Experimental site: The experiment was carried out at the Teaching and Research farm, Oyo State College of Agriculture, Igboora in the derived Savannah zone of Nigeria. The college is located on $7^0$15N and 303^0E of the equator with average annual rain fall 1278mm and average temperature of 20C.

Collection of sample: Pigeon pea was purchased from Towobowo market in Igboora.

Pre-treatment of seed: Raw pigeon pea seeds were soaked at the rate of1kg/3L of water for 12 hours.

Treatment of sample: The soaked seeds were soaked at the rate of 1kg/3L of raw pap water filtrate for 24 hours, initial and final pH was taken. The sample was sundried for 3days, milled and then included in the diet accordingly.

pH range	CCSO
Initial pH	3.8
Final Ph	4.6

CCSO- *Cajanus canjan* soaked in ogi liquor

Experimental diets: A total of ninety birds were used for the study, they were randomly assigned into 3 dietary treatments of 30 birds consisting of 3 replicate often (10) birds per replicates in a completely randomized design experiment. Birds on T1 received the control diets; T2 received 20% level of pigeon pea, while T3 received 40% level of pigeon pea. The experiment lasted for eight weeks.

Table 1: Gross composition of experimental animal diets

Ingredient	T_1 (0%)	T_2 (20%)	T_3 (40%)
Maize	58.00	49.23	40.46
Soyabean	27.00	21.60	16.20
Cajanus cajan	0.00	14.17	28.34
Wheat offal	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00
Lime stone	2.00	2.00	2.00
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Broiler premix	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00
M.E (Kcal/kg)	3005	3014.36	3023.32
Crude protein (%)	21.75	20.80	19.86

M. E- Metabolizable energy

Carcass Analysis: Three birds per treatment were selected and slaughtered. The carcass part were cut which include (live weight, dress weight, head, neck, wing, shank, thigh muscle, drum stick, breast muscle and back) and are weighed and express as percentage of live weight,

Statistical analysis: Following the experimental design, all data collected were subjected to statistical analysis of variance (ANOVA) using SPSS version 17 and means separated by Duncan Multiple Range Test.

Result and Discussion

Table 2: showed the carcass characteristics of broiler finisher fed acid soaked *Cajanus cajan* seed meal diet. There were significant (P>0.05) difference in the live weight, dress weight, plucked weight, dress, neck, wing, shank, thigh muscle, drum stick, breast muscle, and back, while there was no significant (P<0.05) difference in the head. However, birds on T2 recorded the highest value of the live weight (2130.70g), dress weight (1924.30g), plucked weight (206.30g), neck (4.30g), and drum stick% (11.34%). While T3 recorded the lowest value of live weight (1865.70g), dress weight (1682.30g), plucked weight (183.30g), dress % (90.2%), thigh muscle% (10.67%), drum stick % (10.61%), breast muscle % (24.67%), and back % (10.90%). Birds on T1 recorded the highest value of dress percentage (91.10%), shank (4.96%), thigh muscle (11.46%) and breast muscle (25.90%). However, bird on T1 recorded the lowest value of back % (10.68%).

Table 2: Carcass characteristics of broiler finisher fed acid soaked *Cajanus cajan* seed meal diet

Parameters	T1 (0%)	T2 (20%)	T3 (40%)	SEM
Live weight	2082.30[a]	2130.70[a]	1865.70[b]	66.52
Dress weight	1897.30[a]	1924.30[a]	1682.30[b]	62.51
Plucked weight	205.00[a]	206.30[a]	183.30[b]	6.09
Dress %	91.10[a]	90.30[b]	90.20[b]	0.23
Head %	2.96	2.99	2.96	0.008
Neck %	3.76[b]	4.30[a]	4.28[a]	0.14
Wing %	8.90[a]	7.57[b]	8.90[a]	0.36
Shank %	4.96[a]	3.75[b]	4.54[a]	0.29
Thigh muscle %	11.46[a]	10.82[b]	1067[b]	0.20
Drum stick %	11.05[a]	11.34[a]	10.61[b]	0.17
Breast muscle %	25.90[a]	25.27[a]	24.67[b]	0.29
Back	10.68[b]	11.06[a]	10.90[b]	0.09

a,b,c,d; Means on the same rows with different superscript differ significantly (P<0.05)

Table 3: Anti-nutritional factor content of raw and processed pigeon pea

Anti-nutritional factors	Raw	Processed	Percentage reduction
Saponin	0.287	0.242	15.0
Tannin	0.026	0.014	46.15
Trypsin inhibitors	28.74	26.87	6.50
Oxalate	0.117	0.082	29.9

Discussion

There were significant ($P < 0.05$) difference in the values recorded for final live weight, dressed weight, Plucked weight and dressed percentage of broiler fed experimental diets across the treatment. The result of this study confirmed the findings of Fanimo *et al.* (2003) who reported heavier birds produced a greater eviscerated yield. The result of this study showed that highest dressed weight was observed in the broiler fed diet. The lowest back weight was obtained in diet 1 could be attributed to different abilities of the diets to differently induce tissue lay down for the said cut part. That the poorer back cavity for bird fed diet 1 could be attributed to different abilities of the diets to differently induce tissue lay down for the said cut part.

The decrease in the breast muscle, dress percentage, Drum stick and thigh muscle in treatment 3 was an indication that nutrient required for tissue synthesis were not sufficient. This could be attributed to poor utilization of protein due to presence of anti-nutritional factor such as Tannin. Tannin is reported to form complexes with dietary protein as well as endogenous protein including enzymes and this may inhibit the action of proteolitic enzymes from undergoing normal metabolism of proteins. Mathew *et al.* (2010) Reported that higher percentage of breast muscle indicated better protein utilization by birds

Conclusion

It could be concluded that pigeon pea soaked in pap water filtrate can be fed to birds at 20% level of inclusion without having any negative effect on the carcass characteristics of broiler fed experimental diet.

Recommendation

Feeding up to 40% level of inclusion showed fairly good result, however, there is need for adoption of other processing methods to further reduce the level of anti-nutritional factors in legumes seed

References

Akintunde, A. R. Omage., J. J and. Bawa, G. S . 2010. Effects of allzyme supplementation of the utilization of differently processed pigeon pea *(Cajanus cajan)* seeds by broiler chickens. *Proceedings of 35th Conf., Nig. Soc. for Anim. Prod., 14-17 March, 2010, Univ. of Ibadan, Nigeria*, pp: 439-442.

Ameafule, K. U and Obioha, 2005. Performance and nutrient utilization of broiler starter fed diets containing raw, boiled or dehulled pigeon pea seeds. Nigeria journal of Animal Production . 28(1)31-39

Fanimo, A.O., Odoguwa, O.O., Alade, A.H., Ogunnaiake, T.O., and Adesehinwa, A.K. 2003. Growth performance, nutrient digestibility and carcass characteristics of growing rabbits fed cashew apple waste. *Livestock research for rural development*. Vol. 15, No. 8; pp 1-8.

Jaffe; Liner, J.E. 1962. Toxic factors in the edible legumes and their elimination. *Animal J. of Nutrition*, vol. 2: pp281-298.

Matthew, U.D., Tegbe, T.S.B., Omage, J. J., and Adeyinka, I. A. 2010. The effect of duration of cooking pigeon pea (*Cajanus cajan*) seeds on the performance and carcass characteristics of broiler chicks. Nig. *J. of animal science*, Vol, 37. No. 1; pp13-24

Opara, A.U. and Okorie, K.C. (2015). Effect of cooked *Mucuna sloanei* seed meal on the performance, carcass characteristics and apparent nutrient digestibility on broiler finisher birds. *International Journal of Agricultural Bioscience*, vol. 4, no. 4, pp145-149

Carlini, C. R and Udedibie. A. B. I. 1997. Comparative effects of processing methods on haemagglutmating and anti-trypsin activities of *Canavalia ensiformis* and *Canavalia braziliensis seeds. J. Agric Food Chem.*, 45, 4372-4377

GROWTH PERFORMANCE OF STARTER BROILER CHICKENS FED RAW *SENNA OBTUSIFOLIA* SEED MEAL

Assam, E.D.,[1] *Ndelekwute, E. K.,[1] Afolabi, K. D.[1] and Kalla, D.J.U.[2]

[1] Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo, Nigeria.
[2] Department of Animal Science, Faculty of Agriculture, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

**Correspondence author. E-mail: Ndelekwute.ek@gmail.com Tel: +2348061220967*

ABSTRACT
An experiment to determine the growth performance of starter broiler chickens fed raw Senna obtusifolia seed meal (SOSM) was conducted. A total of 150 Arbor-Acre broiler chickens were purchased and fed control diet for 6 days before randomly allotted to five experimental Treatments 1 to 5 (T1 to T5) of 30 birds each, replicated 3 times with 10 birds per replicate in a completely randomized design. The levels of the raw SOSM were 0, 2.5, 5.0, 7.5 and 10%. The experiment lasted for 4 weeks. Results showed that as the level of raw SOSM increased in the diet beyond 5%, the lower the final live weight and daily gain of starter broiler birds. It was concluded that raw SOSM could be included up to 5% in starter broiler diet.

INTRODUCTION
Feeding constitutes an important part of poultry production. Ukachukwu (2015) opined that in poultry and piggery, feed cost is put at about 70-80% of total cost of production because of expensive feed ingredients such as maize and soya bean. This according to the author, is made complex and complicated by competition among human, the industry and farm animals for the same food items as either food for man, feed for animals and raw materials for the industry. Reducing feed cost is a priority for every poultry farmer and animal nutritionist. One of the ways of getting round this problem of high feed cost is by looking for alternative feedstuffs, which have little or no dietary value for man and industry. The use of legume seeds in monogastric nutrition has attracted the attention of researchers worldwide. Several conventional legume seeds such as sword bean, pigeon pea, mucuna species and *Cajanus cajan*, to mention just a few, have been studied and evaluated for inclusion in non-ruminant diets in Nigeria (Udedibie and Nkwocha, 1990; Leon *et al.,* 1991; Ologhobo *et al*., 1993; Ukachukwu, 2000; Akinmutimi, 2004; Ekwe, 2014). There is, however some unconventional plants seeds that are still under-utilized, which little are known about their chemical composition and nutritional values, like sickle pod (*Senna obtusifolia)* seeds. There is, therefore, the need for continuous screening of minor legume seeds like *Senna obtusifolia* for use as unconventional alternative feed resource in monogastric diets. It was in view of the forgoing that this research was undertaken to determine the tolerance level of raw *Senna obtusifolia* seed meal on growth performance of starter broiler chickens.

MATERIALS AND METHODS
Senna obtusifolia seeds used were obtained from Bauchi State, Nigeria. The experiment was conducted at the Teaching and Research farm of University of Uyo, One hundred and fifty (150) day-old arbor acre broilers were purchased from a reputable supplier in Uyo metropolis, Akwa Ibom State, Nigeria. The poultry house was washed and disinfected. Prior to the arrival of the chicks, brooding room temperature was raised to 35^0C using kerosene stove and electric bulbs. The floor of the brooder was sprayed with wood shavings of 2cm thickness. Feeding and drinking troughs were provided. On arrival, the chicks were weighed and given anti-stress. The birds were brooded together for the first six days for acclimatization and fed the control diet. On day 7, the birds were weighed and randomly allotted to five experimental treatments with 30 birds per treatment. Each treatment was replicated thrice with 10 birds per replicate, in a Completely Randomized Design (CRD). Treatment 1 was control while raw *Senna obtusifolia seed* meal was included at 2.5, 5.0, 7.5 and 10% in treatments 2, 3, 4 and 5 respectively in the diet (Table 1). Feed and water were provided *ad libitum* throughout the experiment which lasted for 28 days. Feed intake was determined daily

and weight gain was determined weekly. Necessary vaccinations and medications were strictly adhered to. Data on performance parameters were evaluated and subjected to one-way Analysis of Variance (ANOVA) according to Steel and Torrie (1980) while differences between treatment means were separated using Duncan's Multiple Range Test using computer software IBM SPSS Statistic version 20.

Table 1: Ingredients and nutrient composition of raw *Senna obtusifolia* seed meal fed to starter broilers

Ingredients %	**(T1) 0.0**	**Levels (T2) 2.50**	**Of (T3) 5.0**	**Inclusion (T4) 7.50**	**(%) (T5) 10.0**
Maize	49.18	46.71	44.26	41.81	39.34
Soya bean meal	33.81	33.79	33.74	33.69	33.66
*S. obtusifoli*a seed meal	-	2.50	5.00	7.50	10.00
Palm kernel meal	10.00	10.00	10.00	10.00	10.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/TM premix*	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated nutrients					
Crude Protein (%)	23.00	23.00	23.00	23.00	23.00
Crude Fibre (%)	4.67	4.85	5.03	5.21	5.39
Ether Extract (%)	4.01	3.96	3.91	3.86	3.81
Calcium (%)	1.30	1.31	1.32	1.34	1.35
Phosphorus (%)	1.06	1.07	1.07	1.08	1.09
ME (Kcal/g)	2850	2832	2813	2795	2776

*1kg of premix contains. vitamins A (5,000,000Iu), Vitamin D_3 (1,000,000 1U), Vitamin E (16,000mg), vitamin K_3 (800mg), vitamin B_1 (1,200mg), Vitamin B_2 (22,000mg), Niacin (22,000mg), Calcium panthothenate (4,600mg), Vitamin B6 (2000mg), Vitamin B_{12} (10mg), Folic acid (400mg), Biotin (32mg), Choline chloride (200,000mg), Manganese (48,000mg), Iron (40,000mg), Zinc (32,000mg), Copper (3,400mg), iodine (600mg), Cobalt (120mg), Selenium (40mg), antioxidant (48,000mg).

RESULTS AND DISCUSSION

The growth performance of starter broiler chickens fed raw *Senna obtusifolia* seed meal is shown in Table 2. There were significant differences ($P<0.05$) among the treatment means for all the parameters considered, except for the initial weights. The result showed that the final live weight, daily feed intake and daily weight gain followed the same trend. The mean final weights were 921g for the control, 910g for T2 with 2.5% and 906g for T3 with 5.0%, 745g for T4 with 7.5% and 681g for T5 with 10%. Inclusion of 7.5 and 10% S. obtsusifolia affected final live weight negatively. The final live weight of control, 2.5 and 5.0% was similar. It was observed that above 5.0% inclusion live weight decreased with increased level of raw *Senna obtusifolia* seed meal. Daily weight gain followed similar trend as the final live weight. The feed intake of control, 2.5 and 5.0% were the same. It was also observed that feed intake was depressed by 7.5 and 10%. The result also showed no significant difference in feed conversion ratio and protein efficiency ratio up to 5.0% inclusion compared to the control diet.

The depression in feed intake and poor live weight could be as a result of presence of some anti-nutritional factors like saponins, tannin and phytate in the raw seeds. This agreed with Akinmutimi (2004), who reported poor palatability and consequently low feed intake in diets containing sword bean because of tannin content in raw sword bean. According to him, tannins could induce low feed intake due to its astringent property, as a result of its ability to bind with the protein of saliva and mucosa membrane. This he also opined was as a result of the effect of other anti-nutritional factors such as saponins, phytate, cyanogenic glycosides, trypsin inhibitors, canavanin and con-canavanin A

in the raw sword bean. According to Aletor and Fasuji (1997), cyanogenic glycoside, for instance, upon hydrolysis releases hydrogen cyanide, a substance which has the ability to cause marked weight reduction. The authors observed that cyanide detoxification route in man and animals is through cyanide thiocyanate sulphur transferase (rhodanase pathway), which generally requires organic sulphur donors in the form of methionine and cysteine, thereby precipitating methionine deficiency in an otherwise balanced diet. Akinmutimi (2004) reported that it is this methionine deficiency that resulted in poor growth. Feed conversion ratio (FCR) is an important index of performance which is a direct indication of how best feed offered to birds was utilized for meat production. The lower the FCR value, the better the feed utilization, thus birds with higher FCR value had suppressed growth. This result is in consonance with similar report by Tuleum *et al.* (2009), that broiler chicks on 10% raw *Mucuna pruriens* in balanced formulated ration had depressed growth, due to the limitation imposed on the birds by anti-nutritional factors present in the diet. Akinmutimi (2004) also reported that the poor weight gain by starter broiler birds fed raw sword bean may be due to poor nutrient utilization.

Table 2: Growth performance of starter broiler chickens fed raw *Senna obtusifolia* seed meal

Parameters	Levels of Inclusion of Raw *Senna obtusifolia* Seed Meal					
	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%)	T5 (10%)	SEM
Initial weight (g)	38.02	38.02	38.02	38.02	38.02	0.00
Final weight (g)	921[a]	910[a]	906[a]	745[b]	681[c]	27.49
Average Daily Weight Gain(g)	31.52[a]	31.15[a]	30.99[a]	25.25[b]	22.95[c]	1.03
Average Daily Feed Intake (g)	70.37[a]	69.98[a]	69.56[a]	61.34[b]	54.23[b]	1.34
Feed Conversion Ratio	2.23[c]	2.25[c]	2.24[c]	2.43[a]	2.36[b]	0.03
Protein Efficiency Ratio	1.95[a]	1.94[a]	1.94[a]	1.79[b]	1.84[b]	0.03

[a,b,c] Means with different superscripts in the same row are significantly different (P<0.05)

CONCLUSION

The growth performance of starter broiler chickens fed raw *Senna obtusifolia* seed meal reduced live weight and feed intake beyond 5% inclusion level. In view of the above, raw *Senna obtusifolia* could be included in the diet of starter broiler diet up to 5% without any deleterious effect on growth performance.

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REFERENCES

Akinmutimi, A. H. (2004). Evaluation of Sword Bean (*Canavalia gladiata*) as an Alternative Feed Resource for Broiler Chickens. Ph.D Thesis, Michael Okpara University of Agriculture, Umudike, Nigeria.

Aletor, V.A. and Fasuji, A.O. (1997). Nutrient Composition and Processing Effects on Cassava Leaf (*Manihot esculenta* Crantz) Anti-nutrients. A Paper Presented at the 2nd Annual Conference of ASAN, Lagos, Pp. 231-22.

Augustine, C., Igwebuike, J.U., Salome, S., Midau, A., Ja'afar-Furo, M.R., Mojaba, D.I. and Dazala, I.U. (2010). Evaluation of Economic Performance of Broiler Chickens fed Graded Levels of Processed *Cassia obtusifolia* seed meal. *Int. J. Sust. Agric.* 2(3):47 - 50.

Ekwe, C.C. (2014). Performance of Broiler Chickens fed Graded Levels of Raw and Processed *Mucuna sloanei* Meal in Partial Replacement of Soybean meal in Broiler Diet. Ph.D Dissertation, Department of Animal Nutrition and Forage Science, Michael Okpara University of Agriculture, Umudike, Pp. 51 – 58.

Leon, A.M., Caffin, J.P., Plassart, M. and Piccard, M. (1991). Effects of Concanavalin A from Jackbean Seeds on Short Term Food Intake Regulations in Chicks and Laying Hens. *Anim. Feed Sci. and Technol.* 32:297 – 311.

Ologhobo, A.D., Apata, D.F. and Oyejide, A. (1993). Utilization of Raw Jackbean *(Canavalia ensiformis)* and Jackbean Fractions in Diets for Broiler Chicks. *British Poult. Sci.* 34:323 - 337.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of Statistics. A Biometrical Approach. 2nd edition, MCGraw-Hill Books Company, Inc, New York. Pp. 20-29.

Tuleum, C.D., Carew, S. N. and Adiji, I. (2009). Feeding Value of Velvet Beans (*Mucuna utilis)* for Laying Hens. *Livest. Res. Rural Dev.* 20(8):1 – 5.

Udedibie, A.B.I. and Nkwocha, C.O. (1990). Comparative Study of Jack bean and Sword bean as Protein Supplements for Young Broiler Chicks. *Agric. J.* 24:7-11.

Ukachukwu, S. N. (2000). Chemical and Nutritional Evaluation of *Mucuna cochinchinensis* (Lyon's bean) as an Alternative Protein Ingredient in Broiler Diets. Ph.D Thesis, University of Nigeria, Nsukka, Pp. 5 – 37

Ukachukwu, S. N. (2015). Killers to Edibles. A Key to Sustainable Livestock and National Development. 22nd Inaugural Lecture of Michael Okpara University of Agriculture, Umudike. 15th May, 2015. Pp. 8-11.

HAEMATOLOGY AND SERUM BIOCHEMISTRY OF GROWER RABBITS FED ACHA (*Digitaria elixis*) OFFAL BASED-DIETS SUPPLEMENTED WITH MAXIGRAINS® ENZYME

AZI, J. A., S. E. Alu. and D. M Ogah.
Department of Animal Science, Nasarawa State University, Keffi
Corresponding authors address: julietanyaazi@gmail.com; 08036093161

ABSTRACT
Forty eight growing rabbits of mixed breeds and similar live weight were utilized in a 42 days experiment to evaluate the effect of feeding acha (fonio) offal meal-based diets supplemented with Maxigrain enzyme on their haematology and serum biochemistry. Six treatments diets namely T1, T2, T3, T4, T5 and T6 were compounded to be iso-caloric and iso-nitrogenous, the Acha Offal (AO) was included at 0, 15 and 30% while the enzyme was supplemented at 0 and 200ppm. The experiment was arranged in a 2x3 factorial fitted into Completely Randomized Design. Each treatment was replicated 4 times having two rabbits per replicate. Feed and water were provided to the animals daily and all standard routine management practices were strictly observed throughout the experiment. At the end of the feeding trial, blood samples were collected from each animal for blood analyses. Main effect of Acha offal was not significant (p>0.05)on the haematological parameters except on White Blood Cell(WBC) and Mean Cell Haemoglobin Concentration(MCHC). Effect of enzymes was not different (P>0.05)except on WBC{0ppm (5.75) and 200ppm (6.60)} and MCHC{0ppm (33.27) and 200ppm (33.20)}. Interactive effect of Acha offal and enzyme showed that T2 had the highest WBC (8.80) while T4 had the lowest MCHC (33.10). Serum biochemical parameters were not affected by Acha offalexcept phosphorus where there was a significant (P<0.05) reduction in 30%AO(1.35). Enzymes effect showed that animals on 0ppm had significantly (p<0.05) higher phosphorus (1.83) than 200ppm (1.38). Acha offal supplemented with Maxigrain enzyme can be included in the diets of grower rabbits without adverse effect on haematological and serum biochemical indices.

Keywords: Haematology, Biochemistry, Rabbits, Fonio, Enzymes

INTRODUCTION
The rapid growth of human population has brought the competition between man and livestock for these cereal grains adding to high cost of feeds and consequently high prices of Animal products(meat and egg) resulting to very low levels of protein intake in most developing nations. Therefore, leading to the increased in cost of production, research attention is now geared towards unconventional cereal by-product that will not affect the overall feed quality. One of such cereal grain by-products that could provide energy and fibre is acha offal. Feeding cereal grains (e.g. maize bran and rice bran) as replacement for maize-based diets to rabbits have been significantly reduced the cost of producing feed for livestock reported byUkim*et al*. (2012). It has been reported that many of the cereals by-product and grains contain some phytochemicals which can be reduced by enzymes supplementation Alu *et al*. (2012). Similarly, studies have reported increased feed breakdown especially of fibrous feed materials into easily digestible nutrients by exogenous enzyme supplementation in monogastric feeds Ogbe *et al.* (2013). It is on this background that a research with the objective of determining the haematological and biochemical indices of grower rabbits was conducted.

MATERIALS AND METHODS
Experimental Site
These experiments were conducted at the Teaching and Research Farm of Animal Science Department of the Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia Campus.
Feed Ingredients, Animals and Experimental Design
Acha offal was sourced from the local acha processors within Riyom Local Government Area of Plateau State and preserved under natural condition while other ingredients such as maize, maize bran, rice bran, groundnut cake, fish meal, bone meal lysine methionine were purchased from the suppliers in Lafia, Nasarawa State. Six experimentaldiets were formulated to be isonitrogenous (15% crude protein) and isocaloric of (2500kcal/kg) for the grower phase with three levels inclusion of the acha offal (0, 15 and 30%). The treatments were; T1 = 0% AO with 0ppm enzymes serves as control, T2 = 0% AO with 200ppm enzymes, T3 = 15% AO with 0ppm enzymes, T4 = 15% AO

with 200ppm enzymes, T5 = 30% AO with 0ppm enzymes and T6 =30% AO with 200ppm enzymes. Forty-eight (48) rabbits of similar live weight wererandomly assigned to a test diet in a 3x2 factorial. Each of the experimental treatment was replicated four times in each pen comprising of 2rabbits each.

Hematological and Serum Biochemical Indices Analysis

At the end of the experiment, two set of container was used to collect blood samples. One set contains anticoagulant while the other was anticoagulant free. The blood samples collected into bottles containing anti- coagulant: Ethylene Diaminetetraacetic Acid (EDTA) as reported by Jain (1987) were used for hematological indices {Packed Cell Volume (PCV), Hemoglobin Concentration (HB), mean cell haemoglobin concentratration (MCHC), Red Blood Cell (RBC), White Blood Cell (WBC)}. Serum biochemical indices such as cholesterol,total protein, albumin and globulin creatinine, Erythrocyte (calcium, magnesium and phosphorus) glyceraldhyde were analyzed using SIGMA kits (Feteris, 1965).

Table 1: Nutrients composition of the experimental diets for grower rabbits

	% of maize replace by acha offal					
Ingredients (%)	**T1(0%AO +0ppm)**	**T2 (0%AO +200ppm)**	**T3 (15%A00ppm)**	**T4 (15%AO +200ppm)**	**T5 (30%AO +0ppm)**	**T6 (30%AO +200ppm)**
Maize	40.00	40.00	34.00	34.00	28.00	28.00
AO*	0.00	0.00	6.00	6.00	12.00	12.00
Maize bran	15.00	15.00	15.00	15.00	15.00	15.00
GNC	10.00	10.00	10.00	10.00	10.00	10.00
Rice bran	17.75	17.75	17.75		17.75	17.75
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Full fat soya	7.00	7.00	7.00	7.00	7.00	7.00
palm oil	2.00	2.00	2.00	2.00	2.00	2.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
***Premix**	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Toxic binder	0.25	0.25	0.25	0.25	0.25	0.25
Enzymes	00.00	200.00	0.00	200.00	0.00	200.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrients composition (g/kg)						
ME (Kcal/Kg)	2712.07	2712.07	2674.67	2674.67	2637.28	2637.28
Crude protein	15.71	15.71	16.01	16.01	16.31	16.31
Lysine	1.00	1.00	0.99	0.99	0.97	0.97
Methionine	0.56	0.56	0.55	0.55	0.54	0.54
Ash	4.45	4.45	4.37	4.37	4.30	4.30
Ether extract	7.11	7.11	7.12	7.12	7.14	7.14
Crude fibre	10.50	10.50	11.08	11.08	11.67	11.67
Calcium	1.16	1.16	1.16	1.16	1.16	1.16
Phosphorus	0.58	0.58	0.57	0.57	0.57	0.57

AO = acha offal, ME = metabolizable energy,

*A15,000 I.U, vitamin D3 300,000 I.U.,vitamin E 3,000 I.U., vitamin K 2.50mg, vitamin B_1 (thiamin) 200mg, Riboflavin (B_2) 600mg, pyridoxine (B_6), Niacin 40.0mg, vitamin B_{12} 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg

Statistical Analysis

Data collected were subjected to one or two analysis of variance (ANOVA) for factorial experiment using (SPSS, 2007) Model. Significantly different means were separated using Duncan's Multiple Range Test (Duncan, 1955). The following statistical model was used: $Y_{ijk}= U +A_I +B_J + (AB)_K+e_{ijk}$ where Y_{ijk}=individual observation, U= population mean, A_i = effect of factor A, B_j= effect of factor B, and AB_K = effect of interaction of factor A&B.

RESULTS AND DISCUSSION

The mainand treatment effect of acha offal and enzymes on haematological parameters of grower rabbits are presented in Table 2. The main effect of acha offal was not significant ($p>0.05$) except on White Blood Cell (WBC) and MCHC. The WBC value of control was significantly higher than 15% and 30% acha offal included diets. The result of MCHC was significantly ($p<0.05$) higher in control and 30% acha offal than in 15% acha offal fed rabbits.Thenon-variation in PCV between the control and other treatments indicates that the dietary treatments do not caused anaemic condition to the animals. This agreed with Ogundipe and Johnson (2012) who revealed that maize offal did not caused adverse effect on the haematological parameters of rabbits. Main effect of enzymes on haematological parameters of grower rabbits showed no significant ($p>0.05$) difference between the treatments (0ppm and 200ppm enzymes) except on the value of WBC and MCHC where the highest WBC and MCHC was recorded from animals fed 200ppm and 0ppm enzymes included diets respectively. The increased value of WBC due to inclusion of enzymes suggests an increased immunity in the animals.Thetreatment effect of acha offal and enzyme on haematological parameters of grower rabbit showed no significant ($p>0.05$) difference all the parameters except on WBC and MCHC values. The significantly ($p<0.05$) highest value of WBC (8.80) was recorded from T_2. Meanwhile T_1, T_3, T_4, T_5 and T_6 were not significantly ($p>0.05$) different from each other. MCHC (33.10) was significantly ($p<0.05$) lower in T4 than the rest of the treatments. The increased value of WBC due to inclusion of enzymes suggests an increased immunity in the animals.

Table 2: Main and treatment effect of acha offal and enzyme(Maxigrain) on haematological parameters of grower rabbits

	Parameters								
Treatments	PCV(%)	HBC(g/dl)	RBC(×10^9/L)	WBC (×10^9/L)	Neutrophil(%)	Lymphocyte(%)	MCV(pg)	MCH	MCHC
Acha offal									
0%	40.00	13.30	3.98	7.35^a	56.75	43.00	99.98	32.65	33.28^a
15%	36.50	12.13	3.6	5.25^b	60.25	37.75	101.43	33.73	33.18^b
30%	35.75	11.90	3.52	5.93^b	55.25	44.25	101.70	33.83	33.25^a
SEM	1.93	0.65	0.20	0.37	3.73	4.06	0.71	0.65	0.02
LOS	NS	NS	NS	*	NS	NS	NS	NS	*
Enzyme									
0ppm	36.33	12.08	3.59	5.75^b	56.50	42.67	100.87	33.17	33.27^a
200ppm	38.50	12.80	3.81	6.60^a	58.33	40.67	101.20	33.63	33.20^b
SEM	1.58	0.53	0.17	0.30	3.04	3.32	0.58	0.53	0.02
LOS	NS	NS	NS	*	NS	NS	NS	NS	*
T1	38.50	12.80	3.84	5.90^b	57.50	42.50	99.15	31.80	33.25^a
T2	41.50	13.80	4.12	8.80^a	56.00	43.50	100.80	33.50	33.30^a
T3	36.00	11.95	3.56	5.70^b	60.50	37.00	101.30	33.70	33.25^a
T4	37.00	12.30	3.65	4.80^b	60.00	38.50	101.55	33.75	33.10^b
T5	34.50	11.50	3.38	5.65^b	51.50	48.50	102.15	34.00	33.30^a
T6	37.00	12.30	3.66	6.20^b	59.00	40.00	101.25	33.65	33.20^a
SEM	2.73	0.92	0.29	0.52	5.27	5.74	1.00	0.92	0.03
LOS	NS	NS	NS	*	NS	NS	NS	NS	*

ab means on the same column having different superscript differ significantly ($p<0.05$); NS = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of significant; PCV = Packed cell volume; HBC = Haemoglobin count (g/dl); RBC = Red blood cell (×10^9/L); WBC = White blood cell(×10^9/L) ; MCV =mean cell volume(pg); MCH = Mean corpuscular haemoglobin (fl) = MCHC = Mean cellhaemoglobin concentration(×10^9/L)

The main and treatment effects of acha offal and enzyme on serum biochemical indices of grower rabbits are presented in Table 3. The main effect of acha offal does not significantly ($P>0.05$) affected the serum biochemical parameters except on phosphorus where there was significant ($P<0.05$) reduction in 30% than 0% and 15% acha offal fed rabbits. There was significant ($P<0.05$) effect of enzyme on phosphorus and calcium values. A significant ($p<0.05$) reduction in the value of Phosphorus was recorded and an increased calcium level of the animals was recorded when 200ppm enzymes was included in the diets. The treatment showed no significant ($P>0.05$) difference between the treatments except on the values of phosphorus, globulin and calcium where there was significant ($P<0.05$) difference. Phosphorus was significantly ($P<0.05$) higher in T_1 then in the rest of the treatments. While Globulin was significantly lower in animals fed T_6 diets although no difference

(P>0.05) from T_1 fed animals. This showed that the immunity of the animals is still maintained even when fed the diets. Rabbits fed T_1, T_2, T_3, T_4 and T_5 had no significant (P>0.05) calcium value. This showed that the needed calcium for bone formation in the animals is not affected by the dietary treatments.

CONCLUSION AND RECOMMENDATION

Table 3: Main and interaction effect of acha offal and enzyme(maxigrain) on serum biochemical indices of grower rabbits

Parameters Treatment	CR	UR	T.PROTEIN	Albumin (g/dl)	Glucose	CHO	GOT	P(g/dl)	GLOB	Mg	Calcium	HDL	TR
Acha offal													
0%	90.00	5.03	71.75	31.5	6.30	4.55	56.25	1.78^{a}	31.00	1.15	2.08	1.03	1.18
15%	103.5	5.10	71.50	33.5	6.20	4.45	69.5	1.70^{a}	33.50	1.18	2.60	0.93	1.10
30%	97.50	5.45	69.75	31.25	6.70	4.35	46	1.35^{b}	29.25	1.25	2.65	1.13	1.23
SEM	17.41	0.78	2.86	2.33	0.80	0.32	9.5	0.06	2.40	0.11	0.16	0.08	0.08
LOS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
- Enzymes													
0ppm	89.50	5.05	70.00	31.00	6.60	4.50	56.50	1.83^{a}	33.00	1.12	2.20^{b}	1.07	1.17
200ppm	104.5	5.33	72.00	33.17	6.20	4.40	58.00	1.38^{b}	29.50	1.27	2.68^{a}	0.98	1.17
SEM	14.21	0.64	2.33	1.90	0.65	0.26	7.76	0.05	1.96	0.09	0.13	0.07	0.07
LOS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	*	NS	NS
T1	99.50	5.35	69.00	26.50	6.60	4.60	51.00	2.40^{a}	27.00^{ab}	1.10	2.05^{b}	1.05	1.20
T2	80.50	4.70	74.50	36.50	6.00	4.50	61.50	1.15^{c}	35.00^{a}	1.20	2.10^{b}	1.00	1.15
T3	77.50	4.50	67.50	31.50	5.75	4.15	66.50	1.65^{b}	34.00^{a}	1.15	2.55^{ab}	0.95	1.10
T4	129.50	5.70	75.50	35.50	6.65	4.75	72.50	1.75^{b}	33.00^{a}	1.20	2.65^{ab}	0.90	1.10
T5	91.50	5.30	73.50	35.00	7.45	4.75	52.00	1.45^{bc}	38.00^{a}	1.10	2.00^{b}	1.20	1.20
T6	103.50	5.60	66.00	27.50	5.95	3.95	40.00	1.25^{c}	20.50^{b}	1.40	3.30^{a}	1.05	1.25
SEM	24.62	1.11	4.04	3.00	1.13	0.46	13.44	0.08	3.40	0.15	0.23	0.11	0.12
LOS	NS	NS	NS	NS	NS	NS	NS	*	*	NS	*	NS	NS

^{abc} means on the same column having different superscript differ significantly (p<0.05); NS = not significantly different (p>0.05); SEM = standard error of mean; LOS = level of significant; CR = creatinine (umol/L); T. protein = Total protein (g/dl); G = Glucose (mmol/L); CHO = Cholesterol (mmol/L); GLOB = Globulin (g/dl); HDL = high density lipoprotein(mg/dl); TR = Tryglyceride(mg/dl); UR = UREA(µmol/L); Mg =magnesium

Acha offal based diets supplemented with maxigrain enzymes could be fed to grower rabbits without adverse effect on haematological and serum biochemical indices of the animals.

REFERENCES

Alu, S.E. (2012). Nutrient digestibility and serum biochemistry of laying quails (*Cortunix japonica*) fed sugarcane scrapping meal-based diets supplemented with exogenous enzyme. *IOSR Journal of Agriculture and Veterinary Science*, 1:29-35

Duncan, D.B. (1955). Multiple Ranges and Multiple F-Test Biometrics, 11:1-42.

Elijah, I. O and Ruth, T. S. O. (2012).The effect of probiotic and prebiotic feed supplementation on chicken Health and Gut micro flora: A *review International Journal of Animal and Veterinary Advances* 4(2): 135 – 143.

Feteris, W.A. 1965. A serum glucose method without protein precipitation. *American Journal of Medical Technology* 31: 17-2

Jain, P.C. (1987). Effect of sodium fluoride on erythrocyte membrane function – with reference to metal ion transport in rabbit's chemosphere 16(5):1087-1094.

Ogbe, A. O., Astong, M., Alu, S.E andObeka, A.D. (2013) .Utilization of melon Husk with wild mushroom (*Ganoderma op*) and Enzyme supplement: Effect on performance of Rabbits chicken. *International Journal of Resource studies in Biosciences 1(*2): 1 – 10.

Ogunsipe, M. H. and Johnson, A. O. (2012). Effect of millet offal-based diets on performance, carcass cuts and haematological profile of growing rabbits. *African Journal of Food Science* 6(10):280-286.

SPSS (2007). Statistical package for social science 160 Brief guide :Spssinc 233south wacker drive,11th floor Chicago IL 60606-6412 16.

Ukim, C.I., Ojewola, G. S., Obun, C.O., Ndelekwule, E.N (2012). Performance and carcass organ weight of broilers chicks fed graded levels of acha grains. *Journal of agriculture and veterinary science*.1(2): 28-33.

EFFECT OF RONOXYME HiPhos® SUPPLEMENTATION ON BLOOD PARAMETERS OF GROWER RABBITS FED SUNFLOWER SEED MEAL-BASED DIETS

B.O.ONAZI[1], S.E. ALU[2] AND D.M. OGAH[2]

[1]Dept. of Agricultural Education, School of Vocational Education, Federal College of Education (Tech), Gusau, Zamfara State, Nigeria.

[2]Dept. of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, P.M.B.135, Shabu-Lafia campus, Nasarawa State, Nigeria.

Tel +2348033690937 e-mail: drsamalu@nsuk.edu.ng

ABSTRACT

A 42 day experiment was conducted to evaluate the response of grower rabbits fed cooked sunflower seed meal (SFSM) supplemented with enzyme on blood parameters using 72 growing rabbits. Nine diets namely T1, T2, T3, T4, T5, T6, T7, T8 and T9 were compounded to be isocaloric (2500 kcal/kg, ME) and isonitrogenous (15%) having treatments T1, T2 and T3with 0% inclusion rate of SFS meal and 0, 150 and 250PPM of the enzyme supplementation. Treatments T4 to T6 and T7 to T9 had 10 and 20% levels of SFS meal inclusion rate, respectively but maintaining same levels of enzyme supplementation as in T1 to T3. This arrangement translated to T1, T4 and T7 serving as the control diets for T2 and T3, T5 and T6 and T8 to T9, respectively. The rabbits were randomized and allotted to the 9 treatments and each treatment was replicated 4 times giving rise to a 3x3 factorial arrangement fitted into CRD. The results show that enzyme supplementation significantly (P<0.05) improved RBC, the values increased from 5.23 x10^{12}/l for non-enzyme supplementation to 5.38 -5.73 x10^{12}/l. Similarly, haemoglobin (11.42 vs. 11.37 and 12.01 g/dl), cholesterol (3.83 vs. 4.33 and 4.31mmol/l) and triglyceride (0.95 vs. 1.16 and 1.03mmol/l) were improved (P<0.05) as the level of enzyme supplementation increased in the diets. In view of the significant improvement in some of the blood parameters recorded, rabbit farmers can use the 150 PPM of the enzyme in SFS meal based diets without affecting the health of the rabbits.

Keywords: Enzymesupplementation, grower rabbits, haematologicalindices, ronoxymeHiPhos®, serum biochemistry, sunflower seed meal

INTRODUCTION

Conventional feed stuffs are very expensive and scarce. This high cost and scarcity according to Esonu*et al.*,(2004), are derived from crippling realities which are characteristics of the economics of developing countries, conventional feed ingredients are expensive since they suffer stiff competition with channels in the food chain which command higher priority and can pay higher prices than the compound feed industry (Esonu*et al.*, 2004). Therefore, the use of cereal based feeds in livestock nutrition may not be sustainable especially in developing countries where cereal grains form a major staple in human diets.

Again, the challenge of anti-nutritional factors and anti-nutrients in most non-conventional feedstuffs has remained a major hindrance to their use. Exogenous enzyme supplementation has been advocated (Alu *et al.*, 2012) as one of the ways or methods of alleviating the problems of anti-nutritional factors in feeds. One of such non-conventional protein sources is the sunflower seed, (*Helianthus annuus* L.) which is one of the few crop species that originated in North America. Sunflower was probably first introduced to Europe through Spain, and spread as a curiosity until it reached Russia where it was readily adapted.Commercially available sunflower varieties contain from 39 to 49% oil in the seed. The main object of this research was to evaluate the effect of enzyme supplementation on the blood parameters of grower rabbits fed SFS meal-based diets.

MATERIALS AND METHODS

The study was carried out at the research and teaching farm of Faculty of Agriculture Nasarawa State University Keffi, Shabu-Lafia Campus. It is located in the Guinea Savanna Zone of North Central. It is found in latitude 08 35N and longitude 08 33E. The mean monthly maximum and minimum temperatures were 35.06°C and 20.16°C respectively at the time of the experiment while the mean monthly relative humidity and rainfall were 74.67% and 168-190mm, respectively (NIMET, 2017).

Source of test ingredient

Sunflower seed (SFS) which is the test ingredient was purchased at Gambali Unique Gardens Jos, Plateau State,cooked, sun-dried, crushed and mixed with other feed ingredients to compound the experimental diets.

Chemical analysis

Proximate analysis of SFS was done at Animal Science Laboratory of Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus, using the standard procedure of AOAC (2000). Nitrogen Free Extract (NFE) was calculated using the formula: NFE (%) = 100 – CP + CF + EE + Moisture + Ash.

Experimental diets and design

Nine experimental diets namely T1, T2, T3, T4, T5, T6, T7, T8 and T9 were compounded to be isocaloric (2500 kcal/kg, ME) and isonitrogenous (15%) having treatments T1, T2 and T3with 0% inclusion rate of SFS meal and 0, 150 and 250PPM of the enzyme supplementation. Treatments T4 to T6 and T7 to T9 had 10 and 20% levels of SFS meal inclusion rate, respectively but maintaining same levels of enzyme supplementation as in T1 to T3. This arrangement means that T1, T4 and T7 serve as the control diets for T2 and T3, T5 and T6 and T8 to T9, respectively. Other ingredients were added to meet the nutrient requirements of grower rabbits as described by Olomu*et al.,* (2019). The gross composition of the experimental diets is presented in Table 1.

Table 1: Percentage chemical and energy composition of experimental diets for grower rabbits

	DIETS								
Feed stuff	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Groundnut shell	10.00	10.00	10.00	13.00	13.00	13.00	21.00	21.00	21.00
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Maize Bran	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Groundnuts Cake	8.00	8.00	8.00	4.00	4.00	4.00	4.00	4.00	4.00
SFS (Cooked 3h)	0.00	0.00	0.00	10.00	10.00	10.00	20.00	20.00	20.00
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Maize	30.00	30.00	30.00	21.00	21.00	21.00	11.00	11.00	11.00
Rice Offal	25.00	25.00	25.00	25.00	25.00	25.00	20.00	20.00	20.00
Soybean (full fat)	17.00	17.00	17.00	17.00	17.00	17.00	14.00	14.00	14.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Enzymes(ppm)	0.00	150.00	250.00	0.00	150.00	250.00	0.00	150.00	250.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated chemical and energy composition									
**Energy (kcal/kg, ME)	2515.83	2515.83	2515.83	2532.51	2532.51	2532.51	2579.36	2579.36	2579.36
Crude protein (%)	15.31	15.31	15.31	15.04	15.04	15.04	15.26	15.26	15.26
Crude fibre (%)	8.32	8.32	8.32	11.03	11.03	11.03	15.77	15.77	15.77
Ether Extract (%)	8.52	8.52	8.52	7.56	7.56	7.56	7.13	7.13	7.13
Ash (%)	6.72	6.72	6.72	7.00	7.00	7.00	6.52	6.52	6.52
Calcium (%)	1.32	1.32	1.32	1.28	1.28	1.28	1.30	1.30	1.30
Phosphorus (%)	0.88	0.88	0.88	0.88	0.88	0.88	0.87	0.87	0.87
Lysine (%)	0.92	0.92	0.92	0.98	0.98	0.98	1.03	1.03	1.03
Methionine (%)	0.46	0.46	0.46	0.49	0.49	0.49	0.51	0.51	0.51

*The vitamin – mineral premix supplied the following per 100kg of diet: Vitamin A, 15,000 I.U; Vitamin D_3,

300,000 I.U; Vitamin E 3,000 I.U; Vitamin K, 2.50mg; Thiamin (B_1), 200mg; Riboflavin (B_2), 600mg; Pyridoxine (B_6), 600mg; Niacin, 40.0mg; Vitamin B_{12}, 2mg; Pantothenic acid, 10.0mg; Folic acid, 100mg; Biotin, 8mg; Choline chloride, 50g; Anti-oxidant, 12.5g; Manganese, 96g; Zinc, 6g; Iron, 24g; Copper, 0.6g; Iodine, 0.14g; Selenium, 24mg; Cobalt, 214mg. ME kcal/ kg = 37 X %CP + 81.1 X %EE + 35.5 X %NFE.
**Pauzenga (1985).

Management of rabbits and experimental design

Seventy-two cross-bred growing rabbits of about 6-7 weeks old with a mean weight of 567g were obtained from Dagwam Farms, National Veterinary Research Institute (NVRI) Vom, Jos, and PlateauState. The rabbits were fed *ad-libitum* and had access to drinking water at all times and were administered anti-stress vitamin/mineral premix orally at the recommended dosage after randomization before the commencement of the experiment. Other management practices were adopted as described by Aduku (2004). The rabbits were paired and allotted to the 9 treatments and each treatment was replicated 4 times giving rise to a 3x3 factorial arrangement fitted into a Completely Randomized Design.

Hematological and serological parameters

At the end of the experiment2-5ml of blood samples from 3 randomly selected rabbits per treatment were collected for haematological and biochemical analyses. The first set of blood samples were collected and emptied into labeled sterile universal bottles containing anti-coagulant, ethylene diamine tetra acetic acid (EDTA) for the determination of haematological components while the other set of blood labeled sterile bottles without EDTA for the determination of serum biochemical components. The packed cell volume (PCV) was determined using the micro-haematocrit technique, the red blood cells (RBC) and white blood cells (WBC) counts using the improved Neubauerhematocytometer method, and haemoglobin (Hb) using the Cyanomethemoglobin method as described by Kelly (1979). Serum total proteinwas determined using Biuret method as described by Kohn and Allen (1995). Albumin was determined using Bromoscresol Green (BCG) method as described by Peter *et al.,* (1982). The globulin concentration was obtained by subtracting albumin from the total protein while the albumin/globulin ratio wasobtained by dividing the albumin value by the calculated globulin value.

Data analysis

All data obtained from the experiment were subjected to Two Way Analysis of Variance (ANOVA) and where significant differences are observed the means were separated using Duncan's Multiple Range Test (DMRT) using the Statistical Package for Social Sciences (SPSS) software.

RESULTS AND DISCUSSION

The results of the effect of the ronoxymeHiPhos® supplementation on blood parameters of grower rabbits fed SFS meal (Table 2) show that enzyme supplementation significantly ($P<0.05$) improved RBC. The values increased from 5.23 $x10^{12}$/l for non-enzyme supplementation to 5.38 -5.73 $x10^{12}$/l for enzyme supplemented diets. Similarly, haemoglobin (11.42 vs. 11.37 and 12.01 g/dl), cholesterol (3.83 vs. 4.33 and 4.31mmol/l) and triglyceride (0.95 vs. 1.16 and 1.03mmol/l) were significantly ($P<0.05$) improved as the level of enzyme supplementation increased in the diets. These observations are in tandem to the earlier findings of Alu *et al.,* (2014) who reported significant improvement in some blood parameters such as, Pack cell volume (PCV), White blood cells (WBC), Haemoglobin (Hb), Mean corpuscular volume (MCV),of finisher quails fed enzyme supplemented diets. The values obtained in the present study fell within the normal range of PVC (30-50%),WBC (4-10X10^3/uL) for mature rabbits (Olomu *et al.,* 2019; Alu, 2018).

Table 2. Effect of ronoxymeHiPhos® supplementation on bloodparameters of grower rabbits fed sunflower seed meal diets

Parameters	0PPM	150 PPM	250 PPM	SEM	LOS
PCV (%)	33.83	34.58	35.75	0.52	NS
RBC ($X10^{12}$/l)	5.23^{b}	5.38^{b}	5.73^{a}	0.12	*
WBC ($X10^{9}$/l)	10.08	9.59	11.48	0.61	NS
Hb (g/dl)	11.42^{b}	11.37^{b}	12.01^{a}	0.17	*
MCV(fl)	62.50	64.17	63.00	0.67	NS
MCH (pg)	19.78	20.18	20.25	0.37	NS
MCHC (g/dl)	31.59	31.68	32.48	0.41	NS
Cholesterol (mmol/l)	3.83^{b}	4.33^{a}	4.31^{a}	0.12	*
Triglyceride (mmol/l)	0.95^{b}	1.16^{a}	1.03^{ab}	0.05	*
Total protein (g/L)	41.00	42.92	43.08	1.36	NS
Albumin (g/L)	23.00	21.75	20.92	0.79	NS
Creatinine (mmol/L)	155.08	157.17	152.42	4.32	NS
Glucose (mmol/l)	9.19	8.23	8.80	0.49	NS

a,b = means on the same row having different superscript differ significantly (P<0.05), **NS** = not significantly different (P>0.05), **SEM** = standard error of means

CONCLUSION AND RECOMMENDATION

In view of the significant improvement in some of the blood parameters recorded in the present studies and the lack of difference in the 150 and 250 PPM of enzyme supplemented diets, rabbit farmers can use the 150 PPM of the ronoxyme HiPhos® in SFS meal based diets without affecting the health status of the rabbits.

REFERENCES

Aduku, A.O (2004) Animal nutrition in the tropics; Feeds and feeding, pasture management, monogastric and Ruminant nutrition. Pp. 17-18.

Alu, S. E. (2018). Response of rabbits fed toasted kidney bean seed (*Phaseolus vulgaris*)meal (TKBSM) as a replacement for soybean meal. ISSN 0189-0514 J. Anim. Prod. Res.(2018) 30(1):188-203.

Alu, S. E., Kaankuka, F.G.Carew, S.N. and Tuleun, C.D.(2014).Response of finisher Japanese quails (*Cortunixcortunix japonica*) to enzyme-supplemented sugarcane scrapping meal-baseddietsand costimplication.NSUKJournal ofScienceand Technology(NJST)vol. 1&2 pp 19-30, 2014.

Alu, S.E., Tuleun, C.D., Kaankuka, F.G. and Carew, S.N. (2012). Meat quality of female quails (Cortunixcortunix japonica) fed low or high fibre diets supplemented with Maxigrain® enzyme. Pakistan Journal of Nutrition 11 (12): 1101-1106 ISSN 1680-5194 © Asian Network for Scientific Information.

AOAC, (2002) Association of official Analytical Chemists. Official methods of Analysis. (17th Ed). A Publication of the Association of official Analytical chemists, Washington, D.C. Pp 52-157.

Esonu, B.O., Azubuike, J.C., Ukwu, H.O. and Nneji, C.S. (2004). Effect of enzymes supplementation on the performance of broilers finishers fed *Microdesmispubercula* leaf meal. International Journal of poultry science. 3: 112-114.

Kelly, W.R. (1979). Veterinary Clinical Diagnosis. 2nd edition, London. Bailliere Tindall publishers. Pp 47-56.

Kohn, R.A and Allen, M.S. (1995). Enrichment of proteolitic activity relative to nitrogen in preparation from the rumen for Vitro studies. Animal feeds science and technology, 52 (1/2): 1-14.

NIMET (2017). Nigerian Meteorological Agency, Lafia, Nasarawa State.

Olomu, J.M., Bamikole, M.A and Olomu, C.E.B. (2019). Rabbit production and nutrition: Principles and practice. First Edition. ISBN: 978-9785-978510394-7. A Jachem Publication. Pp.158.

Pauzenga, U. (1985). Feeding parent stock. Zootecnica International. December 1985 PP.22 –24.

Peter, T., Biamonte, G.T and Doumas, B.T. (1982). Protein (Total protein) in serum, urine and cerebrospinal fluids; Albumin in Serum. In: Selected method of clinical chemistry. Vol. 9 (PaulknerWr, Meites S Eds) American Association for clinical chemistry, Washington, D.C.

HAEMATOLOGY OF RABBITS FED CASSAVA PEEL MEAL BASED DIETS SUPPLEMENTED WITH ELEMENTAL SULPHUR

***Bello, K. O.[1], Irekhore, O. T.[2], Adekoya, S. A.[3], Yusuf, A. O.[3]**

1- Institute of Food Security, Environmental Resources and Agricultural Research;
2 – Agricultural Media Resources and Extension Centre;
3- Department of Animal Production and Health,
Federal University of Agriculture, Abeokuta

**Corresponding Author: kazeembello19@gmail.com; belloko@funaab.edu.ng, +2348032204658*

Abstract
This study evaluates the effect of cassava peel meal supplemented with elemental Sulphur (ES) on the haematology of rabbits. Thirty six crossbreed weaner rabbits were allocated to six diets groups containing 0, 25, 50, 75, 100% of ES as replacement for methionine (diets 1-5) while diet 6 had 100% each of methionine and ES dietary concentration. Haemoglobin (Hb) concentration varied significantly ($p<0.05$) across the treatment groups while rabbits fed diet containing equal quantity of methionine and ES recorded least ($p<0.05$) Hb of 8.17g/dl. ES as replacement for methionine had no significant ($p>0.05$) effect on Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) on rabbits fed cassava peel meal based diets. The study concluded that ES as replacement for methionine in the diets of rabbits containing cassava peel meal as basal ingredient had no negative effects on blood formation of rabbits. ES could be used at 50% replacement for methionine in rabbits fed cassava peel meal diets without detrimental effect on health while combination of methionine and ES each at 100% dietary content reduced rabbit haemoglobin.

Keywords: cassava peel, elemental suphur, haematology, methionine, rabbit

INTRODUCTION

The demand for protein of animal origin in Nigeria is greater than the supply (Akinmutimi and Onwukwe, 2002) thus the need to produce livestock such as rabbit that is efficient in feed utilization, strives on roughages, prolific and has good meat quality. Commercial rabbit production however, is faced with the challenge of high feed cost, a phenomenon that makes rabbit production and products expensive.

This challenge has consequently encouraged efforts in researches towards finding and using alternative feed resources that are readily available, less expensive and competed for by man (Osakwe and Nwose, 2008). Cassava peel, a by-product from cassava processing is one of such alternatives. It has high energy content but low crude protein. In order to effectively utilize cassava peel in rabbit feed, the protein content could be made up for by supplementing with yet another less competitive protein source, particularly the amino acids.

Methionine and cystine are among major sulphur-containing (Ostrakhovitch and Tabibzadeh, 2015) amino acids. Methionine has to be supplied in the diet as it forms a large number of key metabolic intermediates essential for life (Marcel *et al.*, 2007). However, methionine as feed ingredient amino acid is expensive. Elemental sulphur (ES) being a component of methionine could serve as an efficient protein supplement (Ehlers, 2018) and in cassava peel meal based diet. When protein is deficient in the animal's normal diet, supplementing its feed with sulfur can improve amino acid balance and also improve pH balance in the blood of animals (Lanka, 2014; Ehlers, 2018).

Blood profile is influenced by the quantity and quality of feed and also the anti-nutritional factors present in the feed (Akinmutimi, 2004). Blood elements can also be used to monitor the protein quality in feeds, especially with feed constituents that affect blood formation (Unigwe *et al*., 2016). Consequently, haematology could be explored to give assessment of rabbits fed cassava peel meal based diets supplemented with ES.

MATERIALS AND METHOD

This study was carried out at the rabbit unit of the Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), Federal University of Agriculture Abeokuta (FUNAAB), Ogun State, Nigeria.

Cassava peel meal was obtained from the International Livestock Research Institute (ILRI), Ibadan, Oyo State, Nigeria while ES was purchased from open market within Abeokuta metropolis. Six diets (Table 1) were formulated containing ES at different levels (0, 25, 50, 75, 100 %) as replacement for methionine to form diets 1-5 while diet 6 had ES added as the same rate with methionine in control diet.

Table 1. Composition of experimental diets

Ingredient	ES inclusion levels as replacement for Methionine (ppm)					
	0	25	50	75	100	ES added as Methionine in control
Maize	22	22	22	22	22	22
Cassava Peel Meal	50	50	50	50	50	50
Groundnut Cake	20	20	20	20	20	20
Wheat offal	2.3	2.3	2.3	2.3	2.3	2.3
Bone	2.5	2.5	2.5	2.5	2.5	2.5
Oyster shell	2.5	2.5	2.5	2.5	2.5	2.5
Lysine	0.1	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.075	0.05	0.025	0.0	0.1
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Elemental Sulfur	0.0	0.025	0.05	0.075	0.1	0.1
Total	100	100	100	100	100	100.1
Analysis						
Metabolisable Energy (Kcal/kg)	2918	2918	2918	2918	2918	2918
Protein (%)	13	13	13	13	13	13
Fat (%)	2.64	2.64	2.64	2.64	2.64	2.64
Crude Fibre (%)	7.64	7.64	7.64	7.64	7.64	7.64

Thirty-six (36) cross breed weaner rabbits of weight range between 700 and 800g were used. The animals were reared using dwarf concrete hutch with the base made of galvanized wire mesh of about 2cm sieve size and laid 30cm above the floor. The rabbits were apportioned into six experimental groups according to the diets. Each treatment was replicated six times. Concrete feeders and drinkers were used. Feed and water were given *ad libitum* for 56days.

Blood collection was done twice; the first at the beginning of the study (Day 1) as baseline data and the second at day 56. Blood sample (2.5 ml) was drawn from each animal according to treatment and replicate and emptied in EDTA bottle for haematological analysis. PCV, Hb and WBC were determined according to Mitruka and Rawnsley (1977) while RBC (Total Erythrocyte Count) was determined according to Baker and Silverton (1982). Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) were estimated using a standard formula.

Data obtained were subjected to one way analysis of variance. Significant differences among treatment means were determined using LSD as contained in SAS (2002) package.

RESULTS

Result of haematology of rabbits fed cassava peel meal based diets with ES as replacement for methionine is shown in Table 2. Only Hb concentration varied significantly ($p<0.05$) across the treatment groups. The value ranged from 8.17 - 15.20g/dl. Rabbits fed diet containing equal quantity of methionine and ES recorded least ($p<0.05$) Hb of 8.17g/dl. Other haematological parameters (PCV, RBC and WBC) were similar ($p>0.05$) across the dietary groups. Also, ES as replacement for methionine had no significant ($p>0.05$) effect on MCV, MCH and MCHC of rabbits fed cassava peel meal based diets (Table 2).

DISCUSSION

Haematological values showed that PCV of rabbits across the treatment groups were within the range of 33 to 50% recommended for healthy rabbits (Hillyer, 1994). This suggested nutritional adequacy of the diets since PCV values did not indicate mal-or-under nutrition according to Church *et al*. (1984).

Haemoglobin functions in transporting oxygen to tissues of animals for oxidation of ingested food. Rabbits on diet containing methionine and ES at same level recorded the least value. Low values of haemoglobin concentration could be due to the harmful effects of high dietary content of ES. Haemoglobin of rabbits fed diets containing 0-100% replacement of methionine by ES were within the normal ranges (9.3 - 19.3g/dl) reported by Mitruka and Rawnsley (1977). According to Togun *et al*. (2007), this is an indication that the diets did not have any adverse effect on energy carrying capacity of the blood of the animals. However, low Hb concentration recorded in rabbits on diet containing same level of methionine and ES could suggest intolerable level and consequently may not be a viable combination level in diets of rabbits perhaps due to antagonistic or toxicity effect. Sulphur is an oxidizing agent and could portend oxidative stress when in excess. This view was supported by Rai *et al*. (2009) who reported that excessive methionine is associated with metabolic syndrome, oxidative and nitrosative endoplasmic reticulum stress in rabbits. According to Mecif *et al*. (2017), methionine is sulphur based protein, excess causes large plasma variations which is associated with the metabolic syndrome.

The RBC values recorded in this study were within the range of 3.07 to 7.50 x 106 /mm3. Similarly, WBC values were still within the normal ranges (2.5 – 12.5 x103/µl) reported by Canadian Council on Animal Care (2017). Riley and Rupert (2015) opined that normal range of values for WBC indicated that the animals were healthy because decrease WBC below the normal range is an indication of allergic conditions and certain parasitic infections.

The MCV, MCH and MCHC values were within the range of 50 - 75 fl, 18 - 24 pg and 34 - 37g/dl respectively, as reported by Gillet (1996) and they are important morphological characteristics used in detecting anaemia (Campbell, 2006).The results therefore indicated that the rabbits were not anaemic and the experimental diets support blood formation in rabbits.

CONCLUSION AND RECOMMENDATION

Based on the findings of this study, the following conclusion could be drawn:

1. ES as replacement for methionine in the diets of rabbits containing cassava peel meal as basal ingredient had no negative effects on blood formation of rabbits

2. ES could be used safely at 50% replacement for methionine in rabbits fed cassava peel meal diets.

3. Combination of each of methionine and ES at 100% dietary content in rabbits diets containing cassava peel meal as basal ingredient reduced haemoglobin content of blood.

REFERENCES

Akinmutimi, H.A. (2004). Evaluation of Sword Bean as an alternative feed resource for broiler chickens. Ph.D Thesis. Michael Okpara University of Agriculture, Umudike, Nigeria.

Akinmutimi, A.H. and Onwukwe, C.C. (2002). Effect of cooking with various concentrated potash on nutrient composition of Lima Beans. *J. Agric. Biotech. Environ*. 1:1-3.

Baker, F.S. and Silverton, R.E. (1982). Introduction to Medical Laboratory Technology, 5th edn Butterworth S.C., London, pp 481-494.

Campbell, L. (2006). Liver: Metabolic functions. Anaesthesia and Intensive care medicine, 7 (2) 51-54 https://doi.org/10.1383/anes.2006.7.2.51

Canadian Council on Animal Care (2017). Guide to the Care and Use of Experimental Animals Volume 1, 2nd Edition. E.D. Olfert, B.M. Cross, A.A. McWilliam (Editors). Publication Date: 1993 Revision Date: March 2017. Pp 209. 1993 ISBN: 0-919087-18-3

Church, J. P., Judd, J. T., Yong, C. W., Kebay, T. L. and Kim, W. W. (1984). Relationship among dietary constituents and specific serum clinical components of subjects eating self- selected diets.

Ehlers, J. (2018). What is sulphur responsible for in animals? Retrieved March 08, 2018 from petsonmom.me

Gillet, C.S. (1996). Selected drug dosage and clinical reference data. In: The Biology of the Rabbits, 2nd Ed, PJ Mauning, DH Ringler and CE Newcomer (eds), Academic Press, Florida, USA, pp: 467–472

Hillyer, E.V. (1994). Pet Rabbits. The Veterinary Clinics of North America, Small Animal Practice, 24(1):25-65

Lanka, K. E. (2014). The importance of macro minerals: Sulphur. The Agri-King Advantage, 5(1) 1-2.

Marcel, E.N., Han, B., Cordoba, F. (2007). Are we getting enough sulphur in our diets? https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2198910/

Mecif, K. O., Bouguerra S. A., Benazzoug, Y. (2017). Plasma and Aorta biochemistry and MMps activities in females rabbit fed methionine enriched diet and their offspring. Journal of Nutrition Metabolism, 2017; 2017: 2785142 published online; doi:10.1155/2017/2785142 PMCID: PMC5241488, PMID: 28133545 (accessed 13/7/2019, 5:56 (+1 GMT)

Mitruka B.M.and Rawnsley H. M. (1977). Clinical biochemical and haematological reference values in normal experimental Animal, Masson. N. Y.

Osakwe, I. I. and Nwose, R. N. (2008): Feed intake and nutrient digestibility of weaner rabbits fed cassava peel as replacement for maize. *Animal Research International*, 5(1): 770 – 773

Ostrakhovitch, E. A. and Tabibzadeh, S. (2015). Homocysteine in chronic Kidney disease. Advances in Clinical Chemistry, 72: 77-106. https://doi.org/10.1016/bs.acc.2015.07.002

Unigwe, C. R.; Marire, B. N.; Omeke, B. C. O.; Abonyi, F. O.; Oladipo, T. A.; and Adebayo, D. M. (2016). Effects of maize-replaced fermented cassava peels and enzyme-supplemented diet on haematology and serum biochemistry of cross-bred female pigs. *International Journal of Advanced Research in Biological Sciences*, 3(6):198-208.

Rai S., Hare D. L., Zulli A. A. (2009). Physiologically relevant atherogenic diet causes severe endothelial dysfunction within 4 weeks in rabbit. International Journal of Experimental Pathology. 90(6): 598-604. Doi:10.1111/j.1365-2613.2009.00668.x. (Accessed 13/7/2019 – 6:10 (+1 GMT)

Riley, L. K. and Rupert, J. (2015). Evaluation of patients with leukocytosis. *American Family Physician* 92(11):1004-1111

SAS. 2002. SAS/STAT Software: Changes and Enhancements through Release 8.1, SAS Institute Inc., Cary, NC.

Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., . . . Mustapha, F. (2007). Effects of chronic lead administration on the haematological parameters of rabbits – a preliminary study (p. 341). Proceedings of the 41st Conferences of the Agricultural Society of Nigeria.

Table 2: Haematology of rabbits fed cassava peel meal based diets with ES as replacement for methionine

Parameters	ES as replacement for Methionine (ppm)					ES added as Methionine in control diet	p-value
	0	25	50	75	100		
Packed cell volume (%)	36.33±1.36	37.00±1.16	37.67±1.20	38.67±2.03	38.64±0.17	34.77±1.23	0.075
Haemoglobin (g/dl)	11.67±0.70[a]	13.57±0.97[a]	15.20±0.67[a]	13.67±1.66[a]	14.35±0.43[a]	8.17±2.13[b]	0.020
Red blood cell (10^3/µl)	5.83±0.34	6.77±0.50	7.63±0.35	6.83±0.81	7.15±0.20	5.08±0.88	0.208
White blood cell (10^3/µl)	7.18±0.50	5.37±0.77	5.50±0.67	6.47±1.30	6.02±0.01	5.40±0.04	0.188
Mean-corpuscular Volume (fl)	60.00±0.00	60.00±0.00	60.00±0.00	60.00±0.00	60.00±0.00	60.00±0.00	0.127
Mean-corpuscular haemoglobin (pg)	20.00±0.00	20.00±0.00	20.00±0.00	20.00±0.00	20.00±0.00	20.00±0.00	0.167
MCHC (g/dl)	33.00±0.00	33.00±0.00	33.00±0.00	33.00±0.00	33.00±0.00	33.00±0.00	0.167

[ab:] Means within row with different superscript differs significantly ($p<0.05$)

MCHC = Mean corpuscular haemoglobin concentration

PERFORMANCE OF BROILER CHICKENS FED DIETS CONTAINING VARYING LEVELS OF MILLET AS A SUBSTITUTE FOR MAIZE

***Bello, K. M, Egbo, M. L and Buba S.A**

Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

**Corresponding Author: adijamusa@gmail.com*

ABSTRACT

The effect of replacing maize with millet was evaluated using one hundred and sixty-eight (168) day old Anak broiler chicks allocated to four (4) dietary treatments. Millet was used to replace maize at 0, 50, 75 and 100% levels coded as diets 1,2,3 and 4 respectively. The experimental design was completely randomized design with three (3) replicates per diet and fourteen (14) birds per replicate. Feed and water were supplied *ad libitum* and the experiment lasted for eight (8) weeks. The results showed that at the starter phase the daily feed intake values of 85.67 and 93.0g on diets 4 and 2 respectively were significantly different ($p<0.05$) while there was no significant difference in the body weight gain. The values ranged from 20.70-24.20g in birds fed diets 1 and 4 respectively. The FCR (3.53) of broilers fed diets 4 (100% millet) was significantly ($p<0.05$) better than the values on other diets. The performance at the finisher phase showed a non significant ($p>0.05$) treatment effect for all parameters. The pooled performance showed broilers fed diet 4 (100% millet) recorded significantly higher daily feed intake ($p<0.05$) and weight gain compared to the other diets. All the carcass characteristics measured were not influenced by the dietary levels of millet. The cost per kg gain was lowest on diet 4 (#30). These findings showed that millet can replace maize at 100% with better results and at reduced cost.

Keywords- Millet, Maize, Broiler, Economy, Performance.

INTRODUCTION

Maize is the most common feed stuff of choice as a major supplier of energy in monogastric animal diets. It is cultivated throughout the tropics where ever there is adequate rainfall. Conventional energy sources like maize have become very scarce and expensive due to multiple uses for human, animal feed and industries (Aduku, 2004). This competition has worsened the feed situation for monogastric animals. Maize alone accounts for about 50-70% of the total feed ingredients in broiler ration (Ojewola and Olugbemi 2011). The national demand for maize is estimated at 15.5 million metric tonnes, while current domestic production stands at 10.5 million tones annually. Several attempts have therefore been made to reduce the cost of feed production by replacing parts of the maize in diets with industrial by products and others (Akintola *et al* 2003, Okere and Akinseyiwa, 2011) such as millet. Millet is a cereal widely growth in drier areas of the tropics. It grows in areas not favourable to maize cultivation and it can be used in poultry diets. Millet resembles maize in composition and feeding value but is considerable higher in protein content. Banerjee (2013) reported CP of 8-12% and 10% for millet and maize respectively. According to Nnenna (1998) millet has a nutritive value comparable to other cereals with a CP of about 11% and sometimes up to 23%. It also has a higher fibre (8.6%) and carbohydrate with ash and fat similar to other cereals. Millet being an early maturing crop is more readily available and cheaper during the middle of the rainy season (July-August) when most other cereals are still in the field.

Abubakar *et al* (2006) fed graded levels of whole millet to broilers and reported cost reduction and no significant reduction in performance of broilers fed millet as a replacement for maize, this they attributed to higher level of crude fibre and anti nutritional factors like tannins present in millet. This study aimed to evaluate the effect of replacing maize with millet in the diet of broiler chickens.

MATERIALS AND METHODS.

Experimental site: the experiment was conducted at the Abubakar Tafawa Balewa University (ATBU) poultry research farm Bauchi. Bauchi is located within the Northern Guinea Savannah on latitude $10^{1}.17^{N}$ longitude 9^{0} 49^{1} E at an altitude of 690.2m above sea level. Bauchi has an annual rainfall of 600mm in the north and 130mm in the south.

Experimental Birds.

One hundred and sixty eight day old Anak broiler chicks were used for the experiments. The birds were brooded for one week there after were divided into four groups of 42 birds each. Each group of 42 birds were divided into 3 replicates of 14 birds per pen. They were weighed and randomly allocated to the 4 dietary treatments in a completely randomized design (CRD). Feed and water were provided *ad libitum.* Routine vaccinations were carried out as when due. The experiment lasted for eight (8) weeks.

Experimental Diets

Four (4) experimental diets were formulated arising from the replacement of maize with 0, 50, 75 and 100% of millet. The diets were isonitrogenous with 23 and 21% CP for the starter and finisher phases respectively (Table 1 and 2).

Gross Performance Analysis:-

The birds were weighed at the beginning of the experiment and thereafter on a weekly basis. Feed intake was measured daily, records of mortality were also taken as they occur. The cost of the four (4) diets were computed from the prevailing market prices of ingredient at time of the study. These were then used to calculate the cost of feed consumed per kg live weight gain of the experimental birds.

Carcass and Gut Characteristics:

Two birds per replicated were randomly selected at the end of the feeding trial. They were starved overnight, slaughtered, plucked and eviscerated. Live weight, dressing percentage and weight of cut parts and internal organs were recorded. Weight of cut parts relative to live weight were expressed as percentages.

Data Analysis:-

All empirical data generated were subjected to analysis of variance using SPSS (2012) and significant differences were separated using Duncan Multiple Range Test of the some package.

RESULTS AND DISCUSSIONS

The performance of the broilers fed millet as replacement for maize were as presented in Table 3. The birds on diet 4 (100% millet) recorded significantly ($P<0.05$) lower daily feed intake and FCR compared to the control and others during the starter phases. Values for the daily weight gain were however similar across the treatments. All the parameters measured also showed a non significant treatment effect during the finisher phases. The overall pooled performance of the broilers showed that those on millet based diet had significantly higher values of daily feed intake and weight gained compared to the control. This finding contradicts those of Ojewola and Olugbemi (2011) who reported significant reduction in performance when broilers were fed millet as a replacement for maize. The better feed efficiency for birds fed diet 4 (100% millet) agrees with the findings of Adamu *et al* (2001) who reported that the use of millet in broilers feeding was more rewarding than maize on account of feed utilization. The better results on the millet based diet compared to the control could be attributed to the higher protein quality of millet compared to maize.

The carcass characteristics and organ weight as replacement for maize showed a non significant treatment effect for all the parameters measured. The highest mortality recorded was 7.1% on diet 2 which perhaps is an indication that millet as source of energy in broilers diet may not be detrimental

The cost analysis (Table 4) showed decrease in feed cost with higher level of millet in diets from #121.88kg for diet 1 (0% millet) to #90.49 for diet 4 (100% millet). Total feed cost per kg weight gained followed the same trend. This is in agreement with the reports of Adamu *et al* (2001) and Abubakar *et al* (2006) who also observed cost reduction of broiler chickens fed millet as replacement for maize. This reduction in feed cost could be due to lower cost of pearl millet when compared to maize during the course of this study.

C0NCLUSION

Based on the result obtained, it can be deduced that millet can completely replace maize as source of energy in broiler chickens diets at both starter and finisher phases without any detrimental effect on performance and carcass quality. There was also a decrease in feed cost with increasing inclusion levels of millet. The use of millet is thereby advocated as an alternative energy source for maize to reduce competition especially during harvest period when it would be cheaper than maize.

Table 1: Percentage Composition of Millet Based Diets Fed to Broiler Chickens at Starter Phase (1-4 weeks)

	Replacement Levels of Millet			
Ingredients	1(0%)	2(50%)	3(75%)	4(100%)
Maize	44.00	22.00	11.00	0.00
Millet	0.00	22.00	33.00	44.00
Soyabean meal	25.49	25.49	25.49	25.49
Groundnut cake	15.00	12.00	11.51	11.01
Wheat offal	10.20	10.70	11.20	11.70
Fish meal	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	2.00	2.00	2.00	2.00
Premix	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Calculated Analysis				
Crude Protein(%)	23.00	23.00	23.00	23.00
ME(Kcal/kg)	2830	2791	2758	2738
Crude Fibre(%)	4.3	5.4	6.08	6.75
Ether Extract(%)	3.90	3.29	3.93	3.27

*Premix supplied the following additional nutrients per kg of diet

Vit. A= 10,000iu, D_3= 1020iu, E=10iu, K= 0.02mg, B_2=9mg B_6=400mg, B_{12}=0.03mg; Nicotinic acid 50mg; C=40mg; calcium D pantothenate=1602; minerals: chloride=4002mg Mn=200mg, Fe=100mg, Cu=4.8mg, Co=0.4mg: Se=0.12mg

Table 2: Percentage Composition of Millet Based Diets Fed to Broiler Chicken at Finisher Phase(5-8 weeks)

	Replacement levels of millet			
Ingredients	1(0%)	2(50%)	3(75%)	4(100%)
Maize	48.00	24.00	12.00	0.00
Millet	0.00	24.00	36.00	48.00
Soyabean meal	20.49	20.49	20.49	20.49
Groundnut cake	8.51	8.01	7.01	6.01
Wheat offal	15.20	15.70	16.20	17.70
Fish meal	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	2.00	2.00	2.00	2.00
Premix	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Calculate Analysis				
Crude protein(%)	21.70	21.8	21.6	21.00
ME(Kcal/kg)	2936	2922	2872	2857
Crude fibre(%)	4.65	5.49	5.94	6.48
Ether extract(%)	3.80	3.80	3.80	3.90

*Premix supplied the following additional nutrients per kg of diet

Vit. A= 10,000iu, D_3= 1020iu, E=10iu, K= 0.2mg, B_6=4mg, B_{12}=0.03mg; Nicotinic acid 50mg; C=40mg; calcium D pantothenate=16.0mg; minerals: chloride=4.8mg; iodine=1.55mg, Co=0.41mg, Se=0.12mg

Table 3: Performance of Broilers Fed Graded Levels of Millet Based Diets

	Replacement levels of millet				
Parameters	1(0%)	2(50%)	3(75%)	4(100%)	SEM
Starter phase					
Daily feed intake (g)	90.33^{ab}	93.00^{a}	88.67^{ab}	85.67^{b}	1.44*
Daily weight gain(g)	20.70	21.50	22.47	24.20	0.79 NS
Feed conversion ratio	4.37^{a}	4.33^{a}	3.90^{b}	3.53^{c}	0.17 *
Finisher phase					
Daily feed intake (g)	126.00	148.70	138.00	153.00	11.39NS
Daily weight gain (g)	40.33	42.33	42.33	46.00	1.32 NS
Feed conversion ratio	3.13	3.10	3.47	3.33	0.16 NS
Pooled phase					
Daily feed intake(g)	108.30^{b}	112.70^{ab}	113.70^{ab}	119.70^{a}	2.15*
Daily weight gain(g)	30.57^{b}	31.93^{ab}	32.43^{ab}	35.13^{a}	0.60*
Feed conversion ratio	3.80	3.73	3.70	3.43	0.00 NS
Mortality (%)	4.80	7.10	4.10	4.80	0.00

*Means in the same row bearing different superscript differ significantly (P<0.05)

NS= Not Significant statistically (P<0.05) SEM= Standard Error of Mean

Table 5: Carcass Characteristics (% body weight) of Broilers Fed Replacement Levels of Millet

	Replacement levels of millet				
	1(0%)	2(50%)	3(75%)	4(100%)	SEM
Live weight (kg)	2.27	2.27	2.33	2.33	0.08 NS
Plucked weight (kg)	2.92	2.40	2.27	2.20	0.19 NS
Eviscerated weight (kg)	1.87	1.87	1.90	1.87	0.06 NS
Carcass weight(kg)	1.67	1.70	1.70	1.67	0.06 NS
Dressing%	73.61	75.03	72.88	71.35	1.32 NS
Gizzard	2.29	2.04	1.97	2.09	0.10 NS
Abdominal fat	1.38	1.46	1.32	2.10	0.28 NS
Liver	2.04	2.00	2.33	2.00	2.24 NS
Heart	0.52	0.47	0.54	0.48	0.05 NS
Lungs	0.79	0.49	0.64	0.57	0.13 NS
Shank	3.34	3.20	4.07	3.63	0.21 NS
Head	2.93	2.55	2.77	2.90	0.25 NS
Small intestine	3.20	4.09	3.51	3.85	0.34 NS
Large intestine	0.14	0.20	0.14	0.15	0.03 NS
Spleen	0.16	0.16	0.16	0.13	0.04 NS
Pancrease	0.27	0.23	0.27	0.25	0.03 NS
Kidney	0.20	0.17	0.25	0.22	0.05 NS
Ceaca	0.70	0.64	0.69	0.49	0.08 NS

NS= No significant difference (p>0.05), SEM= Standard error of means

Table 4: Economic Analysis of Millet Based Diets for Broilers Production.

	Replacement levels of millet			
Parameters	1(0%)	2(50%)	3(75%)	4(100%)
Total feed intake(kg)	6.06	6.30	6.37	6.70
Total weight gain(kg)	1.70	1.79	1.80	1.97
Feed cost(#/kg)	121.88	**92.57**	**91.53**	**90.49**
Total feed cost(#)	738.39	**583.19**	**583.05**	**606.28**
Feed cost/kg gain (#)	463.46	**345.29**	338.92	**307.76**
Cost saving/kg gain	**_**	**117.85**	**124.48**	**152.75**

REFERENCES

Abubakar, A; Bashar, Y.A and Eguke B.O.C (2006). PearL millet as a replacement for maize in the diet of broiler chickens in Sokoto state, Nigeria. Tropical Journal of Agriculture Science. 9:53-61

Adamu, S.B; Waziri; Y.D. and Abattor, F.T (2001). The use of different energy sources on the performance of broiler chickens under a semi arid environment. *Proc.of the 8th Annual conference of Animal Science Association of Nigeria. 17th-19th* September 2001 Maiduguri Nigeria Pp 108-111.

Aduku A.O. (2004). **Animal nutrition in the tropics. Feed and feeding, pasture in the tropics.** Davcon competitions and business bureus, Samaru Zaria, Nigeria Pp. 14

Akinola, L.A; Ekine, O.A and Emedo, C.C (2013). Replacement of maize with whole millet meal in broiler diets in a humid tropical environment. *Proceeding of18th annual conference of animal science association of Nigeria held at Abuja 209-212.*

Banerjee. G.C. (2013). **A textbook of Animal husbandry**. Oxford and IBH 8th edition pp390.

Nnenna J.E. (1998). **Foods of plant origin.** Afro orbis publications Ltd Pp 133.

Ogbonna, J.U; Oredon A.O and Ige, A.k. (2000): The effect of varying levels of cassava meal on broiler gut morphology. *In proceedings 25th Annual Conference Nigerian Society of Animal Production* Pp 143-146.

Ojewola G.S. and Olugbemi I.F. (2011). Millet meal a possible dietary energy source for broiler chicken. (A preliminary study). *In proceedings 36th annual conference of Nigerian society of animal production.* 13-16 march at University of Abuja.pp438-440

Okere I Akinseyiwa A.O.K. (2011). Performance of cockerel birds fed diets containing varying levels of dried cassava tuber as a substitute for maize in the early phase. *In proceedings 36th Annual conference of Nigerian society of animal production* Pp 441-444

SPSS (2012): Statistical Package for Social Sciences (SPSS) 2/version inc. 233 South wiener drinks 11th flow Chicago P.C 60606-6412.

EFFECT OF TUMERIC (*CURCUMA LONGA)* AS FEED ADDITIVES ON HAEMATOLOGICAL PARAMETERS OF BROILER CHICKENS

Daramola, O.T[*], Oloruntola, O.D [+], Jimoh, O.A[*] and Ayodele, S.O*
[*]*Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti*
[+]*Department of Animal Science, Adekunle Ajasin University, Akungba Akoko, Ondo state,*
Corresponding Author: olajumoke.daramola2016@gmail.com

ABSTRACT
The experiment was conducted to investigate the effect of turmeric (Curcuma longa) on haematological parameters of broiler chickens. A total of 108 day old arboacre broiler chicks were divided into three treatment groups in completely randomized design with a total of 12 experimental unit. The birds were assigned at the rate of 36 birds per treatment in 4 replicates of 9 chicks per replicate. Turmeric powder was supplemented to the feed at the rates of 0, 0.5 and 1% throughout the experiment (8weeks). Blood samples (3 birds per treatments) were collected through the jugular veins at the termination of the experiment. All data generated were subjected to analysis of variance (p=0.05). The samples were taken to medical laboratory to determine PCV, RBC, HB, MCV, MCH, MCHC, granulocyte, lymphocyte, monocyte and white blood cell. Result showed that turmeric supplementation positively affected the vital haematological constituents like Pcv, Hb and Rbc of birds fed 0.5 and 1.0% of turmeric but there was increased in monocytes values for birds on diets 2 and 3 which may be attributed to endogenous corticosteroid. It can be concluded that turmeric has the potential to improve immune response in broiler chickens and its use at 1.0% inclusion is hereby recommended for better results.
Keywords : Tumeric, haematology, feed additives, growth promoters and broiler chickens

Introduction
The ban of antibiotics growth promoters was problematics for growth performance and this has led to outbreak of diseases especially sub-clinical necrotic enteritis which led researcher to discover alternatives to synthetic antibiotics (Huyghebaert *et al*.,2011). Different natural growth promoters are used as an alternatives to replace antibiotic growth promoter e.g enzymes antioxidants, herbs and medicinal plants. Herbs, medicinal plants and their extracts are excellent alternatives due to the different beneficial activities (Das *et al*., 2012; Rana *et al*., 2014). Phytogenic feed additives are ideal for poultry because they are natural residue free. Phytogenic growth promoter showed antimicrobial, antiparasitic and antitoxic effects. They enhanced feed consumption, improved digestion and growth performance, minimized the incidence of disease and increased profitability (Yitbreak, 2015). Due to its antimicrobial, antiparasitic and antitoxic properties, the use of turmeric in poultry feed become extensive during the last decade (Khan *et al.*, 2012). The active ingredient present in turrneric root is curcumin. Turmeric contains 3 different analogues of curcumin which contains 5% bis-demethoxycurcumin, 18% demethoxycurcumin and 77% diferuloylmethane curcumin is insoluble in water and soluble in methylsulfoxide, ethanol, oils and acetone (Aggarwal, 2007). Turmeric has good pharmacological properties and can be a useful antimicrobial and antitoxic and safe alternative to antibiotics. The aim of the study was to investigate the effect of different levels of turmeric (*Curcuma longa*) on the haematological parameters of broiler chickens.

MATERIALS AND METHODS
The experiment was conducted at Teaching and Research farm in Federal Polytechnic, Ado-Ekiti. The poultry was thoroughly washed and disinfected. The house was allowed to stay for two weeks before the arrival of the experimental birds. A total number of one hundred and eight broiler chicks of arboacre commercial breed were obtained from a reputable hatchery. In the poultry house used for this study, enough provision was made for space, ventilation and protection against predators and extremes of weather. The birds were used to assess the different levels of turmeric on the haematological parameters of broiler chickens. Three experimental diets used for this study were formulated according to (NRC 1994) at the premises of Teaching and Research farm, The Federal Polytechnic, Ado-Ekiti. Diet 1 was the control diet with no turmeric supplementation, diet 2 contained 0.5% of turmeric supplementation and diet 3 contained 1% of turmeric supplementation. All diets were supplemented with methionine and lysine. The treatments were given to the birds for the period of the experiment (8weeks). There were three treatments with four replicates per treatment. Nine birds were allotted per replicate amounting to 36 birds per treatment. During the brooding exercise, the chicks were given all the recommended vaccination and medication. The turmeric used for this study

was purchased from a local market in Ado-Ekiti, the test ingredient was washed, sliced and sun dried and later ground with grinding machine.
On the last day of experiment (56day), blood samples collection was done in the morning after the birds were starved overnight in order to attain a stable haematological evaluation. Four birds were randomly selected from each experimental diet and blood samples were collected from the jugular vein of the birds. About 3ml of blood samples were collected from each bird in labeled ethylene diamine tetra-acetate (EDTA) bottles to determine the haematological indices. The tubes were immediately capped and the contents mixed gently for about 1minute by repeated inversion. The samples were taken immediately to the laboratory to determine packed cell volume (PCV), total red blood cell (RBC) count, haemoglobin concentration (Hb), mean corpuscular haemoglobin concentration (MCHC), mean cell haemoglobin (MCH), mean corpuscular volume (MCV) was calculated as described by Lamb (1981). The white blood cell, neutrophils (N), lymphocytes (L), monocytes (M) and Eosinophils were determined by the micro-haematocrit method (Dacic and Lewis, 1991).The experiment was completely randomized design (CRD) with a total of 12 experimental units. All data collected in these studies were subjected to analysis of variance. Duncan's Multiple Range Test of one way ANOVA (SPSS17.0 for windows was used to analyse the mean differences of the same parameter, significant differences were considered where necessary at a level of ($P<0.05$).
Composition of experimental diets (g/100g) for
Broiler starter/finisher diets.

RESULTS AND DISCUSSION

The effect of the turmeric supplementation on haematological parameters is presented in Table1. The mean RBC was significantly ($P<0.05$) increased in birds on diets 2 and 3 than birds on control diet suggesting that turmeric supplementation at 0.5 and 1% found to stimulate RBC production at a slightly increased level of supplementation. The mean monocyte was significantly ($P<0.05$) increased in birds on diets 2 and 3. The increased values of monocyte for birds on diets 2 and 3 may be attributed to endogenous corticosteroid which may be due to stress. The PCV, MCHC, MCV, MCH, HB, granulocyte, lymphocyte were not significantly ($P>0.05$) influenced by turmeric supplementation. There were increase in PCV, HB and RBC values which are comparable with the findings of Ajit *et al*. (2014) and Vivian *et al*. (2015) who opined that the increase in the vital constituents like PCV, HB and RBC in birds fed with herbal ingredients like turmeric, garlic, ginger is an indication of improven oxygen carrying capacity of the cells which translated to a better availability of nutrients for utilization by the birds consequently affecting their wellbeing with an active immune system. They were also no sign of anaemia as the degree of anaemia is determined by HB, PCV and RBC count which were in the normal range. Thus, this findings strongly agree with Nagalakshmi *et al*. (1996) and Gowda *et al*. (2008) who reported that bitter principles of medicinal plants possess a strong influence on haematological traits depending on their nutritional status.

Conclusion and Recommendation

It can be concluded that turmeric has the potential to improve immune response in broiler chickens and its use at 1.0% inclusion is hereby recommended for better results

Table 1: Haematological indices of broiler chickens fed experimental diets

	Diets				
	1	2	3	± SEM	P-value
	Turmeric inclusion				
Parameters	**Control diet**	**0.5%**	**1%**		
PCV (%)	**26.33**	**26.58**	**26.82**	**0.59**	**0.48**
RBC ($\times 10^6 mm^3$)	**15.70^b**	**16.54^a**	**16.68^a**	**0.41**	**0.05**
HB (g/100ml)	**8.77**	**8.80**	**8.82**	**0.21**	**0.37**
MCV (fl)	**16.89**	**16.37**	**16.07**	**0.54**	**0.85**
MCH (pg)	**5.62**	**5.67**	**5.65**	**0.16**	**0.99**
MCHC (g/dl)	**33.33**	**33.33**	**33.15**	**0.01**	**0.01**
granulocyte (%)	**24.00**	**23.00**	**20.67**	**1.45**	**0.69**
lymphocyte (%)	**77.00**	**74.00**	**76.33**	**2.78**	**0.92**
monocyte (%)	**2.66^b**	**5.33^a**	**5.40^a**	**0.57**	**0.07**
WBC (mm^3)	**2.43**	**2.53**	**2.30**	**0.14**	**0.84**

Means with different superscript on the same row differ significantly ($p<0.05$). PCV= Packed cell value; Rbc= Red blood cells; Hb=Haemoglobin concentration; MCV= Mean corpuscular volume; MCHC= Mean cell haemoglobin concentration , MCH =Mean cell haemoglobin; WBC=White blood cell

	Diet	
Ingredients	Starter diet	Finisher diet
Maize	46	63
Soybean	26	17
GNC	16	11
Fish meal (72%)	2.0	2.0
Bone meal	6.0	4.0
Oyster shell	3.0	2.0
Premix	0.3	0.2
Methionine	0.3	0.3
Lysine	0.3	0.2
Salt	0.2	0.3
Total	100	100

REFERENCES

Aggarwal, B.B., Surh, Y.J., Shishodias (2007). The molecular targets and therapeutic uses of curcumin in health and disease. Springer Science , Business media, LLC. 595:1-2.

Ajit, S., Doley P., Neeraj and Prasad J. (2014).Effect of dietary supplementation of tulsi (*Ocimum sanctum*) leaf powder on haematology and serum biochemistry of broiler chicks. International *Jrn. Bio. and Pharm. Res.* 5(1): 89-92.

Dacic, J.V and Lewis,S.M (1991). PracticalHaematology. 7th Edition, ELBS with Churchill Living stone, Edinburgh, 54-79.

Das, L., Bhaumik, E., Raychaudhuri, U., and Chakraborty R. (2012). Role of nutraceuticals in human health. *Jrn. Food Sci. Technol*. 49: 173-183.

Gowda, N.K.S, Ledoux, D.R., Rohinghaus, G.E., Bermudez, A.J., Chen, Y.C (2008). Efficacy of turmeric (Curcuma longa), containing a known level of curcumin and a hydrated sodium calcium alumino silicate to ameliorate the adverse effects of aflatoxin in broiler chicks. *Poult.Sci*. 87 : 1125-1130.

Huyghebaert G., Ducatelle, R., Immerseel, Van F. (2011). An update on alternative to antimicrobial growth promoters for broilers. *The Vet. Jrn.*, 187 (2): 182-188.

Khan, R.U., Naz, S., Javdani, M., Nikousefat, Z., Selvaggi, M., Tufarelli, V., Laudadio, V. (2012). The use of turmeric (*Curcuma longa)* in poultry feed. *World Poult. Sci. Jrn.* 68: 97-103.

Lamb, G.N (1981). Manual of Vet. Lab., Techn. Ciba- Geigy Kenya pp. 96-97.

Mitruka, B.M and Rawnsley, H.M (1977). Clinical, Biochemical and Haematological reference values in normal experimental animals. Mass on publishing USA incorporated,New york, USA.

Nagalakshmi, D., Sastry, V.R.B., Agrawal, R.C., Ketiyar, D.K and Verma, S.V.S (1996). Performance of broiler chicks fed on alkali treated (Azadirachta indica) kernel cake as a protein supplement. British Poult. Sci., 37(4):809-818. DOI : 10.1080/00071669608417910.

NRC (1994). Nutrient Requirements of Poultry. 9th rev. ed. Nat. Res. Counc., Natl. Acad. Press, Washington DC.

Rana M.M., Hossain, M.N., Rabby, M.K., Sarkar, M.S.K., Ali, M.S (2014). Performance of broilers fed vegetable based diets supplemented with organic acids and methionine as growth promoter source and antibiotics. *Jrn. Sci. Res. and Rep.* 3(8): 1105-1116.

Vivian,U.O.O., Ndofor-Foleng, H.M, Olorunleke, S.O and Uguru, J.O (2015). Evaluation of growth performance, haematological and serum biochemical response of broiler chickens to aqueous extract of ginger and garlic. *Jrn. Agric. Sci.* 7(4): 167-173. http;//cite seersx.ist.psu.edu.

Yitbreak, M.B (2015). Phytogenics on feed additives in poultry production . A review. International *Jrn. Ext. Res.* 3: 49-60

HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF BROILER STARTER BIRDS FED DIET SUPPLEMENTED WITH NIACIN AND YEAST

*. **EDEH, H. O, OGWUEGBU, M.C, ANI, A.O and OKONWOR, C.S**

Department of Animal Science, University of Nigeria Nsukka, Nigeria

**Corresponding author; Email:henry.edeh@unn.edu.ng. Phone no :(+2348064645061)*

ABSTRACT

The study was carried out to investigate the haematological and serum biochemical effect on starter broiler birds fed supplemented Niacin and yeast. Yeast and niacin were used as supplement in the feed, the level of yeast was constant in T_2 (32.5g), T_3 (32.5g), and T_4 (32.5g), while the level of Niacin varied in T_2 (1.5g), T_3 (3g), and T_4 (4.5g). T1 was the control (no niacin, no yeast included).The study was carried out in the Poultry Unit, Department of Animal Science Teaching and Research Farm, University of Nigeria Nsukka, and it lasted for 8 weeks. A total of one hundred and twenty (120) day old broiler birds were randomly allotted to four (4) dietary treatments with thirty (30) birds per treatment in each pen. The animals were further divided into three replicates with ten birds per replicate in a completely randomized design (CRD). The result of the study on the haematological parameters showed that the inclusion of niacin and yeast had significant effect ($P<0.05$) on the Haemoglobin concentration (Hb), Mean Corpuscular Haemoglobin(MCH), and corpuscular heamoglobin concentration(MCHC). The result of the study on the Serum profile of broiler starter phase showed that the inclusion of Niacin and yeast had significant effect ($P<0.05$) on the cholesterol, triglycerides and Low density lipoprotein (LDL). It is evident from this study that majority of the parameters measured or determined did not favor high inclusion of Niacin and yeast in broiler production. However, the research had established that inclusion of niacin and yeast in broiler production, small dosages have to be administered to avoid overdoes.

Key words: haematology, serum, diets, niacin and yeast

INTRODUCTION

In recent years, consumers' pressure and worries towards harmful effects of antibiotic use and the ban of antibiotics has prompted researchers to think about alternatives to antibiotics in poultry production (Diarra and Malouin, 2014). Probiotics are defined as "live micro-organisms, when administered in adequate amounts; confer a health benefit to the host" (WHO, 2001). Probiotic feed supplementation improves growth, feed efficiency and intestinal health (Giannenas *et al.*, 2012). Among the different probiotic organism, the Lactobacillus and Saccharomyces have most commonly been used. Saccharomyces cerevisiae (SC), one of the most widely commercialized types of yeast, rich in crude protein (40-45%) and its biological values were high and also rich in vitamin B complex, biotin, niacin, pentothenic acid and thiamin (Reed and Nagodawithana,1999) has long been fed to animals and poultry. Niacin is important in energy production and storage and tissue growth (El-Husseiny *et al*., 2008). The availability of niacin in grains and grain by-products is very low, therefore, the need to supplement it in the diet of the birds. Haematology refers to the study of the numbers and morphology of the cellular elements of the blood – the red cells (erythrocytes), white cells (leucocytes), and the platelets (thrombocytes) and the use of these results in the diagnosis and monitoring of disease (Merck Manual, 2012). However, the essence of this study was to investigate the effect of niacin and yeast on haematology and serum biochemical indices of starter broiler birds.

MATERIALS AND METHOD

Location and duration of study

The study was conducted in the poultry unit, Department of Animal Science Teaching and Research farm, University of Nigeria Nsukka. The study lasted for four (4) weeks.

Experimental materials

Niacin and yeast was used for the study. Niacin was gotten from Joechem Agrochemicals in Nsukka, Enugu state. Commercial yeast was also gotten from a reputable dealer in Ogige market in Nsukka.

Experimental animal and management

One hundred and twenty (120) broiler birds of a day old commercial broiler chicks of mixed sexes of the Anak strain were purchased from a reputable source in Nsukka, Enugu state and were used for the

study. The broiler birds were randomly allotted to four (4) dietary treatments with thirty (30) birds per treatment in each pen. The animals were further divided into three replicates with ten birds per replicate in a completely randomized design (CRD). Yeast and Niacin were included in the feed of the broiler birds. The treatments were as follows: T_1= Control (no Niacin, no Yeast included), T_2=32.5g of Yeast + 1.5g of Niacin, T_3=32.5g of Yeast + 3g of Niacin and T_4=32.5g of Yeast + 4.5g of Niacin. Feed and water were supplied ad *libitum* to the birds. Vaccinations and other management practices were strictly followed.

Feed composition table

Table 1: Percentage composition of the starter diets

INGREDIENTS (%)	**STARTER DIET**
Maize	40.00
Soybean cake	33.6
Palm kernel cake	10.40
Wheat Offal	8.00
Bone meal	4.00
Fish meal	3.00
Salt	0.25
Premix*	0.25
Lysine	0.25
Methionine	0.25
TOTAL	**100**

Haematological and serum biochemical evaluation

At the end of the experiment, three birds per treatment were randomly selected and blood samples were collected from the wing veins of each bird using sterilized syringe and emptied into sterilized bottles containing EDTA (Ethylene diaminetetracetic acid) for haematological analysis, and into the bottles without EDTA for serum biochemical analysis. Haematological parameters that were determined included haemoglobin concentration (HbC), packed cell volume (PCV), white blood cell (WBC) count, and red blood cell (RBC) count. Serum metabolites (total protein (TP), glucose albumin, globulin, creatine, cholesterol and calcium) were also determined according to the methods described by Campbell and Coles (1986).

Statistical analyses

Data collected were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) using a statistics package for social sciences. (SPSS 2015) model. Significantly different means were separated using Duncan's New Multiple Range Test (SPSS, 2015).

Result and discussion

Table 2: Proximate analysis for starter feed.

	MOISTURE	PROTEIN	ASH	FIBRE	FAT/OIL
T_1	16.00	23.05	14.00	5.00	1.50
T_2	17.50	23.11	12.00	5.05	1.32
T_3	14.90	24.10	13.94	4.98	1.09
T_4	16.80	23.92	14.00	5.08	1.21

Table 3: Effect of Yeast and Niacin on Haematological parameters of broiler starter phase.

TREATMENT	T_1	T_2	T_3	T_4	SIGNIFICANCE
PCV (%)	27.50 ± 1.44	24.50 ± 0.87	26.33±1.20	26.00 ± 1.73	N.S
RBC (mm^3)	2.76 ± 0.48	2.24 ±0.31	2.62 ±0.12	2.17 ± 0.14	N.S
HB (g/100ml)	9.06 ±0.51^{ab}	10.90 ±1.24^{a}	6.14 ± 1.06^{b}	7.82 ± 1.60^{ab}	*
MCH (%)	35.20 ± 7.02^{ab}	56.90±7.84^{a}	23.88± 5.07^{b}	37.17 ±9.42^{ab}	*
MCHC (%)	32.93 ±0.51^{ab}	44.10± 3.50^{a}	23.79±5.13^{b}	29.54 ±4.64^{b}	*

N.S= not significant, *= significant

The table above indicated that there was no significant difference on packed cell volume(PCV) and red blood cells(RBC), but there were significant effect (P<0.05) of treatments on heamoglobin concentration(Hb), mean corpuscular haemoglobin(MCH), and corpuscular heamoglobin concentration(MCHC). T2 was statistically higher in Hb(10.90 ±1.24),MCH(56.90±7.84) and MCHC(44.10± 3.50) values than Hb(6.14 ± 1.06), MCH(23.88± 5.07) and MCHC(23.79±5.13) values of T3 respectively. T_2 had similar values of Hb, MCH and MCHC with T_1 and T_4. Again T_3, T_1, and T_4 were statistically similar in HB, MCH and MCHC values. The haemoglobin concentration and packed cell volume in this study fell within the normal range of (6.0 – 13.0 g/100ml) and (29 – 38%) respectively according to (Nworgu, 2007). The mean corpuscular haemoglobin and mean corpuscular heamoglobin concentration also fell within the normal range of (32.30 – 60.10pg) and (27.35-45.51%) respectively as reported by Nowaczewski and Kontecka (2012). This suggested that inclusion of niacin and yeast did not constitute of any harmful effect to the broilers. This supports the findings of (Khan and Zafar, 2005) who stated that Haematological parameters are good indicators of the physiological status of animals.

Table 4: Effect of yeast and niacin on Serum profile of broiler starter phase.

TREATMENT	CONTROL	T_2	T_3	T_4	SIGNIFICANT
HDL (mg/dl)	80.08±7.02	69.99±4.02	75.82±5.66	79.14±1.94	N.S
CHOLESTEROL (mg/dl)	68.86±2.85^{c}	68.07±1.40^{c}	111.38±7.06^{b}	126.73±8.02^{a}	*
ALBUMIN(g/dl)	1.15±0.08	1.19±0.10	1.05±0.08	1.27±0.16	N.S
TRIGLYCERIDES(mg/dl)	120.64±14.35^{a}	51.88±7.54^{b}	60.94±23.02^{b}	74.21±9.06^{a}	*
TOTAL PROTEIN(g/dl)	4.73±0.69	3.97±0.43	3.27±0.32	3.50±0.43	N.S
LDL(g/dl)	-66.07±3.47^{c}	-26.73±7.81^{b}	7.87±6.17^{a}	13.22±2.04^{a}	*
GLOBULIN	3.52±0.68	2.78±0.34	2.22±0.30	2.22±0.36	N.S

N.S= not significant, *= significant

Table 4 indicated that there were significant (P<0.05) differences in cholesterol, triglycerides and LDL. T1 and T2 were significantly (P<0.05) lower in cholesterol values than the values of T3 and T 4. T4 was statistically higher in cholesterol value. T1 (120.64±14.35) was significantly (P<0.05) higher in triglycerides value than other treatments. The LDL values of T4 (13.22±2.04) and T3 (7.87±6.17) were significantly higer than other treatments. T1 (-66.07±3.47) had the least value of LDL. This study disagreed with the finding of Kamanna and Kashyap (2000) who reported that the typical effects of niacin causes decreased low density lipoprotein and cholesterol concentrations. And it is also in contrast with the findings of Kamanna and Kashyap (2000) who affirms that niacin is best used to reduce cholesterol serum. These differences could be due to the level of inclusion, environmental factor, climate and management practices. This result agreed with the findings of Djouvinov et al (2005) who reported no significant difference in the level of total proteins in a study with ducklings using a multi-strains probiotic. The result on the value of triglycerides level was in agreement with the findings of Hu *et al*. (2012) who reported that niacin effectively reduces plasma triglyceride levels.

CONCLUSION

This research established that in inclusion of niacin and yeast in broiler production, small dosages have to be administered to avoid overdoes. Notwithstanding, a right dosage of niacin and yeast can enhance the performance of broiler production in terms of haematological, serum biochemical and carcass and organ analysis.

REFERENCES

Campbell, T.W. and Coles, E.H. (1986). Avian clinical pathology. In: Coles E.H (ed) Veterinary Clinical Pathology. 4thedn. Saunders, Philadelphia, pp 279-291.

Diarra, M.S., F, and Malouin, (2014). Antibiotics in Canadian poultry productions and anticipated alternatives Front Microbial, Pp5. 282

Djouvinov, D.; Boichera, S.; Simeonova, T.; Vlaikova, T. (2005). Effect of feeding lactina probiotic on performance, some blood parameters and caecal microflora of mule ducklings. *Trakia Journal of Sciences.*, 3: 22-28.

El- Husseiny, O.M., G.M. Abdul-Aziz, E.R. ElHaroun, and A.M.A.S. Goda. (2008). "Fish Meal Replacer Studies with Nile Tilapia and Mullet under Polyculture Conditions in Egypt". *International Aquafeed.* 9(1):20-29.

Giannenas, I., E. Papadopoulos, E. Tsalie, E. Triantafillou, S. Henikl and K. Teichmann (2012). Assessment of dietary supplementation with probiotics on performance, intestinal morphology and microflora of chickens infected with *Eimeria tenella. Veterinary Parasitology*, 188: 31-40

Hu, M., W.C. Wing Chu, S. Yamashita, D. Ka Wai Yeung, L. Shi, D. Wang, D. Masuda, Y. Yang, and B. Tomlinson. (2012). "Liver Fat Reduction with Niacin is influenced by DGAT Polymorphisms in Hypertriglyceridaemic Patients". *Journal of Lipid Resources*.

Kamanna, V.S and M.L. Kashyap. (2000). "Mechanism of Action of Niacin on Lipoprotein Metabolism". *Current Atherosclerosis Reports*. 2(1): 36-46.

Khan, T. A., & Zafar, F. (2005). Hematological Study in Response to Varying Doses of Estrogen in Broiler Chicken. *International Journal of Poultry Science*, 4(10): 748-751.

Merck Manual (2012). Hematologic reference ranges. Mareck Veterinary Manual. Retrieved from http://www.merckmanuals.com/.

Nowaczewski, S., & Kontecka, H. (2012). Haematological indices, size of erythrocytes and haemoglobin saturation in broiler chickens kept in commercial conditiond. *Animal Science Papers and Reports*, 30(2): 181-190.

Nworgu et al. (2007). Performance and some blood chemistry indices of broiler chicken served fluted pumpkin (*Telferia occidentalis*) leaves extract supplement. *Journal of American-Eurasian Agricultural. and Environmental. Science.*, 2(1): 90-98.

Reed, G. and Nagodawithana, T.W. (1999). Yeast technology (2nd Edn.), VanNo strand Reinhold New York.

SPSS.Com.(2015).IBM(R)SPSS(R) Advantage for Microsoft (R)IBM.Corporation 2010,IBM Corporation Route,100,Somers,N4. 10589.

WHO, (2001). Food and agriculture organization of the united nations/world health organization (Fao/Who). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria Internet Report of a Joint Fao/Who Expert Consultation.

EFFECT OF DIFFERENT INCLUSION LEVELS OF GINGER (*Zingiber officinale* Roscoe) MEAL ON THE PERFORMANCE OF STARTER BROILER CHICKENS

***Egenuka, F. C., Obi, H. N., Achi, J. C., Okere, P.C., Kadurumba, O. E. and Iwuji, T. C.**

Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria.

*Corresponding author's e-mail: fegenuka@gmail.com

ABSTRACT

One hundred and thirty-two (132) day old broiler chicks of Abor-acre strain were used in this study to investigate the effect of different inclusion levels of ginger meal on the performance of starter broilers. The birds were randomly divided into four treatment groups, each comprising of 33 broilers. Each group was further sub-divided into 3 replicates of 11 birds each, in a completely randomized design. Four dietary treatments were formulated. The control diet contained no ginger (0.0 % ginger diet). Diet 2 contained 0.5 % ginger; diet 3 contained 1.0 % ginger and diet 4 contained 1.5 % ginger. The experiment lasted for 30 days. Results from the experiment showed that differences in ginger levels did not affect weight gain and feed conversion ratio but feed intake of the ginger groups were similar but significantly higher ($P < 0.05$) than the control group. Cost of feed and cost/kg weight gain was higher in the ginger groups with diet 4 recording the highest values, though the differences were not significant. 0.5 % inclusion level of ginger meal in broiler starter diets could have positive effects on the birds since birds on this diet exhibited lower feed conversion ratio with minimal feed intake.

Key words: Ginger meal, starter broiler chickens, performance

Introduction

In-feed additives/growth promoters such as antibiotics have normally been used at sub-therapeutic doses to enhance growth in poultry. However, in January 1, 2006 the in-feed antibiotics were banned in European countries (Mansoub, 2010) due to their link to antimicrobial resistance among several pathogenic bacteria in animals and humans (Donogue, 2003). The ban necessitated the search for sustainable and economically viable alternative which was found in phytogenic feed additives (PFAs). PFAs called phytobiotics or botanicals are herbs or plant derived products which on addition to livestock feeds are able to enhance livestock performance trough the improvement of digestibility, nutrient absorption and elimination of pathogenic microbes resident in the animal gut (Balunas and Kinghorn, 2005; Athanasiadou *et al*., 2007). Spices such as ginger, garlic and turmeric and their essential oils have been extensively used as phytogenic feed additives and reported to posses the capacity to improve growth in broilers (Alcicek *et al*., 2003; Windish *et al*., 2007).

Ginger has for hundreds of years been consumed as a delicacy, medicine or spice. Arkan *et al*. (2012) reported that supplementing broilers ration with 0.2 % dried ginger meal increased body weight at six weeks of age. Ademola *et al*. (2009) and Onimisi *et al*. (2005) also reported that supplementation of ginger up to 2 % level in the diet of broilers increased body weight.

Materials and method

Experimental location

This research was conducted at the poultry unit of Teaching and Research Farm of Federal University of Technology, Owerri, Imo State, Nigeria. Owerri lies between latitudes $4^0$4' and $6^0$3' N and longitudes $6^0$15' and $7^0$28' E.

Experimental birds and treatment diets

A total of one hundred and thirty-two (132) day old broilers of Abor-acre strain were used in this experiment. They were weighed on arrival and grouped into four treatment diet groups, each comprising of thirty-three (33) broilers. Each group was divided into three replicates of 11 birds. Each replicate group was housed in a pen measuring 1 m x 1 m. Birds were offered experimental diets from

the first day until they were 30 days of age. Experimental diet 1 (control) contained no ginger. Experimental diets 2, 3 and 4 contained 0.5 %, 1.0 % and 1.5 % dry ginger meal, respectively. All diets were iso-proteinous and iso-caloric ranging from 23.07 – 23.09 % crude protein (CP) and 2870.93 – 2872.73 kcal/kg metabolizable energy. (ME). Table 1 shows the ingredient and calculated nutrient composition of the experimental diets.

Management of birds

The birds were managed on deep litter system and were offered feed and water *ad-libitum*. They were brooded using kerosene stoves, lanterns and electric bulbs. Necessary vaccinations and multivitamins were administered.

Source of experimental materials and processing of ginger

The broilers used in this research were procured from a reputable farm in Ibadan. The fresh ginger was bought from Relief market in Owerri while other feed ingredients were bought from a commercial feed dealer also in Owerri. The fresh ginger was washed, and water was allowed to drain. They were then sliced into small sizes of about 5 mm thickness to facilitate drying. They were sundried for 7 days and milled into fine powdery mass using a hammer mill fitted with 0.01 mm sieve. The powdery mass (ginger meal) was stored in plastic air-tight container and stored at room temperature until needed during feed formulation.

Data collection

The birds were weighed at the beginning of the experiment, weekly thereafter and on the 30th day to ascertain the weight gain. Feed intake was obtained daily by subtracting left-over feed from the feed fed the previous day. From the data collected averages were taken and recorded. Feed conversion ratio was obtained by dividing the average daily feed intake by the average daily weight gain. Cost of feed consumed per bird was calculated by multiplying the unit price of the feeds by the amount of feed consumed in kilogrammes. Cost of feed per kilogramme weight gain was calculated by dividing the cost of feed consumed per bird by kilogramme weight gain of the bird.

Experimental design and data analysis

All data collected from the experiment were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) at 5 % level of probability. Significantly different means were compared using Duncan's New Multiple Range Test as outlined by Obi (1990).

Results

The performance of the starter broilers fed different levels of ginger meal is shown in table 2. There were no significant differences in the final weight and weight gain of the birds, though values were higher in the ginger groups than the control group. The birds fed 1.0 % ginger diet had the highest weight gain followed by those on 1.5 % and 0.5 % ginger diets and then the control group. Feed intake of broilers on ginger diets were similar but significantly higher ($P < 0.05$) than the control group. Birds fed 0.5 % ginger diet had numerically better feed conversion ratio (FCR) though differences were not significant. Cost of feed consumed and cost/kg weight gain were similar though there were numerical increases with increasing inclusion level of ginger meal.

Discussion

In terms of weight gain, the results obtained in this study were similar to those of Zhang *et al* (2009) who reported that inclusion of ginger meal in broiler diets at 5g/kg did not affect daily gain of the broilers. However, Ademola *et al* (2009) and Onimisi *et al*. (2005) have reported that weight gain can be increased at 2 % level of ginger meal inclusion in broiler diets. Our result was in contrast to the findings of Dooley *et al*. (2009) who reported no differences in feed intake by broiler chickens fed ginger extract for a period of 6 weeks. The higher feed intake by birds on the ginger groups may be due to the sweet flavour and aroma of ginger. Similar to our results, Zomrawi *et al*. (2013) reported no significant differences in feed conversion ratio of broiler chickens fed ginger root powder at 1.0 %,

1.5 % and 2.0 % levels respectively. Mohammed *et al*. (2012) noted significant differences in body weight gain, feed intake and feed conversion ratio when broiler chickens were fed diets containing 0.1 % and 0.2 % ginger meal.

Conclusion

0.5 % inclusion level of ginger meal could have positive effects in starter broilers since it exhibited lower feed conversion ratio with minimal feed intake.

Table 1: Ingredient and calculated nutrient composition of experimental broiler starter diets

	Ginger levels (%)			
Ingredients (%)	**0.0**	**0.5**	**1.0**	**1.5**
Maize	51.00	50.50	50.00	49.50
Ginger	0.00	0.50	1.00	1.50
Palm kernel cake	12.00	12.00	12.00	12.00
Soybean meal	22.00	22.00	22.00	22.00
Bone meal	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00
Fish meal	5.00	5.00	5.00	5.00
Wheat offal	3.00	3.00	3.00	3.00
Vitamin/mineral premix*	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated values (%)				
Crude protein	23.09	23.08	23.08	23.07
Calcium	1.33	1.33	1.33	1.33
Phosphorus	1.02	1.02	1.02	1.02
Crude fibre	4.56	4.61	4.67	4.73
Metabolizable energy (kcal/kg)	2872.73	2872.73	2871.53	2870.93

Table 2: Performance of starter broilers fed different levels of ginger meal

Parameters	**Ginger levels**				
	0.0 %	**0.5 %**	**1.0 %**	**1.5 %**	**SEM**
Av. initial live weight (g)	35.44	35.54	36.96	33.57	1.62
Av. final live weight (g)	659.81	762.96	787.72	753.89	41.58
Av. total weight gain (g)	624.38	727.42	750.76	720.32	41.79
Av. daily weight gain (g)	20.80	24.25	25.03	24.01	1.09
Total feed intake (g/bird)	1189.80	1361.10	1463.70	1403.10	--
Feed intake (g/day)	39.66[b]	45.37[a]	48.79[a]	46.77[a]	0.16
Feed conversion ratio	1.91	1.87	1.95	1.95	--
Cost of feed taken/bird	201.31	265.24	322.82	479.63	--
Cost of feed/kg gain (N)	322.42	364.63	429.99	479.63	23.58

[a, b] Means within a row with different superscripts are significantly different ($P < 0.05$).

Av. = average

SEM = Standard Error of Mean

REFERENCES

Ademola, S. G., Farinu, G. O. and Babatunde, G. M. (2009). Serum lipid, growth and haematological parameters of broilers fed garlic, ginger and their mixtures. *World Journal of Agricultural Science*, 5(1): 99 – 104.

Alciceck, A., Bozkurt, M. and Cabuk, M. (2003). The effect of a mixture of essential oils, an organic acid or a probiotic on broiler performance. *South African Journal of Animal Science*, 34: 217 – 222.

Arkan, B. M., Mohammed, A. M. A. and Ali, Q. J. (2012). Effect of ginger (*Zingiber officinale*) on performance and blood serum parameters of broilers. *International Journal of Poultry Science*, 11: 143 – 146.

Athanasiadou, S., Githiori, J. and Kyriazakis, I. (2007). Medicinal plants for helminthes parasite control: facts and fiction. *Animal*. 1(9): 1392 – 1400.

Balunas, M. J. and Kinghorn, A. D. (2000). Drug discovery from medicinal plants. *Life Sciences*,

78(5): 431 – 441.

Donogue, D. J. (2003). Antibiotic Residues in Poultry Tissues and Eggs: Human Health Concerns. *Poultry Science*, 82(4): 618 – 621.

Dooley, S., Gupta, J. J. and Reddy, P. B. (2009). Effect of supplementation of ginger, garlic and turmeric in broiler chickens. *Indian Veterinary Journal*, 86(6): 644 – 645.

Mansoub, N. H. (2010). Comparison of effects of using Nettle (*Urtica dioica*) and probiotic on performance and serum composition of broiler chickens. Global Veterinaria, 8: 247 – 250.

Mohammed, A. B., Al- Rubaee, A. M. and Jalil, A. Q. (2012). Effect of ginger (*Zingiber officinale*) on performance and blood serum parameters of broiler chickens. *International Journal of Poultry Science*, 11(2): 143 – 146.

Obi, I, U. (1990). Statistical method of dictating differences between treatment means. Snapp Press, Enugu, Nigeria.

Onimisi, P. A., Dafwang, I. I. and Omaga, J. J. (2005). Growth performance and water consumption pattern of broiler chicks fed graded levels of ginger waste meal. *Journal of Agriculture for Social Sciences*, 3: 113 – 119.

Windisch, W. M., Schedle, K., Plitzner, C. and Kroismayr, A. (2007). Use of phytogenic products as feed additive3s for swine and poultry. *Journal of Animal Science*, 86:140 – 148.

Zhang, G. F., Yang, Z. B., Wang, Y., Yang, W. R., Jiang, S. Z. and Gai, G. S. (2009). Effects of ginger root (*Zingiber officinale Roscoe*) processed to different particle sizes on growth performance, antioxidant status and serum metabolites of broiler chickens. *Journal of Poultry Science*, 88: 2159 – 2166.

Zomrawi, W. B., Abdel Atti, K. A., Dousa, B. M. and Mahala, A. G. (2013). The effect of dietary ginger root (*Zingiber officinale*) on broiler chicks performance, carcass characteristics and serum constituents. *Journal of Animal Science Advances*, 3(2): 42 – 47.

GROWTH PERFORMANCE AND FEED COST BENEFITS OF BROILER CHICKENS FED GRADED LEVELS OF BRIMSTONE (*Morindalucida* Benth.) LEAF POWDER AS DIETARY PHYTOGENIC ADDITIVE

[*]Fasasi, M.O, [*]Bamgbose, A. M., [*]Oso, A.O., [*]Adelusi, O.O, [**]Oke, O.E, [***]Olayemi, W.A, and [*]Ogunsola, I. A.

[*]Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

[**]Department of Animal Physiology, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

****Department of Agricultural Technology, Yaba College of Technology, Yaba, Lagos, Nigeria.*

** Correspondence: mukhulisololade@gmail.com, +2348136314270*

Abstract

The study determined the growth and feed cost benefits of broiler chickens fed graded levels of Morinda lucida leaf powder (MLP) using a total of 180 day-old broiler chicks (Arbor acre). They were weighed and randomly grouped into four dietary treatments of 3 replicates with 15 chicks each. The dietary treatments consisted of the control (basal diet), control+1g /kgMLP, control+2g/ kgMLP and control+3g/kgMLP diets. Body weights, feed intake and feed conversion ratio (FCR) of the birds were taken on a weekly basis and the feed cost benefits was calculated at the end of each experimental phase.The experiment was laid out in a completely randomized design and data obtained were subjected to one-way analysis of variance. Results obtained showed that inclusion of MLP at 1 and 2g/kg significantly increased ($p<0.05$) the final body weight at starter phase but had no effect ($p>0.05$) on finisher's final weight. Also, feed intake was significantly high ($p<0.05$) in birds on 1g/kgMLP (1528.43g) at starter phase but not significantly influenced ($p>0.05$) by MLP inclusion at finisher phase. FCR on the other hand was not significantly influenced ($p>0.05$) by MLP inclusion at the two phases of the experiment. Cost of feed per kg weight gain was significantly lowered ($p<0.05$) at the finishing phase in birds fed 1g/kg and 2g/kg MLP (₦364.50 and ₦353.48). Inclusion of MLP at 1 and 2g/kg improved feed cost benefit of broiler chickens at finishing phase with no deleterious effect on growth performance.

Keywords: Broilers, Performance, *Morinda lucida*, Starter, Finisher

Introduction

The use of phytogenic additives in poultry production has produced encouraging results that has helped researchers to discover various plant materials that perform various actions like growth stimulation, gut modulation, antibacterial and anti-inflammation. Researchers who reported improved growth performance and cost benefit of poultry birds to phytogenic additives attributed their findings to interaction of phytogenics with intestinal microflora (Lin, 2011), stimulatory effects of phytogenic substances on digestive secretions which result in increase in digestion efficiency (Platel and Srinivasan, 2004) as well as increased feed intake due to improvement in the dietary palatability resulting from the enhanced flavour or odour, emanating from the essential oils present in the plant materials used (Frankic *et al.*, 2009). However, major challenges being faced in the use of phytogenic additives is the determination of the exact quantity of the plant materials to be used to achieve the targeted objective. *Morinda lucida* is an important medicinal plant in African traditional medicine and has been reported to contain important phytochemicals that improve performance (Oduola *et al*., 2010).

The study investigated the growth performance and feed cost benefit of broiler chickens fed graded levels of Brimstone (*Morinda lucida* Benth) leaf powder as phytogenic additives in the diets.

Materials and Methods

Preparation of the test ingredient

Morinda lucida leaf sourced from Emere village, Camp, Abeokuta, Ogun State, Nigeria was properly identified at the Department of Forestry, Federal University of Agriculture, Abeokuta, Nigeria. The harvested leaves were washed, air dried under shade for 2 weeks until the moisture content was below

10% and greenish colour retained, milled into powdery form, sieved using 0.10 mm sieve and stored separately in air tight bag inside a refrigerator till time of use.

Experimental birds and management

The feeding trial was carried out at Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. One hundred and eighty day-old chicks (Abor acre) were purchased from a reputable hatchery in Ibadan, Oyo State, Nigeria. On arrival, the initial weight of the birds were taken and randomly allotted into 4 experimental treatments of 45 birds each. Each treatment group was replicated thrice to have 15 chicks per replicate. The birds were all subjected to standard routine management during the brooding and rearing stages of the experiment. Feeds and water were provided to the birds *ad libitum*. The birds were raised in a standard deep litter poultry pen.

Experimental diets and design

Four different diets were formulated such that the control treatment groups were fed diet containing 0% inclusion level of *M. lucida* leaf powder (MLP) while experimental birds in the second, third and fourth treatment groups received diets containing 1, 2 and 3 g/kg feed *M. lucida* leaf powder (MLP) respectively. The experiment was laid out in a completely randomized design. The gross composition of the experimental diets was shown on Table 1.

Table 1: Gross composition (%) of the experimental diets for starter and finisher phases.

Ingredients	**Starter** (0-4 weeks)	**Finisher** (4-8 weeks)
Maize	52.00	57.00
Wheat Offal	3.00	6.00
Groundnut Cake	17.00	21.00
Soyabean Meal	20.00	9.00
Fishmeal (72% CP)	3.00	2.00
Bone Meal	2.50	2.50
Limestone	1.50	1.50
Common salt	0.25	0.25
DL-Methionine	0.30	0.30
L-Lysine	0.20	0.20
Vit-Min Premix*	0.25	0.25
Total	**100.00**	**100.00**
Determined Analysis		
Crude Protein (%)	23.92	21.39
ME (kcal/kg)	2916.38	2924.18
Ether Extract (EE) (%)	4.04	4.13
Crude Fibre (CF) (%)	3.48	3.43

Data collection

Growth performance

Weekly data was collected for growth parameter indices using the following formula:

$$\text{Weight gain per bird (g)} = \frac{\text{Final weight (g)} - \textit{Initial weight (g)}}{\text{Number of birds}}$$

$$\text{Feed intake per bird (g)} = \frac{\text{Feed suppl ied (g)} - \text{Feed leftover (g)}}{\text{Number of birds}}$$

$$\text{Feed conversion ratio} = \frac{\text{Amount of feed consumed (g)}}{\text{Weight gain (g)}}$$

Feed cost benefit

The feed cost benefit analysis was based on the methods of Anigbogu *et al.* (2010). The formula used for calculating cost benefit parameters includes;

$$\text{Cost of feed/kg (₦/kg)} = \frac{\text{Total cost of feed (₦)}}{\text{Quantity of feed (KG)}}$$

Cost of feed consumed/kg weight gain = feed conversion ratio X cost of feed per kg

Cost of feed intake = quantity of feed consumed (kg) X cost of feed per kg (₦)

Statistical Analysis

Data obtained from the study were subjected into One-way Analysis of Variance (ANOVA) in a Completely Randomized Design using the GLM procedure of statistical analysis software SAS® version 2013. Significant differences among treatment means were determined using Duncan Multiple Range Test (DMRT) as contained in the SAS® software.

Results and Discussion

As shown in Table 2, Feed intake of the birds at the starting phase of the experiment was significantly increased ($p<0.05$) in birds fed 1g/kg and 2g/kg MLP (1528.43 and 1421.40g) respectively and this manifested in the final body weight of the birds too as the birds on 1g/kg and 2g/kg MLP recorded the highest values (820.89 and 765.18g) for final body weight gain at the starting phase of the experiment. The increment in feed intake could be attributed to improved taste of the diet (Windisch *et al*., 2008) and low concentration of antinutritional content of the plant in the 2 inclusion levels. This observation corroborates the report of Muhammad et al. (2014). Also, the stimulatory effect of the phytogenic additives on the appetite and endogenous secretions in the digestive system of the birds which in turn improve the feed utilization (Wenk, 2002) could be related to the improved final body weight gain of the birds on 1g/kg and 2g/kg MLP at starting (820.89 and 765.18g) and finishing (2073.70 and 1990.80g) phases of the experiment. Similarity in feed intake recorded at the finishing phase corroborates the report of Amouzmehr *et al.* (2013), Bushra (2011) and Fadlalla *et al.* (2010).

Cost of feed consumed by birds on 1g/kg and 2g/kgMLP diets (₦233.70 and ₦217.76) were respectively high ($p<0.05$) at the starting phase but not significantly different at the finishing phase. Also, cost of feed per kg weight gain at finishing phase was lowest in birds on 1g/kg and 2g/kg MLP (₦364.50 and ₦353.48) when compared to other dietary treatments. This could be attributed to good feed utilization by the birds on 1g/kg and 2g/kg MLP diets.

Table 2: Growth performance and feed cost benefits of broiler chickens fed *Morinda lucida* leaf powder (MLP) at starting and finishing phases.

Parameters	Control	1g/kgMLP	2g/kgMLP	3g/kgMLP	SEM	**P-value**
Total feed intake (g)						
Starter	1226.94^{c}	1528.43^{a}	1421.40^{b}	1253.20^{c}	38.89	<0.0001
Finisher	3358.80	3644.30	3452.70	3535.60	98.87	0.821
Feed conversion ratio						
Starter	1.99	1.96	1.97	2.09	0.04	0.676
Finisher	3.03	2.91	2.82	3.56	0.11	0.065
Body weight (g)						
Starter	659.39^{b}	820.89^{a}	765.18^{a}	640.74^{b}	25.61	0.007
Finisher	1780.50^{ab}	2073.70^{a}	1990.80^{a}	1635.30^{b}	63.74	0.026
Cost of feed/kg (₦)						
Starter	152.60	152.90	153.20	153.50	-	-
Finisher	124.90	125.20	125.50	125.80	-	-
Cost of feed consumed (₦)						
Starter	187.23^{c}	233.70^{a}	217.76^{b}	192.37^{c}	5.97	<0.0001
Finisher	417.51	456.26	433.32	444.78	12.46	0.807
Cost of feed per kg live weight gain (₦/bird)						
Starter	303.42	299.91	301.65	320.70	5.89	0.636
Finisher	378.51^{a}	364.50^{b}	353.48^{b}	447.67^{a}	14.46	0.059

SEM- Standard error of mean; MLP – *Morinda lucida* leaf powder

Means on the same column having different superscript differ significantly at $P < 0.05$

Conclusion and Recommendation

It can be concluded that inclusion of MLP at 1g/kg and 2g/kg diet posed no deleterious effect but improved performance and cost benefits of broiler chickens at starting and finishing phases. The use of MLP at either 1g/kg or 2g/kg is therefore recommended for improved growth performance and feed cost effectiveness of broiler chickens.

References

- Amouzmehr, A., Daster, B., Nejad, J.G., Sung, K., Lohakare, J. and Forghani, F. 2013. Effect of garlic and thyme extracts on growth performance and carcass characteristics of broiler chicks. *Poultry Industry Technical articles*. Nutrition Article (170).
- Anigbogu, N.M. and Anosike, J.C, 2010. Economic benefit of life-enzyme (*Zymomonasmobilis*) degraded sawdust sweetened cake as feed for Maradi goats. Proceedings of the 15th Annual Conference of Animal Science Association of Nigeria, Sept. 13th – 15th, University of Uyo, Nigeria.
- Bushra H, A. 2011. Effect of dietary levels of Spearmint (*Menthaspicata*) On Broiler chicks Performance .Thesis submitted in partial fulfillment for the requirement of master of science in animal production, department of animal nutrition faculty of animal production university of Khartoum.
- Fadlalla, I.M.T., Mohammed, B.H. and Bakhiet, A.O. 2010. Effects of feeding garlic on the performance and immunity of broilers. *Asian Journal of Poultry Science* (4) 182-189.
- Frankic, T., Voljc, M., Salobir, J.andRezar, V. 2009. Use of herbs and spices and their extracts in animal nutrition. *ActaagriculturaeSlovenica*. 94:95–102.
- Lin, S. 2011. Effect of antibiotic growth promoters on intestinal microbiota in food animals: A novel model for studying the relationship between gut microbiota and human obesity. *Front. Microbiology* 2:53.
- Muhammad, J.J., Sohail, H.K., Salma, N.S., Jamila, S.G., Farooq, H., Mehdi, H. and Muhammad, A. 2014. Effect of dietary supplementation of Aloe vera leaves on growth performance and immunity of Fayoumi Chicks. *Pakistan Journal of Nutrition* 13 (4): 191-195.
- Oduola, T., Bello, I., Adeosun, G., Ademosun, A., Raheem, G. and Avwioro G., 2010. Hepatotoxicity and nephrotoxicity evaluation in Wistar albino rats exposed to Morindalucidaleaf extract. *North American Journal of Medical Sciences* 2 (5), 230–233
- Platel, K., and Srinivasan, K. 2004. Digestive stimulant action of spices: A myth or reality. *Indian Journal of Medical Research* 119:167–179.
- Wenk, C. 2002. Herbs, Botanicals and other related substances. Pp. 1-10 in Proceedings of 11th European Poultry Conference, Bremen, Germany.
- Windisch, W., Schedle, K., Plitzner, C. and Kroismayr, A. 2008. Use of phytogenic products as feed additives for swine and poultry. *Journal of Animal Science* 86:140–148.

UTILIZATION OF GRADED LEVELS OF PEARL MILLET AS DIETARY ENERGY SOURCE BY JAPANESE QUAILS

S.I. Garba[1], O.V. Adelowo[1], M. Abubakar[2], A.S. Muhammad[2] and A.T. Bello[3]
[1]Department of Animal Production, School of Animal Health and Production, Federal College of Animal Health and Production Technology, Vom.
[2]Department of Animal Production, Faculty of Agriculture, Abubakar Tafawa Balewa University, Bauchi.
[3]Livestock Investigation Department, National Veterinary Research Institute, Vom
Corresponding author: sirajowase@gmail.com, 08036071717

Abstract
The experiment was carried out to investigate the inclusion levels of pearl millet in the diets of quails (Coturnix coturnix japonica). Four hundred and eighty (480) two weeks old quail birds were used for the study in an experimental diets that contained 10, 20, 40, 60, 80, and 100% Pearl millet (PM) with 24% CP& 2888kcal/kgME and 20% CP& 2778 kcal/kgME for growing and laying phases, respectively. The experiment lasted for 119 days and data were collected weekly; the parameters measured include feed intake (FI), total weight gain, water intake, egg weight, hen day egg production, and egg quality. At growing phase (2-6 weeks), the parameters measured were significantly different across the dietary levels of Pearl millet. At the laying phase (6-17 weeks) all the parameters measured were significantly (P<0.01) differences except in FI (26.70-30.60 g). It can be concluded that pearl millet can replace maize at 100% levels in diets of Japanese quails without adverse effects on growth performance and hen day egg production.
Key words: Pearl millet, Japanese quail, performance, layer, egg production,

Introduction
Cereal grains, especially maize which form the bulk of energy in poultry feeds are in short supply as a result of industrial and human needs (Nworgu *et al.,* 1999). In view of this, evaluation of pearl millet as alternative energy feedstuffs to maize becomes imperative in areas where their uses are less common. Millet is the most widely grown cereal that has been successfully cultivated in the semi-arid region of Africa and its production cost is relatively low. However, it has little industrial uses in Nigeria (Nyannor *et al.,* 2007). Pearl millet (*Pennisetum glaucum)* is considered as a staple food in Africa and India where it is used to make flour, bread, porridge and "couscous". As a feedstuff it is mainly grown to produce silage, hay (FAO, 2002).

Feeds are the most expensive production input which accounts for 65-75% of the cost of poultry production (Adelowo, *et al,*. 2018). Maize which is the best and major source of dietary energy for quail production has a high competition between human and animal. In view of this, it is highly necessary to search for suitable substitutes for maize in a developing country like Nigeria (Elangovan *et al.,* 2004). This study investigates the performance, carcass characteristics and egg quality of Japanese quails (*Coturnix coturnix japonica*) fed various inclusion levels of Pearl millet (*Pennisetum glaucum)* as energy source.

Materials and Methods
The experiment was conducted at the teaching and research farm of the Federal College of Animal Health and Production Technology, NVRI Vom, Plateau State. Four hundred and eighty (480) two weeks old Japanese quail were used for the study. Initial weight was recorded and the birds were randomly distributed into six treatments with four replicates of 20 chicks in a completely randomised design. Six experimental diets were formulated for the study (Tables 1 and 2). The diets contained 24% CP and 2800kcal/kg ME, and 20% CP and 2600kcal/kg ME for phase I and phase II respectively: the Treatments are; I. Contained 100% Maize as sole source of energy, II. Containing Maize 80%, Millet 20% energy source, III. Containing Maize 60%, Millet 40% energy source, IV. Containing Maize 40%, Millet 60% energy source, V. Containing Maize 20%, Millet 80% energy source, VI. Contained 100% Millet as sole energy source. The diets for both experiments were formulated to meet the nutrient standard of quail, (NRC, 1994) and water was given *ad-libitum* throughout the growing and laying period. Sample of formulated diets was analysed for proximate composition using the method described by AOAC (2006) at Biochemistry Laboratory Department of National Veterinary Research Institute, Vom, Nigeria. The quails were weighed weekly with digital

scale, the parameters measured include feed intake, weight gain, final weight and feed conversion ratio was calculated. Mortality was recorded as it occurred. All the chicks were subjected to same management practices throughout the experimental period. The brooding was done with100watt bulb as sources of heat.

Statistical Analysis: Data obtained from the experiment were analysed using the statistical analysis of variance (ANOVA) procedure of SAS (2010) and significant level of p=0.05, and p=0.01 were used. The treatment means were compared using the New Duncan multiple range test of the same software.

Table 1: Composition of the experimental diets for grower Phase (2-6 weeks)

	Diets (%)					
Ingredients	T1	T2	T3	T4	T5	T6
Maize	50.00	40.00	30.00	20.00	10.00	0.00
Millet	0.00	10.00	20.00	30.00	40.00	50.00
Maize Offal	7.13	7.60	8.05	8.50	8.95	9.42
Groundnut Cake	34.37	33.90	33.45	33.00	32.55	32.08
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2 .00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Premix *	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated composition						
ME (kcal/kg)	2888.00	2888.00	2888.00	2888.00	2888.00	2888.00
Crude Protein(%)	24.00	24.00	24.00	24.00	24.00	24.00
Crude fibre (%)	4.60	4.60	4.60	4.60	4.60	4.60
Ether extract (%)	4.98	4.98	4.98	4.98	4.98	4.98
Calcium (%)	0.80	0.80	0.80	0.80	0.80	0.80
Phosphorus (%)	0.29	0.29	0.29	0.29	0.29	0.29
Lysine (%)	1.13	1.13	1.13	1.13	1.13	1.13
Methionine (%)	0.83	0.83	0.83	0.83	0.83	0.83

*Bio-mix premix supplied per kg diet-vitamin A, 10,000.00 i.u; vitamin D, 2,000.00 i.u; Vitamin E 23,000.00mg; Niacin 27.5mg; Vitamin B_1 1,800mg; Vitamin B_6 30mg; Vitamin B_{12} 0.015mg, Vitamin K_3 200mg; Pantothenic Acid 7,500; Biotin H_2 0.06; Folic Acid 0.75mg; Chlorine 300.00mg; Cobalt 0.2mg; Copper 30mg; Iodine 1.00mg; Iron 200.00mg; Manganese 0.04mg; Selenium 0.2mg; Zinc 30mg; Antioxidant 1.25mg. T1 100% maize, T2 – 80% maize, 20%millet, T3 – 60% maize, 40% millet, T4 – 40% maize, 60% millet, T5 – 20% maize, 80% millet and T6 100% millet.

Table 2: Composition of experimental diets for egg production phase (6-17 weeks)

	Diets (%)					
Ingredients	T1	T2	T3	T4	T5	T6
Maize	50.00	40.00	30.00	20.00	10.00	0.00
Millet	0.00	10.00	20.00	30.00	40.00	50.00
Maize Offal	18.90	19.36	19.80	20.27	20.71	21.19
Ground Nut Cake	22.60	22.14	21.70	21.23	20.79	20.31
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated composition						
ME (kcal/kg)	2778.00	2778.00	2778.00	2778.00	2778.00	2778.00

Crude protein (%)	20.00	20.00	20.00	20.00	20.00	20.00
Crude fibre (%)	4.50	4.50	4.50	4.50	4.50	4.50
Ether extract (%)	4.85	4.85	4.85	4.85	4.85	4.85
Calcium (%)	2.39	2.39	2.39	2.39	2.39	2.39
Phosphorus (%)	0.40	0.40	0.40	0.40	0.40	0.40
Lysine (%)	1.14	1.14	1.14	1.14	1.14	1.14
Methionine (%)	0.86	0.86	0.86	0.86	0.86	0.86

Results and Discussions

Table 3: Performance of Quail Birds Fed the Experimental Diets (2 - 6 weeks)

	Diets						
Parameters	T1	T2	T3	T4	T5	T6	SEM
Feed Intake/bird (g)	12.05^{b}	13.29^{a}	13.45^{a}	13.54^{a}	13.46^{a}	13.43^{a}	0.15^{***}
Weight Gain/bird (g)	90.75^{c}	100.5^{b}	115.25^{a}	113.75^{a}	101.00^{b}	95.75^{b}	0.52^{***}
Initial Weight/bird (g)	20.75	20.50	21.25	21.75	20.50	21.00	0.53^{NS}
Final Weight/bird (g)	111.50^{b}	121.00^{ab}	136.50^{a}	135.50^{a}	121.50^{ab}	116.75^{b}	0.54^{***}
Feed Conversion Ratio	4.65^{b}	4.63^{b}	4.09^{a}	4.17^{a}	4.66^{b}	4.90^{c}	0.06^{***}
Age at 1st egg (days)	39	43	39	39	41	40	1.04^{NS}
Av. Wt. 1st egg (g)	6.00	7.00	5.50	6.75	6.50	6.75	0.49^{NS}
Mortality (Number)	4	3	2	1	4	2	-

^{abc}= means with different superscript on the same row are significantly different, *** = significant at (P<0.001), NS = Not Significant; SEM = Standard Error of Mean.

Table 4: Performance of Japanese quail layers fed the Experimental Diets (6-17 weeks)

	Diets						
Parameters	T1	T2	T3	T4	T5	T6	SEM
Feed Intake (g)	30.60	29.22	26.70	28.72	30.50	28.12	0.98^{NS}
Final Weight (g)	154.53^{b}	164.63^{a}	159.82^{b}	169.97^{a}	167.00^{a}	166.60^{a}	2.94^{***}
Total Weight Gain (g)	43.03^{a}	43.63^{a}	23.32^{b}	34.47^{ab}	45.50^{a}	49.85^{a}	1.01^{***}
Daily Weight Gain (g)	0.56^{a}	0.57^{a}	0.30^{b}	0.45^{ab}	0.59^{a}	0.65^{a}	0.01^{***}
Hen Day Egg Production	59.77^{ab}	86.10^{a}	91.50^{a}	79.01^{a}	80.00^{a}	68.50^{b}	2.35^{***}
Mortality (number)	6	7	7	7	7	11	-

^{abc}= means with different superscript on the same row are significantly different, *** = significant at (P<0.001), NS = Not Significant, SEM = Standard Error of Mean.

The result in this study shows the feed intake at the starter phase (FI) as 12.05-13.54g/day compared to the 10.52 to 11.04g/day reported by Abubakar *et al.* (2007) for quail chicks fed varying levels of rumen content in diets, but at variance with a study conducted at NVRI with observation in daily feed intake of 22.26g per quail at six weeks. Increased feed consumption on weekly basis as the quail grow older as reported by Edache *et al.* (2005). The FI at finisher phase 26.70-30.60 g/day were similar across the diets. This agrees with the observation of Café *et al.* (1999) in their study on feed intake of quails fed graded levels of millet diets. The results of water intake at the starter (20.19 – 23.40 ml/day) and finisher (31.68 – 50.52 ml/day) phase revealed that, the higher the feed intake the higher amount of water consumed. The results of weight gain (WG) recorded during starter phase ranged from 2.59 to 3.29 g/day while that of the finisher period ranged from 0.30 to 0.65 g/day. This is

similar to the reports of NVRI (1996) who evaluated the response of Japanese quails to diets containing three protein levels (20, 22 and 24% CP) and found that birds fed with high protein diet (24% CP) had best growth performance. This also agrees with the reports of Gheeisari *et al.* (2011) which indicated that increasing dietary protein in different stages of growth cause increase in body weight gain of Japanese quail. The result of feed conversion ratio in this study ranges from 4.09-4.90 and is similar to the observation of Al-Hanafy (2012) who reported that during the starting phase (1-6weeks) a significant improvement in feed conversion ratio was recorded.

Conclusion

The study revealed that quail birds fed with the highest inclusion (50%) of pearl millets in their diets were not different in the final weight, weight gain and feed conversion ratio of quails in the control diet and those in diets replaced with hundred percent pearl millet. Hence, pearl millet can replace maize in the diets of Japanese quails without adverse effects on performance and egg production.

References

Abubakar, M., Doma, U. D., D. Kalla, J. U., Ngele, M. B., Bello, A. T. and Marcus, J. S. (2007). Performance and carcass characteristic of Japanese quails (*Cortunix cortunix japonica*) fed rumen contents based diets. *Research in Agricultural Science,* **1**(1): 1 -5 Adelowo, O. V., Oshibanjo, D. O., [1]Olaiya, D. O. and [1]Tangshwan, L. S. (2018). Proximate composition of raw-dried and heat treated *canarium schweifurthii* (atili) fruit as non-convention ingredient in broiler diet. NSAP2018 Conference Proceedings, Abuja

Al-Hanafy, L. A. (2012). Effect of some feed additives on Japanese quail under hot climate. *Master Science Thesis, Faculty of Agriculture. Zagazig.* University Zagazig, Egypt.

AOAC (2006). Official Methods of Analysis Association of Official Analytical chemists. Horwitz (ed) 18th edition. Washington D.C.

Café, M.B., Stringhini, J.H., Mogyca, N.S., Franca, A.F.S. and Milheto-grao, A. (1999). (*Pennisetum glaucum)* (L) (Leeke). Comosubsetitutodo milho emracoes para poedeiras commercials. *Arquivos Brasileiros de medicine veterinaria e Zootechnia,* **51**:171-176.

Edache, J.A., Musa, U., Haruna, R.S., Karsin, P.D., Esilonu, J.O., and Jibrin, I.I. (2005). Calcium requirement of Japanese quail chicks in Plateau State, Nigeria. *Nigeria Journal of Animal Production* **32:**246-252.

Elangovan, A. V., Mandal, A.B., Tyagi, P. K., Toppo, S. and Johri T. S. (2004). Effects of enzymes in diets with varying energy levels on growth and egg production performance of Japanese quail. *Journal of Science.* Food Agriculture. 84:2028-2034.

F.A.O. (2002). Food and Agriculture Organisation of the United Nation. Rome, Italy. Production Year Book volume **58**.

Gheisari A., Habib, A. H., Ghasem, M., Majid, T., Amir, A. and Shahin, S. E. (2011). Effect of different dietary levels of energy and protein on performance of Japanese quails (*Coturnix coturnix japonica)* 2nd *International Conference on Agriculture and Animal Science,* IPCBEE vol. 22. IACSIT Press, Singapore.

National Research Council, (1994). *Nutrient Requirement of Poultry.* 8th rev. ed. National Academy of Sciences, Washington D.C.

NVRI (1996). Farmer Training on Quail Production and Health Management. National Workshop in Quail Sept, 12-14, 1996, National Veterinary research Institute, Vom, Nigeria. Pp:44.

Nworgu, F.C., Adebowale, E.A., Oredein, O.A and Oni, A. (1999). Prospects and economics of broiler chicken production using two plant protein sources. *Tropical Journal of Animal Science,* **2**:159-166.

Nyannor, E.K., Adedokun, S.A., Hamaker, B.R., Ejeta, G. and Adeola, O. (2007). Nutrition evaluation of high digestible sorghum for pigs and broiler chicks. *Journal of Animal Science,* **85:** 196-203.

SAS. 2010. SAS/STAT User's Guide: Version 9.2. SAS Institute Inc., Cary. NC., USA; 2010.

PERFORMANCE OF BROILER STARTER BIRDS FED SORGHUM WITH DIFFERENT ENERGY LEVELS AS REPLACEMENT FOR MAIZE

H. B. USMAN, M. ANANDE AND M. N. SABO

Department of Animal Science, Federal University Dutsin-Ma

Abstract

The effect of substituting maize with sorghum using different energy levels was studied on broiler birds. Broiler chicks were assigned to one of the following experimental diets. T1: maize based diet containing 2,900kcal ME/Kg (control). T2, T3 and T4: were all sorghum based diets 2,900, 3,000 and 3,100 ME kcal/kg respectively. Feed intake, weight gain and feed conversion ratio were measured and determined. The results showed that final weight, weight gain, feed conversion ratio (FCR) and cost of feed per kg gain were similar (P>0.05) among the treatment means. Feed intake differ significantly (P<0.05) among the treatments with T1 having higher feed intake than T3. T2 and T4 have similar (P>0.05) feed intake to both T1 and T3. Total cost of feed consumed (₦/b) differ significantly (p<0.05) with T3 (209.37) having the lowest compared to T1 and T4 (251.76 and 236.71). T2 (215.71) had similar total feed cost to T3 and T4. was statistically similar with T4 having (177.89/kg) compared to the other treatments (213.91, 208.80 and 200.53 for T1,T2 and T3 respectively). In conclusion T4 was the most economical as it had lower FCR and cost per kg gain.

Keywords: *Sorghum, maize, energy, broiler, weight gain*

INTRODUCTION

Cereals are the most widely available and cheap source of high energy feed ingredients for the African farmer. Energy sources constitute the largest component of poultry diets. Globally, Maize is the most common energy source used in poultry feeds, constituting about 40-60% in poultry rations *(*Dayakar-Rao *et al*., 2003*).* This is mainly because their energy source is starch, which is highly digestible and palatable. The metabolizable energy value of maize is generally considered the standard with which other energy sources are compared (Oluyemi and Roberts 2000). The global maize requirement for poultry was estimated at 3.5 million tones at 2003 and was projected to rise to 31 million tons by 2020 (Dayakar-Rao, *et al*, 2003). Where available, other cereals could contribute to provide the seemingly ever increasing demand by the poultry industry.

In Nigeria, Maize production has never been sufficient to meet the needs of the growing human population, because it is a staple food crop for majority of the population (Iken and Amusa, 2004). Thus there is a continuing shortage of maize for use as feed, necessitating the exploration of other energy sources for livestock. To reduce the overdependence on maize, a number of researchers are exploring the use of cereals such as sorghum and millet as alternative energy sources. Sorghum grain is an interesting energy ingredient in poultry diets due to its nutritional composition, which is very similar to corn. (Louis *et al*, 1991).

Sorghum is grown in large quantity in the northern guinea and dry sub humid zones of Nigeria, where it is the second important cereal crop after maize. Its annual production was estimated at 11,700 million metric tons during the 2010 growing season (FAO 2011). The inclusion of sorghum in poultry diets is gaining interest due to favorable nutritional content of the grain. Sorghum can be used in commercial poultry diets to replace maize as an energy source, because they contain similar metabolizable energy (ME) (Kcal/kg) values (3,672 and 3, 667 for yellow and white maize; and 3, 669 and 3, 550 for yellow and red sorghum, respectively) (Tukur, 2011). Previous studies conducted with broiler chickens showed that feeding sorghum yielded similar and sometimes better results in terms of growth performance and carcass characteristics compared to maize (Cramer *et al*..' 2003; Nyamambi *et al.,* 2007). However, some varieties of sorghum have high tannin content, which lowers palatability and efficiency of feed utilization (Davies *et al., 2003,* Garcia and Dale, 2006*),* thus limiting its use in poultry feeds. Some varieties of sorghum can contain up to 6% tannin (Doka *et al., 2004;* Dicko *et al.,* 2015*),* which binds dietary protein making it unavailable for absorption. Owing to their astringent taste, tannins have negative effects on feed intake, palatability and digestibility of nutrients, with a consequent decrease in weight gain of birds (Hassan *et al.,* 2003; Makkar, 2003; Kim and Miller 2005). The objective of this research is to determine the performance of broiler birds fed with sorghum using different energy levels

MATERIALS AND METHOD

Location of the Study area

The study was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma lies on latitude 12°26'N and longitude 07°29'E (Abaje *et al.*, 2014).

Experimental Materials and Animals

Ninety-six day old broiler chicks were sourced and kept for one week to acclimatize before randomly allotted to four treatment groups of 24 birds each. Each treatment was replicated thrice with 8 birds per replicate in a completely randomized design (CRD) the treatments were as follows: Diet 1 is maize based mash diet with the ME value of 2900 kcal/kg (T1) which is the control. Diet 2 is sorghum based mash diet with 2,900 kcal ME/kg (T2). Diet 3 is also sorghum based diet with 3000 kcal ME/kg (T3), and Diet 4 is sorghum with 3100 kcal ME/kg (T4). Birds in each replicate were weighed at the beginning of the experiment and subsequently on weekly basis to determine the weight gain of bird. Feed intake was also recorded daily. Feed conversion ratio, total feed cost and feed cost per kg gain were determined. Mortality was recorded. Routine management practices such as medication and vaccination were rightly observed. The birds were given feed and water *ad libitum*. The experiment lasted for four weeks. The composition of the experimental diets is shown in table 1 below. Data generated was subjected to analysis of variance in a completely randomized design using several linear program of the stat view statistical package (SAS, 2002).

Table 1: Composition of the starter experimental diet

Ingredients	T1 (2900kcalMe /kg)	T2 (2900kcalMe /kg)	T3 (3000kcalMe /kg)	T4 (3100kcalMe/kg)
Maize	57	-	-	-
Sorghum	-	55	54	53
Soybean meal	38.8	38.8	38.8	38.8
Limestone	0.5	0.5	0.5	0.5
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Methionine	0.2	0.2	0.2	0.2
Palm oil	-	2	3	4
Total	100	100	100	100

RESULTS AND DISCUSSION

The proximate composition of the experimental diets is shown in table 2. Performance of broiler chicks fed with maize and sorghum-based diets containing varying energy levels is shown in table 3. Initial body weight did not differ between the treatments. Final weight and weight gain were similar ($P>0.05$) among the treatment means. Feed intake differ significantly ($P<0.05$) among the treatments with T1 having higher feed intake than T3. T2 and T4 have similar ($P>0.05$) feed intake to both T1 and T3. The feed intake observed in this study (1754.92-2016.39g/bird) was higher than that (1264-1415g/bird) observed by Bako J. M. (2018). Feed Conversion Ratio (FCR) was similar ($P>0.05$) amongst the treatments. (sorghum with the highest energy level have (1.44) compared to the other treatments (1.71, 1.80, and 1.68 for T1,T2 and T3, respectively)). The FCR value recorded for the maize and sorghum diets with the same energy density (T1 and T2) were statistically similar. The FCR recorded in this study is similar to the report of Bako J. M. (2018) because the birds in this research gained higher in body weight.

Table 2: Proximate Composition of the Starter phase of the Experimental Diet

Parameters	T1 (2900kcalMe /kg)	T2 (2900kcalMe /kg)	T3 (3000kcalMe /kg)	T4 (3100kcalMe/kg)
Dry matter (%)	86.17	88.38	87.66	87.12
Ash (%)	7.54	3.24	4.07	4.48
Ether extract (%)	16.41	6.27	8.18	10.16
Crude fiber (%)	5.23	6.71	4.64	5.10
Crude protein (%)	27.74	30.91	33.11	30.18
Nitrogen free extract (%)	29.25	41.25	37.66	36.85

Table 3: Performance of broiler birds fed with sorghum using different energy levels at the starter phase

Parameters	Maize control (2900Kcal ME)	Sorghum control(2900 Kcal ME)	Sorghum (3000Kcal ME)	Sorghum (3100Kcal ME)	SEM
Initial weight (kg/b)	0.104	0.104	0.104	0.104	0.000
Final weight (kg/b)	1.288	1.150	1.149	1.538	0.161
Total weight gain (kg/b)	1.18	1.046	1.045	1.434	0.161
Total feed intake (kg/b)	2016.39^{a}	1868.38^{ab}	1754.92^{b}	1922.08^{ab}	64.85
Feed conversion ratio	1.713	1.809	1.681	1.444	0.154
Total feed cost (₦/bird)	251.76^{a}	215.71^{bc}	209.37^{c}	236.71^{ab}	7.834
Feed cost per kg gain (₦)	213.91	208.80	200.53	177.89	18.650

Mean with different superscripts along rows are significantly different ($p > 0.05$) SEM -Standard error of mean

Total cost of feed consumed (₦/bird) differ significantly ($p<0.05$) with T3 (209.37) having the lowest compared to T1 and T4 (251.76 and 236.71). T2 (215.71) had similar total feed cost to T3 and T4. Cost of feed per kg gain was statistically similar with T4 having (177.89/kg) compared to the other treatments (213.91, 208.80 and 200.53 for T1,T2 and T3 respectively).which make T4 the best and recommended treatment for it is more economical and efficient to farmer.

Conclusion and Recommendation

From the results of this study, feeding sorghum using different energy levels as replacement for maize resulted in similar performance. Sorghum can therefore replace maize in the diet of broiler starter especially with palm oil inclusion.

References

Bako, J. M. (2018). Effect of feeding Germinated Brown Sorghum and Methionine supplementation on performance of broiler chicken. A thesis submitted in partial fulfillment for the award of a Master's Degree in Animal Nutrition and Feed Science in the Faculty of Veterinary Medicine, Department of Animal Production, University of Nairobi.

Cramer, K.R Wilson, K.J. Moritz, J.S. and Beyer, R.S. (2003). Effect of Sorghum-Based Diets Subjected to Various Manufacturing Procedures on Broiler Performance. *Journal of Applied Poultry Research*. 12:404-410.

Dayakar-Rao B., Binu, M. Bharath Kumar, K. A., Karthikeyan, K. Hymajyothi, S., Shahid, P., Ratnavathi, C. V. and Seetharama, N. (2003). Industrial Utilization of Sorghum in India. Status and Prospects. NRCS (National Research Center for Sorghum) Report Number 13: 16pp.Department of Animal production, Faculty of Science and Agriculture,

Davies, A. J., Dale, N. M. and Ferreira, F. J. (2003). Pearl Millet as an alternative feed ingredient in broiler diets. *Journal of Applied Poultry Research,* 12: 137-144.

Dicko, M. H., Gruppen, H., Traore, A. S., Van Berkel, W. J. H. & Voragen, A. G. J., (2005). Evaluation of the effect of germination on content of phenolic compounds and antioxidant activities in sorghum varieties. *Journal of Agriculture and Food Chemistry.* 53, 2581-2588.

Doka, O., Bicanic, D. D., Dicko, M. H. & Slingerlands, M. A. (2004). Photoacoustic approach to direct determination of the total phenolic content in red sorghum flours. *Journal of Agriculture and Food Chemistry*. 52, 2133-2136.

FAO (2011). Food and Agriculture Organization of the United Nations, FAO statistical database http://aps.Fao.org

Hassan, L. A., Elzubeir, E.A. & EL Tinay, A. H. (2003). Growth and apparent absorption of minerals in broiler chicks fed diets with low or high tannin contents. *Tropical Animal Health Production*. 35, 189-196.

Iken, J. E. and Amusa, N. A. (2004). Maize research and production in Nigeria. *Africa Journal of Biochemistry*, 3(6): 302-307.Influence of a E. coli-derived phytase on nutrient utilization in broiler starts fed diets containing varying concentrations of phytic acid. Poult. Sci. 85:82-89.

Kim, H. S. & Miller, D.D. (2005). Proline-rich proteins moderate the inhibitory effect of tea on iron absorption in rats. *Journal of Nutrition*. 135, 532-537.

Louis, G. F., Lewis, A. J. and Peo, E. R. (1991). Feeding value of grain sorghum for the lactating sow. Journal of Animal Science. 69:223-229.

Makkar, H.P.S (2003). Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. *Small Ruminant Research*. 49:241-256.

Nyamambi, B. Ndlovu, L. R. Naik, Y. S. and Kock, N. D. (2007). Intestinal growth and function of broiler chicks fed sorghum based diets differing in condensed tannin levels. *South Africa Journal of Animal Science*, 37(3):202-214.

Oluyemi, J. A. and Roberts, F. A. (2000). *Poultry Production in Warm Wet Climates*. 2nd edition. Spectrum Books Ltd. Ibadan, Nigeria. 244pp.

Tukur, H. M. (2011). *Egg production in Africa*. In: Improving the safety and Quality of Eggs and Egg products. Vol. 1: Egg Chemistry, production and Consumption. Nys, Y. Bain, M. and immerseel, F.V. (eds). Woodhead Publishing Ltd., UK. 27-38.

PERFORMANCE OF WEANER RABBITS FED SELECTED FORAGES AS SUPPLEMENT

Ibrahim, H. and Mohammed, U.

Department of Animal Production, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria. Correspondence: ihadiza080@gmail.com. 08036101761

Abstract

Feeding trial was conducted with 36 weaner rabbits of mixed sexes and breeds to evaluate the performance of rabbits fed selected forages with concentrate. The rabbits were randomely allocated in to four treatment groups in a complete randomized design. Each treatment was replicated three times with three rabbits per replicate. Four experiment diets were formulated. Diets one was supplemented Tridax procumbens with concentrate which served as control (TI), Amaranthus with concentrate, Fiscus carpensis leaves with concentrate and water melon peel with concentrate in diet 2, 3 and 4 respectively. The test materials were supplied at 100g per replicate. The trial lasted for 56 days. Data were generated on *growth performance (initial weight, final weight, total weight gain, daily weight gain, weekly weight gain, daily feed intake ad feed conversion ratio) and nutrient digestibility parameters were measured* . Results obtained revealed that the value of *there were no significant ((*P>0.05) *difference observed among the growth parameters and nutrient digestibility. It is concluded that T1 could be used for growing rabbit diets for optimum performance Therefore T1 can be recommended as best selected forages with concentrate*

Keywords: **Weaner, Rabbits, Forages, Supplement, Selected**

Introduction

One of the solutions to the problem of protein shortage in the diet of most Nigerians is the rearing of rabbits at both subsistence and commercial levels. Rabbits play an important role in the supply of animal protein to the Nigerian populace (*Amaefule et al., 2005*) and they possess a number of features that are of advantage which include high growth rate, high efficiency in converting forage to meat, short gestation period and high prolificacy, relatively low cost of production and high nutritional quality of rabbit meat (Biobaku and Oguntona, 1997). Forages such as *Panicum maximum* (Guinea grass), *Pennisetum purpureum* (Elephant grass), *Tridax procubens* are acceptable by rabbits (*Abu et al, 2008*). The use of non-conventional feed is gaining ground in Nigeria. Studies have shown that a 50:50 mixture of centorcema pubescens and a maize concentrate diet is optimal for maximum performance (*Nworgu et al, 1999).* One of the major problems of intensive rabbit production in Nigeria is feed because of the competition between man, industries and animals for conventional feed stuffs. This has led to the high cost of conventional feed resources and has account for about 70% of total cost of production (Akinmutimi, 2004). Therefore, this study is designed to estimate Comparative Evaluation of weaner rabbits fed forage as supplement.

Materials and Methods

Location of the Experiment; The research work was carried out at the Rabbit Section of the Teaching and Research Farm of Ibrahim Badamasi BabangidaL University Lapai , Niger state . Lapai lies between latitude 9.31˚and 9.45˚, east of the equator and is very close to Minna,the state capital (Usman, 2011).

Source of Rabbits, Test Ingredient , Experimental Diets and Management of Rabbits

The thirtysix weaned rabbits of mixed sexes and breeds were obtained from Sultan Veterinary Consult farm No 2, Samaru Street hayindogoSamaru Zaria, Kaduna state . Different forage wastes as Tridax procumbens, Ammaranthus waste, fig leaves, and water melon waste were collected from the surrounding environment in Lapai town, Lapai Local Government Area of Niger state, Nigeria. They were washed with salt solution prior to feeding the animals while premix, salt, lime stone and salt were obtained from Minna . Thirty six weaned rabbits mixed breeds and sexes, age between 5-6 weeks were randomly allocated to four treatment groups with nine

rabbits per treatment. Each treatment had three replicates of three rabbits per replicate. The same experimental diet was formulated with crude protein set at 23% for each. T1 was designated as concentrate with Amarathus, T2 concentrate and Tridax procumbens waste, T3 concentrate with fig leaves waste and T4 concentrate and water melon peels. using ivermecin Vitacox-plus and Neo-furaseryl-plus were adequately given as well. The cages were well clean disinfected with Dettol and equipped with drinkers and feeders. Prior to the experiment, the animals were fed concentrate and allowed the adjustment period of one week to enable the animals get used to their various cages and diets. Fresh clean water was provided ad-libitum and the forages were measured before giving throughout the research period. The experiment lasted for 8 weeks

Table:1 Proximate Composition of Experimental Diet

Ingradients	$T_{1:}$	$T_{2:}$	$T_{3:}$	$T_{4:}$
Maize	76.00	76.00	76.00	76.00
Fish meal	1.50	1.50	1.50	1.50
Groundnut cake	20.00	20.00	20.00	20.00
Limestone	1.00	1.00	1.00	1.00
Bone meal	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100

Key

T_1= Concentrate plus Ammarathus(100g) **T_2** = Concentrate plus Tridaxprocumbeans(100g)

T_3 = Concentrate plus Fig leaves (ficusCarpensis) (100g) **T_4** = Concentrate plus Water Melon Waste (100g)

Data collection

Performance Parameters

The parameters measured on the feeding traits were feed intake, Body weight gain and feed conversion ratio. The following formulae were used for growth performance parameter computation.

$$\text{Daily feed intake (g)} = \frac{\text{Quantity of feed offered-leftover}}{\text{Number of rabbits X Number of Days}}$$

$$\text{Weekly weight gain (g)} = \frac{\text{Final weight- Initial weight}}{\text{Number of Days}}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of Feed Consumed}}{\text{Weight gzin}}$$

Nutrient Digestibility : Digestibility study was conducted using nine rabbits per treatment during the seventh week of feeding. Faecal sample were collected daily by placing of Aluminum zinc underneath each replicate for five. At the end of each collection period, the faecal samples were bulked, oven dried at 80°C for 12 hrs and grounded for proximate analysis according to package (SAS, 1998) procedures.

Data Analysis: Data generated were subjected to Analysis of Variance (ANOVA) Using Statistical Package (SA S, 1998).

Results and Discussion

The result of growth performance of weaner rabbits fed selected forages as supplementis presented (Table 2(showed there were no significant (P>0.05) differences in the values obtained for growth parameters measured across the treatment groups Although, higher values were recorded for final weight, treatment one had the highest value (3618g) while treatment four have the least value (3167g) , Also treatment three had highest value for total weight gain (1227g) while treatment four had the least value (950g). For the daily weight gain, treatment three had the highest value (21.90g) while treatment four has the least value (16.97g).feed conversion ratio, the result shows that treatment four had the highest value (12.63g) while treatment three had the lowest value (7.04g). However, treatment one had highest value for final body weight and daily feed intake. This implies that selected forages used as supplement in the diet with concentrate has no significant deleterious effect on the weight gains of the weaner rabbits. This also indicates an effective utilization of the forages by the rabbits.

Table 2:Growth Performance of Weaner Wabbits Fed Sselected Forages as Supplement.

Parameters	Treatments					
(g)	T_1	T_2	T_3	T_4	SEM	LSD
Initial weight (g)	2467	2383	2233	2217	62.92	NS
Final weight (g)	3618	3535	3460	3167	1.24	NS
Total weight gain(g)	1152	1168	1227	950.0	87.15	NS
Daily weight gain (g)	20.57	20.87	21.90	16.97	1.56	NS
Weekly weight gain (g)	144.06	146.11	153.32	118.77	10.89	NS
Daily feed intake (g)	160.40	144.58	150.62	135.96	5.69	NS
Feed conversion ratio	7.35	7.07	7.04	9.47	0.77	NS
Key						

NS: No Significant difference SEM: standard error of mean LSD: level of significant difference

The result of chemical composition of faecal sample as shown (Table 3) revealed that diet four (T_4) had the highest value percent dry matter, crude protein and crude fibre (91.00 %, 3.70% and 33.30%) . This probably could be as a result of increase fibre content. This particularly in consonant with Cheeke and Amberg; (1972) who reported that increase CF resulted in voluntary feed intake in growing rabbit as a means of compensating for feed. The observation also in line with the report of Esonu *et al*., (2003) who reported that inclusion of fibrous material had an energy dilution effect on feed and consequentially increases feed intake.

Table 3: ProximateAanalysis of Faecal Sample

Parameters (%)	Treatments			
	T_1	T_2	T_3	T_4
Dry matter	89.00	82.00	86.00	91.00
Crude protein	3.60	3.20	3.20	3.70
Crude fibre	32.70	33.20	32.20	33.30
Ash	2.50	2.60	2.60	2.60
Ether extract	4.10	4.00	3.60	4.30
Nitrogen free extract	43.20	38.00	35.00	31.00

Conclusion; There were no significant differences in all the parameters measured among the treatment group . However, rabbit fed diet one (T_1) had better performance in final body weight and daily feed intake.

Recommendation; Based on the conclusion from this trial (T_1) that recorded higher values for final body weight and daily feed intake can be recommended for optimum growth and performance.

References

Abu, O. A., Onifade, A.A., Abanikanda, O.T.F., and Obiyan, R.I. 2008**..**Status and Promotional Strategy for Rabbit Production in Nigeria.Inproceedings of 9th World Rabbit Congress Verona, *Italy June 10th - 13th, 2008.pp1499-1503http://worldrabbit-science.com/WRSA-proceedings/congress-2008verona/Verona-200 htm#managementAccessed8thjanuary2012.*

Akinmutimi, A.H., 2004. Evaluation of Sword Bean (Anavaliagladiata) as an Alternative Feed Resource for Broiler Chickens. P.H.D. Thesis Micheal Okpara University of Agriculture Umudike: 10 – 26.

Akinmutimi, A.H., 2006. Determination of Optimal Dietary Level of Inclusion of Cooked Sword Bean Meal in Broiler Starter Diet. Akinmutimi, A.H., U.V. Odoemelam And S.F.

Amaefule, K.U. and Obioha, F.C. (2005). Performance of Pullet Chicks Fed Raw or Processed Pigeon Pea (Cajnus Cajan) Seed Meal Diets. Livestock Research for Rural Development vol. 17, #33.http://www.cipav.org.co/lrrd/17/03/ amae 17033.htm

Amy, E.H., (2011). Nutritional Requirements for Rabbits. Monogastric Nutritionist, Shur-Gain Nutreoco Canada Inc.

Biobaku, W.O. and Oguntona, E.B. (1977). The Effects of Feeding Multi Nutrient Mini Blocks and Pelleted Diets on The Growth of Rabbits. Nigeria.

Cheeke, P.R. and Amberg, J.W. (1972). Protein Nutrition of the Rabbit Nutrition 5:259 – 263.

N.S.R. Sastry and C.K. Thomas., (2005). Livestock Production Management Fourth Revised and Enlarged Edition, Kalyani Publishers.

Nworgu, F.C., Olupona, J.A., Olukoya, J.A. and Bamgbose, A.M. (1999). Principles and Procedures of Statistics. A Biochem Approach 2nd Edition Me Graw – Hill Kogakwha Ltd. Tokyo.

Statistical Analysis System (SAS). (1998).Computer Software , *Version 9 Statistic SAS* institute Inc.cary, N.C. 27513, U.S.A.

Usman, H.I. (2011). Effect of time of intercropping soybean on weed suppression and performance of unland rice in southern guinea savanna of Nigeria. Ph.D thesis, Department of Crop production, Federal University of Technology Minna. Pp24.

Yusuf, A.M., Garba, M.H., Olafedhan, O.A., Okafor, C.I., (2009). Evaluation of the Feeding Potentials of *Vitelleria paradoxum, Naucleau latifolia and Terminaliam croptera* Forages as Supplement to Concentrate Feed for Weaner Rabbits. Proc. 34th Annual Conf. of Nig. Soc. for Animal Production., Calabar, 117 – 119.

EFFECTS OF REPLACING WHEAT OFFAL WITH COWPEA TESTA ON THE PERFORMANCE AND ECONOMIC ANALYSIS OF BROILER CHICKENS

Igwebuike, J. U[1*]., Garnvwa, I[2]. Medugu, C. I[1]. and Augustine, C[2].

1. *Department of Animal Science, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria*
2. *Department of Animal Production, Adamawa State University, Mubi, Nigeria.*

** Corresponding Author email: bbsaleh@unimaid.edu.ng, Phone No. +2348185927245*

ABSTRACT

The effects of replacing wheat offal with cowpea testa was investigated using one hundred and fifty one week-old broiler chickens for a period of 9 weeks. The chickens were randomly divided into 5 dietary treatments in groups of 30 chickens and replicated 3 times with 10 chickens per replicate in a Randomized Complete Block Design (RCBD). Broiler starter and finisher diets were compounded and cowpea testa was used to replace wheat offal at graded levels of 0%, 25%, 50%, 75% and 100%. Results obtained indicated no significant (P>0.05) difference in all the parameters. The economic analysis revealed that the feed cost (₦/kg) decreased with increasing levels of cowpea testa in the diets while, no significant (P>0.05) difference was recorded on the feed cost per weight gain (₦/kg gain). However, there was a corresponding improvement in savings in the overall cost of production at 25% cowpea testa diet. Cowpea testa could therefore replace wheat offal at 25% of the wheat offal in broiler diets and thus recommended in areas where the cost of wheat offal is high and supply inadequate.

Keywords: Wheat offal, cowpea testa, broiler chickens, performance, economic analysis

INTRODUCTION

Feed remains one of the most important single input in poultry enterprise, accounting for 60 – 70% of the total cost of commercial poultry production (Olajide, 2010). The utilization of un-conventional feed resources could be an alternative for expanding the feed resource base for poultry, because they are less expensive than the conventional ones. Agro-industrial by-products (AIBs) have in recent times formed the focus of research in animal nutrition especially for monogastrics and their use as un-conventional feed sources has offered opportunities in alleviating the problems associated with animal feed supply (Babatunde, 1989). However, there are limitations when some of the various products such as rice husk or bambara nut waste are fed to poultry. Problems associated with digestion and absorption of nutrients has been noted due to high fibre concentration (Ani, 2007).

Agro-industrial by-product such as wheat offal is in high demand, making the product expensive. There is therefore, a need to explore cheaper alternative such as cowpea testa. Cowpea testa contains 17% crude protein, 2.6% ether extract, 20.3% crude fibre and 1005 kcal/kg of metabolizable energy (Sonaiya, 1993). This implies that cowpea testa is comparable with other un-conventional feedstuff. Cowpea testa is cheap and available where cowpea production is abundant. The objective of this study was to investigate the productive and economic performance of broiler chickens fed cowpea testa as a replacement for wheat offal.

MATERIALS AND METHODS

Study Area. The study was carried out at the poultry unit of Livestock Teaching and Research Farm, Department of Animal Production, Adamawa State University, Mubi. Mubi is located between latitude 9°30' and 11°N of the equator and longititude 13° and 13°45'E of the Greenwich meridian and lies in Guinea savannah zone of Nigeria. The rainfall starts in April and ends in October. It has an annual rainfall of about 750 mm to 1100 mm per annum with temperature ranges between 15.2°C and 39°C (Adebayo and Tukur, 1999) .

Experimental Diets. The experimental diets contained cowpea testa which was dried and ground into meal. The cowpea testa meals (CTM) were used to replace wheat offal (WO) at 0%, 25%, 50%, 75% and 100% levels in the diets. Composition of the experimental diets is presented in Table 1.

Experimental Design. A total of one hundred and fifty (150) day-old chicks were randomly assigned to five (Adebayo and Tukur, 1999) treatment diets. Each treatment consists of three (Ani, 2007) replicates of ten (Akinfala *et al.*, 2013) chickens in a Randomized Complete Block Design (RCBD).
Experimental Stock and Management. The chicks were purchased from ECWA hatchery Jos, Plateau State and used for the study. The chicks were brooded for seven (Pauzenga, 1985) days and allotted to treatment group / diets. Standard management practices and vaccination schedule were carried out. Experimental diets and adequate drinking water were provided *ad libitum* throughout the experimental period. The experiment lasted for nine (Oluyemi and Roberts, 2000) weeks.

Chemical Analysis: Proximate composition of the feed ingredients was analyzed using AOAC (2004) methods. The energy values of the feeds were calculated using the formula of Pauzenga (1985) expressed as:
ME (kcal/kg) = 37 x %CP + 81 x % EE + 35.5 x % NFE.

Statistical Analysis: Data collected were analyzed using statistical package (Statistix 9.0 version). Least significant difference (LSD) was used to separate the means where significant differences ($p<0.05$) occurred.

Table 1. Composition (%) and Calculated Analysis of the Experimental Broiler Starter and Finisher Diets

		Replacement Levels of Wheat Offal with Cowpea Testa				
Ingredient		**0%**	**25%**	**50%**	**75%**	**100%**
Maize	S	44.55	44.55	44.55	44.55	44.55
	F	50.61	50.61	50.61	50.61	50.61
SBM	S	30.45	30.45	30.45	30.45	30.45
	F	24.39	24.39	24.39	24.39	24.39
Fish meal	S	5.00	5.00	5.00	5.00	5.00
	F	5.00	5.00	5.00	5.00	5.00
Wheat offal	S	16.00	12.00	8.00	4.00	0.00
	F	16.00	12.00	8.00	4.00	0.00
Cowpea testa	S	0.00	4.00	8.00	12.00	16.00
	F	0.00	4.00	8.00	12.00	16.00
Bone meal	S	2.50	2.50	2.50	2.50	2.50
	F	2.50	2.50	2.50	2.50	2.50
Salt	S	1.25	1.25	1.25	1.25	1.25
	F	1.25	1.25	1.25	1.25	1.25
Vitamin Premix	S	0.25	0.25	0.25	0.25	0.25
	F	0.25	0.25	0.25	0.25	0.25
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis (%)						
Crude protein	S	22.00	22.08	22.16	22.24	22.32
	F	20.00	20.08	20.16	20.24	20.32
Crude fibre	S	3.97	4.44	4.91	5.30	5.65
	F	3.76	4.23	4.70	5.18	5.65
Ether extract	S	4.06	4.07	3.99	3.85	3.92
	F	4.01	3.97	3.94	3.90	3.87
Calcium	S	1.32	1.67	2.03	2.39	2.74
	F	1.32	1.67	2.02	2.38	2.74
Phosphorus	S	0.77	0.08	0.82	0.84	0.86
	F	0.75	0.78	0.80	0.82	0.84
ME (kcal/kg)	S	2900.85	2866.85	2831.85	2797.25	2762.65
	F	2919.03	2884.43	2849.83	2815.23	2780.76

SBM: Soyabean meal, ME: Metabolizable energy, S = Starter, F = Finisher

Results and Discussion

The proximate composition of the experimental diet at starter and finisher phases were presented in Table 2. Result obtained showed that the dry matter ranged from 96.70% to 97.20% and 94.80% to 95.40% for starter and finisher diets, respectively. The crude protein levels of 20.10 to 23.00% and 17.20% to 20.50% for starter and finisher diets, respectively were obtained. The crude protein contents increased with increasing level of cowpea testa in the diets. Similarly, the ether extract levels increased with increasing level of cowpea testa. The ash followed similar trend and levels of nitrogen-free extract recorded in this study were 47.70% to 55.60% and 51.10% to 60.90% for starter and finisher diets, respectively. The values of crude protein obtained in this study were within the recommended values of 18 to 24% reported by (Olomu, 2011) for broiler chickens at nine (Oluyemi and Roberts, 2000) weeks of age.

Result of the growth and economic performance is presented in Table 3. There were no significant ($p>0.05$) difference in final weights, daily feed intake, and daily weight gain. Feed conversion ratio followed the same trend. The result of mortality showed that 6.67% of the chickens died during the experimental period which was within the recommended mortality rate for broiler chickens (Oluyemi and Roberts, 2000).

Result of economic analysis showed that, the total feed cost ranged from ₦1026.65 to ₦1974.42. The total weight (₦/kg) gain recorded were ₦1947.16 to ₦2017.26. The feed cost (₦/ kg) decreased from ₦168.55 to ₦176.55 as level of cowpea testa increased. The feed cost /kg gain was drastically reduced (₦518.47) at 25% level of cowpea testa inclusion. The analysis revealed that at 25% replacement level of wheat offal by cowpea testa, the feed cost decreased from ₦176.55 to ₦168.55/kg. If the total feed cost contributes 60 to 70% cost of poultry production according to (Olajide, 2010), 5% decrease is appreciable in order to boost the profitability of broiler enterprise when using non-conventional feed ingredients. The cost of total feed intake was relatively higher (₦1957.41) at 75% replacement level and lower (₦1026.55) at 25%. This was probably as a result of enhanced feed intake by the broiler chickens as the level of cowpea testa increases. The results of cost benefit analysis obtained in this study were in line with Akinfala *et al.* (2013) and Kwari *et al.* (2012) who used varied non-conventional fibre sources in poultry diets.

Table 2. Proximate Composition of the Experimental Broiler Starter and Finisher Diets

	Replacement Levels of Wheat Offal with Cowpea Testa				
Parameter	**0%**	**25%**	**50%**	**75%**	**100%**
Starter Diets					
Dry matter	97.00	96.70	96.80	96.70	97.20
Crude protein (%)	20.10	20.60	21.80	22.70	23.00
Crude fibre (%)	7.80	8.00	8.20	8.70	9.20
Ether extract (%)	8.00	8.20	8.50	9.20	9.30
Ash (%)	5.50	7.00	7.80	7.80	8.00
NFE (%)	55.60	52.90	51.50	48.50	47.70
Finisher Diets					
Dry matter (%)	95.40	95.00	94.80	94.70	95.00
Crude protein (%)	17.20	17.90	18.70	19.80	20.50
Crude fibre (%)	6.40	7.20	7.60	8.20	9.00
Ether extract (%)	4.20	4.90	5.70	6.30	6.80
Ash (%)	6.70	6.80	7.20	7.40	7.60
NFE (%)	60.90	58.60	55.60	53.00	51.10

NFE = Nitrogen-Free Extract.

Table 3. Growth and Economic Performance of Broiler Chickens fed Varying Levels of Cowpea Testa Meal as Replacement for Wheat offal

	Replacement Levels of Wheat Offal with Cowpea Testa					
Parameters	**0%**	**25%**	**50%**	**75%**	**100%**	**SEM**
Initial wt. (g/bird)	100.67	100.00	101.67	100.00	100.00	3.93^{NS}
Final wt. (g/bird)	2065.00	1945.00	1990.00	1873.33	1920.00	80.67^{NS}
Daily feed intake (g/bird)	98.56	93.35	110.14	98.93	103.54	3.35^{NS}
Daily wt. gain (g/bird)	32.02	31.58	31.34	31.07	29.32	0.39^{NS}
Total feed intake (g)	6209.28	5881.05	6938.82	6231.33	6873.47	-
Total feed intake (kg)	6.21	5.88	6.34	6.23	6.88	NAS
FCR (feed: gain)	3.07	2.97	3.58	3.19	3.58	0.28^{NS}
Total wt. gain (g)	2017.26	1989.54	1974.42	1957.41	1847.16	-
Total wt. gain (kg)	2.01	1.20	1.97	1.96	1.85	NAS
Feed cost (₦/kg)	176.55	174.51	172.57	170.55	168.55	NAS
Feed cost / kg gain (₦/kg)	543.18	518.47	620.67	544.65	602.8	46.04^{NS}
Mortality	1.00	2.00	2.00	3.00	2.00	-

SEM = Standard Error of Means, NS = Not significant (p>0.05), FCR = Feed Conversion ratio, NAS = Not Analyzed Statistically

CONCLUSION AND RECOMMENDATIONS

Cowpea testa diets can favourably replace wheat offal in the diets of broiler chickens without adverse effects on performance. Cowpea testa was readily available and cheaper than wheat offal in the study area. The economy of poultry production using 25% level of cowpea testa to replace wheat offal was more rewarding in terms of financial benefits especially the feed cost per / kg gain. Farmers should be encouraged to use cowpea testa to replace wheat offal in areas where wheat offal is scarce and costly. More study should be carried out to explore other non-conventional feed resources for feeding poultry.

REFERENCES

Adebayo, A.A. and Tukur, A.L., 1999. *Adamawa State in Maps*. Paraclete publishers, Yola, Nigeria. Pp. 164 – 166.

Akinfala, E.O., Matamni, O. and Tinuala, J. A., 2013. Nutrient characterization of cassava plant meal and its utilization by broiler chickens in the Tropics. *Livestock Research for Rural Development*, 23(11). Retrieved on 10th June, 2013 from www.irrd23/11akin23229.htm.

Ani, A.O., 2007. Effects of raw bambara groundnut (*Vigna subterranean* L.) waste on the performance of growing rabbit. *Agroscience J. Trop. Agric. Food Environ and Ext.ension*. 6(1): 82 – 88.

AOAC, 2004. Official Method of Analysis, 18th edition, Washington D.C. USA.

Babatunde, G.M., 1989. Alternative formulation of livestock feed in Nigeria. Report of the Committee on alternative feed resource submitted to the presidency, Federal Republic of Nigeria. Pp 1 – 3.

Kwari, I.D., Diarra, S.S., Igwebuike, J.U., Nkama, I. Issa, I., Hamaker, B.R., Hancock J.C., Jauro, M., Seriki, O.A. and Murphy I., 2012. Replacement value of low tannin sorghum (*Sorghum bicolor*) for maize in broiler chicken diets in semi arid zone of Nigeria. *Int, J. Poult. Sci.*, 11(5): 333 – 337.

Olajide, R., 2010. Performance of hydro-broiler chicks fed diets containing graded levels of raw and cooked with cocoyam (*Colacasia esculenta*) corm. *Proceedings of the 5th Annual Conference of Animal Science Association of Nigeria* (ASAN), University of Uyo, Nigeria 13th – 15th September, 2010, pp. 435 – 438.

Olomu, J. M., 2011. *Nutrient Requirements of Poultry. Principles and Practice.* St. Jackson Publication, Benin city, Nigeria. Pp. 112 – 113.

Oluyemi, J. A. and Roberts, F.A., 2000. *Poultry Production in Warm Wet Climates*. 2nd edition. McMillian Education Limited, London and Basingstoke pp. 244.

Pauzenga, U., 1985. Feeding parent stock. *Zootecnia International*. Pp. 22 – 25.

Sonaiya, E. B., 1993. Evaluation of non-conventional feed ingredients as supplement for scavenging chickens. *Proceedings of the World's Conference of Animal Production*. Edmoton, Alberta, Canada. 17th October, 1993. pp. 28 – 29.

PERFORMANCE AND NUTRIENT DIGESTIBILITY OF BROILER CHICKENS FED FERMENTED SHEA BUTTER CAKE BASED DIETS WITH SUPPLEMENTAL NUTRIZYME®(COCKTAIL OF ENYZMES+PROBIOTICS)

[*]Aguihe P.C, [+]Ilaboya I.I and [#]Ukom, S. K

[*]Department of Animal Production and Health Technology, Federal College of Wildlife Management New Bussa.[+]Department of Animal Production and Technology, Edo State College of Agriculture, Iguoriakhi.[#]Department of Agricultural Education, College of Education, Ikere-Ekiti.

[*]Corresponding email: aguihepc@gmail.com

Abstract

A 28-day feeding trial was conducted to evaluate the growth performance and nutrient digestibility of broilers fed fermented shea butter cake meal (FSBCM) with cocktail of enzyme+probiotic (Nutrizyme®) supplementation. A total of 240, 4-week old broiler chickens were distributed into 4 treatments with 5 replications of 12 birds each using a completely randomized design. The 4 treatments comprised T_1 as control diet without FSBCM; T_2 contained 20% FSBCM replacing maize in control diet; T_3 and T_4 contained T_2diet with 0.05% and 0.1% supplemental Nutrizyme, respectively. Each 100g of Nutrizyme contains protease, xylanase, lipase and Lactobacillus acidophilus. Performance parameters measured were body weight, feed intake, weight gain, and feed:gain ratio. At the end of feeding trial, 3 birds per replicate were selected and placed in a metabolic cage for nutrient digestibility trial. Data collected were statistically analyzed using one way analysis of variance (ANOVA) of general linear model procedures of SAS (2012) software package and treatment means differences were separated using Turkey test.The result showed that higher ($P<0.05$) weight gain was obtained in birds fed control and T_3 diets and improved ($P<0.05$) feed:gain was obtained in T_3 diets group. Feed cost/kg gain was lowest ($P<0.05$) in T_3 and T_4 diet. Crude protein, crude fiber and crude fat digestibility were similar ($p>0.05$) among control, T_3 and T_4 groups but higher ($p<0.05$) than T_2 group. In conclusion, minimum inclusion of 0.05% supplemental Nutrizyme improved performance and digestibility of nutrients with lower feed cost/kg gain in broiler finisher chickens fed FSBCM based diets.

Keywords: Feed additive, Shea butter cake, Performance, Digestibility, Broilers

Introduction

The intensive competition between man and his livestock for scarce conventional feed ingredients has resulted to high cost of producing poultry birds and its products, hence calling for urgent utilization of potential agroforestry by-products such as shea butter cake (SBC). The SBC, as a by-product obtained during the processing of shea nuts to produce shea butter, has been identified to spare these conventional feed ingredients in livestock diets because of their low price, availability and high nutritional potential (Orogun *et al*., 2015). Currently, probiotics and enzymes have been used as a feed additive in diets of different classes of poultry to enhance productive performance and immune responses (Patil *et al*., 2015**).** In this regard, the effect of addition of feed additives such as enzymes and probiotics to poultry diets of different nutritive values has been investigated and resulted in positive effects on live body weight, feed:gain, carcass yield and serum profile of the birds, regardless if it was added to a nutritionally-adequate diet or a diet of diminished nutritive value (Zhang *et al*., 2014). Studies have shown that enzymes and probiotics exhibit the potential to maintaining beneficial microflora in the gastrointestinal tract by inhibiting the growth of pathogenic microorganisms and increase the efficiency of nutrient utilization through improving the intestinal health resulting in higher activities of endogenous enzymes (Angel *et al*., 2011; Chiang and Pan, 2012; Dida, 2016; Getachew, 2016).The use of probiotics and exogenous enzymes in poultry feeds to improve bird performance is not a new practice but has long been documented but the information on the synergy of the two feed additives has been scanty**.** Based on this information, this present study was conducted to evaluate the performance of broiler chickens fed fermented shea butter cake meal with Nutrizyme (cocktail of enzymes+probiotics) supplementation.

Results

The nutrient composition of the experimental diets as shown in Table 1 depicted that they were all isonitrogenous and isocaloric. Performance characteristics of broiler finisher chickens fed experimental diets are presented in Table 2. Average final body weight and body weight gain of the

birds fed control diet were higher (P<0.05) than other treatment diets, while those fed T3 and T4 were similar (P>0.05) but higher than those fed T2 diet which recorded the lowest (P<0.05) mean values. Birds fed T4 recorded the lowest (P<0.05) average feed intake followed by those fed T3 while those fed control and T2 diets have similar (P>0.05) higher average feed intake. The FCR of birds fed control diet did not differ (P>0.05) from those fed T3 and T4 but significantly (P<0.05) lower than those fed T2. The feed cost/kg gain of birds fed T3 and T4 diets were similar but significantly lower (P<0.05) than those fed control and T2 diets.The apparent nutrient digestibility of broiler finisher chickens fed experimental diets are presented in Table 3. Birds fed control diet had similar (P>0.05) crude protein digestibility with birds fed T3 and T4, but were higher (P<0.05) than those group fed T2. Birds fed T3 had the highest (P<0.05) crude fiber and fat digestibility and was similar to those fed control and T4, while those fed T2 recorded the lowest (P<0.05) mean values.

Table1: Gross composition of experimental diets for broiler chickens (21-49 d)

Ingredients	**Control**	**FSBC-Nz**	**FSBC+0.05%Nz**	**FSBC+0.1%Nz**
Maize	58.85	46.85	46.80	46.75
Soybean meal	31.00	30.00	30.00	30.00
Fishmeal	3.00	2.70	2.70	2.70
Shea butter waste	0.00	12.00	12.00	12.00
Vegetable oil	2.70	4.00	4.00	4.00
Di Calcium Phophate	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
Vitamin-Premix	0.25	0.25	0.25	0.25
Mineral-Premix	0.25	0.25	0.25	0.25
DL-Methionine	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Threonine	0.20	0.20	0.20	0.20
Nutrizyme	0.00	0.00	0.05	0.10
Total	100	100	100	100
Determined Nutrients				
CP (%)	20.24	20.43	20.43	20.43
ME (kcal/kg)	3089.88	3060.53	3060.53	3060.53

FSBC – Fermented shea butter cake; Nz - Nutrizyme

Table 2: Performance of broiler chickens (21 - 49 d) fed Nutrizyme supplemented shea butter cake based-diets

Parameters	Control	T_2	T_3	T_4	SEM	P-values
Average initial weight (g/bird)	760.42	756.25	754.17	758.33	1.68	0.680
Average final body weight (g/bird)	2400.00^{a}	2072.92^{c}	2283.33^{b}	2237.50^{b}	46.22	0.042
Average weight gain (g/bird)	1639.58^{a}	1316.67^{c}	1529.17^{ab}	1479.17^{b}	45.77	0.039
Average feed intake (g/bird)	2075.00^{a}	2029.17^{a}	1908.33^{b}	1856.25^{b}	35.58	0.018
Feed:gain ratio	1.27^{b}	1.54^{a}	1.24^{b}	1.25^{b}	0.07	0.083
Feed cost/kg	185.94	177.65	177.65	177.65	--	--
Feed cost/kg gain	236.14^{b}	273.58^{a}	220.29^{c}	222.06^{c}	0.34	0.036

^{ab} Means in the same row with different superscript differ significantly (P<0.05)

T_2 - FSBC: Fermented sheabutter cake without Nutrizyme supplementation, **T_3 - FSBC+0.05% Nz:** Fermented sheabutter cake with 0.05% Nutrizyme supplementation,**T_4- FSBC+0.1% Nz:** Fermented sheabutter cake with 0.1% Nutrizyme supplementation

Table 3: Apparent nutrient digestibility of broiler chickens (21-49 d) fed Nutrizyme supplemented shea butter cake based diets

Nutrients	**Control**	T2	T3	T4	SEM	P-values
Crude protein %	76.56[a]	63.57[b]	75.98[a]	78.01[a]	3.23	0.021
Crude fiber %	74.34[a]	66.86[b]	76.87[a]	73.83[a]	1.09	0.039
Crude fat %	68.75[b]	52.87[c]	85.85[a]	87.93[a]	5.98	0.018
Nitrogen Free Extract (NFE) %	88.09	82.35	86.92	85.87	4.87	0.823

[ab ab] Means in the same row with different superscript differ significantly (P<0.05)

T_2 - FSBC: Fermented sheabutter cake without Nutrizyme supplementation, **T_3 - FSBC+0.05% Nz:** Fermented sheabutter cake with 0.05% Nutrizyme supplementation, **T_4- FSBC+0.1% Nz:** Fermented sheabutter cake with 0.1% Nutrizyme supplementation

Discussion

Supplementation of Nutrizyme in FSBC based diets revealed significant improvement in live body weights, weight gain, feed intake and FCR as well as crude protein and fiber digestibility of birds compared to the group without supplemental Nutrizyme. Higher growth rate of birds in Nutrizyme group may be attributed to inhibition of growth of the enteropathogens in the gut by decreasing the intestinal pH and efficient utilization of nutrients by the beneficial microbes. Edwin *et al.* (2002), reported improved live weight due to multi-enzymes in diet. The increased weight gain observed in T3 and T4 may be due to the activities of the probiotic microbes. This is supported by the report of previous findings (Mansoub, 2010; Amer and Khan, 2012) that probiotic microbes elaborate digestive enzymes which help the host enzymes to increase digestibility and improve efficiency of feed utilization and weight gain. Also, it has been demonstrated that probiotics and enzymes have the potential to breakdown complex feed into smaller substances making their digestion and absorption by the host animal easier (Ghomi *et al*., 2012; Chuka, 2014). Moreover, birds receiving the diet with supplemental Nutrizyme had improved feed conversion ratio similar to control group than those on FSBC diet without supplemental Nutrizyme. This is attributed to enhancement of feed utilization efficiency and bioavailability of nutrients due to combined effect of supplemental enzymes and probiotics in the broiler's diet (Craig *et al*., 2008; Chiang and Pan, 2012; Dida, 2016). These findings are in accordance with Elongvan *et al*. (2004) who also reported better feed:gain on addition of probiotic and enzymes in diet of quails. In addition, earlier studies have shown that availability of better quality nutrients may increase the release of endogenous enzymes (Zhou *et al*., 2013); thus improving the nutrient digestibility and performance in broiler chicken (Tazi et al., 2014).

Conclusion and Recommendation

Supplementation of the fermented sheabutter cake meal based diet with Nutrizyme (cocktail of enzymes and probiotics) at a minimum inclusion of 0.05% showed an improved performance and nutrient digestibility in broiler finisher chickens. Therefore, utilization of agroforestry byproducts in poultry diets allows for the option of combined supplementation of enzymes and probiotics to enhance growth and feed:gain with lower net feed costs.

References

Angel, C.R., Saylor, W., Vieira, S.L. and Ward, N. (2011). Effects of a monocomponent protease on performance and protein utilization in 7- to 22-day-old broiler chickens. *Poultry Science*, 90:2281-2286.

Amer, M. Y. and Khan, S. H. (2012). A comparison between the effects of a probiotic and antibiotic on the performance of Desi chickens. *Veterinary World*, 5(3): 160-165.

Chiang, S. S and Pan, T. M. (2012). Beneficial effects of *Lactobacillus paracesei* subsp. Paracasei and its fermented products. *Applied Microbiology and Biotechnology*, 93(3): 903-916.

Chuka E. (2014). Comparative study of the effects of probiotic and commercial enzyme on growth rate, haematology and serum biochemistry of broiler chicken. *J. Food Process.Technol.5: 367*-374

Dida, M. F. (2016). Review paper on enzyme supplementation in poultry ration. *International Journal of Bioorganic Chemistry*, 1(1): 1-7.

Edwin, S. C., Vishwanathan,K.,.Mohan, B. and Purushottaman, M. R. (2002). Effect of replacing maize with broken rice on growth of performance of broilers. *Indian Journal of Poultry Sci*., *37 (2):187-189.*

Elangovan, A. V., Mandal, A. B.,Tyagi, P.K.,Tyagi,P.K.,Tappo, S. and. Johri, T. S. (2004). Utilization of sorghum and finger millet with or without feed enzymes in broiler chickens. *J. of Appli. Anim. Res*. 26*(1): 33-38.*

Getachew, T. (2016). A review on effects of probiotic supplementation on poultry performance and cholesterol levels of eggs and meat. *Journal of World Poultry Research*, 6(1): 31-36.

Ghomi, M.R., Shahriari, R. Langroudi, H.F., Nikoo, M., Von, E.E. (2012). Effects of exogenous dietary enzyme on growth, body composition and fatty acid profiles off cultured great sturgeon *Husohuso* fingerlings. *Aquatic International*, 20: 249-254.

Mansoub, N. H. (2010). Effect of probiotic bacteria utilization on serum cholesterol and triglycerides contents and performance of broiler chickens. *Global Veterinaria*, 5(3): 184-186.

Matsui, I., Matsui, E., Ishi, K.K., Miyairi, S. and Honda, K. (1990). The enzymatic and molecular characteristics of saccharomycopsis α-amylase secreted from saccharomyces cerevisiae. *Agric. Biol.Chem.,54: 2009-2015.*

Orogun, A.J., Oniye, S.J. and Olugbemi, T.S. (2015). Growth and Hematological Response of broiler starter chickens fed diets containing shea butter cake. *J. Sci. Res.* 1 (2): *304-310.*

Patil, A. K, Kumar, S., Verma, A. K. and Baghel, R. P. S. (2015). Probiotics as Feed Additives in Weaned Pigs: A Review. *Livestock Research International, 3(2): 31-39.*

SAS.(2012). Statistical Analysis system. SAS Version 9.2 user's guide. Cary, NY, SAS institute.

Tazi, S. M.A. Mukhtar, E.l., Mohamed, K.A. and Tabidi, M.H. (2014). Effect of using black pepper as natural feed additive on performance and carcass quality of broiler chicks. *Global Advanc. Res. J. of Agric. Sci., 4(2): 108-113.*

Zhang, Z. F. and Kim, I. H. (2014).Effects of multistrain probiotics on growth performance, apparent ileal nutrient digestibility, blood characteristics, caecal microbial shedding, and excreta odor contents in broilers. *Poultry Science, 93(2): 364–370.*

Zhou, Y., Yuan, X., Liang, X. F., Fang, L., Li, J., Guo, X. Z., Bai, X.L. and He, S. (2013). Enhancement of growth and intestinal flora in grass carp: The effect of exogenous cellulose. *Aquaculture, 416-417(2): 1-7.*

GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF WEANER RABBITS FED DIETARY LEVELS OF PARKIA (*Parkia biglobosa)* PULP MEAL.

Imam, D. N., *Bello, K. M., Adamu, N and Egbo, M. L.

Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi. Nigeria.

**Correspondence Author: adijamusa@gmail.com.*

ABSTRACT

This study was carried out to determine the utilization of dietary levels of parkia pulp meal by weaner rabbits. A total of 16 weaner rabbits were usedand the Parkia pulp meal was included at 0, 33.3, 66.7 and 100% levels in a completely randomized design. The experiment was conducted in 4 replicates per treatment. Data were collected on daily feed intake, daily weight gain and carcass analysis. The daily feed intake ranged from 45.58-51.12g on diet 2 and 3 respectively while the daily weight gain ranged from 11.43-13.57 on diets 4 and 1 respectively. The best FCR of 3.23 was recorded on the control diet and this shows progressive decline with increasing inclusion levels of parkia pulp meal. However, the result of the experiment showed a non significant treatment effect on all the performance parameters. The carcass analysis also showed a non significant treatment effect on all the parameters except the liver and large intestine ($P<0.005$). The feed cost/kg also ranged from 4.31-90.02 on diet 4 and 1 respectively. The feed cost/kg weight gain also ranged from N290.70-355.73 on diets 1 and 4 respectively. The result shows that parkia pulp meal can only replace 33.3% of maize in weaner rabbits diets because at higher level the cost per kg is higher.

Key Words: Maize, parkia pulp, performance carcass, rabbits

INTRODUCTION

The high cost of grains caused by high demand by man, livestock and industries has necessitated the need to source for other viable alternative energy sources for the animals. One of such alternative is parkia pulp meal. Parkia pulp meal obtained from the African locust bean (ALBP) fruit (*parkia biglobosa)* after the husk and seed have been removed. The African locust bean tree is a perennial legume which belongs to the sub family *mimosoidea* and family *leguminosea i*n West African subregion. According to Abeke (2005) the seed represent 10% of the fruit while the pulp is 90% and it composition depends on the variety, climate and processing technique.

The parkia pulp which is a yellow powdery substance is used by natives in making gruel (Kunu). It is very rich in carbohydrate which makes it an excellent energy source. According to (Akoma 2001) parkia pulp is use in rural Africa during emergencies occassioned by grain scarcity which is an indication of its edibility and non toxicity. It has low level low level of anti nutritional factors which is an indication that parkia pulp meal is partially safe for incorporation into broiler chickens. The proximate composition of locust bean pulp reported by Afolayan *et al (*2014) indicated that it has a low CP content of 3.1%, NFE of 66.39% and apparent metabolizable energy value of 2344kcal/kg. Bot *et al* (2013) reported a CP of 11.52%, CF of 12.49%, EE of 3.09%, ash of 4.08 and Nitrogen Free Extract of 68 32%. The wide variation in CP (3.1-11.52%) could be attributed to geographical locations, varietal differences or method of processing.

In a feeding trial with locust bean pulp meal as an energy source in diet for egg type chickens, inclusion levels of 22.3 and 30% LBP were recommended for chicks and pullets diets respectively (Afolayan et al 2014). Bot *et al* (2013) used LBP as alternative energy source in broilers diet and concluded that broiler chickens can tolerate up to 25% of LBPM without a negative effect on performances. This research was conducted to evaluate the performance of weaner rabbits fed graded levels of ALBPM as replacement for maize.

MATERIALS AND METHODS

This study was conducted at the Rabbitry Unit, Teaching and Research Farm, Abubakar Tafawa Balewa University Bauchi. Bauchi is located within the Northern Guinea Savannah Ecological Zone at Latitude 10^1 17^N and Longitude 9^1 19^1E at altitude 6902m above sea level. The area is characterized by two distinct seasons (dry and rainy). The dry season begins in October and end in April with a

temperature range of 13.7^0-38^0C, while the rainy season is from April-September with a temperature range of 16-32^0C.

Experimental Design and Management of the Rabbits

Sixteen weaner rabbits of Mongrel breed were used for the study in a completely randomized design. The study was conducted over a period of five (5) weeks after an adjustment period of five (5) days. The rabbits were each housed in a metabolic cages. Feed and water were supplied *ad libitum.* Daily record of feed intake and weekly weight were taken.

There were Four experimental diets containing varying replacement levels of ALBPM: 0,33.33, 66.67 and 100% for maize designated as diets 1,2,3 and 4 respectively. The experimental diets were as shown in Table 1. The experiment was conducted in four (4) replicates of one rabbit per replicate.

Data Collection

Daily feed intake and weekly weight gain were recorded over the five weeks of the study, which form the performance parameters. The Cacass characteristics data were generated at the end of the feeding trial when all the rabbits were slaughtered, skinned, eviscerated and various organs weighted and values recorded as percentage of live weight

Statistical Analysis

The data generated above were analyzed using SPSS (2012) and means were separated using DMRT.

RESULTS AND DISCUSSION

The performance of rabbits fed graded levels of ALBPM were as shown in Table 2. The results of the daily feed intake, daily weight gain and feed conversion ratio showed a non significant dietary treatment effect. The daily feed intake ranged from 45.58-51.12g on diets 2 and 3. This finding contradicts the report of Bot (2013) on broiler chickens and Afolayan et al (2014) on layers fed ALBPM. The daily weight gain of rabbits though not significant showed progressive decrease with increase in inclusion level of ALBPM. This could be due to the higher energy value of maize compared to the experimental material. This is in agreement with Bot *et al* (2013) that also recorded significant decline in daily weight gain with increasing levels of ALBPM in broiler chickens diet which they attributed to low energy and higher levels of fibre and increase powdery nature of diets as the level of ALBPM increased. Similarly, the FCR also showed a non significant progressive increase with increase in ALBPM inclusion level where values of 3.23 -4.27 were obtained on control and diet 4 (100% ALBPM replacement) respectively. This agrees with Kwari and Igwebuike (2002) that also reported an increase in feed conversion ratio with increase in parkia pulp in broilers diet. Bot *et al* (2013) and Afolayan et al (2014) also reported a significant increase in FCR as the level of parkia pulp increase in broilers and layers diets respectively. The reduced feed efficiency on the test diets compared to the control diet could be due to reduced growth rate with inclusion of the experimental material. The cost analysis (Table 4) which was computed using the prices of the feed ingredients during the time of the research showed decrease in cost per kg of feed (₦ 84.31-90.30 on diet 4 and 1 respectively) with increase in parkia pulp meal inclusion level. The feed cost per kg weight gain however showed progressive increased with increasing level of test material inclusion. The cost ranged from ₦290.77-360.00 on control and diets 4 respectively. This finding contradicts the expectation that the use of unconventional feed ingredients in non-ruminant feed would result into cheaper cost of production (Abeke 2005). This is however related to the lower protein content of the experimental material and reduced performance recorded with its inclusion.

The carcass analysis of rabbits fed varying levels of ALBPM is shown on Table 3. Most of the parameters analyzed showed a non significant treatment effect. The weight of the liver and large intestine though were significantly ($p<0.05$) affected by dietary treatments, were not following any regular pattern. This finding shows that the inclusion of ALBPM in the diet of weaner rabbits has no negative effect on the carcass characteristics of rabbits.

CONCLUSION

From the results of this study, the following conclusions were drawn:

1. Replacing 33.3% of maize with parkia pulp meal has no negative effect on performance and feed cost of weaner rabbits

2. Higher inclusion level of parkia pulp meal in rabbits diets leds to reduced cost /kg of feed and increased feed cost per kg weight gained.

3. Inclusion of parkia pulp in weaner rabbits diet has no negative effect on their carcass characteristics

Table 1: Percentage Composition of Experimental Diets

	Replacement levels of parkia pulp meal			
Ingredients	0%	33.3%	66.6%	100%
Maize	43.7	29.2	14.5	0
Parkia pulp meal	0	14.5	29.2	43.7
Soya bean meal	19.6	19.6	19.6	19.6
Palm oil	0	1.0	1.5	2
Wheat bran	20	20	20	20
Rice offal	10	9	8.5	8.0
Fish meal	3	3	3	3
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Total	100	100	100	100
Calculated Analysis				
Crude protein (%)	18	17.7	17.3	17.0
ME (Kcal/kg)	2447.3	2391.9	2252.5	2139.1

Table 2: Performance of Weaner Rabbits Fed Graded Levels of Parkia Pulp Meal

	Replacement levels of parkia pulp				
Ingredients	0%	33.3%	66.6%	100%	SEM
Initial weight (g)	410	380	310	400	-
Daily feed intake	47.62	45.58	51.2	48.81	6.11^{NS}
Daily weight gain	15.36	13.57	13.21	11.43	1.38^{NS}
Feed conversion ratio	3.23	3.33	3.91	4.27	0.31^{NS}
Final weight	950	840	780	800	20.12^{NS}
Feed cost/kg (₦)	90.30	89.70	86.73	84.30	-
Feed cost ₦/kg weight	290.77	298.65	339.11	360.00	-

NS= Nonsignificant difference($p>0.05$). SEM= Standard error of means

Table :3 Carcass Yield and Gut Characteristics of Rabbits Fed Varying Levels of Parkia Pulp.

	Replacement levels of parkia pulp				
Parameters	1(0%)	2(50%)	3(75%)	4(100%)	SEM
Live weight (kg)	800 733.33	700	800	101.04^{NS}	
Dressed weight (g)	377.66	306.68	325.7	385.68	32.11^{NS}
Dressing %	47.22	41.82	46.53	48.21	3.84^{NS}
Head (%)	9.87	10.36	11.82	9.50	0.79^{NS}
Feet (%)	2.32	5.16	4.17	2.50	7.22^{NS}
Liver	0.32^{a}	0.27^{b}	0.32^{a}	0.17^{c}	0.07*
Lungs	0.86	1.17	0.72	0.84	0.13^{NS}
Heart	0.18	0.19	0.20	0.20	0.06^{NS}
Abdominal fat	0.50	0.53	0.53	0.55	0.25^{NS}
Small intestine	7.73	9.72	6.57	9.29	0.85^{NS}
Large intestine	0.53^{a}	0.47^{a}	0.39^{b}	0.46^{a}	0.08*

*abc means in a row with different superscripts differ significantly (P<0.05), NS= Not significantly different (P>0.005), SEM Standard error of means.

REFERENCES

Abeke, F.O. (2005). Evaluation of the nutritive value of *lab lab purpereus* beans in replacing groundnut cake in poultry diets Ph.D Theses, Animal Science Department ABU, Zaria.pp28.

Afolayan,M,,Bawa,G.S., Sekoni, A.A; Abeke, F.O. and Daramola, S.T. (2014). Effect of inclusion levels of African locust bean (*Parkiabiglobose*) pulp on growth parameter of egg type chicken (0-20 weeks)- *Nigerian Journal of Animal Science* **16**(1): 51-60.

Akoma, O., Onuha, S.A and Ozigis, A.A. (2001): Physio-chemical attributes of wine produced from the yellow pulp of *parkia biglibosa* using traditional juice extraction technique. *Nigerian Food Journal **19**: 75-79.*

Bot, M.H., Bawa, G.S. and Abeke F.O. (2013): Replacement value of maize with African locust bean (*Parkia biglobosa*) pulp meal on performance, hematological and carcass characteristics of broiler chickens. *Nigerian Journal of Animal Science* **15**: 59-70.

Bouzouita,N., Khalid,A., Zgouli,S., Cheli,L, Chekki,R., Chaabouni,M and Thonart,P (2007). The analysis of crude protein and purified locust bean gum. A comparision of samples from different carob tree population in Tunisia. *food chemistry.*101:1508-1515.

Kwari, I.D. and Igwebuike J.U. (2002): Performance of broiler chickens fed graded levels of African locust bean (*Parkia biglobosa*) pulp. *Proceedings of the Nigerian Society of Animal Production* (NSAP) September, 17-19th held at University of Maiduguri Nigeria.

SPSS (2012): Statistics package for social sciences (SPSS) 21 version inc 233 South weaker drive, 11th floor, chicago I.L. 60606-6412.

GROWTH PERFORMANCE AND COST BENEFITS OF BROILER CHICKENS FED DIETS CONTAINING GARLIC AND GINGER POWDER AS ADDITIVES

Irekhore O. T.[*], Alli O. O.[+], Bello K. O.[#], Oluwalana E. O. A.[*]

[*-] Agricultural Media and Extension Resource Centre
[+-] Department of Animal Nutrition
[#-] Institute of Food Security, Environmental Resources and Agricultural Research; Federal University of Agriculture, Abeokuta
Corresponding Author: raykemi@yahoo.com; +2348033900920

Abstract
This study evaluated the growth performance and cost benefits of broiler chickens fed diets containing garlic powder, ginger powder or their combination as additives at 0-4weeks of age. A total of 240 day old broiler chicks were randomly assigned to four dietary treatments formulated to meet nutrient requirements at the starter phase. Control diet contained neither garlic nor ginger powder. The second diet contained garlic powder at 5g/kg diet, the third diet contained ginger powder at 5g/kg diet while the fourth diet contained a combination of garlic and ginger powder each at 2.5g/kg diet. The birds were randomly allotted to the four dietary treatments in six replicates and fed ad libitum for four weeks. Data were collected on growth performance and cost estimations were made on diets and feeding. Higher (p<0.05) feed intake, cost per kilogramme diet, cost of feed per bird and cost per kilogramme weight gain were recorded among birds fed diets containing the feed additives. Feed conversion ratio was lowered (p<0.05) in birds fed the control diet. Mortality rate was reduced (p<0.05) with inclusion of garlic or ginger at a rate of 5g/kg or their combination at 2.5g each/kg in diet of starter broilers. The study concluded that garlic powder or ginger powder (5g/kg diet) or their combination (2.5g each/kg diet) could be explored as feed additives at the starter phase of broiler chickens production where organic growth as well as effective reduction in mortality is paramount.

Key words: garlic, ginger, additive, performance, livability.

Introduction
Modern production of poultry particularly the meat type requires very short and fast production cycles and hence fast growth rate of birds to meet increasing demands. It is an interesting fact that chicks grow fast and gain up to seven times their hatch weight in the first month while building healthy digestive tract and immune system will improve their growth (AAF, 2018). The gut and general health as well as performance of the poultry are greatly influenced by the intestinal microbial community and the complex interaction with the host birds (De Guseem, 2018). Gut health and immune support tools and strategies are therefore key requirements in a starter-grower nutrition. Antibiotic or antimicrobial growth promoters have hitherto been intensively used in broiler's rations to improve health, performance and productivity (Immerseel, 2019). However, they are now infamous because of the resultant bacterial resistance and their negative impacts on the consumers' health over time. The use of safer alternatives like phytogenic feed additives which offer with affordable costs, reduced risk of toxicity, minimum health hazard, and high suitability, positive consumer opinions and acceptance, and environmental friendliness (Rehman and Munir, 2015; Jones, 2018) have been gaining popularity over the years. Phytogenics including herbs and spices and their products have flavouring properties and exert effects on the gut environment or gut cell wall of animals and enhance the effectiveness of nutrient utilization for better health and productivity (Hanieh *et al*., 2010; Al-Shuwali *et al*., 2015; AAF, 2018; Jones, 2018). Hence, the use of phytogenic substances such as garlic and ginger. While garlic (*Allium sativum*) has been used as natural feed additives in poultry nutrition for broiler and growers due to its antibacterial and immune-modulatory properties (Rehman and Munir, 2015), inclusion of ginger in the diet of broilers have been reported to aid weight gain and feed conversion (Safa, 2014). Al-Shuwali *et al.* (2015) opined that garlic and ginger have strong stimulating effects on immune and digestive systems of birds. Recent research works on the combination of ginger and garlic as feed additives (Issa *et al*., 2012; Karangiya *et al*., 2016) have shown encouraging results with regards to weight gain, feed efficiency and lowered mortality in poultry. Confusion about choice of product, perceived lack of sufficient commercial and scientic data to support the efficicacy of products and whether they have real economic benefits may desuade animal producers and feed

manufacturers from using phytogenics (Jones, 2018). Therefore, according to De Guseem (2018), the next and best approach in use of alternative additives for improved gut health and animal performance is to list what has been achieved with the estimated cost per kilogramme bird produced. However, there is a dearth of report on the cost benefits of garlic and ginger as feed additive for broiler starter and this necessitated this study.

Materials and Methods

The study was carried out at the Poultry Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Nigeria. The area is located in the derived savannah vegetation zone of Southwest Nigeria with altitude 76m above sea level; latidude (7.1475^0N and 3.3619^0E), and an average temperature of 34^0C (Google Earth, 2019).

The test ingredients, processed garlic and ginger powder were sourced from open market and incorporated into a basal starter diet formulated to contain 22% crude protein and metabolizable energy of 2873kcal/kg. The control diet had no garlic or ginger powder as additive. Diets 2 and 3 had garlic powder and ginger powder included respectively, at a rate of 5g/kg diet while diet 4 had each of garlic and ginger powder included at a rate of 2.5g/kg diet.

A total of two hundred and forty day old broiler chicks were obtained from a reputable hatchery and randomly allocated into the four dietary treatments in six replicates. The birds were reared under good animal production practices. The respective starter diet according to treatment as well as water was provided to the birds *ad libitum* for a period of four weeks. Performance parameters such as feed intake, weight gain and feed conversion ratio were recorded according to treatment and replicate. Prevailing market prices of feed and test ingredients were used to determine costs: per kilogramme diet, of feed consumed per bird and per kilogram body weight gain. All data collected were subjected to one way analysis of variance using the SAS statistical package (SAS, 2002) while significant means were separated using Duncan Multiple Range Test as contained in SAS.

Results and Discussion

Effect of inclusion of powdered garlic, ginger or their combination as feed additive on the growth performance of broiler chickens at the starter phase is presented in Table 1. Dietary inclusion of ground garlic, ginger or their combination had no influence ($p>0.05$) on final weight and daily weight gain of starter broiler chickens. Non-significant effects observed in the final weight and daily weight gain of 0-4weeks old broiler chickens in this study showed that the phytogenic additives used did not influence those parameters. This is in agreements with findings (Demir *et al.,* 2003; Issa *et al.,* 2012) that inclusion of garlic in diets for broiler chickens did not influence performance. However, daily feed intake (DFI), feed conversion ratio (FCR) and mortality of starting broiler chickens were significantly ($p<0.05$) influenced by dietary treatments. Birds fed the control diet recorded least DFI and FCR (57.88g/d and 1.56, respectively). These were higher and similar among additives treatment groups. High feed intake was observed among birds on phytogenics based diets. This is in line with findings (Mohammed *et al.,* 2012 and Karangiya *et al.,* 2016) that inclusion of ginger powder in the diets of broilers resulted in positive effect on feed intake. The report of Javandel *et al.* (2008) showed that higher levels of feed consumption was obtained when broiler chickens were fed diets with garlic inclusion. However, Oloyede *et al.* (2017) reported lower feed consumption of garlic based diets. This was not the case in the present study as the birds under this dietary treatment had higher feed intake.

Birds in all the treatment groups had similar final weight and daily weight gain, indicating that the stimulating effect of ground garlic, ginger or their combination on feed intake did not translate to higher weight gain in the birds. This probably explains why the feed conversion ratio was poor for the birds in the phytogenic treated groups. Disparity between the results obtained in this trial and those of other researchers could be due to variations in actual bioactive ingredient intake due to variations in composition of the phytogenic material which could be affected by climate, harvesting conditions among other factors as exposited by Maurin (2018).

No mortality was recorded for birds fed diets containing garlic, ginger or their combination. However, birds on the control diet recorded mortality rate of 0.83% indicating that the phytogenic feed additives impacted better immunity on the birds and hence higher livabilty. This suggests beneficial effects of phytogenics on the health of the birds. The report of Rehman and Munir (2015) and Karangiya *et al.* (2016) indicated that the use of these phytogenics improved immune system of birds give credence to the result obtained in this trial.

Table 1: Growth performance of broiler chickens fed diets containing garlic and ginger as additives at starter phase (0-4 weeks)

Parameters	Control (0g/kg)	Garlic (5g/kg)	Ginger (5g/kg)	Garlic (2.5g/kg) + Ginger (2.5g/kg)	P-value	SEM
Initial weight (g/b)	40.00	40.00	40.00	40.00	0.000	0.000
Final weight (g/b)	1082.00	1015.50	1063.50	1048.33	0.52	15.674
Daily weight gain (g/b)	37.21	34.84	36.55	36.01	0.52	0.55978
Daily feed intake (g/b)	57.88^{b}	62.64^{a}	62.59^{a}	62.76^{a}	0.01	0.661
Feed conversion ratio	1.56^{b}	1.80^{a}	1.71^{ab}	1.77^{a}	0.025	0.032
Mortality (%)	0.83^{a}	0.00^{b}	0.00^{b}	0.00^{b}	<0.001	0.085

^{ab} - means within same row having different subscript differ significantly ($p<0.05$, $p<0.01$, $p<0.001$))

All the feed cost parameters measured were significantly ($p<0.001$) influenced by the dietary treatments. Cost per kilogramme feed (CKF) increased ($p<0.001$) with inclusion of the phytogenic feed additives. Diet with garlic powder as additive had highest ($p<0.001$) CKF (₦190.15/kg) while the control diet had the least (₦174.90/kg). Values recorded for feed cost per bird (FCB) and feed cost per kilogramme weight gain (FCKWG) were similar across the phytogenic groups while birds in the control group recorded significantly ($p<0.001$) lower FCB (₦283.46) and FCKWG (₦272.70). Increased cost of feed as well as higher cost of feed consumed per bird with the inclusion of garlic and ginger in the diet is obviously due to additional cost of the garlic and ginger powder added to the diet. In the same vein, high feed cost per kilogramme weight gain obtained for birds fed diets containing garlic, ginger or their combination was due to the higher cost of feed coupled with their higher values of feed conversion ratio. As opined by Maurin (2018), costs of utilizing phytogenics like ginger and garlic are non-negligible while the expensive nature of their use may be due to low exploration and the need to use them in appreciable quantities.

Table 2: Cost benefits of broiler chickens fed diets containing garlic and ginger as additives at starter phase (0-4 weeks)

Parameters	Control (0g/kg)	Garlic (5g/kg)	Ginger (5g/kg)	Garlic (2.5g/kg) + Ginger (2.5g/kg)	P-value	SEM
Feed cost per kilogramme diet (₦/kg)	174.90^{d}	190.15^{a}	189.10^{c}	189.62^{b}	<0.001	1.332
Cost of feed consumed (₦)	283.46^{b}	333.51^{a}	331.40^{a}	333.20^{a}	<0.001	5.153
Feed cost per kilogramme weight gain (₦/kg)	272.70^{b}	342.05^{a}	324.02^{a}	334.77^{a}	<0.001	7.364

^{abcd} - means within same row having different subscript differ significantly ($p<0.001$)

Conclusion

Feed intake, cost per kilogramme diet, cost of feed per bird and cost per kilogramme weight gain were increased with inclusion of garlic or ginger at a rate of 5g/kg or their combination at 2.5g each/kg in diet of starter broiler chickens. Poor feed conversion ratio was obtained when garlic or ginger or their combination was included in the diets of starter broiler chickens. No mortality was recorded for the birds in the phytogenic fed groups. It is therefore recommended that garlic powder or ginger powder at inclusion rate of 5g/kg diet or their combination (2.5g each/kg diet) can be explored as feed additives at the starter phase of broiler chickens for improved livabilty of birds.

References

AAF (2018). Six (6) things to look for in a starter-grower feed. All About Feed Magazine, March 26, 2018. Available online at www.allaboutfeed.net. Accessed 21/9/2018

Al-Shuwaili, M. A, Ibrhim, E. I. and Al-Bayati, M. T. N. (2015). Effect of dietary herbal plants supplements in turkey diet on performance and some blood biochemical parameters. *Global J. Biosci. and Biotech.*, 4(1): 85-89.

Demir, E., Sarica, S., Ozcan, M. A., and Suicmez, M. (2003). The use of natural feed additives as alternatives for an antibiotics growth promoter in broiler diets. *Bri. J. Poult. Sci.*, 44: 544-545

De Gussem, M. (2018). Gut Health in Poultry: A holistic approach. All About Feed Magazine, December 13, 2018. Available online at www.allaboutfeed.net. Accessed 25/1/2019.

Hanieh, H., Narabara, K., Piao, M. Gerile, C., Abe, A. and Kondo, Y. (2010). Modulatory effects of two levels of *Alliums* on immune response and certain immunological variable, following immunization in white leghorn chickens. *Anim. Sci. J.*, 81(6): 673 – 680.

Immerseel, F. (2019). The science behind peptidoglycans in poultry production. *Int. Poult. Prod.* 27(4): 19.

Issa, K. J. and Omer, J. M. A. (2012). Effect of garlic powder on the performance and lipid profile of broilers. *Open J. Anim. Sci.*, 2(2): 62-68.

Javandel, F., Navidshed, B. Seifdavati I. Pourrahimi, G. H. and Baniyaghoub, S. (2008). The favourite dosage of garlic meal as a feed additive in broiler chicken ration. *Pak. J. Biol. Sci.*, 11: 1746-1749.

Jones, G. (2018). Evolution in the evaluation of phytogenics. All About Feed Magazine, June 14, 2018. Available online at www.allaboutfeed.net. Accessed 17/6/2018.

Karangiya, V. K., Savsani, H. H., Patil, S. S., Garg, D. D., Murthy, K. S., Ribadiya, N. K. and Vekariya, S. J. (2016). Effect of dietary supplementation of garlic, ginger and their combination on feed intake, growth performance and economics in commercial broilers. *Vet. World*, 9(3): 245.

Maurin, J. (2018). A 5-step guide on how to assess plant extracts. Feed additives, All About Feed Magazine, May 18, 2018. Available online at www.allaboutfeed.net. Accessed 18/6/2019.

Mohammed, A. B., Mohammed, A. M. and Ali-Jail Q. (2012). Effects of ginger (*Zinigiber officinale*) on performance and blood serum parameters of broiler. *Int. J. Poul. Sci.*, 11(2): 143-146.

Oloyede, T. A. and Fasuyi, A. O. (2017). Garlic (*Allium sativum*) powder as an additive in Broilers (Finisher Phase) Part 2: Growth performance, hypo-cholesterolemic effect and economic implications. *J. Experi. Agric. Int.*, 18(5):1-14.

Rehman, Z. and Munir, M. T. (2015). Effect of garlic on the health and performance of broilers. *Veterinaria*, 3(1): 32-39.

Safa, M. A. E. (2014). Response of broiler chicks to diets containing different mixture levels of garlic and ginger powder as natural feed additives. *Int. J. Pharma. Res. and Allied Sci.*, 3 (4): 27-35.

SAS (2002). SAS/STAT User's Guide: Statistics 8.2 SAS Institute Inc., Cary, NC. U.S.A. GrawHill Book Co.N.Y.

EFFECT OF DIFFERENTLY PROCESSED MANGO SEED KERNEL MEAL ON PERFORMANCE OF BROILER CHICKENS

Jatutu, S. S., Bello, K. M and Kalla, D. J. U
Department of Animal Production, Abubakar Tafawa Balewa University Bauchi State, Nigeria
Corresponding author email: samsonshalom@gmail.com
+ 2347035421636

Abstract

An experiment was conducted to evaluate the effects of differently processed mango seed kernel meal (MSKM) on broiler chickens for eight weeks. The processing methods include: soaking for 24 and 72hours, boiling and soaking and boiling. The level of anti-nutritional factors and performance of broiler chickens were obtained. The results indicated that the different processing methods reduced the anti-nutritional factors: boiled and soaked has the best percentage reduction of tannin (84.31%), and oxalate (37.08%), Boiled mango seed kernel has the highest percentage reduction of saponin (35.68%) and flavonoid (34.15%), while Soaked for 24hours reduces alkaloid (47.43%) better compared to boiling (32.87%). Two hundred and twenty-five (225) day old broiler chicks were randomly allotted to five dietary treatments with three replicates of 15 birds each in completely randomized design. The experimental diets consisted of raw, soaked for 24hours, soaked for 72hours, boiled and soaked and boiled mango seed kernel meal included at 10% in both broiler starter and finisher diets designated as T1, T2, T3, T4 and T5. The performance results show that final weight at the finisher phase were significantly (P<0.05) higher in T2 (1583.33g) compared to all other treatments. The average water intake in the finisher was significantly (P<0.05) higher in birds fed soaked 72hours (T3) and soaked and boiled MSKM than the other treatments. There were no significant differences in the feed intake, weight gain, feed conversion ratio in both the starter and finisher phase. Treatment 5 recorded the lowest feed cost per kg weight gain (306.31₦/kg) in the starter phase while at the finisher phase it ranges from 231.46-297.54₦/kg in T5 and T4 respectively. From the experiment conducted, it is therefore concluded that different processing method can be used to reduce the effect of anti-nutritional factors and mango seed kernel can be used in broiler diet without adverse effects on the birds, although soaked for 24 hours' mango seed kernel gave the best result.

Keywords: mango seed kernel, anti-nutritional factors, broiler chickens, performance

Introduction

Mango seeds contain some anti-nutritional factors such as tannin, phytic acid, oxalic acid, trypsin inhibitors etc. Tannins are responsible for astringent taste, low digestibility of the feed, hence reduced feed intake due to reduction in palatability and /or acceptability (Rafiu *et al.,* 2014), which is in contrary to its good source of soluble carbohydrates (Diarra and Usman, 2008). Drying, soaking, leaching and fermentation have been reported to be simple means of detoxifying these feed sources to reduce the presence of anti-nutrients and toxic components (Aregheore, 1998). Boiling has been reported to be effective in reducing the tannin content of mango kernel (Diarra and Usman 2008). Similarly, boiling reduced the tannin content of the kernel from 9.89 to 1.26%, representing about 87.26% reduction (Diarra *et al*. 2011). Diarra *et al.* (2010) reported no adverse effect of boiling on the crude protein, crude fibre, ether extract and nitrogen free-extract of the kernel. This research is aimed at determining the effect of differently processed mango seed kernel on anti-nutritional factors content and growth performance

Materials and Methods

Experimental Site:

The experiment was conducted at the Poultry Unit of Bauchi State College of Agriculture Bauchi Teaching and Research farm. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East (BSD, 2009).

Experimental Design and Management of Birds

A total of two hundred and twenty-five (225) broiler chicks were used for the experiment. They were randomly divided into five treatment groups of 45 chicks per group in a completely randomized

design (CRD) consisting of three replicates of 15 birds each. Birds were reared on a deep litter, with feed and water provided *ad libitum*. Left over feed and body weight of birds were monitored on a weekly basis for the starter and finisher phases of the experiment and routine vaccines were given as recommended. All feed not consumed were removed, weighed and deducted from feed given daily to get the daily feed intake. Daily water consumption is obtained by subtracting left over water from the total volume of water supplied.

Collection and Processing of Mango seed into Mango Seed Kernel Meal

Mango Seed Kernel were collected from various locations in Sibire, Ardo kola LGA of Taraba State. The kernels were obtained by cutting the seed coat using a knife or crushed with a hammer. The Mango Seed Kernel (MSK) obtained were divided into five parts. The parts processed either by soaking for 24 and 72 hours, boiling and soaking for 24 hours and boiled.

Soaking of mango seed kernel for 24 hours

The Mango Seed Kernel were soaked in water for 24 hours at the rate of 100g per 1.5 litre of water in containers. The water was changed at regular intervals of 8 hours. The Mango Seed Kernels were then removed and sundried. The dried MSK were then milled before incorporation into the diets.

Soaking of mango seed kernel for 72 hours

The Mango Seed Kernel were soaked in water for 72 hours at the rate of 100g per 1.5 litre of water in containers. The water was changed at regular intervals of 8 hours for 3 days. The Mango Seed Kernels were then removed and sundried. The dried MSK were then milled before incorporation into the diets.

Boiling of mango seeds kernel

The Mango Seeds Kernel were put in boiling water at the rate of 100g per 1.5 litre of water at 100°C temperature for 30 minutes. The sample were removed, drained, sun dried, and milled before incorporation into the diets.

Soaking for 24 hours and boiling of mango seeds kernel

The Mango Seed Kernel were soaked in water for 24 hours at the rate of 100g per 1.5 litre of water in containers. The Mango Seeds Kernel was put in boiling water at the rate of 100g per litre and half of water at 100°C temperature for 30 minutes. The sample was removed, drained, sun dried, and milled before incorporation into the diets.

Experimental Diets

Five broiler starter and finisher diets were formulated. Diet 1 was the control 10% raw MSKM, diet 2, 3,4 and 5 contained soaked for 24 hours, soaked for 72 hours, soaked for 24 hours and boiled and boiled MSKM respectively all at 10% level of inclusion as replacement for maize.

Determination of anti-nutritional factors in mango seeds kernel

The anti-nutrient compositions of raw and differently processed samples of mango seed kernel were determined by the methods, Mega (1982) and Fasset (1966).

Results and Discussions

Effects of processing Methods on the Levels of Anti-Nutritional Factors in Mango Seed Kernel

The values obtained for anti-nutritional factors shows that the raw mango seed kernel were higher than those processed. The reduction of tannin content in this study (78.43%) for boiled MSKM is in agreement with the findings of Mbajunwa (1995) and Diarra and Usman (2008). These authors observed that cooking is an efficient method of reducing the tannin content of feeds. This level is however, higher than the 75% reduction obtained by Diarra and Usman (2008) under the same conditions of heat and time, probably due to differences in the solubility of the tannins in mango kernel varieties. The reduction in tannin level obtained with boiling mango seed kernel in this study, agrees with the report of Kaankuka *et al*., (1996) who observed that cooking was effective in reducing tannin content of soybean seeds. However, the percentage (78.43% and 84.31%) for both boiled and soaked and boiled were higher than 77.06% reported by Chia *et al*. (1997) after cooking *Phaseoulus angularis* and *D. lablab* for 60 minutes.

The percentage of saponin (raw mango kernel) 11.07% is higher than 2.96% reported by Orayaga *et al.,* (2018). Percentage reduction of Alkaloid, Oxalate and Flavonoid ranged from 32.87-47.43%, 12.92-37.08% and 16.58-34.15% respectively which agree with Dakare *et al.,* 2012) 22.6 -90.6%, 11.1 -65.1%, 16.4 -95.1% respectively. Processing methods was observed reduces the quantity of anti-nutritional factors in mango seed kernel.

Performance of Broiler Chickens Fed MSKM

The increased weight gains as well as final body weight during the finisher phase of broiler chickens fed differently processed mango seed kernel meal could be due to the fact that during boiling, some of the nutrients might have been denatured as reported by Parsons *et al*. (1992) and the leaching of soluble proteins in processing water. Mbajunwa (1995) also reported the leaching of soluble minerals in water. This could be the reason for the reduced weight gain and final weight of birds that were fed boiled mango seed kernel. The weight gain of the started phase ranged from 17.55-20.32g/b/d is similar to 14.40-20.42 g/b/d as reported by Diarra and Usman (2008). The average feed intake (94.93-105.64 g/b/d), average weight gain (33.97-47.68 g/b/d) and feed conversion ratio (2.25-2.96) of the finisher phase is similar to 104.15-109.06 g/b/d feed intake, 30.25-38.85g/b/d weight gain and 2.81-3.47 feed conversion ratio as reported by Orayaga *et al.,* (2015).

Conclusion and Recommendation

Different processing method can be used to reduce the effect of anti-nutritional factors. MSKM can be used in broiler diet without adverse effects on the birds, although soaked for 24 hours' mango seed kernel gave the best result. Other processing methods other than soaking and boiling that will help detoxify and improve the nutritive value of mango seed kernel should be investigated.

Table 1: Composition of Broiler Starter Diets (1-4 weeks)

	Treatments				
Ingredients	**Control Raw**	**Soaked for 24 hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**
	T1	**T2**	**T3**	**T4**	**T5**
Maize	38.86	38.86	38.86	38.86	38.86
Full-fat Soya bean	34.44	34.44	34.44	34.44	34.44
MSKM	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	0.50	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
T OTAL	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
ME (Kcal/Kg)	2,917.67	2,917.67	2,917.67	2,917.67	2,917.67
Crude Protein %	23.00	23.00	23.00	23.00	23.00
Crude fibre %	4.60	4.60	4.60	4.60	4.60
Ether Extract %	3.84	3.84	3.84	3.84	3.84
Calcium %	1.39	1.39	1.39	1.39	1.39
Phosphorus %	0.89	0.89	0.89	0.89	0.89
Lysine %	1.66	1.66	1.66	1.66	1.66
Methionine %	0.54	0.54	0.54	0.54	0.54

* Premix: Composition of vitamin per kg is as follows: Vitamin A, 8000iu; Vitamin D31600iu; Vitamin E5iu; Vitamin K 0.200mg; Vitamins B, thaimine B. 0.5mg; Riboflavin B2 4mg; Pyridoxine B6 0.015mg; Niacin 0.015mg; B12 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biofin 0.020mg; chlorine chloride 0.02mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si Co) 0.056g.

MSKM- Mango Seed Kernel meal

ME- Metabolizable Energy

Table 2: Composition of Broiler finisher diets (5-8 weeks)

Ingredients	Treatments				
	Control Raw	**Soaked for 24 hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**
	T1	**T2**	**T3**	**T4**	**T5**
Maize	46.79	46.79	46.79	46.79	46.79
Full-fat Soya bean	26.01	26.01	26.01	26.01	26.01
MSKM	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
T OTAL	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
ME (Kcal/Kg)	2978.32	2,978.32	2,978.32	2,978.32	2,978.32
Crude Protein %	20.00	20.00	20.00	20.00	20.00
Crude fibre %	4.29	4.29	4.29	4.29	4.29
Ether Extract %	3.92	3.92	3.92	3.92	3.92
Calcium %	1.54	1.54	1.54	1.54	1.54
Phosphorus %	0.93	0.93	0.93	0.93	0.93
Lysine %	1.43	1.43	1.43	1.43	1.43
Methionine %	0.40	0.40	0.40	0.40	0.40

* Premix: Composition of vitamin per kg is as follows: Vitamin A, 8000iu; Vitamin D31600iu; Vitamin E5iu; Vitamin K 0.200mg; Vitamins B, thaimine B. 0.5mg; Riboflavin B2 4mg; Pyridoxine B6 0.015mg; Niacin 0.015mg; B12 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biofin 0.020mg; chlorine chloride 0.02mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si Co) 0.056g.

MSKM- Mango Seed Kernel meal
ME- Metabolizable Energy

Table 3: Effects of Processing Methods on the Anti-Nutritional Factors in Mango Seed Kernel

Parameters	Treatments				
	Control Raw T1	Soaked for 24 hours T2	Soaked for 72 hours T3	Boiled T4	Soaked and boiled T5
Tannin (%)	0.51	0.20	0.12	0.11	0.08
Reduction (%)		60.78	76.47	78.43	84.31
Saponin (%)	11.07	10.50	8.12	7.16	7.20
Reduction (%)		5.15	26.65	35.68	34.96
Alkaloid (%)	22.02	11.05	15.10	14.11	11.41
Reduction (%)		47.43	42.44	32.87	45.72
Oxalate (Mg/g)	2.40	2.09	1.70	1.89	1.51
Reduction (%)		12.92	29.67	21.25	37.08
Flavonoid (%)	6.15	5.13	5.07	4.05	4.20
Reduction (%)		16.58	17.56	34.15	31.71

Table 4: Performance and Cost-Benefit of Broiler Chickens Fed Differently Processed Mango Seed Kernel at Starter Phase

Parameters	Treatments					
	Control Row T1	Soaked for 24 Hours T2	Soaked for 72 hours T3	Boiled T4	Soaked and boiled T5	SEM
Initial body weight (g)	120.00	122.22	126.67	124.45	126.67	4.66NS
Final body weight (g)	488.89	548.89	513.33	502.22	546.67	30.50NS
Av. feed intake (g/b/d)	44.75^{b}	52.27^{a}	48.15^{b}	45.32^{b}	49.09^{ab}	2.38
Av. weight gain (g/b/d)	17.55	20.32	19.47	17.99	20.00	1.16NS
Feed to gain ratio	2.55	2.57	2.47	2.52	2.47	0.10NS
Water intake (ml/d)	1194.60^{b}	1296.66^{a}	1276.51^{ab}	1190.16^{b}	1227.78^{ab}	40.04
Feed cost/weight gain (₦/kg)	317.32	322.32	307.68	312.63	306.31	
Mortality (number)	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b}: means within the same row bearing different superscripts are significantly different (P<0.05)
NS: No Significant Difference
SEM: Standard Error of Mean

Table 5: Performance and cost-benefit of Broiler Chickens Fed Differently Processed Mango Seed Kernel at Finisher Phase

	Treatments					
Parameters	**Control Row**	**Soaked for 24 Hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**	**SEM**
	T1	**T2**	**T3**	**T4**	**T5**	
Initial body weight (g)	603.33[b]	671.11[a]	676.67[a]	579.99[b]	676.44[a]	25.98*
Final body weight (g)	1216.67[bc]	1583.33[a]	1400.00[ab]	1033.33[c]	1450.00[ab]	95.67*
Av. Feed intake(g/b/d)	101.50	105.64	101.26	94.93	100.75	4.75NS
weight gain (g/b/d)	36.65	47.68	41.99	33.97	46.32	9.02NS
Feed to gain ratio	2.96	2.25	2.48	2.94	2.48	0.71NS
Water intake (ml/d)	1724.38[ab]	1700.21[ab]	1931.88[a]	1580.63[b]	1879.58[a]	105.42*
Feed cost/weight gain (₦/kg)	294.30	234.50	254.17	297.54	231.46	
Mortality (number)	5	5	2	4	2	

[a,b,c]: means within the same row bearing different superscripts are significantly different (P<0.05)

NS: Not Significant

SEM: Standard Error of Mean

Reference

Aregheore E.M. (1998), "A review of implications of antiquality and toxic components in conventional feedstuffs advocated for use in intensive animal production in Nigeria", *Vet Hum Toxicology*; **40**(1): 35-9.

Bauchi State Diary (BSD), (2009). ABU/ICT-Centre database, http//:www.nigeriagalleria.com/Nigeria/statenigeria/bauchistate.

Chia, C.L., Hamilton, R.A. and Evans, D.O. (1997). Mango. College of Tropical Agriculture and Human Resources, University of Hawai'i at Manoa, Honolulu. Coates L., T. Cooke, D. Persley.Pp 23-28

Dakare, M. A., Danladi, A. A., Abel, A. S. and Sunday, E. A. (2012) Effects of processing technique on the nutritional and antinutritional contents of mango (*Mangifera indica*) seed kernel. *World Journal of Young Researchers* **2** (3): 55-59.

Diarra, S.S. and Usman, B.A. (2008) Growth performance and some blood variables of broiler chickens fed raw or boiled mango kernel meal. *International Journal of Poultry Science* **7** (4): 315-318.

Diarra, S.S., Saleh, B., Kwari, I.D. and Igwebuike, J.U. (2011) Evaluation of boiled mango kernel meal as energy source by broiler chickens in the semi-arid zone of Nigeria. *International Journal of Science and Nature* **2** (2): 270-274.

Diarra, S.S., Usman, B.A. and Igwebuike, J.U. (2010) Replacement value of boiled mango kernel meal for maize in broiler finisher diets. *Journal of Agricultural and Biological Science* **5** (1): 47-52.

Fasset, D.W. (1966). **Oxalate: Toxicants occurring naturally in foods**. National Resources Council, Washington D.C. pp 69.

Kaankuka, F.G., Balogun, T. F. and Tegbe, T. S. B. (1996). Effects of duration of cooking full fat soy bean on proximate analysis, levels of anti- nutritional factors and digestibility of weanling pigs, *Animal Feed Science Technology.* **62**: 229-232

Mbajunwa, O.K., 1995. Effect of processing on some anti-nutritive and toxic components of the African oil bean seed (Pentaclethra macrophylla Benth). *J. Food Sci., Agric.,* **68**: 153-158.

Mega, J.A (1982). Phytate: its chemistry, occurrence, food intearaction, nutritional significance and method of analysis. *Journal of Science Food and Agriculture* **7**: 18-35.

Orayaga, K.T., Oluremi O.A., Tuleun C.D and Carew S.N (2015). The feed value of composite mango (*Mangifera indica*) fruit reject meal in the finisher broiler chicken's nutrition. *African Journal of Food Science and Technology* **6**(6): 177-181.

Parsons, C.M., K. Hashimoto, K.J. Wedekind, Y. Han, and D.H. Baker, 1992. Effect of over processing on availability of amino acids and energy in soyabean meal. *Poultry Science* 71:133-140.

Rafiu T. A., Babatunde G. M., and Odunsi A. A. (2014). Performance, Carcass and Meat Characteristics of Broiler Birds Fed Processed Mango Kernel Meal Based Diets. *International Journal of Applied Research and Technology*. **3**(9): 23-26.

PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF LAYING HENS FED DIETS SUPPLEMENTED WITH SELENIUM AND VITAMIN E

Jemiseye, F. O., Ogunwole, O. A., Adedeji, B. S. and Mosuro, A. O.
Agricultural Biochemistry & Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria

Abstract
An experiment was conducted to assess the effect of supplemental selenium and vitamin E on performance and blood profile of laying hens. In a completely randomised design, ISA brown hens (n=192) at week 20 of age were assigned to six experimental diets: T1 (Basal diet), T2 (Basal diet + 0.5 mg selenium), T3 (Basal diet + 1.0 mg selenium), T4 (Basal diet + 1.5 mg selenium), T5 (Basal diet + 20 mg vitamin E), T6 (Basal diet + 40 mg vitamin E*). Each treatment was replicated four times with eight birds per replicate. Data were recorded daily for performance characteristics.* At week 26, blood was sampled from hens and analysed using standard procedures. Supplemental selenium and vitamin E had no significant effect ($p>0.05$) on hens' *p*erformance. However, dietary supplemental selenium and vitamin E had significant influence on eosinophils and monocytes. Eosinophils of hens on T1 (4.25) was similar to 4.00, 3.50, 4.33 and 3.75 recorded for hens on T2, T3, T4 and T5, respectively but higher than 1.33 obtained for hens on T6. Similarly, monocyte value in T1 (2.0) was similar ($p>0.05$) to T2 (3.25) and T3 (3.25) but lower than 4.00, 3.75 and 4.00 obtained in hens on T4, T5 and T6, respectively. It was therefore concluded that supplementation of vitamin E and selenium up to 40 mg/kg and 1.5 mg/kg, respectively had no significant effects on hen's performance.
Keywords: Performance, Haematology, Selenium, Vitamin E, Stress.
Corresponding author: jemiseyefo@gmail.com**, 08037064917**

Introduction
Stress exerts negative effects on the body such as disturbance of acid-base balance of the blood, various changes in metabolism and oxidative damage to the cells (Ertas and Sahik 2002). This often has resultant effect on egg production and quality, feed consumption, live weight and overall productivity in chickens.

When formulating feed for animals, nutritionists take into account several factors including stress management and immunity enhancement as very critical (Linge, 2005). The use of antioxidant nutrients in this respect cannot be overemphasized. Antioxidants are substances that can scavenge, suppress or reduce the formation of reactive oxygen species (Khan *et al*., 2011; Lu *et al*., 2010) that are constantly produced *in vivo* in the course of the physiological metabolism in tissues (Surai, 2015). Reactive oxygen species are detrimental to productive performance in laying birds (Assar *et al*., 2016). Antioxidants nutrients such as vitamin E and selenium *have been implicated in immune functions of domestic animals (Finch and Turner, 1996) and* with important roles in maintaining chicken health, productive and reproductive performance (Surai, 2002). However, there have been conflicting reports (Scheideler, 2010: Adebiyi *et al*., 2004) on the benefits of Selenium and vitamin E in poultry. *Therefore, t*he objective of this study was to evaluate the effect of dietary selenium and α-tocopherol supplementation on performance and haematological status of laying hens.

Materials and methods
Experimental Site and Animal Allotment
The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. *A total of 192, ISA brown hens at the point of lay (20 weeks of age) were assigned to six experimental diets in an experiment that lasted twenty weeks. The experiment was a completely randomized design with each treatment replicated four times and with eight birds per replicate.*

Experimental Diets
Basal diet was supplemented with selenium and vitamin E as follows: T1=Basal diet, T2=Basal diet + 0.5mg selenium/kg, T3= Basal diet + 1.0mg selenium/kg, T4= Basal diet + 1.5mg selenium/kg, T5=Basal diet + 20mg vitamin E/kg, T6=Basal diet + 40mg vitamin E/kg*)* Feed and water were supplied *ad libitum*. (Jemiseye and Ogunwole 2019).

Data collection and analysis

During the period of the trial, pen temperature-humidity index was monitored three times daily, between the hours of 7:00-8:00, 12:00-13:00 and 17:00-18:00 using digital thermo-hygrotherms placed strategically at different locations within the pen house. Temperature Humidity Index (THI) was calculated from the average ambient temperature and relative humidity obtained using the formula: $THI = 0.6\ T_{db} + 0.4\ T_{wb}$, where, T_{db} = dry bulb temperature and T_{wb} = wet bulb temperature. Eggs were collected daily and recorded, hen day egg production was calculated by number of eggs laid divided by number of chicken at the period of data collection, feed intake was calculated by subtracting left over from feed offered to the chickens, egg were weighed with sensitive scale to obtain egg weight and egg mass was calculated from the percent hen day egg production and average egg weight. At week 26 of laying, blood was collected from two birds per replicate via the jugular vein into heparinized test tubes for haematology. Packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC) and differential counts were determined using standard procedures (Schalm *et al.*, 1975).

Statistical analysis

Data were subjected to analysis of variance using the SAS (1999) package. Means were separated using Duncan's multiple range test of the same package.

Results and Discussion

Temperature-humidity index of the experimental pen: Temperature-Humidity index of the experimental pen is shown in Figure 1. The maximum and minimum values were 30.40 and 25.10, respectively. The reported temperature and relative humidity were higher than thermoneutral temperature range (18-22 ^{o}C) of laying chicken reported by Charles (2002). Pen house temperatures beyond thermoneutrality have been reported to aggravate stress in chickens (Adedeji and Ogunwole, 2018) as higher ambient temperature and relative humidity have direct implications on feed consumption.

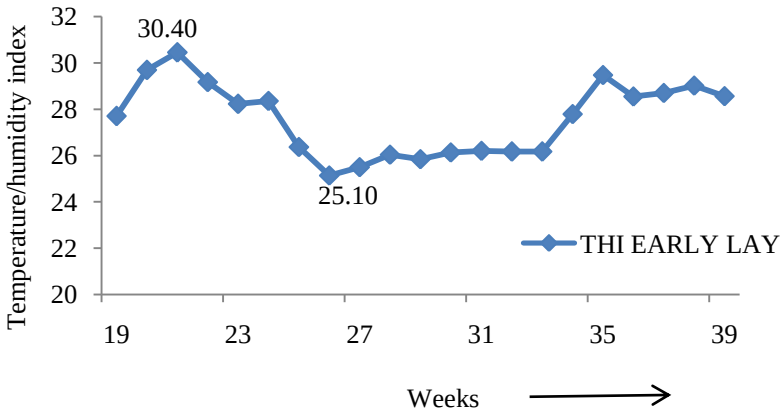


Figure 1: Temperature-humidity index of the experimental pen

Performance of laying chickens: Performance of laying chicken fed diet supplemented with selenium and vitamin E is shown in Table 1. **S**upplementation of layers' diet with selenium and vitamin E at the early laying phase did not have any significant effects ($p>0.05$) on the performance parameters measured. This observation corroborated earlier findings of Adebiyi *et al.* (2014) that neither vitamin E nor selenium and their combination increased hen day percentage and weight in turkeys. Also, Scheideler (2010) reported that there were no overall effect of vitamin E on egg production. Although, high temperatures have been reported to reduce production performance in laying hens (Deng *et al.*, 2012), this was not so as observed in this study. This may further emphasise the alleviating effect of antioxidants (Se and vitamin E) in stress management *(*Khan *et al*., 2011*)*.

Table 1. Performance of laying chicken fed diet supplemented with selenium and vitamin E

Parameters	T1	T2	T3	T4	T5	T6	SEM
Hen day egg production (%)	40.80	36.98	43.88	35.60	46.34	42.99	1.79
Feed intake (g)	90.46	96.88	92.63	94.04	94.38	98.67	1.38
Egg weight (g)	53.28	57.77	51.95	50.93	53.69	58.72	1.56
Egg mass (g)	21.79	21.46	22.88	17.90	24.94	25.63	1.25

T1-Basal diet, T2-Basal diet+0.5mg selenium/kg, T3-Basal diet+1.0mg selenium/kg, T4-Basal diet+1.5mg selenium/kg, T5-Basal diet+20mg vitamin E/kg, T6-Basal diet+40mg vitamin E/kg. Means in the same row with different superscripts are significantly different (P<0.05). SEM-standard error of mean

Haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation. Table 2 shows the haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation. There were no significant differences (p> 0.05) across treatments for all haematological parameters measured except for monocytes and eosinophils. Eosinophils of hens on T1 (4.25) was similar to 4.00, 3.50, 4.33 and 3.75 recorded for hens on T2, T3, T4 and T5, respectively but higher than 1.33 obtained for hens on T6. Similarly, monocyte value in T1 (2.0) was similar (p>0.05) to T2 (3.25) and T3 (3.25) but lower than 4.00, 3.75 and 4.00 obtained in hens on T4, T5 and T6, respectively. Blood is significant in measuring the physiological, nutritional and pathological status of animals (Olorode *et al*., 2007). Elevated monocyte and eosinophil levels observed in this study was an indication that inclusion of the supplements improved the responsiveness of the immune cells to invading germs. This observation supports earlier position of *Finch and Turner (1996)* on the relevance of Se and vitamin E in immune function. Bush (1991) had earlier pointed out that low levels of WBC especially eosinophil and basophil in chickens could lead to poor immunity against diseases and may be an indication of poor health conditions due to parasitic disturbances. A slight deviation from this was observed in T6 for eosinophils. This however could imply that supplemental vitamin E beyond 20mg/kg of diet may lower eosinophil count in chicken.

Table 2: Haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation

Parameters	T1	T2	T3	T4	T5	T6	SEM
PCV (%)	28.50	28.75	30.75	30.66	31.25	29.33	0.73
RBC ($x100^6$ IU/L)	2.91	3.09	3.30	2.87	2.87	3.37	0.10
Hb (g/100mL)	9.30	9.45	10.22	10.03	10.40	9.03	0.28
PLAT ($x100^5$)	1.62	1.72	2.41	2.31	2.28	2.06	1.34
WBC ($\times10^{10}$IU)	1.77	1.81	1.98	1.89	1.98	1.85	3.37
LYMP (%)	64.00	64.25	58.50	65.66	63.25	57.00	1.47
HET (%)	29.75	30.25	35.75	25.33	31.50	35.66	1.56
HET:LYMP	0.48	0.48	0.63	0.40	0.50	0.63	0.03
MON (%)	2.00^b	3.25^{ab}	3.25^{ab}	4.00^a	3.75^a	4.00^a	0.22
EOS (%)	4.25^a	4.00^a	3.50^a	4.33^a	3.75^a	1.33^b	0.32

T1-Basal diet, T2-Basal diet+0.5mg selenium/kg, T3-Basal diet+1.0mg selenium/kg, T4-Basal diet+1.5mg selenium/kg, T5-Basal diet+20mg vitamin E/kg, T6-Basal diet+40mg vitamin E/kg. PCV-Packed cell volume, RBC_ Red blood cell, WBC_ white blood cell, Hb- Haemoglobin, LYMP-Lymphocytes, HET-Heterophyl, PLAT-platelets, MON- Monocytes, EOS-Eosinophils. ^{ab}Means in the same row with different superscript are significantly different (P<0.05).

Conclusion

Supplemental selenium and vitamin E in the diets of laying hens had no effects on performance and haematological parameters except for monocytes and eosinophils.

References

Adebiyi, O. A. Oludare, O. F. Majekodunmi, B and Adeniyi, O. A. (2014). Effect of Vitamin E or Selenium on Blood Profile and oxidative Stability of Turkey meat. *Journal of Animal Production Advances*, **4**(7). 469-475.

Adedeji, B. S. and Ogunwole, O. A. (2018). Performance and physiological response of heat stressed growing pullets fed diets supplemented with ascorbic acid. *Nigerian Journal of Animal Production* **44**(5): 167-176.

Assar, A. S., Muhammad S. K., Saleem, K., Nazir, A., Ibrahim, A. A., Rifat, U. K. and Tao, S. (2016). Effect of different levels of alpha tocopherol on performance traits, serum antioxidants enzymes, and trace elements in Japanese quail (Coturnix coturnix japonica) under low ambient temperature. *Revista Brasileira de Zootecnia*, **45**(10): 622-626.

Bush, B. M. (1991). **Interpretation of Laboratory Results for Small Animal Clinicians**. Backwell Scientific Publications, London, ISBN: 9780408108492, Pages: 515.

Charles, D. R. (2002). **Responses to the thermal environment.** In: Poultry Environment Problems, A guide to solutions (Charles, D.A. and Walker, A.W. Eds.), Nottingham University Press, Nottingham, United Kingdom, pp.1-16.

Deng, W., Dong, X. F., Tong, J. M. and Zhang, Q. (2012). The probiotic Bacillus licheniformis ameliorates heat stress-induced impairment of egg production, gut morphology, and intestinal mucosal immunity in laying hens. *Poultry Science*, **91**(3) :575-82.

Ertas, N. O. and Sahik, K. 2002 preventing heat stress with different feeding methods in laying hens. *Turkish Journal of Veterinary and Animal Science*, **26**: 453-462

Finch, J. M., Turner, R. J. (1996). Effects of selenium and vitamin Enon immune responses of domestic animals. *Research in Veterinary Science* **60**: 97-106.

Jemiseye, F. O. and Ogunwole, O. A. (2019). Effects of serial dietary supplement of selenium and vitamin E on laying hens performance, egg quality attributes and deposition of vitamin E in eggs. *Journal of Animal Production Research*, **31** (1): 101-110.

Khan, R., Naz, S., Nikousefat, Z., Tufarelli, V., Javdani, M., Rana, N. and Laudadio, V. (2011). Effect of vitamin E in heat-stressed poultry. *World's Poultry Science Journal*, **67**: 469-478.

Linge P. (2005). The use of probiotic and yeast derivatives in India. *World Poultry* 21: 12-15

Lu, T., Piao, X. L., Zhang, Q., Wang, D., Piao, X. S. and Kim, S. W. (2010). Protective effects of *Forsythia suspensa* extract against oxidative stress induced by diquat in rats. *Food Chemical Toxicology*, **48**: 764-770

Olorode, B. R., Adeniran, R. A. and Abiola, J. O. (2007). Effect of graded levels of *Moringa oleifera* seed meal on haematological values and organs weight of broiler chicken. *Tropical Journal of Animal Science*, **10**: 63-67.

Packer, L. (1991). Protective role of vitamin E in biological system. *American Journal of Clinical Nutrition*, **53**:1050-1055.

SAS (1999). SAS/STAT User's guide Version 8 for windows SAS Institute Inc. cary NC.

Schalm, O. W., Jain, N. C. and Carroll, E. J. (1975). Veterinity haematology (3rd ed., p.15- 218). USA: Lea & Fabiger, Philadelphia.

Scheideler, S. E. (2010). Supplemental vitamin E and selenium effects on egg production, egg quality, and egg deposition of α-tocopherol and selenium. *The Journal of Applied Poultry Research*, Volume **19** (4): 354–360.

Surai, P. F. (2015). Antioxidant Systems in Poultry Biology: Superoxide Dismutase. *Journal of Animal Research and Nutrition*, 1:8.

Surai, P. F. (2002). **Selenium: Natural Antioxidants in Avian Nutrition and Reproduction**. Nottingham, Nottingham University Press, UK.

HAEMATOLOGICAL RESPONSE OF BROILER CHICKENS FED GRADED LEVELS OF SWEET POTATO (*Ipomoea batatas*) MEAL

A. I. Jibril, *N. B. Rano

[1]*Department of Animal Science, Bayero University Kano, Nigeria*

***Corresponding author E-mail address:** nbrano.asc@buk.edu.ng*

Mobile Phone Number: 08093524481

Abstract

The experiment was conducted to evaluate the effect of feeding graded levels of sweet potato meal on performance and haematological indices of broiler chickens. A total of one hundred and eighty Anak strain day-old broiler chickens were fed varying levels of sweet potato meal at 0, 5, 10 and 15% dietary inclusion levels. The birds were randomly allotted to four dietary treatments which were replicated four times with fifteen birds per replicate in a completely randomized design. The compounded experimental diets (starter and finisher) were fed ad libitum. Fresh clean drinking water was given ad libitum throughout the days of the experiment. Routine medications and vaccinations were also observed. Results of haematological indices revealed no significant ($p>0.05$) differences in White Blood Cells (WBC), Haemoglobin (Hb), Mean Corpuscular Volume (MCV) Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and Lymphocyte (LYM) across the treatments. However, significant ($p<0.05$) difference was observed in the concentration of Red Blood Cells (RBC). It was concluded that dietary inclusion of sweet potato meal up to 15% in the diet of broiler chickens at both starter and finisher phases had no negative effects on performance and haematological indices of the birds.

Key words: Sweet Potato, Haematology, Broiler Chickens

Introduction

The scarcity and prohibitive cost of commercial energy sources like maize and sorghum for poultry rations, has been the main cause of the high cost of poultry products especially in developing countries. To arrest this situation, poultry farmers all over the world and particularly those of the developing countries are forced to think of those plants that can be easily grown and yield more *per* unit area as compared to maize for inclusion in poultry rations. This will subsequently lead to a reduction of the cost of production of poultry products (meat and egg) Nazmus (2013). Sweet potato (*Ipomea batatas*) is produced in considerable quantities in Nigeria and form important energy source for human and livestock feeding. The sweet potato meal is readily available at cheap cost in many parts of the country, because it has limited value to some human and for industrial uses. Sweet potato is one of the world's most important food crops; its main nutritional importance has been its starch content. However, sweet potato can also be a source of other nutritionally important dietary factors such as Vitamin A, Ascorbic acid, Thiamin, Riboflavin and Niacin (Dominguez, 1990). The few available reports agree that sweet potato can be incorporated into diets of chickens but should not be made the sole source of energy (Lee, 1979 and Tewe, 1991) as cited by Afolayan (2010). Sweet potato meal (SPM) can be used with an energy value of more than 2830 ME kcal *per* kg. According to composition values, potato meal(PM) contains more than 65% starch, 6.74% ash, 12.72% CP, 23.48% CF, and 0.99% EE on a DM basis. SPM have been reported to be cheaper than maize and wheat (PAN, 1995). Thus, they reduced feed cost and maintain production effici. This study therefore, was designed to evaluate the effect of feeding graded levels of sweet potato meal on performance and haematological indices of broiler chickens.

Materials and Methods

The experiment was conducted at the Poultry Unit of the Teaching and Research farm of the Abubakar Tafawa Balewa University Bauchi. Bauchi State is one of the states in the northern part of Nigeria that span two distinctive vegetation zones, namely; Sudan savannah, and the Sahel savannah. The state is located between latitude 9° 3' and 12° 3' North and longitudes 8° 50' of the equator with a total land area of 49,119 km² representing about 5.3% of Nigeria′s total land mass. One hundred and eighty (180) day-old Anak strain broiler chicks were randomly allotted to four dietary treatments comprising forty-five (45) chicks *per* treatment which were replicated three times, with fifteen chicks *per* replicate in a completely randomized design. Four experimental diets were formulated and designated as A, B, C and D to contain sweet potato meal (SPM) at 0, 5, 10 and 15% levels of inclusion. Treatment one (A) did not contain the test ingredient, it served as control (Table 1). The

diets were formulated to meet the 23% and 20% crude protein requirements of broiler chickens for starter and finisher phases respectively. Fresh sweet potatoes were obtained from potato vendors in Ningi L.G.A of Bauchi State. The roots were washed, chopped using kitchen knife and sun dried for about three (3) days on concrete floor to reduce enzymatic and microbial reactions which may lead to spoilage. The dried sweet potato was milled and incorporated during feed mixing at different levels.Fresh clean drinking water with multivitamins (vitalyte) was given *ad libitum* throughout the days of the experiment. Routine medications and vaccinations were also observed. The experiment lasted for eight weeks.

Data Collection and Statistical Analysis

At the end of the feeding trial (8th week), two birds were selected on the bases of average pen weight from each replicate for collection of blood samples for haematological analysis and carcass measurements. The birds were fasted overnight and blood samples were collected early in the morning through the wing veins into sample tubes containing anti-coagulant. The direct measurement of erythrocytes values;{Haemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cells (RBC), White Blood Cells (WBC) Mean Corpuscular Haemoglobin (MCH). Absolute erythrocyte indices; {Mean Corpuscular Haemoglobin Concentration (MCHC), and Mean Corpuscular Volume (MCV) were determined using the methods described by Bush (1991). Data on haematological indices were subjected to analysis of variance using Steel and Torrie (1980) and DMRT was used to separate the means.

Table 1 Composition of Experimental Diets at Finisher Phase (20%Cp) (5-8 Weeks) of Age

	% Replacement of Sweet Potato with Maize (SPM)			
Ingredients	A (0)	B (5)	C (10)	D (15)
Maize		52.4	46.62	40.86	35.06
Soybean		24.4	25.18	25.94	26.74
SPM		0	5	10	15
Wheat offal		15	15	15	15
Fish meal		4	4	4	4
Limestone		1.5	1.5	1.5	1.5
Bone meal		2	2	2	2
Premix*		0.25	0.25	0.25	0.25
Salt		0.25	0.25	0.25	0.25
Lysine		0.1	0.1	0.1	0.1
Methionine		0.1	0.1	0.1	0.1
Total		100	100	100	100
Calculated Analysis					
ME (Kcal/kg)		2857.57	2856.58	2857.72	2857.3
CP (%)		20	20	20.01	20.01
CF (%)		3.75	3.71	3.63	3.58
EE (%)		7.19	7.13	7.06	7
Ca (%)		1.56	1.56	1.56	1.56
TP (%)		0.66	0.67	0.67	0.66

**Premix contained Vitamin A=12,500 IU; Vitamin D3=3,000 IU; Vitamin E=150mg; Vitamin K=3mg; Vitamin B2=8mg; Vitamin B6=5mg; VitaminB1=2mg; Vitamin B12=30mmg; Nicotinamide 50mg; Pantothenate 10mg; Folic acid 2mg; Biotin 150mmg; Vitamin C 35mg; Choline 300mg; Copper10mg; Manganese 80mg; Zinc 60mg; Iron 30mg; Iodine 2mg; Selenium 0.25mg; Molybdenum 0.2mg; Calcium ($CaCO_3$) limestone 70g/kg*

Results and Discussion

The result of haematological characteristics is presented in Table 2. The values ranged from 1.85 to 2.53% RBC. Birds fed diets C and D presented significantly ($p<0.05$) lower values compared to birds fed diet D (Fig.1). The values obtained for RBC of birds fed sweet potato meal based-diets were lower than the range of 3.07 - $7.05x10^6$/mm³ reported by Fudge (1999) and also lower than 5 - 8x10mm³ as reported by Anon (1980). Hackbath *et al.* (1983) reported that increased RBC values were associated with high quality dietary and disease free animals. RBC is responsible for the transportation of oxygen and carbon dioxide in the blood as well as manufacture of haemoglobin hence higher values

indicates a greater potential for this function and a better state of health (Olugbemi *et al*., 2010). Moreover, the result of RBC in this experiment corresponds with the findings of Onu *et al*. (2011) in their experiment on performance and blood chemistry of starter broilers. However, PCV, WBC, HGB, MCV, MCH, MCHC and LYM were statistically similar ($p>0.05$) among the treatment groups. The comparable values for WBC of birds suggests that the birds were healthy. The PCV count of diet A recorded the highest value of 34.43% followed by diets B and D with the values of 32.17 and 30.83% respectively.

Table 2: Haematological Characteristics of Broiler Birds Fed Different Inclusion Levels of Diets Containing Sweet Potato Meal

(SPM %) Parameters	A (0)	B (5)	C (10)	D (15)	SEM
RBC (%)	2.37^{bc}	1.88^{ab}	1.85^{a}	2.53^{c}	0.15*
WBC (10^{12}/ml)	121.43	105.87	90.07	132.93	12.99^{NS}
PVC (10^{9}/ml)	34.43	32.17	26.93	30.83	13.08^{NS}
HB (g/dl)	16.03	14.00	12.70	15.20	1.58^{NS}
MCV (fl)	145.03	143.17	145.53	144.43	1.86^{NS}
MCH (pg)	67.53	70.73	68.63	70.83	2.10^{NS}
MCHC (g/dl)	46.57	49.40	47.10	49.07	1.62^{NS}
LYM (%)	67.20	64.33	45.63	4.63	25.18^{NS}

*a,b,c mean within the same row bearing different superscripts differ significantly ($p<0.05$), NS = Not Significant, *= Significant ($p<0.05$), SEM= Standard Error of Mean, RBC= Red blood cell, WBC= White blood cell, PCV= Pack Cell Volume, HB= Haemoglobin, MCV=Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration, LYM = Lymphocyte.*

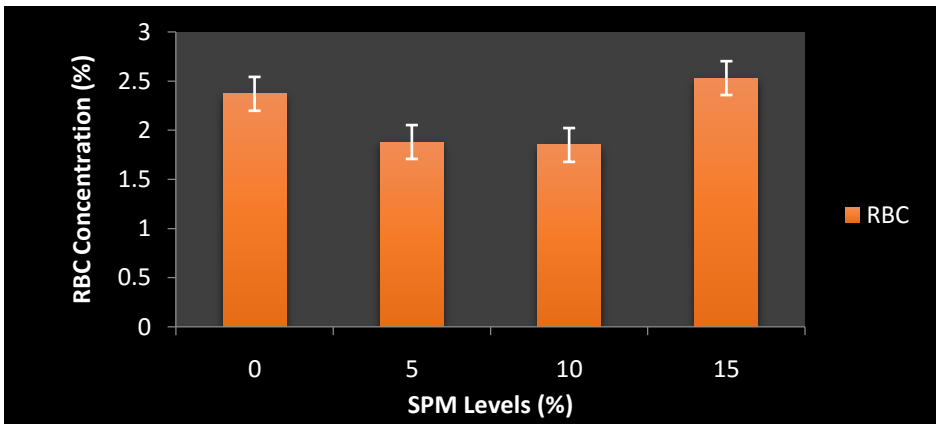


Figure 1: Effect of SPM level on concentration of RBC

Conclusion

The result of this study revealed that inclusion of sweet potato meal up to 15% dietary level of inclusion in broiler chickens diet at starter and finisher phases had no negative effects on performance and haematological indices of the birds.

References

Afolayan, S.B. (2010). Evaluation of sweet potato meal as a source of energy in the diet of chickens. *Ph.D. Dissertation Department of Animal Science*, Ahmadu Bello University, Zaria, Nigeria

Anon, (1980). "*Guide And Care Of Experimental* Animal".*Canadian Council of Animal Care. Ottawa Canada* pp: 185-190.

Dominguez, P. L. (1990). Feeding Sweet Potato to Monogastrics; In Root, Tubers, Plantains and Bananas in Animal Feeding. *Proceeding of FAO Expert Consultation* held in CIAT, Cali, Colombia 21th – 25th January, 1990. Edited: David Machin and SolverigNyvold.

Fudge, C. S. (1999). Laboratory Medicine: Avian and Exotic Pets. WbSuaders, Philadelphia, USA

Lee, P.K and Yang, Y.F. (1979). Comparative study of high protein sweet potato clips and common sweet potato clips as substitute for corn grain in diet on growth, feed efficiency and carcass quality on the growing fattening pigs. *Journal of the Taiwan livestock Research* 12 (1) 31-48

Nazmus, S.M., (2013). "Effect of Potato (*Solanum tubarosum*) Meal on Broiler Production" *M.Sc Thesis.* Department of Poultry Science, Bangladesh Agricultural University Mymensingh, 2202

Onu, P.N and Aneibo, A.O (2011). "Influence of Moringa oleifera leaf meal on the performance and blood chemistry of starter broilers" *International Journal of Food, Agriculture and Veterinary Science*. VOL. 1(1) pp. 38-44.

Tewe, O. O. (1991). Sweet potato utilisation in poultry diets, Tropic Root Crops. A developing economy Editors: Ofori F. and Hahn S. K: *Proceedings of the Ninth Symposium of the International Society for Tropical Roots Crops.* Accra Ghana pp 426-435.

BIOCHEMICAL INDICES OF BROILER CHICKENS FED DIETS CONTAINING GINGER, GARLIC AND GARLIC-GINGER MIXTURE

John, U. E*. Onunkwo, D. N. and Udofia, S. M.

[1]Department of Animal Nutrition and Forage Science, Michael Okpara University of Agriculture, Umudike, Abia State
*E-mail of the corresponding author: uduakobongjohn@gmail.com, +2348089268849

ABSTRACT
This study was conducted to evaluate haematological response of broiler chickens fed garlic, ginger and garlic-ginger mixture. Four experimental broiler starter and finisher diets were formulated such that the diets contained 1.0% ginger (T_2),garlic (T_3) and garlic-ginger mixture (0.5 ginger + 0.5 garlic) (T_4), respectively. The control diet (T_1) contained no garlic or ginger or their mixture. The diets were fed to one hundred and twenty (120) day old Cobb broilers in a 56- day feeding trial. The diets were randomly assigned to four groups of 30 birds in a completely randomized design (CRD) replicated 3 times. Each replicate contained 10 birds. Broiler starter and finisher diets were fed for 0-28 and 29-56 day of age, respectively. The result obtained showed no significant differences in all the parameters measured on biochemical indices of broiler chickens. Birds on treatment group were slightly better than control group on biochemical indices of broiler fed diets containing ginger, garlic and their mixture. Ginger, garlic and their mixture should be considered an effective phytogenic feed additive in diets formulation for improved health and welfare of the birds.
Key Words: Garlic, Ginger, Mixture, Broiler, Biochemical Indices

INTRODUCTION
The ban on the use of antibiotic growth promoters in livestock and poultry nutrition by the European Union has generated interest in the search for an alternative. This has given rise to the use of different feed materials in poultry feed formulations to enhance growth rate, improve feed efficiency and utilization (Raeesi *et al.,* 2010; Oleforuh-Okoleh *et al.,* 2014; John and Emenalom 2018).Phytogenic feed additives are currently used in livestock and poultry production because of their positive properties including; anti-inflammatory, antiseptic, sedative, bactericidal, gut functions, fungicidal, antiviral, antioxidant, growth-promoting efficacy, dietary palatability, immune stimulating, stimulation of digestive enzyme and absorption of nutrients (Cross *et al.,* 2007; Steiner, 2009; Puvaca *et al.,* 2013).

These plant-derived compounds which include; herbs, spices and essential oils or oleoresins, are normally incorporated into diets for improved productivity in livestock and poultry. A variety of these phytogenic feed additives including ginger and garlic have been widely used as alternatives to synthetic antimicrobial growth promoters in livestock and poultry rations. Ginger,(*Zingiber officinale*) and garlic (*Allium sativum*) are widely used species in various foods and beverages and in medicine (Chrubasik *et al.,* 2005). Ginger contains; gingerol, gingerdiol and gingerdione which have the ability to stimulate digestive enzymes, affect microbial activity, anti-oxidative, anti-inflammatory, antiseptic, anti-parasitic and immune modulatory properties when used in poultry diet (Zhang *et al*., 2009; Mohamed *et al*., 2012; Akintobi *et al.,* 2013). On the other hand, garlic contains sulphur compounds; allin, diallysulphide, allyldisulphide and allicin (Chang and Cheong, 2008).

According to Shewita and Taha (2018), Ebegbulem (2018), Herve *et al.,* (2018) and Oleforuh-Okoleh *et al.,* (2015), George *et al.,* (2015), Ebrahimnezhad *et al* (2014) who reported role of ginger and garlic on biochemical indices of broiler chickens. The aim of this work therefore, is to determine the biochemical indices of broiler chickens fed diets containing 1% ginger or garlic and ginger-garlic mixture, respectively.

MATERIALS AND METHOD
Experimental site
This experiment was conducted at the Poultry Unit of the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Nigeria. Owerri is located in the South-East agro-ecological zone of Nigeria. It lies between latitude $4^0 4^1$ and

$6^0 3^1$Nand longitude $6^0 15^1$ and $8^0 15^1$E with mean annual rainfall, temperature and relative humidity of 2250mm, 26.5-27^{0}C and 70-80%, respectively (Adeyemi, 2011).

Processing of test materials and diets

Ginger and garlic used for the experiment were procured fresh from a market in Owerri. The light scaly leaves on garlic were removed and the bulb separated into cloves. Both ginger and garlic were then sliced into 3-4 slices, sun-dried for 5 - 7 days depending on the intensity of the sun, ground into meals using an attrition mill and stored for use in broiler diets. Four experimental broiler starter and finisher diets were formulated such that diet 1 (control) contained none of the test materials. Diets 2, 3 and 4 contained 1.0% ginger, garlic and mixture (0.5 ginger + 0.5 garlic), respectively. The ingredient composition of the experimental diet is shown in Table1.

Experimental birds and design

One hundred and twenty (120) day-old broiler chicks of Cobb strains were used for the trial. The birds were divided into 4 groups of 30 birds each. Each group was sub-divided into 3 replicates of 10 birds each and housed in a 1.4 x 1.4 m compartment in the cemented floor, covered with wood shavings as the litter material in an open-sided poultry building. The pens were covered with black polythene for the first two weeks to control wind and heat. Each pen contained a feeder, drinker and a stove (to supply heat) for the first two weeks. Three pens were randomly assigned to an experimental diet in a completely randomized design. Feed and water were provided *ad libitum.* The starter and finisher diets were fed for 0 – 28 day and 29 – 56 day of age, respectively. Routine medications and other routine poultry management practices were maintained. The blood samples were collected into heparinized tubes from the basilica wing vein of the birds between 07 – 08 am at 56 day of age from three birds *per* treatment for biochemical analysis. The samples were sent to Federal Medical Centre, Owerri for the blood analysis. Data collected were subjected to statistical analysis using the General Linear Models (GLM) procedure of SAS® and the Student Newman-Keul's test $P < 0.05$.

Results and Discussion

The inclusion of garlic, ginger and their mixture did not affect the biochemical indices of the bird measured. However, garlic, ginger and their mixture tended to be superior to control group which increase the biochemical indices of the birds as shown in table (2). This result is in line with the finding of Ebrahimnezhad *et al* (2014) documented no significant differences ($P>0.05$) in all the parameters except low density lipoprotein on blood chemistry of broilers fed different level of ginger root powder. Shewita and Taha (2018) documented non-significant effect on low density lipoprotein, globulin, albumin, alanine aminotransferase and aspartate aminotransferase. George *et al.,* (2015) also reported that, inclusion of graded levels of ginger on broilers diets has no significant effect on total protein, creatinine, urea, aspartate aminotransferase, alanine aminotransferase and alkaline phosphate. Ebegbulem (2018) observed significant effect on total protein, cholesterol, glucose, globulin, creatinine and urea of birds fed ginger supplemented diets.

This result is not in agreement with the findings of Herve *et al.,* (2018) that reported significant effect on total protein, cholesterol, triglyceride, globulin, aspartate aminotransferase and alanine aminotransferase of Japanese quail fed ginger essential oil. Oleforuh-Okoleh *et al.,* (2015) also reported significant difference on biochemical response of broiler chickens to aqueous extract of ginger and garlic. The slight increase in biochemical indices of birds may be due to bioactive compound in ginger such as gingerol, shogaols, gingerdiol, gingerdione, and some related phenolic ketone derivatives which have powerful antioxidant and immunostimulatory properties that allow them to improve immune responses.

Table 1: Ingredient and Nutrient Composition of the Experimental Starter and Finisher Broiler Diets

	STARTER				FINISHER			
Ingredient	T_1 (0%) Control	T_2 (1%) Ginger	T_3 (1%) Garlic	T_4 (0.5+0.5%) Ginger+Garlic	T_1 (0%) Control	T_2 (1%) Ginger	T_3 (1%) Garlic	T_4 (0.5+0.5%) Ginger+Garlic
Maize	48.00	48.00	48.00	48.00	58.00	58.00	58.00	58.00
Soybean Meal	26.00	26.00	26.00	26.00	19.00	19.00	19.00	19.00
PKC	7.00	7.00	7.00	7.00	6.00	6.00	6.00	6.00
Wheat Offal	4.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00
Spent Grains	7.00	7.00	7.00	7.00	6.00	6.00	6.00	6.00
Fish Meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Methione	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit/Tm Premix+	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Ginger	-	1.00	-	0.50	-	1.00	-	0.50
Garlic	-	-	1.00	0.50	-	-	1.00	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Chemical Analysis(%DM)								
Crude Protein	23.13	22.64	22.71	22.50	18.65	18.46	18.58	18.84
Crude Fibre	6.05	7.85	5.80	6.33	4.57	5.16	4.81	5.09
Esther Extract	6.88	5.26	3.19	1.93	5.57	5.61	5.25	5.99
Ash	10.39	10.78	9.99	10.00	13.42	12.33	12.58	13.12
NFE	53.54	55.47	58.31	59.54	57.79	59.54	59.18	56.96
ME (Kcal/kg)	3268.30	3110.95	3106.95	3025.00	3148.95	3168.70	3153.90	3162.20

Table 2: Effect of different diet treatments on the biochemical indices of broiler

PARAMETERS	T_1 (0%) Control	T_2 (1%) Ginger	T_3 (1%) Garlic	T_4 (0.5+0.5%) Garlic+ginger	SEM
Uric acid (mg/dl)	2.77	4.70	4.45	1.99	0.57
Calcium (mg/dl)	8.38	8.76	9.56	8.87	0.21
Phosphorus (mg/dl)	2.40	2.70	3.80	3.40	0.26
Urea (mg/dl)	11.45	11.65	11.10	10.55	0.19
Creatinine (mg/dl)	0.55	0.45	0.40	0.40	0.03
Total protein (g/dl)	3.33	4.00	4.84	4.24	0.26
Albumin (g/dl)	1.94	1.94	2.20	1.99	0.07
Globulin (g/dl)	1.40	2.06	2.64	2.25	0.22
ALT (ul)	16.00	11.50	12.00	14.00	1.35
AST (ul)	89.50	87.00	70.50	67.00	7.98
ALP (ul)	1435.45	1474.40	1548.45	1459.40	52.40

References

Adeyemi, A. (2011). Complete guide to Nigerian tourism, local culture and investment opportunities. www.cometonigeria.com.

Akintobi, O. A., Onoh, C. C., Ogele, J. O., Idowu, A. A., Ojo, O. V. and Okonko, I. O. (2013). Antimicrobial activity of *Zingiber officinale* extract against some selected pathogenic bacteria. *Natural Science*, 11(1):7-15.

Chang, K. J. and Cheong, S. H. (2008). Volatile organosulfur and nutrient compounds from garlic by cultivating areas and processing methods. *Fed. Am. Soc. Exp. Bio. J.*, 22: 1108-1112.

Chrubasik, S., Pittler, M. H. and Roufogalis, B. D. (2005). *Zingiberis rhizome*: a comprehensive review on the ginger effect and efficacy profiles. Phytomedicine, 12(9):440-449.

Cross, D. E., McDevitt, R. M., Hillman, K. and Acamovic, T. (2007). The effect of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. *British Poultry Science*, 48:496–506.

Ebegbulem, V. N. (2018). Haematological and biochemical indices of broiler chickens fed ginger (zingiber officinale) based diets. *Ife Journal of Agriculture,* 30 (2): 1-7.

Ebrahimnezhad, Y., Azarakhsh, V. and Salmanzadeh, M. (2014) The effects of ginger root (*zingiber officiale*) processed to different levels on growth performance, carcass characteristics and blood biochemistry parameters in broiler chickens. *Bull. Env. Pharmacol. Life Sci.*, 3 (5): 203-208.

George, O.S., Kaegon, S.G. & Igbokwe, A.A., (2015). Feed additive effects of graded levels of ginger *(Zingiber Officinale)* on serum metabolites of broilers. J. Agric. Vet. Sci. 8, 59-62. Doi: 10.9790/2380-08325962.

Herve, T., Raphaël, K. J., Ferdinand, N., Vitrice, F. T. L., Gaye, A., Outman, M. M. and Marvel, N. M. W. (2018). Growth Performance, Serum Biochemical Profile, Oxidative Status, and Fertility Traits in Male Japanese Quail Fed on Ginger (*Zingiber officinale*, Roscoe) Essential Oil. *Veterinary Medicine International*, 1-8.

John, U. E. and Emenalom, O. O. (2018). Effect of dietary garlic, ginger and their mixture onthe performance of broiler chickens. *Proc. 43rd Annual Conference of the Nigerian Society for Animal Production, FUT Owerri, March 18th-22nd, 2018,* 542-545.

Mohamed, A. B., Al-Rubaee, A. M. M. and Jalil, A. Q. (2012). Effect of Ginger (*Zingiber officinale*) on Performance and Blood Serum Parameters of Broiler. *Int. J. Poult. Sci*., 11: 143-146.

Oleforuh-Okoleh, V. U., Chukwu, G. C. and Adeolu, A. I. (2014). Effect of ground ginger and garlic on the growth performance,carcass quality and economics of production of broiler chickens. *Global J. Bio-Sci. Biotechnol*., 3: 225-229.

Puvaca, N., Glamocic, D., Levic, J., Peric, L., Stanacev, V. and Milic, D. (2013). Beneficial effects of phytoadditives in broiler nutrition. *World's Poultry Science Journal*, 69: 27-34.

Raeesi, M., Hoseini-Aliabad, A., Roofchaee, A., Zareshahneh, A. & Pirali, S. (2010). Effect of periodically use of garlic (*Allium sativum*) powder on performance and carcass characteristics of broiler chickens. *World Academy of Science, Engineering and Technology*, 44.

Shewita, R.S. and Taha, A. E. (2018). Influence of dietary supplementation of ginger powder at different levels on growth performance, haematological profiles, slaughter traits and gut morphometry of broiler chickens. S. Afr. J. Anim. Sci. 48: 997-1008.

Steiner, T. (2009). Phytogenics in animal nutrition, natural concepts to optimize gut health and performance. Nottingham University Press, Nottingham, NG11 0AX, UK. 191p.

Zhang, G. F., Yang, Z. B., Wang, Y., Yang, W. R., Jiang, S. Z. and Gai, G. S. (2009). Effects of ginger root (*Zingiber officinale*) processed to different particle sizes on growth performance, anti- oxidant status, and serum metabolites of broiler chickens. *Poult. Sci*., 88:2159-2166.

EFFECT OF DIFFERENT HEAT TREA TMENT OF BAOBAB (*Adansonia digitata*) SEED AS AN ALTERNATIVE PLANT PROTEIN SOURCE ON HAEMATOLOGICAL AND BLOOD CHEMISTRY OF LOCAL TURKEY

L. A. SAULAWA, M. G. GARBA, M. N. SABO AND A. UMAR

Department of Animal Science, Federal University Dutsin-Ma

ABSTRACT
An experiment was conducted to evaluate the effect of boiling time of baobab (Adansonia digitata) seed meal as a partial replacement of soya beans meal on anti-nutritional factors, haematological and blood chemistry of local turkey. Raw baobab seeds were boiled for 30, 60, 90 and 120 minutes. The boiled baobab seed meals (BBSM) were used to replace 10% of soya beans meal. Seventy five poults were randomly selected and allocated to treatment diets with 15 poults per treatment and 5 poults per replicate. Proximate analysis of the experimental diets and anti-nutritional factors of the raw and boiled (30, 60, 90 and 120mins) BBSM were carried out. On the 9th week of the feeding trial, blood was collected from the poults for haematological and blood chemistry assays. The results obtained showed there was general reduction in the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) as a result of different boiling time of raw baobab seed. Monocyte count was different (P<0.05) among the treatment means with 30 mins BBSM having the highest count. The 30 mins BBSM recorded higher (P<0.05) creatinine compared the other treatments. Alkaline phosphate content was higher (P<0.05) for the control and 30 mins BBSM compared to 120 mins BBSM. It can be concluded that boiling reduces the content of anti-nutritional factors of raw baobab seeds and assisted the growing turkey in handling the anti-nutritional factors.
Keywords: Baobab, Local Turkey, Haematological, Blood chemistry, turkey

INTRODUCTION
Protein is a global index for measuring well-being of a country (Abdu, 2012). The basic sources of protein in Nigeria are the ruminant and the non-ruminant. The ruminant animals' production is seriously in dangerous stage due to insurgency in the north-east, cattle rustling in the north-west, and seasonal fluctuation of feed which resulted in reducing the supply of protein sources, the next alternative are poultry sources, but poultry is seriously affected by high cost of feed due to high competition between man, industries and poultry. Protein source is the major scarce and expensive ingredient in poultry production there by taking 75-80% of the total cost of production. Hence the need to source for alternative but promising feedstuffs. One of such alternative is baobab (*Adansonia digitata)* seed. Baobab (*Adansonia digitata*), locally called kuka (Hausa) and luru (Yoruba), which is another non-conventional feed stuff that is readily available in Nigeria particularly in the North. The use of legumes as a component of poultry feed has been limited by the content of anti-nutritional factors (ANF). Abdu (2012) and Saulawa *et al* (2014) reported that the inclusion of above 10% raw Baobab seed meal as plant proteins in diets of broilers leads to a significant impairment of growth and other undesirable physiological and biochemical alterations.

The examination of blood gives the opportunity to investigate the presence of several metabolites and other constituents in the body of animals and it plays a vital role in the physiological, nutrition and pathological status of an organism *(*Aderemi, 2004*). According to* Afolabi, *et al*, (2010), changes in haematological parameters are often used to determine various status of the body and to determine stresses due to environmental, nutritional and/or pathological factors. Hence, this study was conducted determine the effect of different time of hot water treatment on proximate composition and anti-nutritional factors of baobab and also its effect as a partial replacement for Soybeans on haematological and blood chemistry parameters of local turkey.

MATERIALS AND METHOD
Experimental Site
The study was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma lies on latitude 12°26'N and longitude 07°29'E (Abaje *et al.*, 2014).

Processing of Baobab Seeds

The raw seeds of baobab were collected from Dutsin-ma market and were divided into five parts and boiled at different time interval. Boiling was carried-out according to the recommendation of Ukachukwu, *(*2000) for *Mucuna cochinchinensis*. The equal quantity seeds were boiled for 30mins, 60mins, 90mins and 120mins using equal vol. of water differently. Thereafter, they were brought down and a basket was used to drain the seeds and allowed them to sun dry.

Experimental Animal, their Management and Data Collection

One hundred (100) day old turkeys were housed and brooded in a deep litter. All routine management practices were strictly adhered to. At the end of the fifth (5) week (brooding period), 75 birds were allotted to five (5) experimental diets and replicated three times in a completely randomized experimental design. Diet was soybeans based (control), while 10% boiled baobab seeds boiled for 30, 60, 90 and 120 minutes were used to quantitatively replace equivalent weight of soya beans meal in diets 2, 3, 4 and 5 respectively. Feed and water were given *ad libitum* throughout the experimental period which lasted for nine (9) weeks.

Table 1 Composition of the Experimental Diets (%)

	Period of boiling (minutes)				
	0	**30**	**60**	**90**	**120**
Ingredient	**(T1)**	**(T2)**	**(T3)**	**(T4)**	**(T5)**
Maize	60.2	60.2	60.2	60.2	60.2
Soybean	26.00	16.00	16.00	16.00	16.00
BBSM meal	0.00	10.00	10.00	10.00	10.00
GNC	10.00	10.00	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lim	1.00	1.00	1.00	1.00	1.00
Salt	0.3	0.3	0.3	0.3	0.3
Premix	0.3	0.3	0.3	0.3	0.3
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Total	100.00	100.00	100.00	100.00	100.00
Feed cost N/kg	148.96	139.76	139.86	139.91	139.96
Calculated Analysis					
Crude protein (%)	21.56	18.57	18.70	18.57	18.47
Energy (ME kcal/kg)	2915.5	2793.29	2792.39	2780.29	2779.49
Crude Fibre (%)	2.79	2.82	2.68	3.22	2.97
Calcium (%)	1.16	1.16	1.16	1.16	1.16
Phosphorus (%)	0.67	0.69	0.69	0.69	0.69
Fat	2.63	2.08	3.04	2.96	2.98
Methionine	0.46	0.43	0.43	0.43	0.43
Lysine	1.27	1.12	1.12	1.12	1.12
Determined Analysis					
Dry matter	94.28	94.60	93.88	94.26	94.31
Crude protein	17.82	18.04	17.96	17.99	18.00
Crude fibre	9.24	8.98	9.11	9.25	8.80
Oil	4.48	4.36	4.52	4.19	4.39
Ash	6.03	5.88	5.07	5.46	7.47
Nitrogen free extract	56.7	57.5	57.2	57.3	55.6

On the 9th week of the feeding trial, 3 poults were randomly selected from each dietary replicate for blood collection. Blood was collected from the sub-clavicular vein of each poult using a scalp vein needle set. About 5ml of blood was collected into two (2) sets of three sterilized glass tubes/bottles containing Ethylene Diaminetetra-acetic Acid (EDTA) for Haematological studies. Blood samples for serum biochemical studies were collected into plain containers for serum separation.

Haematological parameters measured were red blood cell (RBC), haemoglobin (Hb), white blood cell counts (WBC), packed cell volume (PCV), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular Haemoglobin (MCH) and mean corpuscular Volume (MCV) were all determined.

Serum biochemical parameters considered were total serum protein, serum albumin, glucose, cholesterol, creatinine, urea, serum glutamate oxaloacetate transfarase (SGOT), alkaline phosphate (ALP) and serum glutamate phosphate transfarase (SGTP). Data from the experiment are subjected to one way analysis of variance (ANOVA) using SAS software (SAS 1999).

RESULTS AND DISCUSSION

Table 2 shows the result of different anti-nutritional factors obtained in both raw and boiled baobab seeds. There was general reduction in the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) as a result of different boiling time of raw baobab seed though reduction varies in degree with different boiling period. The highest percentage reductions in trypsin is T5 (1.98), tannin T4 (1.08) and in phytate T4 (2.79) were observed when the raw baobab seed were boiled with different boiling period.

The haematology parameters of turkey fed boiled baobab seed meal for different duration is shown in table 3. The result shows that RBC, Hb, PCV, WBC, Neutrophills, Lymphocyte and MCHC were not affected (P<0.05) by the feeding baobab seed meal boiled for various duration a replacement for soyabean meal.

Table 2 Effect of hot-water treatment on the anti-nutritional factors of baobab seeds (mg/kg)

Anti-nutritional factors	Boiling Time(mints)					
	0	**30**	**60**	**90**	**120**	**± SEM**
Tannin	2.88^{a}	2.96^{a}	2.38^{b}	2.30^{b}	1.98^{c}	0.03
Phytate	1.60^{a}	1.48^{b}	1.50^{ab}	1.08^{c}	1.11^{c}	0.04
Trypsin inhibitors	3.43^{a}	3.30^{b}	2.98^{c}	2.79^{d}	2.81^{d}	0.03

a, b, c, d, e, = Means within rows with different superscript are significantly different (p<0.05).

Table 3 Haematological values of Turkey Fed Experimental Diets

	TREATMENT					
PARAMETERS	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Red blood cell (RBC) x10^6/mm	5.40	5.20	5.73	5.27	5.27	0.23
Haemoglobin (HB) g/dl	10.63	10.45	10.97	10.53	10.30	0.46
Packed cell volume (PCV) %	32.00	31.50	33.00	31.67	31.00	1.38
White blood cell (WBC)x10^3/mm^3	10.73	9.90	9.63	6.30	10.23	2.34
Mean corpuscular volume (MCV) mm^3	59.21^{ab}	60.58^{a}	57.52^{b}	60.10^{a}	58.98^{ab}	0.66
Mean corpuscular haemoglobin %	19.67^{ab}	20.10^{a}	19.12^{b}	19.99^{a}	19.59^{ab}	0.21
Mean corpuscular haemoglobin concentration	33.22	33.18	33.24	33.26	33.22	0.05
Band	1.00	1.oo	1.33	0.00	1.00	0.87
Neutrophils %	15.00	7.50	7.00	12.33	10.33	3.47
Lymphocytes %	78.67	82.00	85.33	86.33	85.00	4.07
Monocytes %	5.33^{b}	9.00^{a}	4.00^{bc}	1.00^{c}	3.00^{bc}	1.01
Eosinophil %	0.00^{b}	0.50^{ab}	2.00^{a}	0.33^{ab}	0.67^{ab}	0.57
Basophils %	-0.00	0.00	0.00	0.00	0.33	0.15

a,b,c,d means in the same row with different super scripts are significantly (P<0.05) different
SEM – Standard error of means

Monocyte count was different (P<0.05) among the treatment means with 30 mins BBSM having the highest count. 90 mins BBSM recorded the lowest which is statistically lower P<0.05) than the control and the 30mins BBSm but similar (P<0.05) with both 60 and 120 mins BBSM. Eosinophil count of the 60 mins BBSm was significantly higher (P<0.05) than that of the control but similar with the other treatments. The 30, 90, and 120 mins BBSM had similar Eosinophil count with the control. MCV was affected by the feeding of BBSM to growing turkey with 30 and 90 mins BBSM having hiher MCV than 60 mins BBSM.The control and 120 mins BBSM have similar MCV with the 30, 60, and 90 mins BBSM. Similar to MCV, MCH was higher than the 30 and 90 mins compared to 60 mins BBSM. The control and the 120 mins BBSM have similar MCH with the 30, 60, and 90 mins BBSM.

The result of the serum biochemistry of growing turkey fed BBSM is shown in table 4 all the parameters considered as shown in the table were not affected except for creatinine and alkailine

phosphate (ALP). The 30 mins BBSM recorded higher (P<0.05) creatinine compared the other treatments.The control, 60, 90, and 120 mins BBSM had similar (P>0.05) creatinine content. Alkaline phosphate content was higher (P<0.05) for the control and 30 mins BBSM compared to 120 mins BBSM. The 60 and 90mins BBSM had similar (P>0.05) alkaline phosphate with both the control and 30 mins BBSM and the 120 mins BBSM.

Table 4: Serum Biochemical Indices of Turkey Fed Experimental Diets

	TREATMENT					
PARAMETERS	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Total protein	3.07	3.90	3.60	3.40	3.60	0.26
Albumins	35.33	37.33	35.67	37.33	38.00	3.46
Globulins	37.00	42.00	35.67	35.67	34.00	4.31
Serum glutamate oxaloacetate (SGOT)/(AST)	17.67	21.00	19.67	19.33	15.00	6.31
Serum glutamate phosphate (SGPT)	7.67	6.50	7.33	10.67	4.50	3.98
Creatine	23.33 b	54.00 a	28.00 b	30.00 b	17.50 b	6.76
Alkaline phosphate (ALP)	67.67 a	66.67 a	52.67 ab	48.33 ab	43.50 b	6.80
Total serum protein (TSP)	72.33	56.33	71.33	73.00	72.00	7.91

a,b,c,d means in the same row with different super scripts are significantly (P<0.05) different
SEM – Standard error of means

Conclusion and Recommendation

From the results of this study it can be concluded that boiling reduces the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) of raw baobab seeds. Boiling of raw baobab seeds for more than 30 mins assisted the growing turkey in handling the anti-nutritional factors. Hence, monocyte count and serum creatinine content decreased with increased boiling time. It is recommended that 10% raw baobab seeds boiled for a minimum of thirty minutes can be used to replace soyabean meal in diets of growing turkey.

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REFERENCES

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology*; Vol. 6, No. 2; 2014

Abdu, L.S 2012. Chemical and nutrient evaluation of Baobab (*Adansonia ditata)* seed meal as alternative protein source broiler diet. Ph. D Dissertation. Micheal Okpara University of agriculture, Umudilke, Abia State.

Aderemi F. A (2004). Effects of replacement of heat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology ans serum biochemistry of pullet chicks. *Tropical Journal of Animal Science, 7 147 – 153.*

Afolabi, K.D Akinsoyimu, A.O Olajide, R. and Akinleye S.B (2010). *Haematological parameters of the Nigerian local grower chicnkens fed varying dietary levels of palm kernel cake (P.247)* Proceedings of 35th Annual Conference of Nigerian Society for Animal Production.

Saulawa, L.A, Yaradua A.I, and Shuaibu, L. (2014). Effect of different Processing methods on proximate, mineral and anti-nutritional factors content of Baobab (*Adansonia digitata*) seeds. *Pakistan Journal of Nutrition*, 13(6): 314-318.

Ukachukwu, S.N (2000). Chemical and nutritional evaluation of *Mucuna cochichinensis* (Lyon Beans) as an alternative protein ingredients in broiler diets (Phd) thesis, University of Nigeria Nsukka.

EFFECTS OF CAGE LOCATION AND TIER LEVEL ON PERFORMANCE AND EGG QUALITY CHARACTERISTICS OF ISA BROWN HENS

[1]Lamidi, A.W., [1]Obi, C.C., [1]Ojelade, A.Y.P. and [2]Ayoola, A.A.A.
[1]Department of Agricultural Education, Federal College of Education (Technical), Akoka-Yaba, Lagos State, Nigeria. [2]Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
Email: lammiwise2000@yahoo.com

Abstract
This study was carried out to determine the effects of cage location and tier-level on performance and egg quality characteristics of Isa Brown hens. One-hundred and eighty laying hens of similar body weights at 40 weeks of age were housed inside 3-tier cages denoted as Top (T), Middle (M) and Bottom (B) tiers in cages placed facing the Open side (OS) and the Corridor side (CS) of a battery cage pen. The 70-day long experiment was a Randomized Complete Block Design with a 2 x 3 factorial arrangement of treatments. Data on feed consumption and egg production were recorded daily and egg quality was determined at 5-weeks interval. Cage location had no effect on feed consumption and feed efficiency throughout the experimental period. However, the effects of cage location and tier level and their interaction were significant ($p<0.05$) on hen-day production throughout the experiment. Although cage location and tier level did not have any statistical influence on egg weight, other quality indices such as shape index, yolk index, albumen index and Haugh unit responded significantly ($p<0.05$) to the treatments. It is therefore recommended that poultry farmers should pay due attention to cage location and tier level as part of key determinants of egg production and quality.

Keywords: cage location, tier-level, performance, egg quality

Introduction
Egg production occupies a key position in the quest to meet the demand for the much-needed animal protein of the teeming population of most communities especially in the low-income food deficit countries. A lot of concerns have been raised by poultry scientists about the dynamics of egg production and its quality after oviposition.

Several factors have been identified to militate against the performance of laying hens housed in battery cages. Awoniyi (2003)) reported that, because there is an unavoidable variation in light intensity among multi-tier cage systems, a balance is needed between providing sufficient light at the bottom tier and avoiding excessive light intensity at the top tier. In another study, Yildiz *et al*., (2006) found that the lack of a homogenous light intensity in multi-tier system and each cage location in semi confined laying hen houses adversely affects egg production and quality. Karaman *et al*., (2013) reported that environmental conditions are not the same in every part of the caged layer house, and differences in micro-environments such as in ventilation,lighting and temperature might occur among cage tiers.

Cage location within the battery cage house and cage tier-level has been of serious research concern to poultry scientists. Poultry products and their quality are affected significantly by genetic and ecological conditions such as the indoor environment of the poultry house (Ahmed and Singh, 2007) Earlier researchers (Vovensy, 1990 and Sahin, 2012) investigated the effects of cage location and tier levels on performance of layers and reported great variability among the groups caged at different tier levels facing windows and located at corridor.External and internal quality of eggs are dependent on genotype and environmental factors such as housing system, oviposition time, age, ambient temperature and nutrition as well as their interactions (Tunova and Gous, 2012). Although diverse variations in performance and egg quality have been recorded among hens subjected to different housing coditions, more work is needed particularly considering the fact that existig reseaches on the subject were undertaken outside Nigeria and with no specific genotype in mind. Therefore, the present study was conceived to determine the effects of cage location and tier-level on performance and egg quality characteristics of Isa Brown hens reared in tropical Rain forest of Nigeria.

Materials and Methods

Birds and Management

This study was carried out at the Department of Agricultural Education Poultry Unit, Federal College of Education (Technical), Akoka, Lagos, Nigeria.The experiment was a randomized complete block design with a 2x3 factorial arrangement of treatments. A total of 180 Isa Brown layers of similar body weights at 40 weeks of age were blocked into location: Open side (OS) and Corridor side (CS) and cage (40 x 36 x 40cm, width x depth x height) as Top (T), Middle (M) and Bottom (B) tiers. Each treatment was replicated 5 times in 10 cells in each tier level of the 2 location types with each cell containing 3 hens. The experiment lasted 70 days aside from 14 days adaptation period (20 March to 29 May, 2017). Average daylight and darkness during the experimental period were 12.30 and 11.30h/d respectively, with no artificial lightening.

Data collection

Feed consumption and egg production were recorded daily and egg quality was determined at 5-weeks interval. Egg production was expressed as hen-day egg production; feed consumption was calculated as daily feed consumption. Feed efficiency was calculated as kilogram of feed consumed per kilogram of egg produced. A total of 60 eggs were randomly picked with 2 eggs per replicate at week 40 and subsequently at weeks 45 and 50 respectively for the determination of quality parameters such as shape index, shell thickness, albumen index, yolk index and Haugh unit. Apart from egg weight, formulas and methods as reported by Ergum *et al*., (1987) were used to determine other egg quality traits. Similarly, Haugh unit was calculated using the values recorded for the egg weight and albumen height as expressed by Haugh (1937) and enunciated by Asuquo *et al.* (1992) in the formula thus: $HU = 100 \log (H + 7.5 - 1.7W^{0.37})$ Where H = Albumen height in mm, W = Egg Weight in g. The data obtained were subjected to analysis of variance (ANOVA) according to SAS (1998) while differences between groups were determined by Duncan multiple –range test.

Results and Discussion

The results of performance indices from the experimental groups are presented in Table 1. The results of this study indicated that cage location had no effect on feed consumption and feed efficiency throughout the experimental period. However, hen day production was significantly ($p < 0.05$) influenced at 40th and 50th weeks old. A sharp contrast in HDP was observed as tier-level significantly ($p<0.05$) increased egg yield at 45th week old. Birds housed in the bottom tier produced more eggs ($p < 0.05$) than those in other tiers. The effects of cage location, tier level and cage location by tier level interaction on HDP were significant ($p < 0.05$) throughout the experimental period while such effects did not exist in other performance parameters investigated. This finding agrees with that of Sahin (2012) who reported that hens at location Facing Window had greater egg production than hens at Corridor side. The improved egg yield observed with birds on the open side of the pen at 40th and 50th weeks could be attributed to better exposure to light intensity as reported by earlier researchers (Awoniyi 2003; Yildiz *et al*., 2006; and Karaman *et al*., 2013). Vovensy (1990) and Ahmed and Singh (2007) also posited that environmental conditions are not the same in every part of the caged layer house, and differences in micro-environments such as ventilation, lighting and temperature might occur among cage tiers. Tier-level effect on egg yield at 45th week old contradicts the findings of Karaman *et al*., (2013) who reported that hens at the top-tier produced more eggs as a result of better exposure to lightning than those at the lower tiers. The significant interactive effects of cage location and tier level observed for HDP in the present study is consistent with the findings of Vowensy (1990) who reported great variability among the groups caged at different tier levels facing windows and located at corridor.

Table1: Performance parameters of Isa Brown hens at different cage locations and tier levels

Treatments		Feed consumption (g/day)			Feed efficiency (Kg feed/Kg eggs)			Hen day production (%)		
Cage location	Tier level	40th week	45th week	50th week	40th week	45th week	50th week	40th week	45th week	50th week
Open side		103.35	104.00	103.91	1.72	1.82	1.76	76.04[a]	73.64	40.72[a]
Corridor side		104.14	103.98	104.02	1.71	1.79	1.71	71.06[b]	70.72	34.79[b]
	Top	103.61	104.12	104.02	1.72	1.82	1.80	73.35	70.72[b]	39.90
	Middle	104.02	103.88	104.04	1.72	1.77	1.69	74.20	70.00[b]	38.82
	Bottom	104.31	103.98	104.58	1.70	1.81	1.71	73.10	75.83[a]	39.05
ANOVA								Probability		
L		NS	NS	NS	NS	NS	NS	*	NS	*
T		NS	NS	NS	NS	NS	NS	NS	*	NS
L X T		NS	NS	NS	NS	NS	NS	*	*	*
SEM		0.03	0.19	0.33	0.02	0.02	0.03	1.16	1.14	0.52
R^2		0.03	0.01	0.05	0.01	0.06	0.11	0.16	0.24	0.30

[a,b;] means on the same column with different superscripts are significantly different ($p<0.05$)

L = Cage location; T = Tier-level

The results of egg weight (g), egg shape index (%) and egg shell thickness (mm) are presented in Table 2. Cage location, tier level and cage location by tier level interaction did not have significant impact ($p > 0.05$) on egg weight throughout the experimental period. Tier level and cage location by tier level interaction ($p < 0.05$), but not cage location, affected egg shape index at 45th week of age. Hens caged in top tier recorded higher shape index (82.32%) than those in middle and bottom tiers with mean values of 78.59% and 78.59% respectively. This suggests that high light intensity prevalent at the top tier level might have resulted in superior shape index. However, this trend is at variance with the findings of Yildiz *et al.,* (2006) and Awoniyi (2003) who reported that neither cage location nor tier level affected shape index, yolk colour or yolk index. Moreover, cage location and cage location by tier level interaction had significant ($p < 0.05$) effect on shell thickness at 40th week of age. Hens in cages on open side produced eggs with thicker shells (0.31mm; Table 2) than those at corridor side (0.26mm). The effect of location and tier level on shell quality is largely unknown. However, Leeson and Lewis (2004) posited that egg shell quality was independent of light intensity or cage location and tier effect of cage level in other studies including hens.

Table 2: External quality parameters of Isa Brown hens' eggs at different cage locations and tier levels

Treatments		Egg weight (g)			Egg shape index (%)			Egg shell thickness (mm)		
Cage location	Tier level	40th week	45th week	50th week	40th week	45th week	50th week	40th week	45th week	50th week
Open side		60.57	57.43	59.64	76.86	80.83	78.75	0.31[a]	0.25	0.23
Corridor side		61.48	59.51	61.45	78.72	78.72	76.84	0.26[b]	0.25	0.21
	Top	60.80	57.25	58.15	78.17	82.32[a]	78.28	0.28	0.26	0.22
	Middle	60.60	59.32	62.08	77.93	78.59[b]	77.36	0.28	0.24	0.24
	Bottom	61.68	57.50	61.40	77.27	78.59[b]	77.74	0.29	0.26	0.22
ANOVA							Probability			
L		NS	NS	NS	NS	NS	NS	*	NS	NS
T		NS	NS	NS	NS	*	NS	NS	NS	NS
L X T		NS	NS	NS	NS	*	NS	*	*	NS
SEM		1.02	0.89	1.03	0.62	0.72	0.62	0.01	0.01	0.01
R^2		0.01	0.05	0.12	0.09	0.28	0.10	0.07	0.16	0.07

[a,b;] means on the same column with different superscripts are significantly different ($p<0.05$)

Table 3 summarizes the effects of cage location and tier level on internal quality parameters of Isa Brown hens' eggs. Significant cage location and cage location by tier level interaction ($p < 0.05$) effects existed in yolk index at 50th week of age. Hens in cages on open side had superior yolk index (52.02%) to those on corridor side (47.39%). Conversely, Haugh unit responded ($p < 0.05$) to tier level and cage location by tier level interaction at 50th week of age. Mean value of 87.29 recorded for hens in top tier was higher than 81.28 and 81.20 obtained for those in bottom and middle tiers respectively. Furthermore, significant cage location by tier level interaction effects ($p < 0.05$; Table 3) occurred in all the internal parameters at different periods of the experiment. For instance, albumen index (45th week), yolk index (40, 45 and 50th weeks) and Haugh unit (50th week) all responded to cage location by tier level interaction effects. This implies that, while cage location and tier level did not significantly affect internal egg quality indices, cage location by tier level interaction did. This corroborates the findings of Yildiz *et al*., (2006) who reported that despite a lack of effect of tier level, there were significant cage location by tier level interaction effects on albumen index and Haugh unit. Since albumen index and Haugh unit are key determinants of inner egg quality, the outcome of the present study suggests that these parameters should not be ignored when considering environmental factors militating against egg production and quality.

Table 3: Internal quality parameters of Isa Brown hens' eggs at different cage locations and tier levels

Treatments		Albumen index (%)			Yolk index (%)			Haugh unit		
Cage location	Tier level	40th week	45th week	50th week	40th week	45th week	50th week	40th week	45th week	50th week
Open side		86.93	95.23	77.99	44.62	49.44	52.02[a]	89.35	88.62	83.99
Corridor side		92.61	89.43	76.43	47.21	45.70	47.39[b]	88.56	86.94	82.50
	Top	86.10	95.23	83.57	47.10	46.25	49.92	88.80	87.40	87.29[a]
	Middle	90.93	88.42	73.51	45.60	48.68	48.13	89.00	86.86	81.20[b]
	Bottom	92.27	93.33	74.55	45.06	47.78	51.07	89.08	89.08	81.28[b]
ANOVA							Probability			
L		NS	NS	NS	NS	NS	*	NS	NS	NS
T		NS	NS	NS	NS	NS	NS	NS	NS	*
L X T		NS	*	NS	*	*	*	NS	NS	*
SEM		3.01	2.43	2.39	0.92	0.95	0.86	0.92	0.97	1.13
R^2		0.06	0.10	0.13	0.01	0.17	0.31	0.01	0.06	0.23

[a,b;] means on the same column with different superscripts are significantly different ($p<0.05$)

Conclusion and Recommendation

The findings of this study revealed that cage location and tier level as well as their interaction had significant effects on egg production with hens in cages facing the open side producing more eggs than those facing the corridor side at 40 and 50 weeks old. Generally, cage location and tier level did not have any statistical influence on egg weight but other quality indices such as shape index, yolk index, albumen index and Haugh unit responded significantly to the treatments. It is therefore recommended that poultry farmers should pay due attention to cage location and tier level as part of key determinants of egg production and quality.

References

Ahmed, M. and Singh, P. (2007). Estimates of genetic parameters for some economic traits in White Leghorn. *Indian Poult. Sci., 42.* , 311-312.

Asuquo, B.O., Okon, B.O. and Ekong, A.O. . (1992). Quality parameters of Isa Brown and Nigerian local chicken eggs. *Nigerian Journal of Animal Priduction, 19* , 1-5.

Awoniyi, T. (2003). The effect of housing on layer chicken's productivity in the 3-tier cage. *Int. J. Poult. Sci., 2* , 438-441.

Baxter, M. (1994). The welfare of laying hens in battery cages. *Vet. Rec., 134* , 614-619.

Ergun, A. S. (1987). Utilization of vetch by laying hens. *J. Fac. Vet. Med. Ankara, 34* , 449-466.

Haugh, R. (1937). The Haugh Unit for measuring egg quality. *U.S. Egg Poultry Magazine, 43* , 552-555.

Karaman, S., Sekeroglu, A. & Duman, M. (2013). Physical characteristics and performance of laying hens caged in different tiers and environmental parameters of each tier. *Am. Soc. Agric. Biol.Eng., 56.* , 321-328.

Leeson, S. a. (2004). Changes in light intensity during the rearing period can influence egg production in domestic fowl . *british Poultry Science. 45* , 316-319.

Sahin, S. (2012). Effects of cage location and tier level on performance and egg quality traits of layin hens. *J. of Anim. & Vet. Advs., 11:14* , 2380-2383.

SAS. (1998). SAS User's Guide: Statistics. Version 7. Cary, INC., USA: SAS Institute Inc.

Tunova, E. & Gous, R.M. (2012). Interaction between oviposition time, age and environmental temperature and egg quality traitsin laying hens and broiler breeders. *Czech. I. Anim. Sci., 57* , 541-549.

Yildiz, A., Lacin, E., Hayirli, A. and Macit, M. (2006). Effects of cage location and tier level with respect to light intensity in semi confined housing on egg production and quality during the late laying period. *J. Applied Poult. Res., 15* , 355-361.

PERFORMANCE AND SERUM BIOCHEMISTRY OF BROILER CHICKEN FED GRADED LEVELS OF GARLIC (*Alliumsativum*) POWDERAT STARTERPHASE IN SOKOTO, NIGERIA

M. M. Mikailu*., Z. S. Jega*., A. M. Dalhatu*., K. M. Aljameel* and A. Z. Sanusi**

**Department of Animal Science, Faculty of Agriculture, UsmanuDanfodiyo University, Sokoto. P. M. B. 2346,Sokoto State, Nigeria.*

***Department of Animal Science, Faculty of Agriculture, Federal University Dutsimma, P. M. B. 5001, Katsina State, Nigeria.*

Corresponding Author: maryammikailu@gmail.com +2348067009399

Key words: Broiler Chicken, Garlic Powder, Performance and Serum Biochemistry

ABSTRACT

This experiment was carried out at the Research Unit of the Department of Animal Science, UsmanuDanfodiyo University Sokoto which is located at Veterinary Clinic, Aliyu Jodi Road, Sokoto.120 day old broiler chicks were studied in this research to determine the effect of garlic (Allium sativum) powder on the performance and serum biochemistry on the broiler chickens at starter phase. This experiment lasted for 4 weeks. Birds were randomly alloted to 5 treatments with 3 replicates each using CRD. Each treatment consisted of 24 birds and 8 birds per replicate. Treatment 1 was positive control with experimental diet only, treatment 2 was negative control with experimental diet with Neomycin antibiotic supplement and treatments 3, 4 and 5 were experimental diets with 1%, 2% and 3% garlic powder supplement.Results of the experiment showed significant ($P<0.05$) differences in average daily feed intake/bird, BWG and average daily weight gain/bird. There were no significant differences in initial body weight, final body weight, feed conversion ratio and mortality. There were also no significant difference in ALP, ALT, AST, Na, Cl and K.This experiment observed garlic had no effect on broiler growth performance and serum biochemistry at starter phase statistically. Although, numerically garlic supplemented treatments showed decreased liver enzyme activity in relation to antibiotic which indicated a healthy status. It was also concluded that these effects may not be observed due to the short duration of the experiment.

Introduction

Background of the Study

Broiler production has gained prominence in Nigeria since independence in order to meet the average daily protein requirement of Nigerians (Adene and Oguntade, 2006). Meat is an important composition of the diet for healthy living as it is a good source of essential amino acids. Broiler production involves the rearing of chicken for meat. The main requirements of broiler production are feed, housing and health management. The main concern of producers is to achieve growth of birds within a short period of time and prevent loss. In an attempt to achieve this, producers use substances that can improve growth and health status of the birds (Butaye*et al*., 2003).

Feed additives are added in poultry feed to improve nutritive value of ingredients, improve quality, improve feed conversion efficiency, increase growth rate and enhance performance (Brussels, 2005). Antibiotic growth promoters are feed additives which are primarily added in feeds to improve growth, improve feed utilisation and prevent diseases (Brussels, 2005). Antibiotics are chemical substances produced by a microorganism which can kill or inhibit the growth of another microorganism, most common of which are penicillin, oxytetracyline and tetracycline (Dantas*et al*., 2008). Antibiotics have been extensively used to prevent disease infections in poultry and to improve growth and carcass quality. However, the increased use of antibiotics leads to development of resistance in bacteria, residual drug effect and drug toxicity. Also, antibiotics have side effects on animals and humans consuming the animals' product due to drug residue (Sharma *et al.*, 2008).

Alternatives to antibiotics have gained interests in poultry production many of which are plants and their extracts. Recently, many countries have banned the use of antibiotics because of their harmful side effects and increased awareness about the alternatives of antibiotics such as herbs and medicinal plants to eliminate these threats (Manesh*et al.*, 2012).

Alternatives to antibiotics recognized include probiotics, phytogenics and organic acids growth enhancers (Borazjanizadeh*et al*., 2011). Many bio-active ingredients which include alkaloids, flavonoids, mucilage, saponin and tannin are new generation antibiotics (Wang *et al*., 1998; Wenk, 2000). Nutritionists are shifting their attention from the utilisation of chemical growth promoters to phytogenic growth promoters in recent years (Iji*et al*., 2001).

Common plants and herbs gaining interest as phytogenic growth promoters include; ginger, garlic, onion, turmeric, rosemary, oregano and thyme (Panda, 2009). These plants and their extracts have been used in human and animal medicine without knowledge of their exact effect and potency. Some growth promoters act as pro-nutrients because of the role they play in enhancing the physiology and microbiology of the animal. Many active ingredients from plant are considered as pro-nutrients and recently been tried in animal feed (Biovet, 2005). Active principles of the plant or plant chemicals present in certain parts of the plant confer therapeutic effect (Zhang *et al*., 2009).

Garlic (*Allium sativum*) has many beneficial uses in many regions worldwide. The use of garlic for its flavour is common across the world for a long time. It has been used as medicines for both humans and animals especially in the treatment of cold. Garlic plants have active ingredients and phenolic compounds that can reduce numbers of intestinal pathogens, minimize nutrient loss and improve performance; garlic also has pharmacological, antimicrobial and antioxidant effects (Al-amin*et al*., 2006; Tapsell*et al*., 2006; Ali *et al*., 2008). It acts on the appetite, intestinal micro flora and stimulate the pancreatic secretions to increase endogenous activity and immune system. Garlic can be used as good alternative for common artificial growth promoters like antibiotics (Demir*et al*., 2003).

One of the main concerns in poultry production in Nigeria is disease outbreak. Antibiotic growth promoters have been used to promote growth, prevent infection and control diseases. The use of antibiotic growth promoters is presently facing serious criticism and has raised global concerns as some reports revealed their ill effects among which is development of microbial resistance to the products and their potential harmful effects on human health (Rahmatnejad*et al*., 2009).

The use of antibiotic growth promoters can result in the development of drug-resistant bacteria (Alexander *et al*., 2008). Those resistant bacteria can infect humans through the food chain and thus it is a public health concern (Torres *et al*., 2010; Bekele and Ashenafi, 2010). Also, drug residues may be consumed by humans and this can lead to toxicity in humans. With all these side effects and harmful effects known there is need for decrease in the use of antibiotics but also there is need to find safer alternatives that can provide the benefits of antibiotic growth promoters.The major aim of this research is to determine the effect of garlic on the performance and serum biochemistry of broilers fed graded levels of Garlic powder as an additive from plant extract.

Materials and Methods

Study Area

The experiment was carried out at the Teaching and Research Unit of the Animal science Department, Faculty of Agriculture, UsmanuDanfodiyo University Sokoto located at the Veterinary Clinic, Aliyu Jodi road, Sokoto. Sokoto State is located at the extreme North –western part of Nigeria and lies at latitude 13.057^{o}N and longitude 5.2457^{o}E. It has an altitude of 350m (Mammam*et al*., 2000). The climate is dry and hot with temperature range of 16.3^{o}C – 40.6^{o}C, an average temperature of 28.4^{o}C and average humidity of 43%. Sokoto is a tropical area and has an annual average rainfall of 629 mm (Kowal and Knabe, 1972).

Experimental Materials

A Total of 120 day old broiler chicks were used for the experiment. They were grouped into 3 replicates and assigned to 5 treatments, with each treatment having 24 chicks and 8 chicks in each replicate using Complete Randomized Design. Garlic was purchased from the Sokoto central market, dried, ground into powder and added to the feed at graded levels (1%, 2% and 3%). Antibiotics (Neomycin) was purchased from veterinary drugs store and used according to manufacturer's instruction.

Experimental Diets

All ingredients for the experimental diets were purchased from the Sokoto central market, processed and properly mixed. Five treatments diet were formulated which include; the basal diet with no supplement labelled as treatment 1 (T1) served as positive control, the basal diet with antibiotic supplement as treatment 2 (T2) served as negative control, basal diet with 1% garlic powder supplement as treatment 3 (T3), basal diet with 2% garlic powder supplement as treatment 4 (T4) and basal diet with 3% garlic powder supplement as treatment 5 (T5). The antibiotic supplement was used according to label instruction.

Table 1. Gross Composition of the Experimental Diet

Ingredients	Starter phase
Maize	56.85
Soya bean meal	37.85
Soya bean oil	1.11
Calcium	1.00
Limestone	1.00
Salt	0.20
Methionine	0.41
Lysine	1.08
Premix	0.50
Total(kg)	100
Nutritional Composition	
Metabolisable energy (Kcal/kg)	2988
Crude protein (%)	21.00
Methionine (%)	0.46
Lysine (%)	1.20
Phosphorus	0.50

Management of Experimental Animals
Birds were reared for 4 weeks in a deep litter system pen. Birds were brood and allowed to acclimatize to the environment for seven days. Same basic management care of broiler production was given to all the birds. Feeds and water was provided *ad-libitum*.

Feed intake was calculated daily by measuring the weight of feed given and weight of any left over. Weight gain was taken on weekly basis and feed conversion ratio was calculated from it. All required vaccinations were administered. At the end of the experiment 2 birds were randomly selected from each treatment and blood samples were taken from the birds. Blood samples were taken from the jugular veins of the birds for serum biochemical analysis. 26 mortalities were recorded at the end of the experiment: 4 in treatment 1, 5 from treatment 2, 8 from treatment 3, 4 from treatment 4 and 6 from treatment 5.

Experimental Design
Complete Randomized Design (CRD) was used.

Data Collection
The parameters measured were growth performance parameters (feed intake, live weight gain and feed conversion ratio) and serum biochemical parameters (alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, sodium (Na), potassium (K) and chloride (Cl)).

Growth Performance
Weight of feed given and feed residue were measured daily and difference of the two was recorded as daily feed intake. Live weight gain was measured weekly and recorded. Weight gain was determined as the difference between the weight of birds at the end of the experiment and the initial weight at the beginning of the experiment. Feed conversion ratio was determined as the ratio of feed intake by weight gain (FI\BWG).

Serum Biochemical Analysis
Blood samples were collected in plain bottles at the end of the experiment from the using sterile syringe. The biochemical analysis was conducted at UsmanuDanfodiyo University Teaching Hospital (UDUTH). The blood ALT, AST, ALP, Na, K and CL were determined.

Data Analysis
The Data obtained from the experiment was subjected to analysis of variance (ANOVA) using SPSS. Least significant difference (LSD) was used to separate between the means.

RESULTS AND DISCUSSION

Growth Performance of the Broiler Chickens

Table 2. Growth Performance of the Broiler Chickens

	Treatments					
Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Average daily Intake (g)/ bird	41.5[a]	39.15[ab]	38.41[b]	37.35[b]	37.63[b]	0.69
Initial body weight (g)/ bird	109.63	104.17	120.55	108.92	110.13	5.92
Final body weight (g)/bird	428.57	503.97	411.43	423.81	389.29	42.91
Weight gain (g)/ bird	318.94[b]	399.8[a]	290.88[b]	314.89[b]	279.16[b]	16.71
Average daily weight gain (g/day)	11.39[ab]	14.28[a]	10.39[b]	11.25[ab]	9.97[b]	1.02
Mortality (%)	3.13	5.25	8.38	4.13	6.25	2.38
Feed conversion ratio (FCR)	3.6	2.74	3.70	3.32	3.77	0.48

There were significant (P<0.05) differences among the treatments in average daily intake (g)/bird, weight gain (g)/bird and average daily weight gain/bird. Birds in treatment 1 (positive control) with no supplement have similar value to treatment 2 (T2) with antibiotic supplement and show significantly (P<0.05) higher average daily feed intake compared to the other treatments. Birds in treatment 2 (negative control) supplemented with antibiotic were significantly (P<0.05) higher in weight gain/bird in comparison to the other treatments. Treatments 1, 3, 4 and 5 all have similar body weight gain (g)/bird. Treatment 2 showed relatively higher significance (P<0.05) in average daily weight gain (g/day). Treatment 1 (positive control) and treatment 4 (2% garlic supplementation) showed similar average daily weight gain statistically, while treatment 3 (1% garlic) and treatment 5 (3% garlic) were least significant (P<0.05) on average daily weight gain (g/day).

There were however non-significant differences among the treatments in feed conversion ratio, initial and final body weight (g)/bird and mortality.

Serum Biochemistry of the Broiler Chickens

Table 3. Results of Serum Biochemistry of the Broiler Chickens

Parameters	**Treatments**					
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**
ALP (u/l)	317.5	226.5	328.5	347.5	200.5	0.621
AST (u/l)	93.5	88	127.5	101	108	0.132
ALT (u/l)	22	129	69.5	23.5	55.5	0.264
Na (mmol/l)	142	142	138	142.5	140	0.957
K (mmol/l)	5.15	4.0	4.65	5.85	5.1	0.466
CL (mmol/l)	106.5	116.5	100.5	102.5	101.5	0.827

There were non-significant differences among the treatments in ALP, AST, ALT. Na, Cl and K. ALP values of all the treatments were higher than the reference range values. Treatment 5 and treatment 4 recorded the lowest and highest values for ALP. AST values of all the treatments were within the reference range values. Although no significance between the treatments statistically, treatment 3 had the highest value numerically and treatment 2 had the lowest. ALT values of treatments 1and 4 were within the reference range while treatments 2, 3 and 5 had values higher than the reference range. Treatment 1 had the lowest value and treatment 2 had the highest.

Na values of the treatments were within the reference range. Treatment 1 and 2 recorded the same values. Treatment 4 and treatment 3 had the highest and lowest values respectively. K values of all the treatments were higher than the reference range except treatment 2 which was within the range. Cl values of all the treatments were within the reference range. Treatment 2 had the highest Cl value while treatment 3 had the lowest.

DISCUSSION

Growth Performance of the Broiler Chickens

Supplementation of garlic as feed additive did not have effect on feed intake of broiler chickens in this experiment. A significant (P<0.05) decreased feed intake was observed among the treatments fed garlic and this may be due to the strong odour of garlic as reported by Onu (2010). This result is in agreement with the result of Rahmanetjad*et al.* (2009) which reported that the inclusion of garlic as a feed additive at 1000 g/tonne did not have effect on the feed intake as well as on weight gain and feed conversion ratio in broiler chickens. Horton *et al.* (1991) also reported that inclusion of garlic in the diets of male broiler chickens did not improve performance of the chickens. The studies of Rahardja*et al*. (2010) is in contrast with this result as it observed an increase in feed intake of laying hens fed garlic at 1%, 2% and 4%.

Chickens fed with garlic supplemented diet had the least body weight gain in this experiment. Also, chickens fed with garlic had the highest FCR although not statistically significant (P>0.05) it is indicative of poor feed conversion efficiency. This maybe as a result of the short period of the experiment as some of the effect may take a longer time to manifest and may not be noticeable at the starter phase Antibiotic had more effect on body weight gain of broiler chickens in this research. This result correlates the reports of other studies that supplementation of garlic in the diets of broiler chickens had little or no influence on the performance of broiler chickens (Freitas et al., 2001; Demir et al., 2003). Fadlalla*et al*. (2010) reported non-significant effect on the body weight and feed conversion ratio of birds fed garlic powder. Aji*et al*. (2011) also reported non-significant effect of garlic on feed conversion ratio. Farhad*et al*. (2011) reported a significant decrease in the body weight and daily weight gain of birds fed with blends of medicinal herbs: garlic, cinnamon, thyme, rosemary and anise in comparison with the control treatment. However, this research is not in conformity with the results of Kumar et al. (2010) which reported a significant increase in the body weight of broilers given garlic as growth promoter at starter level.

Among the treatments fed garlic treatment 4 had a better FCR (3.32) as compared to treatment 3 (3.70) and treatment 5 (3.77). Treatment 4 also had the highest weight gain/ bird and daily weight gain (314.89g, 11.25g/day) in comparison to treatment 3 (290.88g,10.39g/day) and treatment 5 (279.16g,9.97g/day) although they were all statistically same. Treatment 4 also had the highest final body weight (423.81g) numerically although statiscally non-significant (P>0.05). These values can suggest best dosage of garlic for performance of broiler chickens at starter phase.

Serum Biochemistry of the Broiler Chickens

ALP, ALT and AST are also referred to as liver enzymes as they are liver bio-markers. They are used to indicate an injury or damage to the liver. Serum ALP, AST and ALT were not significantly different between the treatments in this research. This is in line with the results of Kumar *et al.* (2013) which stated no significant changes in ALP of broiler fed garlic. Also, Demir*et al.,* (2003) and Dieumou*et al.* (2009) reported garlic had no significant effect on serum AST and ALT which is in agreement with this result. However, Rehman*et al.* (2011) reported a significant decrease in the serum ALP, AST and ALT of broilers given aqueous extract of a mixture of garlic, berberine, aloe vera and ginger. ALP values were higher than the reference range in this research. This may be as a result of the age of the birds as ALP level is higher in young animals as a result of rapid bone growth (Kaneko *et al.,* 2010). ALP is an indicator of liver health and can also be used to assess renal function (Basten, 2010). It is found in the bile duct, bone and kidney. AST values of treatments in this research were within the reference range and this indicates a normal liver function. An increase in AST value indicates liver injury, shock or chronic liver problem (Basten, 2010). Treatments 2, 3 and 5 showed high level ALT above the reference range. High level ALT may indicate active hepatitis due to drug, virus or toxins (Basten, 2010). Treatment 2 had the highest ALT value in this study which may be an indication of effect of the antibiotic on liver.

Na, K and Cl are blood electrolytes and help to maintain blood and tissue fluids in balanced state. All the serum electrolytes were within normal range except potassium values of T1, T3, T4 and T5. A study by Aka *et al.* (2010) observed a significant decrease in the serum Na and Ca with increase in garlic supplementation which is usually the result of increase in excretion of the Na and Ca. This is associated with increased water loss and suggests that increased dosage of garlic leads to hyponatranaemia and hypocalcaemia. In this study the supplementation of garlic at 1% (T3) showed lower sodium level while at higher dosage 2% (T4) and 3% (T5) there was an increase in the Na level.

Conclusion

Based on the results obtained from this experiment, garlic powder as feed additive did not have an effect on the growth performance of the broiler chickens at starter phase. There was also no effect on the serum biochemistry statistically. However, the treatments supplemented with garlic powder showed a lower level of liver enzymes activity an indication of a more healthy liver status. Treatment 4 (2% garlic) was concluded as the most effective

dosage on BWG, FCR and FI as compared to other garlic supplemented treatments. More research need to be done on garlic as a natural growth promoter; the best dosage to be supplemented, the best form of supplementation (powder, aqueous or oil) and the duration of usage to obtain best result. Also, studies on processing methods that will decrease the strong odour of garlic without reducing its beneficial compounds should be done so as to avoid the risk of decreased feed intake which may be due to the odour as observed in this research. Researches on other plants and herbs such as ginger, turmeric, cloves and onion should be done to ascertain the benefits of natural compounds as growth promoters and their effect on animal production. These plants and herbs can be studied singly or as mixtures to obtain the best results that will make commercial producers embrace their use.

REFERENCES

Adene, D.F. and A.E. Oguntade (2006). *The structure and importance of the commercial and rural based poultry industry in Nigeria*. Nigerian Poultry Sector Report, FAO (Rome) study.Pp 55

Aji, S.B., K. Ignatius, Y.A Ado, J.B. Nuhu, A. Abdulkarim, U. Aliyu, M.B. Gambo, M.A. Ibrahim, H. Abubakar, M.M. Bukar, H.M. Imam, P.T. Numan (2011). Effects of feeding onion and garlic on some performance characteristics of broiler chickens. *Research Journal of Poultry Sciences*, 4(2): 22-27.

Al-amin, Z.M., M. Thompson, KK.Al-Qattan, R. Peltonen-Shalabyand M. Ali (2006). Anti-diabetic and hypolipideamic properties of ginger (*Zingiberofficinale*) in streptozotocin-induced diabetic rats. *British Journal of Nutrition*, 96: 660-666.

Alexander,T.W., L.J. Yanke, E.Topp, M.E. Olson, R.R. Read, D.W. Morck and T.A. McAllister (2008). Effect of subtherapeutic administration of antibiotics on the prevalence of antibiotic-resistant *Escherichia coli* bacteria in feedlot cattle. *Applied Environmental Microbiology*, 74: 4406-4416.

Ali, B.H., G. Blunden, M.O. Tanira and A. Nenmar (2008). Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiberofficinale*). A review of recent research. *Food, Chemical and Toxicology*, 46: 409-420.

Basten, G. Dr. (2010). *Introduction to clinical Biochemistry: interpreting blood results*. Graham Basten (Dr.), (Ed.). Ventus publishing.Pp 23

Biovet S and Laboratories A. (2005). The intensive Production and the spreading of high productivity genetic stocks have conditioned the common use of chemical substances known as "Growth Promoters''. www.Thepigsite.com/articles.Pp 12

Borajzanizadeh, M., M. Eslami, M.B. Pour, M. Chaji and J. Fayazi (2011). The effect of clove and oregano on economic value of broiler chicken diet under hot weather condition of Khuzesta. *Journal of Animal and Veterinary Advances*, 10 (2): 169-173.

Butaye, P., L.A. Devriese and F. Haesebrouck (2003). Antimicrobial growth promoters used in animal feed: Effects of less well known antibiotics on gram-positive bacteria. *Clinical Microbiology Rev*iews, 16:175-188.

Brussels, A.N (2005). Ban on antibiotic as growth promoters in animal feeds enters into effect. European Commission, Reg. 1831/20031 EC.Pp 66

Demir, E., S. Sarica, M.A. Ozcan and M. Suicnez (2003). The use of natural feed additives as alternatives for an antibiotic growth promoter in broiler diets. *British Journal of Poultry Sci*ence, 44: 44-45.

Dibner, J.J. and P. Buttin (2002). Use of organic acids as a model to study the impact of gut microflora on nutrition and metabolism. *Journal of Applied Poultry Research*, 11: 453-463.

Dieumou, F.E., A. Teguia, J.R. Kuaite, J.D. Tamokou, N.B. Fonge and M.C. Dongmo (2009). Effects of ginger (*Zingiberofficinale*) and garlic (*Allium sativum*) essential oils on growth performance and gut microbial population of broiler chickens. *Livestock research for Rural Development*, 21(8):

Fadlalla, I.M.T., B.H. Mohammed and A.O. Bakhiet (2010). Effect of feeding garlic on the performance and immunity of broilers. *Asian journal of poultry science*, 4(4): 182-189.

Farhad, K., S. Ghorbanali, K. Ahmad and V. Asad (2011). Evaluation of different medicinal plants blends in diets for broiler chickens. *Journal of Medicinal Plants Research*, 5: 1971-1977.

Freitas, J.B., R.T. Fonseca, R.N. Soares, H.S. Rostagno and P.R. Soares (2011). Utilization of garlic (*Allium sativum L.*) as growth promoter of broilers. *RevistaBrasileira de Zootechnia,* 30: 761-765.

Iji, P.A., A.A. Saki and D.R. Tivey (2001). Intestinal structure and function of broiler chickens on diet supplemented with a mannan oligosaccharide. *Journal of the Science of Food and Agric*ulture, 81: 1186-1192.

Kaneko,J.J., J.W. Harvey, M.L. Bruss (1997). *Clinical biochemistry of domestic animals*. Academic press, Califonia, USA.Pp 45

Kumar, S., A. Kumar and A. Chandra (2013). Alteration in serum biochemical parameters due to garlic (*Allium sativum*) supplementation in broilers diets. *African Journal of Biotechnology,*12(29): 4691-4698.

Kumar, S., K.C. Sharadamma and P.M. Radhakrishna (2010). Effects of a garlic active based growth promoternon growth performance and specific pathogenic intestinal microbial counts of broiler chicks. *International Journal Poultry Science,* 9: 244-246.

Manesh, M.K., S. Kazemi and M. Asfari (2012). Influence of poly germander (*Teucriumpolium*) and watercress (*Nasturtium officinale*) extract on performance, carcass quality and blood metabolites of male broilers. *Research Opinions in Animal and Veterinary Sci*ence, 2: 66-68

Onu, P.N (2010). Evaluation of two herbal spices as feed additives for finisher broilers. *Biotechnology Animal Husbandry*, 26 (5-6): 383-392.

Panda , K., S.V.R. Rao and M.V.L.N. Raju (2006). Natural growth promoters have potential in poultry feeding systems. *Feed Technology*, 10: 23-35.

Rahardja,D.P., M.R. Hakim, W. Pakiding and V.S. Lestari (2010). Hypocholosterolemic effect of garlic powder in layig hen: low cholesterol egg? *Journal of Indonesian Tropical Animal Agriculture*, 35:16-21.

Rahmatnejad, E., H. Roshanfekr, O. Ashayerizadeh, M. Mamooee and A. Ashayerizadeh (2009). Evaluation of the effect of several non-antibiotic additives on growth performance of broiler chickens. *Journal of Animal and Veterinary Advances,* 8 (8): 1670-1673.

Rehman, S.U., F.R. Durrani, C. Naila, U.K. Rifat and F. Rehman (2011). Comparative efficacy of different schedules of administration of medicinal plants infusion on hematology and serum biochemistry of broiler chicks. *Research Opinions in Animal and Veterinary Sciences*, 1(1): 8-14.

Tapsell, L.C., I. Hemphill, L. Cobiac, C.S. Patch, D.R. Sullivan, M. Fenech and K.E. Inge (2006). Health benefits of herbs and spices: the past, the present, the future. *The Medical Journal of Australia*, 185: 4-24.

Wang, R.J., D.F. Li and S. Bourne (1998). Can 2000 years of herbal medicine history help us solve problems in the year 2000? In T.P. Lyons(Ed.), *proceedings of Alltech's 14th annual symposium*. Biotechnology in the feed industry (pp 273-291). Nicholasville, KY: Alltech Technical Publications, Nottingham University Press.Pp 67

Wenk, C. (2000). Why all the discussion about herbs? In T.P. Lyons (Ed.), *proceedings of Alltech's 16th annual symposium*. Biotechnology in the Feed Industry (pp 79-96). Nicholasville, KY: Alltech Technical Publications, Nottingham University Press.Pp 43

Zhang , G.F., Z.B. Yang , Y. Wang, W.R. Yang, S.Z. Jiang and G.S. Gai (2009). Effects of ginger root (*Zingiberofficinale*) processed to different particle sizes on growth performance, antioxidant status and serum metabolites of broiler chickens. *Journal of poultry Science,* 88: 2159-2166.

COMPARATIVE PERFORMANCE OF TWO STRAINS OF LAYER CHICKS FED HONEY AS REPLACEMENT OF ANTIBIOTICS

M. N. SABO, M. UMAR AND L. A. SAULAWA

Department of Animal Science, Federal University Dutsin-Ma

ABSTRACT
The present study examined the comparative performance between two strains of layer chick reared in the semi-arid region and fed honey in place of antibiotics. Two egg layer strains, made up of one brown (Lohman Brown classic), one black (Nera Black) were sourced from reputable hatchery. Eighty eight day old chicks from each of the strains were in a 2 x 2 factorial arrangement in a completely randomized design with the two strains (Lohmann brown classic and Nera black) and administration of honey (with and without) as the factors. These made up four treatments which were replicated thrice with 22 chicks per replicate. Feed intake and body weight were measured and weight gain and feed conversion ratio were determined. The results of the study showed that performance parameters of two strains measured were statistically similar except for Mortality. Nera black strain had a higher mortality. The total feed cost of the brown strain was higher having ₦240.768 as compared with Lohmann Brown strain having ₦220.096. Even though there are no significant differences between the treatments in feed cost per kg gain, numerically brown strain had higher feed cost per kg gain (₦455.240) than Black strain (₦450.371) birds. Feeding honey as replacement for antibiotics did not affect (P>0.05) final weight, weight gain, total feed intake FCR and total water intake. Mortality is slightly higher (P<0.05) for layer strain chicks that are not fed water with honey then those fed water with honey.
Keywords: Strain, semi-arid, honey, performance, chicks

INTRODUCTION
The egg industry is enjoying increased production as consumers become more educated about the nutritive value of eggs and as more eggs are processed (Leeson and summers, 2005). Eggs are relatively inexpensive per unit of protein and energy contained in yolk and albumen, and so egg consumption continues to increase in developing countries (Leeson and summers, 2005). Most of the major international poultry breeders are located in temperate countries while much of the world's poultry production takes place under more extreme temperature conditions in the tropical regions. Often humid conditions are very extreme, in addition to the prolonged periods when the temperature is over 30°C (Gowe and Fair full 2008).

The availability and affordability of eggs and poultry meat will go a long way to meet the protein needs of several populations in hot regions. An obvious constraint on poultry production in these regions is the climate. It is certain that the genetic potential of poultry is greatly affected by the environment. It is in response to some of these questions that this study will be conducted to evaluate comparative performance of commercial layer strains reared in semi-arid tropics and fed honey as replacement for Antibiotics.

MATERIALS AND METHODS
The study was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma lies on latitude 12°26'N and longitude 07°29'E (Abaje *et al.*, 2014).

Two egg layer strains, made up of one brown (Lohman Brown classic), one black (Nera Black) were sourced from reputable hatchery. Eighty eight day old chicks from each of the strains were in a 2 x 2 factorial arrangement in a completely randomized design. The two strains (Lohmann brown classic and Nera black) and administration of honey (with and without) served as the factors giving four treatments and replicated thrice with 22 chicks per replicate.

The chicks were reared in floor pens covered with a thick layer of wood shavings. The birds were reared up to 8 weeks of age. Feed and water were supplied *ad libitum* during the whole period. They were fed diet having crude protein contents of 20.0% and energy contents of 2,800kcal/kg (NRC, 1994; Leeson and Summers, 2005). A given quantity of feed was measured and fed to the birds on a weekly basis. From which weekly feed intake was measured. The birds were weighed in the early

morning before receiving any feed and water using a weighing balance at two weeks' interval during the experimental period. Initial and final body weights of the birds were measured at the beginning and end of the experiment respectively. Average daily weight gain and feed conversion ratio were determined. Water intake was also determined. Mortality was recorded. Data from all experiments were analyzed using the general linear models (GLM) procedure of SAS software (SAS Institute Inc., 1994) according to a completely randomized design. Data were subjected to analysis of variance. Where the analysis of variance is significant, Duncan's multiple range test was used to separate the treatment means (Steel and Torrie, 1980).

RESULT AND DISCUSSION

The growth performance of chicks of two strains of commercial layer chicken is shown in Table 1. All the performance parameters of two strains measured in this study were statistically similar except for Mortality. Contrary to this Olawumi and Dudusola (2012) and Yakubu *et.al* (2007) reported that Nera black genotypes are more feed efficient and converted feed given to produce more egg than Lohman brown strain under the same condition. The only explanation for these differences may be attributed to genotype variability.

Table 1: Performance of Chicks of two Strains of Commercial Layer Chickens in Semi-Arid Region (0-10 weeks)

Parameter	Brown strain	Black strain	SEM
Initial weight (kg/bird)	0.036	0.032	0.001
Final weight (kg/bird)	0.529	0.569	0.021
Total weight gain (kg/bird)	0.493	0.537	0.021
Total feed Intake (kg/bird)	1.448	1.584	0.014
Feed conversion ratio	2.955	2.963	0.130
Total feed cost (₦/bird)	220.096	240.768	5.600
Feed cost/kg gain (₦)	455.240	450.376	7.002
Mortality	2.750[b]	4.250[a]	0.382

a, b, c, d, e, = Means within rows with different superscript are significantly different ($p<0.05$).

There was difference between the two layer strains in terms of total feed cost of the two layer strains. The total feed cost of the brown strain was higher having ₦240.768 as compared with Lohmann Brown strain having ₦220.096. The black strain has higher total feed cost than the brown strain because the Black strain had higher feed intake, which translates to the higher feed cost. Even though there are no significant differences between the treatments in feed cost per kg gain, numerically brown strain had higher feed cost per kg gain (₦455.240) than Black strain (450.371) birds. This is because black strain had higher FCR (2.963) than brown strain (2.955) but the lower the better FCR.

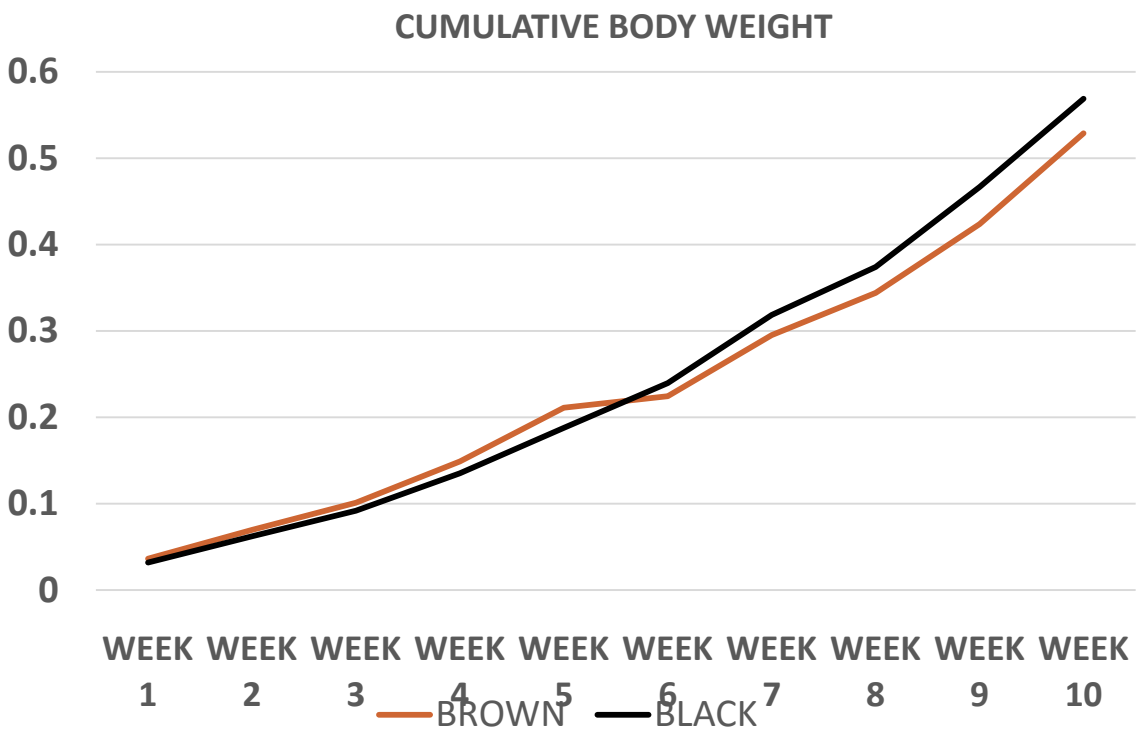


Fig. 1: Cumulative Weight Gain of Commercial Layer Strain Chicks Reared in Semi-Arid Tropics

The cumulative weight gain of commercial layer strain chicks reared in semi-arid tropics shown in figure 1. The body weight of the Brown strain is slightly higher than black strain at initial stage but decline at 6 weeks while Black strain continuously increasing.

Main effect of Strain of Commercial Layer Strains fed honey as replacement for antibiotics (7-10 weeks)

The initial weight, total feed intake and water intake were statistically different for the two strains of the layer chicks fed honey as replacement for antibiotics as shown in table 2. Total feed intake was higher ($P<0.05$) for the black strain (1.253kg/bird) compared to the brown strain (1.127kg/bird). The black strain also consumed more ($P<0.05$) water (290.800 ml/bird) than the brown strain (243.297 ml/bird). The final weight, weight gain, FCR and mortality were similar ($P>0.05$) for the two strains.

Table 2: Performance of Chicks of two Strains of Commercial Layer Chickens Fed Honey as Replacement for Antibiotics (7-10 weeks)

	Initial weight	Final weight	Weight gain	Total feed Intake	FCR	Total Water Intake	Mortality
Strain							
Brown	**0.295**	**0.529**	**0.234**	**1.127^{b}**	**4.964**	**243.297^{b}**	**1.000**
Black	**0.318**	**0.569**	**0.251**	**1.253^{a}**	**5.128**	**290.800^{a}**	**1.750**
SEM	**0.005**	**0.021**	**0.019**	**0.011**	**0.440**	**6.957**	**0.426**
Honey							
Water + honey	**0.317**	**0.534**	**0.217**	**1.172**	**5.502**	**267.090**	**0.750^{b}**
Water – Honey	**0.297**	**0.564**	**0.267**	**1.208**	**4.589**	**267.007**	**2.000^{a}**
SEM	**0.005**	**0.021**	**0.019**	**0.011**	**0.440**	**6.957**	**0.426**

a, b, c, d, e, = Means within rows with different superscript are significantly different ($p<0.05$).
FCR – Feed conversion ratio

Main effect of honey fed to Commercial Layer Strains as replacement for antibiotic (7-10 weeks)

The final weight, weight gain, total feed intake FCR and total water intake were similar (P>0.05) for layer strain chicks fed water with or without honey as replacement for antibiotics as shown in table 2. Mortality is slightly higher (P<0.05) for layer strain chicks that are not fed water with honey then those fed water with honey. This agrees with the observation of Babaei *et al.* (2016) who reported that feed intake was not affected when they fed honey to Japanese quails. Contrary to the results of this study Babaei *et al.* (2016) observed differences in the weight gain and FCR of Japanese quails fed honey.

Conclusion and Recommendation

From the result of the study, the two layer strains performed similarly in all measured parameters except for mortality which was higher for Nera black strain. Feeding honey in place of antibiotic reduced mortality of layer strain chicks. More researches should be conducted to further compare the performance of different layer strains chicks during laying phase and the mechanism of action of honey as replacement for antibiotics.

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REFERENCES

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology*; Vol. 6, No. 2; 2014

Babaei, S., Rahimi, S., Torshizi, M. A. K., Tahmasebi, G. and Miran, S. N. K. (2016). Effects of propolis, royal jelly, honey and bee pollen on growth performance and immune system of Japanese quails. *Veterinary Research Forum*, 2016 Winter; 7(1): 13-20

Gowe, R. S. and Fairfull, R. W. (2008). Breeding for Resistance to Heat Stress. In N.J. Daghir. (Ed) Poultry production in hot climates (2nd ed.) CABI, Massachusetts Cambridge, USA

Leeson, S. and Summers, J.D. (2005). *Commercial Poultry Nutrition*, Third Edition. Nottingham University Press, Nottingham, England.

National Research Council, (1994). *Nutrient requirement of poultry*. 9th revisededition. National Academy of Sciences, Washington DC. 45pp

Olawumi S. and Dudusola I. (2012). Part-term performance traits of commercial layer strains in the derived Savannah zone of Nigeria. *Journal of Animal Science Advances* 2:332-337.

Statistical Analysis System, (1994). Statistical users guide. SAS institute Inc. Cary, North Carolina, U.S.A.

Steel, R.O.G. and Torrie, J.H. (1980). Principles and Procedures of Statistics. A biometrical approach. Students edition. McGraw-Hill Int. Books Co. London.

Yakubu A, Salako AE, Ige AO (2007). Effects of genotype and housing system on the laying performance of chickens in different seasons in the Semi-Humid Tropics. *International Journal of Poultry Science* 6:434-439.

EFFECT OF SPLIT MEALING ON GROWTH PERFORMANCE OF PIGS

M.H. Ogunsipe, I. Ibidapo and O.A. Dada

Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria

Corresponding author: moogunsipe2009@yahoo.com moogunsipe2009@gmail.com ogunsipemh@aceondo.edu.ng

Abstract

The study examined the performance and cost implications of pigs on split mealing. Forty five (45) weaner pigs (Large white x Landrace) were allotted to three (3) treatments replicated 15 times of a pig per replicate in a completely randomized design in a feeding trial that lasted for 112 days. The treatments imposed were based on frequency of one or two or three meals a day. A measured quantity of feed at 5% body weight were made into either one or two or three portions and fed once or twice or thrice at 8.00 am or 8.00 am and 12.00.pm or 8.00 am and 12.00 pm and 4.00 pm, respectively throughout the experimental period. Data collected on daily feed intake and weekly weight gain were analyzed by one way analysis of variance using SPSS and differences in means where significant were separated using Duncan option of the software. Feed intake and weight gain of pigs were not influenced (P>0.05) by the frequency of feeding. Although, numerical improvement by 11.71% in the weight gain and 9.17 – 15.96% in feed intake were observed in pigs fed three times daily compared with those fed once or twice daily. Cost of pig production showed that the cost of feed expended to gain a kilogram weight of pigs was lesser in pigs fed twice (₦328.37) or thrice (₦343.45) a day when compared with those fed once daily (₦355.29). The study showed that feeding pigs' on split meal thrice daily improved weight gain with lower cost of production. Pig farmers are encouraged to feed their pigs thrice a day for better growth and higher economic advantage.

Keywords: economic advantage, performance, pigs, split mealing.

Introduction

Profitable pig enterprise is anchored on the efficient use of feed resources to optimize growth and minimize cost. Attempts to enhance the utilization of alternative feed resources such as agro-industrial wastes has largely proved not to be very effective due to quality concerns such as low protein content, high fibre content and anti-nutritional properties. Since most of the alternative energy and protein sources are not widely accepted as first choice in livestock feed formulation, researchers are now evolving a feeding management strategy that will promote good growth and ensure lean carcass meat.

The choice of feeding periods for pigs is based entirely on nutritional and economic considerations (INRA, 1984). For example, feeding restriction is commonly practiced with market pigs to improve carcass quality and feed efficiency while decreasing production costs (Wood *et al.*, 1996; Candek Polokar *et al.*, 1998), whereas free access to a low protein diet increases back fat thickness and intramuscular content (Gondret and Lebret, 2002).

In Nigeria, most farmers feed their pigs once daily while others allow the animals' free access to agro-by-products throughout the day. In conventional pig feeding management, however, more variable feeding management systems are applied.

The question of how often the pigs should be fed for efficient feed utilization still remains unanswered. The present study was to assess the effect of split mealing on the performance and cost implications of weaned pigs.

Materials and methods

The study was carried out at the Pig Unit, Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria. A basal diet was formulated (Table 1) to meet the nutrients requirements for pigs (NRC, 2012).

Table 1. Gross composition of experimental diet, g/100g

Ingredients	Composition
Maize	53.8
Groundnut cake	8.13
Soybean meal	10.8
Palm kernel cake	15.5
Wheat offal	9.97
Limestone	0.50
Premix	0.50
Lysine	0.15
Methionine	0.15
Salt	0.50
Total	100

A measured quantity of feed at 5% body weight were made into either one or two or three portions and fed once or twice or thrice daily at 8.00 am or 8.00 am and 12.00.pm or 8.00 am and 12.00 pm and 4.00 pm, respectively throughout the experimental period. A total of forty five (45) weaner pigs (Large white x Landrace) of mixed sexes were randomly distributed to the three (3) treatments of 15 replications of a pig per replicate in a completely randomized desgn. Data collected on daily feed intake, weekly weight gain and calculated values for feed conversion ratio were analyzed by one way analysis of variance using SPSS and differences in means were separated using Duncan option of the software

Results and discussion

The numerical improvement in feed intake, weight gain and feed conversion ratio of pigs in this study is in agreement with the study on broiler chickens (Urdaneta – Rincon and Leeson, 2002; Tolkamp *et al.*, 2005; El-Fiky *et al.*, 2008; Chris *et al.*, 2011). Gaber and Hanafy (2008) reported that offering little quantities at time intervals improved feed utilization with concomitant increase in weight gain. From the economic indices measured, feeding pigs on split meals of twice or thrice daily recorded higher economic advantage compared with offering the whole feed in a single meal. The profitability ratio further confirms the economic benefit of employing split feeding in the management of pigs.

Table 2. Performance and economics of production of pigs on varying feeding frequency

	Frequency of feeding, in days				
	Once	Twice	Thrice	SEM	Sig
Performance indices					
Initial body weight, kg/pig	6.67	6.63	6.63	0.77	0.83
Final live weight, kg/pig	55.33	55.33	62.67	4.06	0.74
Average weight gain, kg/pig	0.44	0.44	0.50	0.32	0.62
Average feed consumed, kg/pig	1.32	1.22	1.45	0.11	0.65
Feed conversion ratio	3.01	2.78	2.88	0.08	0.26
Cost and Returns					
Cost					
Purchase price	3335	3315	3315		
Labour	450	450	450		
Pen maintenance	125	125	125		
Depreciation on building	87.75	87.75	87.75		
Cost of feed, N/kg	118.43	118.43	118.43		
Cost of feed, ₦/kg weight gain	355.29	328.37	343.45		
Cost differential, N	-	26.92	11.84		
Relative cost benefit, %	-	7.58	3.33		

Cost of weight gain, ₦	17363.02	16065.03	19116.97
Total cost, ₦	21360.77	20042.78	23094.72
Returns			
Return on sale, ₦	27665	27665	31335
Net profit, ₦	6304.23	7622.22	8240.28
Profit/kg over control group, ₦	-	1317.99	1936.05
% Profit over control group	-	20.91	30.71
Profitability ratio			
Benefit cost ratio (BCR)	1.29	1.38	1.36
Rate of return (ROR)	0.29	0.38	0.36
Gross ratio (GR)	0.77	0.72	0.74

Conclusion

Judging from the result of this study, feeding pigs on split meals twice or thrice daily enhanced weight gain, reduced cost of feeding and yielded higher profit compared with offering the whole feed in a single meal. Pig farmers are encouraged to employ split feeding in pig production.

References

Candek-Polokar, M., Lefaucheur, L., Zlender, B. and Bonneau, M. (1998). Effect of age and weight at slaughter on longissimus dorsi muscle: biochemical traits and sensory quality in pigs. *Meat Sci.*, 48: 287-300.

Chris, B., Ndome, A.O. and Alfred, A. (2011). Effect of feeding frequency on feed consumption, growth and feed conversion of Clarias gariepinus × Heterobranchus longifillis & hybrids. *American-Eurasian J. Sci. Res.*, 6: 06-12.

El-Fiky, A.M., Soltan, F.H., Abdou, S., El-Samra, C.S. and El-Neney, B. (2008). Effect of light regime and feeding frequency on some productive physiological traits and hormonal profiles in broiler chicks. *Egypt Poult. Sci.*, 28: 711-743.

Gaber, M.A.N. and Hanafy, M.A. (2008). Relationship between dietary protein source and feeding frequency during feeding Nile Tilapia, Oreochromis niloticus (L) cultured in concrete tanks. *J. Appl. Aquacul.*, 20: 200-212.

Gondret, F. and Lebret, B. (2002). Feeding intensity and dietary protein level affect adipocyte cellularity and lipogenic capacity of muscle homogenates in growing pigs, without modification of the expression of sterol regulatory element binding protein. *J. Anim. Sci.*, 80: 3184-3193.

INRA (1984). L'Alimentation des animaux monogastriques: Porc, lapin, volailles. (Institute National de la Recherche Agronomique). INRA Paris.

NRC. National Research Council (2012). Nutrient Requirements of Swine. 11th revised edition, National Academy of Science, Washington, DC.

Tolkamp, B., Sandilands, J.V. and Kyriazakis, F.U. (2005). Effects of qualitative feed restriction during rearing on the performance of broiler breeders during rearing and lay. *Poult. Sci.*, 84: 1286 – 1293.

Urdaneta – Ricon, I.N. and Leeson, S. (2002). Quantitative and qualitative feed restriction on growth, characteristics of male broiler chickens. *Poult. Sci.*, 81: 679-688.

Wood, J.D., Brown, S.N., Nute, G.R., Whittington, M., Perry, A.M., Johnson, S.P. and Enser, M. (1996). Effects of breed feed level and conditioning time on the tenderness of pork. *Meat Sci.*, 44: 105-112.

HEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF JAPANESE QUAILS FED DIFFERENT ENERGY SOURCES IN SEMI ARID ENVIROMENT OF GASHUA, YOBE STATE

BY

Maidala, A., lawan, A., Amaza, B.I., Sudik, S.D., Dunya, M.A., Adejumo, I.O., Makinde, O.J., Hanafi, S. and Bomoi, A.

Federal University Gashua Yobe State, Nigeria

aminumaidala@fugashua.edu.ng, aminunyari@gmail.com, drmaidala@yahoo.com

+2348035914479

Abstract

An experiment was conducted to assess the effect of millet and sorghum as alternatives to maize on hematology and serum biochemical parameters of quails. Three hundred (300) day old quails were sourced form National Veterinary Institute Jos. The birds were brooded for two weeks and randomly allotted to three (3) different energy sources i.e. maize, millet and sorghum designated as treatment 1, 2 and 3 respectively. The birds were fed with experimental diets for eight weeks and blood were collected for hematology and serum biochemical parameters. Results showed that packed cell volume (50.20-56.00), red blood cells (4.72-5.21) and hemoglobin (16.98-18.38) were statistically similar (P>0.05). The serum biochemical parameters showed that total protein (36.20-39.80), globulins (11.60-14.44), total protein (36.20-39.80), glucose (12.68-14.82), cholesterol (5.36-6.78), urea (17.80-20.00) and ASAT (1.98-2.08) were not affected by the different energy sources (P>0.05). It can be concluded that the alternative energy sources can be used in quail's production without deleterious effects on hematology and serum biochemistry of quails in semiarid environment.

Keywords: Quail's, energy sources, hematology, serum biochemistry

Introduction

Nigerian livestock industry has been greatly affected by high cost of feed which is reported to account for 60-85% of the total cost monogastric production (Sanni and Ogundipe, 2005). This high cost of feeds has necessitated the search of alternative energy sources. Maize is the major source of energy in poultry feeds and energy constitute about 40% of the feed cost in livestock production in Nigeria (Ijaiya et al., 2012). Maize also serves as staple food for good proportion of Nigerians. The ever growing demand for maize for human consumption, livestock feeds and some industrial uses has pushed its market price to an alarming height (Odukwe, 1994). This is because maize is high in energy and forms the standard (100) against which other cereals grains is compared (Atteh, 2002). Therefore, any cereal can be alternative to maize in poultry feed industry and could be the only immediate solution to reduce cost of poultry production. Hematological and serum biochemical parameters could serve as a baseline line information for comparisons of nutrient deficiency, physiology and health status of farm animals (Daramola et al., 2006: Maidala *et al.*, 2014). The aim of this research work is to evaluate the use of millet and sorghum as alternative energy sources on hematology and serum biochemical parameters of Japanese quails in semi-arid environment of Gashua, yobe state.

Materials and methods

Study area

The study was conducted in teaching and research farm of Federal University Gashua, Yobe state. Bade local government lies between latitude 10^0 and 11^0 east of Greenwitch and longitude 13^0 and 12^0 north of equator (Geoname/yobe state 2016).

Sources and processing of Ingredients

The millet and sorghum were purchase in Bade Central Market. The supplements were purchase from animal care Kano state. The maize, millet and sorghum were used to formulate the experimental diets which are isonitrogenous and isocaloric, the composition of the experimental diets are shown in Table 1.

Experimental birds and management

Three-hundred-day old quail chicks were sourced from National Veterinary Research Institute Vom, Plateau State. The birds were brooded for two weeks. The birds were randomly allotted to three dietary treatments, there are one hundred birds per treatment replicated five times (twenty birds per replicate) in a completely randomized design (CRD). The experiment lasted for eight weeks.

Blood profile analysis

Ten (10) birds per treatment (i.e. two birds per replicate) were randomly selected, fastened overnight. Samples of blood were collected from the brachial vein using 1ml disposable syringe and needle, the blood were stored in a blood samples bottles with and without anticoagulant (EDTA). Blood samples were analyzed for hematological parameters according to routine available clinical methods described by Baker *et al*. (1998). The biochemical parameters were determined by biuret reaction expanded by Bush, (1975). Data sets generated were subjected to analysis of variance ANOVA SPSSS 2010. LSD was used to separate the means.

Results and Discussion

The percentage composition of the experimental diets is shown in Table 1, the hematological and serum biochemical parameters are shown in Table 2. Results showed that packed cell volume, hemoglobin and red blood cells were not affected by the different energy sources ($P<0.05$), this finding suggested that the alternate energy sources provide enough energy for quail's metabolism. The values are within the normal range of 42 – 45% and 7 – 13g/dl for PCV and Hb (Banerjee, 2009) and 31 – 50% for PCV (Schalm *et al*., 1975). Similarly, the MCH, MCV and MCHC were not affected by different types of energy. The uniform values of the RBC, Hb, MCH, MCV and MCHC obtained in this study indicated that there were normal bone marrow functions, no macrocytic, hypochromic and autoimmune hemolytic anemia. Neutrophils was affected by the different energy sources ($P<0.05$), the neutrophils were better in millet and sorghum diets and this implies higher resistance to infection and bacteria while lymphocytes were better in the control diets. The serum biochemical studies revealed that albumin, total protein, globulins, glucose, chlorine and calcium were statistically similar ($P>0.05$) and this suggest that millet and sorghum can be alternative energy sources. The potassium and bicarbonate were affected across the treatment ($P<0.05$), the control diet had higher values of this mineral compared to alternative energy sources. Similarly, the control diet had higher level of sodium compared to alternative energy sources. The cholesterol, urea, creatine, ASAT, ALP and TB were not affected by the different energy sources ($P<0.05$), and this indicate that the liver and the kidney were physiologically normal. Higher significant values of ALAT ($P<0.05$) were observed in the control diet while the lowest was observed in millet diet, this suggest that millet is safer compared to maize for normal liver functions. Similarly, the CB were statistically higher in the control diet ($P<0.05$) and lowest in millet based diet. Results of this study indicated that the alternative energy sources can replace maize as energy sources in the diets of Japanese quails without adverse effect on hematological and serum biochemical parameters.

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References

Atteh, J.O. (2002). Principles and practice of livestock feed manufacturing. Adlek Printers. Ilorin Kwara State Nigeria, Pp: 13-17.

Baker, F.J., Silverton, R.E. and Pallister, C.J. (1998). Baker and Silverton's introduction to medical laboratory technology. 7th Edition. Butterworth –Heinemann, Linacre House, Jordan Hill Oxford.

Benerjee, G.C. (2008).Textbook of Animal Husbandry. Bidhan Chandra Krishi Viswadyala. Oxford and IBH publishing company. PVT. LTD Bhatti

Bush, B.M. (1975).Veterinary Laboratory Manual. Williams Heinemann Medical book Limited. London, U.K., pp. 447.

Daramola, J.O., Adeloyr, A.A., Fatoba, T.A. and Solladoye, A.O. (2006). Hematology and serum biochemical parameters of west African dwarf goats. livestock research for rural development. 17(8)P3

Ijaiya, A. T., Aremu, A., Egena, S. S. A., Akinwale, M. O., Alao, R. O. and Mamman, H. (2012). Growth, performance and nutrient digestibility of Japanese quails (Coturnix coturnix japonica) fed graded levels of fermented cassava peel meal. In Bitto, I. I., Kaankuka, F. G. and Attah, S. (Eds.) Proceedings of the 37th Annual Conference of Nigerian Society for Animal Production, 18 – 21 March, 2012. University of Agriculture Makurdi, Benue state, Nigeria. Pp 391-394.

Maidala, A., Doma, U.D. and Egbo, L.M.(2014). Heamatological and serum biochemical indices of broiler chickens fed differently processed African locust bean seeds (Parkia biglobosa). Nig. Soc. for Anim. Prod. 16 - 19 March, 2014. Babcock Univ. Ilishan-Remo, Ogun State, Nigeria.

Odukwe, C. A. (1994). The feeding value and composition of cassava root meal for broiler chicks. Ph.D Thesis, University of Nig. Nsukka, Nig. 20-27

Sanni, S.A. and Ogundipe, S.O. (2005). Economics of some modules of poultry production in Kaduna state. *Nigerian Journal of Animal Production* **32** (1):102- 107.

Schalm OW, Jain NC and Caroll EJ 1975. Veterinary Haematology. 3rd ed, Lea and Febiger, Philadelphia.
www.Geoname/yobestate Retrieved 15 march/2015

Table 1: Percentage composition of experimental diets fed to quails

Ingredients	Maize	Millet	Sorghum D
Maize	52.03	00.00	00.00
Millet	00.00	52.03	00.00
Sorghum	00.00	00.00	52.03
Full fat soyabean	29.07	29.07	29.07
Wheat offal	10.00	10.00	10.00
Fishmeal	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00
Lysine	0.20	0.20	0.20
Methionine	0.20	0.20	0.20
Salt	0.25	0.25	0.25
DRPremix*	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis			
Crude protein (%)	21.00	21.00	21.00
Metabolizable energy (kcal/kg)	2879	2745	2725

*****Each kilogram contains Vit A 3600, 000 IU. Vit. D_3 600.000 IU. Vit E 4.000.000mg. Vit B_1-B_6 640, 1600, 600, 4.00mg. Panthothenic acid 2000mg, Biotin 300mg. Manganese 16000mg. Manganese 16000mg. Selenium80mg. Vit. K_3 600mg. Cobalt 80mg. Copper1200mg. Zinc 12,000mg. Folic acid 200mg. Choline chloride700000mg. Antioxidant 500mg.

Table 2: Hematological and serum biochemical parameters of quails fed different energy sources

Parameters	T_1 Maize	T2 Millet	T3 Sorghum	SEM	P-value
Packed cell volume (%)	53.80	56.00	50.20	1.40	0.246
Red blood cells (X 106/mm	5.21	4.91	4.72	0.49	0.321
Haemoglobin (g/dl)	17.49	18.38	16.98	0.45	0.482
MCH (fl)	103.26	114.05	106.36	1.56	0.214
MCH (pg)	0.33	0.32	0.33	1.22	0.078
MHCV (%)	32.51	32.82	33.82	0.56	0.065
Neutrophils	25.20^{b}	32.60^{a}	32.60^{a}	1.45	0.041
Lymphocyte	74.80	67.25	67.40	1.55	0.055
Albumin (g/100ml)	24.60	23.80	25.40	0.52	0.045
Total protein (g/100ml	36.20	37.80	39.80	0.82	0.480
Globulins	11.60	14.00	14.44	0.80	0.207
Glucose (mmol/l)	14.82	12.84	12.68	0.77	0.322
Chlorine	143.40	128.20	131.40	3.80	0.484
Potassium	8.38^{a}	4.83^{b}	4.18^{b}	0.65	0241
Cholesterol	5.36	6.34	6.78	0.29	0.006
Urea (µmol/l)	20.00	18.60	17.80	0.86	0.112
HCO_2	29.00^{a}	18.60^{b}	17.80^{ab}	0.86	0.112
Sodium	168.80^{a}	153.00^{b}	154.00^{b}	2.55	0.070
Calcium	3.20	3.36	3.00	0.07	0.006
AST (UI/L)	2.00	1.94	2.08	0.04	0.242
ALT (UI/L)	124.20^{a}	117.20^{ab}	108.80^{b}	2.64	0.266
ALP (IU/L)	38.80	36.00	32.00	1.06	0.044
TB	302.00	342.00	330.00	17.07	0.659
CB	15.48^{a}	8.38^{b}	10.82^{ab}	1.18	0.029

Means bearing different superscripts were statistically different

EFFECT OF RED HOT PEPPER (*Capsicum annum*) ON PEROXIDE VALUE, FREE FATTY ACID AND THIOBARBITURIC ACID OF MEAT OF HUBBARD BROILER CHICKENS

Makinde, A.A.* Egena, S.S.A . and Otu, B.O

Department of Animal Production, Federal University of Technology, P.M.B. 65, Minna, Niger State, Nigeria.

***Corresponding author email: markbayo16@gmail.com**

2347063191919

Abstract

This study aims to evaluate the effect of using Red Hot Pepper (RHP) as a dietary additive on peroxide value, free fatty acid and thiobarbituric acid levels of meat of Hubbard broiler chickens. For this purpose, 120-day old broiler chickens were fed diets containing varying levels of RHP. The birds were kept on deep litter throughout the duration of the study. A complete randomized design with 4 treatments and 3 replicates per treatment, with 4 levels of RHP supplementation (0%, 1.00%, 1.25%,1.50%) was used for the experiment. Each replicate contained 10 birds making 30 birds/treatment. The results showed that at 8 weeks, addition of RHP did not significantly (p>0.05) effect all the parameters measured. It was concluded that, RHP as an additive in Hubbard broiler chicken's diets had no negative lmpact on the meat quality parameters of interest.

Keywords: Red hot Pepper, Hubbard broilers, peroxide value, thiobarbiturate, free fatty acid.

Introduction

There is growing interest in the use of herbs as growth promoters and additives in the feed of birds. Evidence suggest that some herbs and spices have different active substances (Al-Kassie and Witwit, 2010) which could impact on the productivity of broiler chickens. The inclusion of dried red hot pepper for instance is reported to have a positive effect on the feed consumption of broiler chickens (Yoshioka *et al.*, 1999). Red hot pepper increases the ability of birds to reduce the deposition of cholesterol and fat in the body and contributes to decreasing the level of triglycerides and hence, work to support the vascular system in the body (Al-kassie et al 2010). Hencken (1991) opined that dried red hot pepper is rich in vitamin C which helps tremendously in improving production through its contribution in the reduction of heat stress. Reduction of heat stress is based on the fact that bird's consumption of dried red hot pepper induces a considerable change in energy balance when given free access to food (Yoshioka *et al.*, 2001).

Alkassie *et al.* (2011) revealed from their study, that the inclusion of red hot pepper at levels of 0.50, 0.75 and 1.00% in the diets of hybrid line Ross 308 broiler chickens, improved body weight gain and feed conversion ratio. The investigation of Thiamhirunsopit *et al*. (2014) using different forms of red hot peppers showed that better growth performance was observed in chickens fed experimental red hot pepper treatments in comparison to those fed the control diet. However, research works done to test the response of broiler chickens fed >1.00% red hot pepper is scarce. Therefore, the objective of this study is to evaluate the effect of feeding higher levels (>1.00%) of powdered red hot pepper on peroxide value, free fatty and thiobarbituric acids of meat obtained from Hubbard broiler chickens.

Materials and Methods

The experiment was conducted at Mike farm located at Shango area, Minna, Niger state, Nigeria. Minna is located in the Southern Guinea Savanna zone on latitude 9° 31 and 9° 42' North and Longitude 6° 29 and 6° 41' East with annual rainfall range of 1,200-1,300mm, and temperature range of 38-40^{0}C. The area has an altitude of 1,475m above sea level, and is characterized by two seasons; wet season (April-October) and dry season (November-March).The average temperature is 27.3^{0}C (FUTMIN, 2012).

The powdered hot red pepper was purchased from Minna Central market and was further dried at room temperature to retain its reddish colour and reduce the moisture content. It was ground with a Polystar blender (PV-BL999B, China) to pass through a 1.5mm sieve. Complete randomized design was used for the experiment, with the 120 day old chicks used for the research, divided into four treatment groups each with three replicates of 10 birds per replicate. The same commercial starter and finisher feed were fed to all the birds. The distinguishing factor is the dried powdered red hot pepper which was incorporated into the diets at 0.00, 1.00, 1.25 and 1.50%, respectively. The experimental birds were raised on deep litter. Before the arrival of the birds, the house was cleaned and disinfected with a germicide to avoid transmission of diseases to the new chicks. On arrival of the chicks, their initial body weight was taken and recorded. They were given broad spectrum antibiotics and supplied with anti stress and glucose in water. A known amount of feed was given to the birds in each treatment based on their dietary treatment. They were vaccinated against Newcastle and Infectious bursal diseases. The parameters measured were the peroxide level, free fatty acid level and thiobarbituric acid levels of meat obtained from the broiler chickens. Meat obtained from the chickens were stored at refrigerated temperature (2- 4^0C) and on a daily basis, samples was taken and analysed for a maximum of fourteen days. Meat were sampled at 2 days interval (2, 4, 8, 10, 12 and 14, respectively) and analysed using the method as described by guy et al.,(2013). Data collected were analyzed using the statistical package for social scientists (SPSS, 2016).

Results

The results (Table 1) shows the effect of red hot pepper (*Capsicum annum*) on the peroxide value of meat obtained from Hubbard broiler chickens. There was no significant ($p>0.05$) differences observed between the treatments in the peroxide value on day 2, 4, 6, 8, 10, 12 and 14, respectively. The addition of RHP in the diets of the birds did not also affect ($p>0.05$) the peroxide value cumulatively from day 2-14 days.

Table 1: Effect of red hot pepper (*Capsicum annum*) on the peroxide value of meat from Hubbard broiler chickens

Days	T_1	T_2	T_3	T_4	SEM	LOS
2	64.83	53.00	65.50	67.30	6.59	NS
4	137.92	140.00	118.28	113.18	7.65	NS
6	144.17	149.58	135.17	137.29	8.09	NS
8	156.25	155.42	146.29	138.23	9.58	NS
10	268.33	230.00	265.35	229.69	10.35	NS
12	232.50	251.25	222.39	258.72	14.69	NS
14	258.33	268.33	250.09	282.72	10.70	NS

SEM = standard error of mean; T1= control diet (0% RHP); T2 = RHP inclusion at 1.00%; T3 = RHP inclusion at 1.25%; T4 = RHP inclusion at 1.50%; LS = level of significant; ns = not significant ($p>0.05$).

Presented in Table 2, is the result of the effect red hot pepper (*Capsicum annum*) on the free fatty acid level of meat od Hubbard broiler chickens. The results showed no significant ($p>0.05$) difference between the treatments from day 2 to 14 in the values of free fatty acids. Cumulatively, no significant ($p>0.05$) effect of RHP was observed in the free fatty acid of the meat from birds fed the different inclusion levels of RHP.

Table 2: Effect of red hot pepper (*Capsicum annum*) on free fatty acid level of meat from Hubbard broiler chickens

Days	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**	**LOS**
2	0.66	0.53	0.49	0.66	0.15	NS
4	1.77	1.42	1.67	1.58	0.22	NS
6	1.95	1.80	1.88	2.17	0.25	NS
8	1.88	1.48	1.45	2.37	0.45	NS
10	2.08	1.84	1 .87	2.00	0.25	NS
12	3.09	3.53	3.01	3.32	0.45	NS
14	3.89	3.76	3.78	3.59	0.46	NS

SEM = standard error of mean; T1= control diet (0% RHP); T2 = RHP inclusion at 1.00%; T3 = RHP inclusion at 1.25%; T4 = RHP inclusion at 1.50%; LS = level of significant; ns = not significant ($p>0.05$).

Table 3 shows the result of the effect of red hot pepper (*Capsicum annum*) on the free fatty acid level of meat of Hubbard broiler chickens. The results showed no significant ($p>0.05$) difference between the treatments from day 2 to 14 in the values of free fatty acids. Cumulatively, no significant ($p>0.05$) effect of RHP was observed in the free fatty acid of the meat from birds fed the different inclusion levels of RHP.

Table 3: Effect of red hot pepper (*Capsicum annum*) on thiobarbituric acid level of meat from Hubbard broiler chickens

Days	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**	**LOS**
2	0.14	0.14	0.12	0.14	0.003	NS
4	0.41	0.40	0.42	0.45	0.012	NS
6	0.45	0.46	0.47	0.51	0.14	NS
8	0.58	0.60	0.59	0.51	0.25	NS
10	0.64	0.77	0.72	0.69	0.25	NS
12	0.96	0.97	1.0	0.97	0.16	NS
14	1.52	1.50	1.50	1.63	0.36	NS

SEM = standard error of mean; T1= control diet ($p>0.05$); T2 = RHP inclusion at 1.00%; T3 = RHP inclusion at 1.25%; T4 = RHP inclusion at 1.50%; LS = level of significant; ns = not significant ($p>0.05$).

Discussion

The experiment materials, influences the quality of the fat deposited on broiler carcass (Bai and Lara, 2005). The result of this study showed no difference between birds fed the control and those fed the RHP based diets. This means that meats of the birds fed the control and the RHP based diets are less susceptible to peroxidation and the production of free fatty acid and thiobarbituric acid. Oxidation of meat could reduce the shelf life of meat and meat products. Contrary to results obtained In the current, Puvaca *et al*. (2015) reported that broiler chickens fed diets containing spices achieved better lipid profile status compared with those on un-supplemented feed. This could probably be due to the anti peroxidase effect of the spice used. Possibly, a higher level of RHP in the feed could elicit a similar reaction and or effect.

Conclusion

The results of the study Indicates the the use of dry red hot pepper as an additive up to 1.50%, prevented spoilage of meat obtained from Hubbard broiler chickens. No difference was observed in the peroxide value, free fatty acid and thiobarbituric acid levels of the birds fed the control and those fed the RHP based diets.

References

Al-Kassie, G.A.M. and Witwit, (2010). A comparative study of diet supplementation with a mixture oof herbal plants and dandelion as a source of probiotics on the performance of broilers. *Pakistan journal nutrition* 9:67-71.

Al-Kassie, G.A.M., Al-Nasrawi, M.A.M. and Ajeena, S.J. (2011). The effects of using hot red pepper as a diet supplement on some performance traits in broiler. *Pakistan Journal of Nutrition* 10: 842-845.

Bai N.C and Lara L.J.C, . (2005). Qualide E Digestibilidade De GordURAS e oleos na alimentacao de aves. *In:XI congreso de la amena yl del clana, 2005; cancium mexico* p. 159-177.

Hencken, H. (1991). Cooling the burn from hot peppers. *Journal of the American Medical Association* 266: 2766.

Guy. L and Randal. J k., (2013). Hydrogen peroxide and cell signalling. *Science direct. https//www.sciencedirect.com*

Pucava et all. (2015).effect of phytogenic feed additives (allium sativum L.) ON BROILER CHICKEN NUTRITIO ON BREAST MEAT QUALITY and tissue cholesterol content. *proccedings of international scientific conference*, vukor, Croatia 7:75-80.

SPSS (2016). Statistical Package for Social Scientists. Version 16.

Thiamhirunsopit *et al*. (2014). EFFECT OF CHILI MEAL (Capsicum frutescens LINN.) on growth performance, stress index, lipid peroxidation and ilea nutrient digestibility in broilers reared under high stocking density condition. *Animal feed science and technology*. 192:90-100

Yoshioka, M., St-Pierre, S., Drapeau, V., Dionne, I., Doucet E., Suzuki, M. and Tremblay, A. (1999). Effects of red pepper and caffeine consumption on energy balance in subjects given free access to foods. *British Journal of Nutrition* 80: 503-510.

Yoshioka, M., Doucet, E., Drapeau, V., Dionne, I. and Tremblay, A. (2001). Combined effects of red pepper and caffeine consumption on energy balance in subjects given free access to foods. *British Journal of Nutrition* 85: 203-211.

HAEMATO-BIOCHEMICAL RESPONSE OF GROWING RABBITS FED BOILED AFRICAN STAR APPLE (*CHRYSOPHYLLUM ALBIDUM*) KERNEL MEAL AS REPLACEMENT FOR MAIZE IN THE DIET

MAKINDE O.J[1,2]*., AREMU, A[2]., ALABI O.J.[2,4], JIYA E.Z[2]., OMOTUGBA, S.K[3], SIKIRU, A.B[2], OPOOLA E[4] and IBIKUNLE K.Y[5]

[1]Department of Animal Science, Federal University, Gashua, Nigeria.
[2]Department of Animal Production, Federal University of Technology, Minna, Niger State, Nigeria.
[3]Department of Basic Science, Federal College of Wildlife Management, New Bussa.
[4]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.
[5]National Institute of Hospitality and Tourism, Edo State, Nigeria.

*Corresponding Author's Email- johyinmak@yahoo.com

ABSTRACT:

The effect of dietary boiled African star apple kernel meal (BASAKM) as substitute for dietary maize on haemato-biochemical indices of growing rabbits were investigated. Seventy five 35-d old crossbreed (New Zealand x California white) rabbits weighing 591.00±0.15 g were allotted to 5 treatments (15 rabbits per treatment; 5 rabbits per replicate) in a completely randomized design. Five experimental diets (pelleted; 3 mm diameter and 6 mm in length) were formulated such that BASAKM replaced dietary maize at 0 %, 25 %, 50 %, 75 % and 100 % in rabbit diets (Diets 1, 2, 3, 4 and 5, respectively). A control diet (diet 1) had crude protein: 17 %, crude fibre: 10.35 %, metabolizable energy: 2647.50 kcal/kg. The study lasted for 56-d. At 91 d of age, the neutrophil level of rabbits fed diets 2, 3 and 4 decreased significantly compared to those fed the control diet (-5.20 %, -3.65 % and -9.69 %, respectively; P=0.0384. Results indicate that growing rabbits could tolerate BASAKM in their diets without adverse effect on haemato-biochemical indices of growing rabbits.

Key words: African star apple, Kernels, Maize, Boiling, Rabbits, haemato-biochemical

INTRODUCTION

The inclusion of alternative feedstuffs in animal diets might be interesting in some circumstances (relative price, feed quality), but it is limited because of the lack of information on their nutritive value. This is the case with African star apple (*Chrysophyllum albidum*) kernel meal, a by-product generated after the consumption of the fruits. African star apple (*Chrysophyllum albidum*) popularly called "Agbalumo" among the Yoruba tribe of Western Nigeria is also known as "Agwaluma" and "Udara" in Hausa and Igbo languages respectively. It is primarily cultivated for its sweet fleshy fruits which had been reported as an excellent source of vitamin C, iron, thickener or jam and flavours to diets, and raw materials to some manufacturing industries such as resin (Adisa and Fajola, 2000). Star apple belongs to the *Sapotacae* family and is believed to have originated from the low-lands of Central America and West Indian. It is common in both urban and rural centres in Nigeria especially during the months of December through April. The ripe fruit is highly perishable, and deteriorate within five days of harvest (Adisa and Fajola, 2000). Several researchers (Agbabiaka *et al.*, 2013; Makinde *et al*., 2017) have reported on the nutritional and medicinal importance of *Chrysophyllum albidum*. Apart from the report of Jimoh *et al.* (2014) on haematological changes in the blood of *Clarias gariepinus* fed *Chrysophyllum albidum* seed meal as energy source, there is dearth of information on the potential of African star apple seeds/kernels as alternative feed source. Therefore, this present paper reports experiment designed to investigate the haemato-biochemical indices of growing rabbits fed different levels of boiled African star apple kernel meal diets.

MATERIALS AND METHODS

Study site

The experiment was conducted from October to December, 2016 at the Rabbitry Unit of the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Gidan Kwano Campus (Permanent site), Minna, Niger State.

Experimental feed, design, animals and their management

The African star apple kernels used for this study were sourced from African star apple fruit farmers in Osogbo, Osun State. African star apple seeds are always available between December and April. The seeds were gathered, washed with water to clean the dirts, allowed to dry under the shed for 7 d and carefully crushed with palm kernel machine so as to separate the kernel from the seed coat. Then, dried African star apple kernel was subjected to boiling at 100 °C for 15 minutes at the rate 1 kg kernel to 5 litre of water (Jimoh *et al*., 2014) after which water was drained off by means of 10 mm sieve and the boiled kernels were air dried under the shed for 7 d, milled using hammer mill with a sieve size of 3 mm and analysed in the laboratory.

Five experimental diets (diets 1, 2, 3, 4 and 5) were formulated to support optimal rabbit growth (de Blas and Mateos, 2010) as shown in Table 1. Diets 1 to 5 contained 0 %, 25 %, 50 %, 75 % and 100 % BASAKM, respectively as substitute for dietary maize. The diets were pelleted to 3 mm diameter and 6 mm in length and then analysed for chemical composition (Table 1). Seventy five 35-d old crossbred (New Zealand x California white) weaner rabbits of equal sexes weighing 591.00±0.15 g, certified healthy by a veterinarian, were allotted to 5 dietary treatments (15 rabbits per treatment; 5 rabbits per replicate) in a completely randomized design. The rabbits were housed in wire meshed cages, accommodated in a well-ventilated pen, supplied water and experimental diets *ad libitum* and the pen was cleaned and disinfected daily for 56 d which the study lasted.

Table 1: Gross Composition of Experimental Diets (%)

	Control	**Replacement levels of boiled ASAKM**			
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Ingredients (%)	0%	25%	50%	75%	100%
Maize	40.00	30.00	20.00	10.00	00.00
***Boiled ASAKM**	00.00	10.00	20.00	30.00	40.00
Maize offal	25.00	25.00	25.00	25.00	25.00
Soyabean meal	12.00	12.00	12.00	12.00	12.00
Fish meal	1.20	1.20	1.20	1.20	1.20
Groundnut cake	18.00	18.00	18.00	18.00	18.00
Limestone	1.00	1.00	1.00	1.00	1.00
Bonemeal	2.00	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20	0.20
****Premix**	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Chemical composition (%)					
Dry matter	91.61	93.70	91.51	93.90	92.12
Crude protein	15.70	16.42	16.03	16.18	15.33
Ether extract	4.00	5.15	5.06	4.25	4.75
Ash	3.81	3.64	4.29	3.46	3.66
Digestible energy (Kcal/kg)	2701.44	2689.64	2687.65	2714.44	2691.17

*Boiled ASAKM=African star apple kernel meal. **Premix in diets provided per kg: Vit. A 10000 IU, Vit. B 2000 IU, Vit. E 13000 IU, Vit. K 1500mg, Vit. B12 10mg, Riboflavin 5000mg, Pyridoxine 1300mg, Thiamine 1300mg, Panthothenic acid 8000mg, Nicotinic acid 28000mg, Folic acid 500mg, Biotin 40mg, Copper 7000mg, Manganese 48000mg, Iron 58000mg, Zinc 58000mg, Selenium 120mg, Iodine 60mg, Cobalt 300mg, Choline 27500mg.

Data collection

Blood samples were collected from 9 rabbits per group at 91 d of age for determination of haemato-biochemical indices. The selected rabbits were fasted overnight before blood collection. About 5 mL of blood were collected from the prominent ear vein of the rabbits using a ten gauge hyposeranic needles. Two millilitres of blood sample was collected into labelled sterile bottles containing ethylenediamine tetraacetic acid (EDTA) as anti-coagulant for the determination of haematological parameters, while the remaining 3 mL blood sample for serum analysis was collected into anticoagulant-free bottles, allowed to clot at room temperature and centrifuged at 3000 rpm for 10 min. The supernatant sera were harvested and stored at 4 °C in a refrigerator for subsequent biochemical analysis (Coles,1986). The analyses were carried out at the General Hospital Laboratory, Minna.

Statistical analysis

Data were subjected to analysis of variance in a completely randomized design using SAS software (SAS Institute, 2015, Version 9.3). Significant difference between individual means was highlighted by Duncan's procedure of the same software. Mean differences were considered significant at $P<0.05$

RESULTS

The results of the effect of boiled African star apple kernel meal on haematological parameters of growing rabbits at 91 d of age are presented in Table 2. There were no significant differences ($P>0.05$) in all the parameters measured except neutrophil. The neutrophil level of rabbits fed diets 2, 3 and 4 decreased significantly compared to those fed the control diet (-5.20 %, -3.65 % and -9.69 %, respectively; *P=0.0384*).

Table 3 shows the results of the effect of boiled African star apple kernel meal on serum biochemistry of growing rabbits at 91 d of age. There were no significant differences ($P>0.05$) in all the serum parameters analysed. Albumin, globulin, total protein, glucose, cholesterol, triglyceride and urea were not influenced ($P>0.05$) by the dietary treatments.

Table 2: Effect of Boiled African star apple kernel meal on haematological parameters of growing rabbits

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	*P-value*
No. of rabbits	9	9	9	9	9		
White blood cell (x 10^3/mm^3)	9.24	10.67	8.75	7.61	9.37	0.39	0.0938
Red blood cell, (x 10^6/mm^3)	5.41	5.27	4.93	5.46	5.62	0.25	0.8343
Haemoglobin (g/dl)	10.42	10.75	10.62	10.55	10.39	0.21	0.9515
Packed cell volume (%)	31.34	31.45	32.67	31.67	31.15	0.28	0.2828
Basophil (pg)	1.98	1.29	1.48	1.34	1.67	0.15	0.4088
Neutrophil (%)	46.93^a	41.73^b	43.28^b	37.24^c	48.72^a	1.33	0.0384
Monocyte (%)	3.29	3.61	3.31	2.72	3.99	0.25	0.3599
Lymphocyte (%)	57.33	53.99	52.14	51.03	64.06	2.91	0.4187
Mean corpuscular haemoglobin (pg)	19.61	20.90	21.54	19.68	18.48	0.94	0.7117
Mean corpuscular volume (fl)	58.74	61.18	66.75	59.25	55.42	2.95	0.6295
Mean corpuscular haemoglobin concentration (g/dl)	33.25	34.21	32.58	33.32	33.38	0.76	0.9371

abc = means with different superscripts on the same row are significantly different ($P<0.05$), SEM= Standard error of mean, P = Probability value.

Table 3: Effect of Boiled African star apple kernel meal on serum chemistry of growing rabbits

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	*P-value*
No. of rabbits	9	9	9	9	9		
Albumin (g/dl)	1.93	2.59	2.54	2.37	2.74	0.15	0.2946
Globulin(g/dl)	4.14	3.37	3.39	4.53	3.53	0.27	0.3552
Total protein(g/dl)	6.08	5.96	5.92	6.90	6.26	0.20	0.3136
Glucose (mmol/L)	3.06	2.44	3.01	2.54	1.95	0.32	0.6287
Cholesterol (mmol/L)	1.48	1.34	0.78	1.72	1.61	0.11	0.0514
Triglyceride (mmol/L)	1.31	2.20	1.32	1.97	1.21	0.19	0.1880
Urea (mmol/L)	2.20	3.21	3.02	2.85	2.79	0.24	0.5380

SEM= Standard error of mean, P = Probability value.

DISCUSSION

The blood profiles have been used widely to establish the health status of animals particularly when they are subjected to dietary treatment that could affect their well being. Thus, Aro and Akinmoegun (2012) and Isaac *et al.* (2013) identified haemoglobin (Hb), PCV, WBC, RBC, MCH and MCHC among others as blood parameters that are useful in feed toxicity and feed quality monitoring and their effect on health status of the animals. In this study, only neutrophils was significant among the haematological parameters measured. The range of 37.24-48.72 % observed for neutrophil in this study is within the normal range reported by Mitruka and Rawnsley (1977) for growing rabbits. The non significant difference observed among most of the haematological parameters measured implies that the haematopoietic activity was enhanced identically by the dietary treatments and by extension the health status of the rabbit was not compromised by replacing maize with boiled African star apple kernel meal in the diets of growing rabbit. Thus, in most cases the blood parameters reported here falls within the ranges reported by Latimer *et al.* (2003) and Ibrahim *et al.* (2014).

CONCLUSION

The result obtained from this study showed that boiled African star apple kernel meal can be considered as a high energy source in place of maize and growing rabbits could tolerate BASAKM in their diets without impairing the haemato-biochemical indices of the animals.

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REFERENCES

Adisa, V.A. and Fajola A.O. (2000). Post Harvest seed rots of three species of citrus in Southwestern Nigeria. *Indian Phytopathology*, 35: 595-603.

Agbabiaka, L.A., Eke, L.O.and Nwankwo, C.F. (2013). Nutrients and Phyto-Chemical Assay of African Star Apple Kernel (*Chrysophyllum africanum*) as Potential Feedstuff in Fish and Livestock Production. *British Journal of Applied Science and Technology*, 3(4): 1215-1219.

Aro, S.O. and Akinmoegun, M.B. (2012). Haematology and red blood cell osmotic stability of pigs fed graded levels of fermented cassava peel based diets. Proceedings 17th Annual Conference of Animal Science Association of Nigeria, 152-153.

de Blas, C.and Mateos, G.G. (2010). Feed formulation. In: Nutrition of the Rabbit. 2nd Edition (eds. C.de Blas and J. Wiseman). CAB International. The United Kingdom. pp. 229.

Coles, E. H. (1986). Veterinary clinical chemical pathology. 4th Edition. W.B. Saunders Co. Philadelphia, USA. p. 10-97.

Ibrahim, A.A., Aliyu, J., Ahmad, A., Muhammad, A.I. and Amin, A.B. (2014). Effect of different dietary levels of Sabara leaf meal (*Guiera senegalensis*) replacement on growth performance and nutrient digestibility of rabbits on North Western Nigerian. *Nigerian Journal of Animal Science*, 16: 76-84.

Isaac, L.J., Abah, G., Akpan, B., Ekaette, I.U. (2013). Haematological properties of different breeds and sexes of rabbits. Proc. of the 18th Annual Conference of Animal Science Association of Nigeria, 24-27.

Jimoh, W.A., Ajasin, F.O., Adebayo, M.D., Banjo, O.T., Rifhat, A.O. and Olawepo, K.D. (2014). Haematological Changes in the Blood of *Clarias gariepinus* fed *Chrysophyllum albidum* seed meal replacing maize. *Journal of Fisheries and Aquatic Science,* 9: 407-412.

Latimer, K.S., Mahaffey, E.A. and Prasse, W.K. (2003). Duncan and Prasse's veterinary laboratory medicine: Clinical laboratory medicine: Clinical pathology, 4th edition. Wiley-Blackwell. New Jersey. USA.

Makinde, O.J., Aremu, A., Alabi, O.J., Jiya, E.Z. and Ibe E.A. (2017) Roasted African Star Apple (*Chrysophyllum albidum*) Kernel Meal improves growth performance of Growing Rabbits. *Tropical and Subtropical Agroecosystems*, 20(3): 457–464.

Mitruka, B.M. and Rawnsley, H.M. (1977). Clinical, biochemical and haematological reference values in normal and experimental animals. Masson Publishing, USA, Inc., 83:134-135.

SAS. (2015). Statistical Analytical Systems, Users Guide Version 9.3, SAS Institute Inc., Cary, North Carolina, USA.

REPLACEMENT VALUE OF AFRICAN LOCUST BEAN (*Parkia biglobosa*) FRUIT PULP FOR MAIZE IN WEANER RABBITS DIET

Mohammed S[1*], Ijaiya A.T[2], Ayanwale B.A[2], and Kudu Y.S[2]

[1]Niger State Agricultural and Mechanization Development Authority Zone II, Kuta Niger State
[2]Department of Animal Production Federal University of Technology, Minna Niger State, Nigeria.
*Corresponding author: mohammedsani90042@gmail.com
Phone number – 08036389573, 08070426419

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Abstract

A feeding trial of 84 days was conducted to assess the replacement value of African Locust bean fruit pulp for maize in weaner rabbits diet. Five diets were formulated, such that 100% maize and 0.00% fruit pulp of African fruit pulp at (T1), 75% maize and 25% inclusion of African locust bean at (T2), 50% maize and 50% African locust bean pulp as (T3), 25% maize and 75% African fruit pulp at (T4) while (T5) contain 100% fruit pulp of African locust bean and 0.00% maize respectively. Seventy five (75) weaner rabbits (5-6wks old) with average initial weight between 610.67g -622.60g were randomly allocated in a complete randomized design (CRD) experiment to the five diets with fifteen (15) weaner rabbits in each treatment which were subdivided into three (3) replicates having five (5) weaner rabbits in each replicate. The weaner rabbits were housed in individual cage compartment. Proximate composition of the experimental diets fed to weaner rabbits carried out indicated that T1 had dry matter content of 93.28 %, crude protein of 19.80 % and also 12.41 % of crude fiber. Ether extract was higher in T5 with 8.48 %, while nitrogen free extract contained in T3 had the highest value of 51.17 %. However ash content in T5 has the highest value of 7.83 %. The metabolizable energy in all the dietary treatment shows that T5had the highest value of 3013.21 ME/Kcal/Kg. Data were collected on daily feed intake and weekly weight. Feed conversion ratio, protein efficiency ratio, energy efficiency ratio, nutrient digestibility and feed cost benefit ₦ (kg) were calculated. Weaner rabbits fed 75% maize and 25% African fruit pulp (T2) consumed more feed and significantly gained more weight P<0.05 than those fed the other diets. Feed conversion ratio, protein efficiency ratio and energy efficiency ratio were not significantly (P>.0.05) influence by the treatment diets. Average feed cost of production with inclusion of maize was estimated at ₦311.25 in T1 while the African locust bean fruit pulp inclusion was ₦161.81in T5, a cost difference of ₦149.44, this resulted to a progressive reduction in the cost treatment of feed with increase in the level of fruit pulp of African locust bean meal. The results of this study indicated that when 25% fruit pulp of African locust replaced maize, the rabbits performed better than the control diet and also of more economical option.

Keywords: Fruit pulp, weaner rabbits, diet, proximate, metabolizable.

INTRODUCTION

There is an estimate of an annual five to seven percent growth rates for meat consumption, such increase cannot be met easily by large animals like sheep and cattle because of their slow production cycle, they may however be met by short cycle animals such as rabbits, poultry and pigs. The growing demand for maize in the last few years for both human and livestock consumption has pushed its market price to an alarming rate and that has directly affected the production cost of farm animals particularly the non –ruminants.(Igwebuike *et al*., 2003). The fruit pulp is obtained from the locust bean tree. The African Locust bean, (*Parkia biglobosa*) is a perennial tree. It grows in the savanna region of West African up to the edge of the Sahel zone. The fruit of the plant is straight or sickle shaped 15.6cm -31.20cm long and 2.6cm broad with thick waxy margin. When dried it is light brown with black seed embedded in yellowish mealy tasting pulp (Edigwe *et al*., 2012). The study herein conducted is to evaluate the replacement value of African locust bean fruit pulp for maize in weaner rabbits diet.

MATERIALS AND METHOD.

Experimental site – The experiment was carried out at the Rabbit unit of Animal Teaching and Research Farm, located at Gidan Kwano, Federal University of Technology Minna, Niger State.

SOURCE OF EXPERIMENTAL INCREDIENTS – Pulp of locust bean was purchased at Dandaudu village 56km away from Minna. Five dietary treatment were formulated at 16% crude protein requirement

with energy level of 2884.16(Kca/kg) for the rabbits using Pearson square method of feed formulation. Scwartz and Allen (2012).

EXPERIMENTAL DESIGN

A total of seventy five (75) rabbits of mixed sexes and breeds (New Zealand and chinchilla) were randomly allotted to five treatment groups as T1, T2, T3, T4, and T5 with three (3) replicate each, containing (5) rabbits in each replicate.

MANAGEMENT OF EXPERIMENTAL RABBITS.

Rabbits were kept in hutches made up of wood and mesh wire, with height of 60cm, and width 40cm. Hutches were enclosed in a house under intensive system were the floor of the house is cemented on the. All hutches and house were disinfected before commencement of the experiment work. (Olomu, (2008)

DATA COLLECTION AND ANALYSIS

Initial weight of weaner rabbits were taken at the first day on commencement of the experiment. Formulated feed were weighed each morning on daily basis and fed to rabbits in each treatment. Left over feed were weighed the following morning and feed intake obtained. by difference. Initial body weights of all the weaner rabbits were obtained on the first day of commencement of the experimental work, while the weekly body weight were obtained by weighing the weaner rabbits at the end of each week

Table 1 Feed composition and calculated nutrients of experimental diets fed to rabbits at weaner stage.

INGREDIENT (%)	T1 100:00	T2 75:25	T3 50:50	T4 25: 75	T5 100:00
Maize	60.74	45.56	30.37	15.18	00.00
Locust bean fruit pulp	00.00	15.18	30.37	45.56	60.74
Soyabean meal	24.61	24.61	24.61	24.61	24.61
Rice husk	10.00	10.00	10.00	10.00	10.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.30	0.30	0.30	0.30	0.30
Methionine	0.80	0.80	0.80	0.80	0.80
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.25	0.25	0.25	0.25	0.25
Total (kg)	100.00	100.00	100.00	100.00	100.00
Calculated nutrients					
Crude Protein	17.01	17.25	17.49	17.72	17.012
Crude Fibre	10.36	11.09	11.82	12.55	13.28
ME (Kcal/Kg)	2884.16	2788.22	2792.22	2796.22	2648.87
Protein: calorie Ratio	1:149	1:146	1:143	1:139	1:137
Calcium	1.40	1.45	1.47	1.49	1.51
Phosphorous	1.03	1.03	0.99	0.99	0.79
Methionine	1.01	1.00	0.98	0.97	0.96
Lysine	0.87	0.88	.088	0.88	0.89
Ether Extract	0.23	0.21	0.31	0.28	0.22

* = The premix provides nutrients kg^{-1}: Vit. A, 500 IU; Vit. D_2,1500 IU; Vit. E 3, IU; Vit. K,2 mg; Niacin, 15 mg; Vitamin B_{12},0.8 mg;Riboflavin, 3 mg; Pantothenic, acid 6 mg; Chlorine, 3 mg; Folic acid, 4 mg; Manganese, Iodine, 1.0 mg; Cobalt, 1.2 mg; 8 mg; Zinc, 0.5 mg.

Kg = kilogram

ME = Metabolizable energy

Kcal = Kilo calorie

Table 2 Proximate Composition and Calculated Energy Values of Experimental Diets Fed to Weaner Rabbits

Nutrient	T1	T2	T3	T4	T5
Dry matter (%)	93.28	92.22	91.58	92.42	92.10
Crude protein (%)	17.41	16.68	16.01	16.44	15.85
Crude fibre (%)	12.71	10.44	11.26	10.74	10.47
Ether extract %	5.19	7.21	7.97	8.26	8.48
Nitrogen free extract (%)	51.14	50.30	51.17	49.79	49.47
Ash (%)	6.83	7.59	7.17	7.19	7.83
Metabolizable Energy (ME/Kcal/Kg)	2947.58	2915.82	2953.02	2963.02	3013.21

% - Percent, T1- 100 % Maize and 0.00 % Fruit pulp of African locust bean.
T2 = 75 % Maize and 25 %, Fruit pulp of Africa locust bean,
T3 = 50 % Maize and 50 % Fruit pulp of Africa locust bean,
T4 = 25 %, Maize and 75 % Fruit pulp of Africa locust bean,
T5 = 100 % Fruit pulp of Africa locust bean and 0.00 % Maize,
ME = Metabolizable energy,
Kcal = Kilo calorie,
Kg = Kilogram

Table 3 Performance characteristics of weaner rabbits fed inclusion levels of dried fruit pulp of African locust bean

Treatment	T1	T2	T3	T4	T5	±SEM	LS
Average initial weight (g)	610.67^{a}	616.67^{a}	622.00^{a}	622.00^{a}	618.67^{a}	25.9	NS
Average final body weight (g)	1508.33^{ab}	1561.67^{a}	1413.33^{c}	1396.67^{c}	1455.67^{bc}	20.06	**
Average Weight gain (g)	897.67^{a}	944.00^{a}	791.33^{a}	774.67^{a}	839.00^{a}	38.86	NS
Average daily weight gain (g)	10.69^{a}	11.23^{a}	9.43^{a}	9.22^{a}	9.96^{a}	0.46	NS
Total Feed intake (g)	3603.33^{a}	3631.66^{a}	3609.83^{a}	3377.00^{a}	3375.10^{a}	165.27	NS
Average Daily Intake (g)	42.90^{a}	43.23^{a}	40.59^{a}	40.20^{a}	40.17^{a}	2.18	NS
Feed Conversion Ratio	4.06^{a}	3.75^{a}	4.56^{a}	4.40^{a}	4.03^{a}	0.3	NS
Protein Efficiency Ratio	2.22^{a}	2.36^{a}	2.45^{a}	2.22^{a}	2.31^{a}	0.11	NS
Energy efficiency Ratio	1.31^{a}	1.35^{a}	1.33^{a}	1.24^{a}	1.21^{a}	0.06	NS
Cost/Weight Gain (₦ /Kg)	311.25^{a}	253.25^{ab}	206.21^{ab}	192.8^{bc}	161.81^{c}	21.04	**
Mortality %	0.00^{a}	0.00^{a}	0.00^{a}	0.20^{a}	0.20^{a}	0.13	NS

^{abc} Means in the same row with different superscript are significantly different
T1 = 100 % Maize and 0.00 % Fruit pulp of African locust bean,
T2 =75 % Maize and 25 %, Fruit pulp of Africa locust bean,
T3 = 50 % Maize and 50 % Fruit pulp of Africa locust bean,
T4 -=25 %, Maize and 75 % Fruit pulp of Africa locust bean,
T5 =100 % Fruit pulp of Africa locust bean and 0.00% Maize.
SEM = Standard error of mean, LS – Level of significance,
** = Significant at ($P < 0.05$),
NS = Not Significant ($P > 0.05$),
g = gram

RESULTS AND DISCUSSION

Rabbits fed 25% replacement level of fruit pulp of African locust bean diet had a higher feed intake and with a significant (P<0.05) weight gain than diet containing 75% and 50% levels respectively. This result agrees with Gernah *et al*., (2007) that low level of sweetness in the pulp yield a higher intake at 25% inclusion compared to the increased level of 50% and 75%. The high average weight recorded in 25% replacement level could be as a result of high level of feed intake by the rabbits in the treatment, this result agrees with Osagie (2011) that weight gain is directly related to feed intake, while low growth rate in diet 4 could be as a result of low intake of feed. The feed conversion ratio did not show a significant different (P>0.05) in all the dietary levels. Diet 2 shows lowest value, this is in agreement with the work of Okah (2004) who reported that the higher the weight gain per unit feed consumed, the lower the value of feed efficiency obtained. Protein and energy efficiency ratio did not show a significant difference (P>0.05) in all the diet. The ₦311.25 cost of fruit pulp of African locust bean, and maize ₦161.81gave rise to a cost differential of₦149.44, this resulted to reduction in the cost of feed as level of fruit pulp of African locust bean meal is increased ((Kwari and Igwebuike 2010)

CONCLUSION AND RECOMMENDATION

The result of this study reveal that fruit pulp of African locust bean could replace maize at 25% level for weaner rabbits diet without adverse effect on their performance. This level of replacement had less cost than maize based diet. However the effect of dietary fruit pulp of African locust bean on the performance of rabbits depends on the nutrient profile. The levels of maize in the reference diets might also influence performance of the rabbits.

REFERENCES

Gernah, D.I Atolagbe, M.O & Echegwo C.C (2007). Nutrient composition of the African locust bean (*Parkia biglobosa)* Fruit pulp. Nigeria food journal vol. 25 no. 1 pp190-196

Igwebuike, J.U, Kwari, I.D and Usman Y. (2003) The replacement of maize grain with grain residue in concentrate diets in growing rabbits proceedings of 8 annual conference of the Animal science Association of Nigeria (As An) Sp+-g16-18th 2003. FUT Minna N/state

Kwari I.D and Igwebulke J.U (2010) performance of brother chickens fed graded levels of African locust bean *(Parkia Biglobosa)* pulp. Proceeding of the Nigeria sovety for animal production (NSAP) Sept. 17th -19th University of Maiduguri, Nigeria.

Okah Y (2004) Effects of dietary replacement of maize with maize processing waste on the performance of boiler starter. Proceedings of the 29th Annual conference of Annual science Association of Nigeria pp.2-4

Olomu, J.M. (2008). *Monogastric Animal Nutrition. Principles and Practice.* Second Edition, St. Jackson publishing, Benin City, Nigeria.

Osagie, J.A (2011). Some chemical constituent of the fruits pulp of *Parkia elappertoniana* as potential industrial raw material. Savanna 9 (2): 24-27

Scwartz, B.S. and Allen B.A (2012). Plants allmantarieset vie AgricoladeL`Afque Noire Larose Paris. Vol 3: 110-115.

GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND CARCASS CHARACTERISTICS OF RABBITS FED VARYING LEVELS OF GROUNDNUT HAULM WITH CONCENTRATE

MOHAMMED, J.D., ADAMA, T.Z. AND TSADO, D. N.

Federal University of Technology, Minna Niger State

Correspondence: jiyadanladi2@gmail.com 08036461758

& nmatsado@gmail.com 08037295616

ABSTRACT

The aim of this study was to assess the growth performance, nutrient digestibility and carcass characteristics of rabbits fed varying levels of groundnut haulm (GH) with concentrate. All together, 54 weaner rabbits of 6-7 weeks of an average initial weight of 735.81g were included in completely randomized design and fed six (6) dietary treatments of: 100% concentrate and 0% groundnut haulms (T_1, control), 80% concentrate and 20% GH (T_2), 60% concentrate and 40% GH (T_3), 40% concentrate and 60% GH (T_4), 20% concentrate and 80% GH (T_5) and 0% concentrate and 100% GH (T_6). In most of the treatments, the total feed intake, the body weight and carcass weight showed no significant ($p>0.05$). There were significant difference ($p<0.05$) in visceral organs and sensory characteristics when rabbits are fed groundnut haulms included diets than concentrate diets.

Keywords: Rabbits, groundnut haulms, concentrate, growth, carcass

INTRODUCTION

Food and Agricultural Organization (2004) reported low per capita animal protein consumption in developing countries particularly in humid tropics which calls for improvement in the production of short-cycle animals like rabbit. If rabbits are judiciously managed, they can kindle about six times in a year with the average of 6-7 kittens per kindling (Adeyemo *et al.,* 2013). This improvement is also essential by the rapid population growth with resultant increase in the demand for protein from animals.Rabbits have been identified to play vital role in the supply of quality protein especially in rural and peri-urban areas within the tropics (Egbo *et al*., 2001) this is because, they mature early and their meat has high protein, low fat, low energy and low cholesterol value (Adeyemo *et al.,* 2013). Rabbits have a short generation interval with high litter size and can be raised at the backyard which is well suited to small holder rabbit producers. It is important to note that, feed supply and quality is the major limiting factor to vibrant rabbit production in Nigeria. To make rabbit rearing more viable as a small-scale business, Makinde *et al*. (2014) had advocated the development of alternative feeding materials that are relatively cheap when compared with commercial feeds or conventional feedstuffs. Rabbits can be raised on high fibre feeds and materials that are not utilized by man and since they do not compete with man for grains, they have the advantage over swine and poultry (Adeyemo *et al.*, 2013). One of the non-conventional feedstuff and under-exploited forage feedstuff for rabbits in Nigeria is groundnut haulms which has high crude protein value.

MATERIALS AND METHODS

The experimental animals were sourced from the Rabbitry Multiplication Unit Minna, of the Niger State Ministry of Livestock and Fisheries. Groundnut haulms was sourced from Animal feed sellers, opposite NEPA office Minna. Concentrate was sourced from Sammy ventures, behind U.K. Bello arts theater, Minna. The study lasted for twelve weeks during which the rabbits were served with concentrate diet in the morning (8:00 am) and groundnut haulms (4:00 pm) of a known weight on a daily basis. Water was also provided *ad libitum*. Left over feeds were recorded to determine the daily feed intake.

RESULT AND DISCUSSION

In **Table 1.0** significant statistical differences between treatment and the parameters measured were noticed ($P < 0.05$). The final body weight (BW) of rabbits irrespective of treatment was all doubled their initial BWs. Nonetheless, very significant statistical difference was observed in feed intake observed between the treatments studied. Studies in rabbits have shown that BW tends to increase correspondingly with increase in feed intake, particularly forage (as seen in T_3) (Houndonougbo *et al.*, 2012; Maidala 2016) in which case feed intake have been positively correlated with level of fibre in rations. In these studies, poor digestion and utilisation of protein were reported to be responsible for the poor growth against the expected growth rate. The growth performance in terms of feed intake, body weight gain, final body weight and feed conversion ratio of rabbits fed only concentrate and those on 40% concentrate plus 60% groundnut haulms were similar. This may be attributed to the fact that forage is considered an important feed for rabbits growth and they are capable of digesting leaf protein effectively (Cheeke and Patton, 1982). This finding agrees with Bamgbose *et al*. (2003) who reported that rabbits can perform well with mixed regimen of forages and concentrates up to 50 % reduction without any adverse effect on growth. Also, lyeghe-Erakpotobor *et al*. (2002) observed significant effect of diets on intake of rabbits offered a combination of concentrate, grass and other forages. Similarly, Shiawoya and Musa (2006) reported that feeding of forage like mango, banana and tridax leaves can successfully support growth when fed with concentrate diets for weaner rabbits.

Table 1.0: Growth performance of rabbits feds varying levels of groundnut haulms and concentrate based diets

Parameters (g)	T1	T2	T3	T4	T5	T6	SEM	P-value
Initial body weight	727.11	728.22	741.22	742.22	742.44	784.55	13.93	0.71
Total feed intake	5754.69^{a}	6263.43^{a}	5320.12^{b}	5450.93^{ab}	4903.93^{c}	5197.71^{b}	24.43	0.00
Body weight gain	1033.30^{a}	1000.01^{a}	1100.12^{a}	1031.04^{a}	986.33^{b}	991.51^{b}	32.59	0.02
Final body weight	1760.41^{ab}	1728.23^{b}	1841.34^{a}	1773.26^{ab}	1728.77^{b}	1740.06^{b}	48.26	0.01
Feed conversion ratio	5.56^{a}	6.26^{a}	4.83^{b}	5.28^{ab}	4.97^{b}	5.24^{ab}	0.84	0.03

abc = means in abc = means in the same row carrying different superscript are significantly ($p<0.05$) difference.

The meat sensory properties of rabbits fed groundnut haulms and concentrate based diets showed beneficent ($P<0.05$) increase in the appearance, tenderness and overall acceptability of the meat (Table 2.0). While significant statistical difference was recorded in the organoleptic properties of fried rabbit meat in this study between the treatments ($P<0.05$), other studies obtained contrary results (Raïssa *et al.*, 2018;)

Table 2.0: Sensory characteristics of rabbit meat fed varying levels of groundnut haulms and concentrate based diets

Parameters	T1(keys)	T2( )	T3( )	T4( )	T5( )	T6( )	SEM	P-value
Colour	8.33	7.66	7.66	8.00	7.66	7.33	0.47	0.33
Juiciness	8.66	8.66	8.00	7.66	7.66	7.66	0.66	0.22
Appearance	7.66[a]	8.00[a]	7.66[a]	7.33[a]	7.66[a]	6.33[b]	0.48	0.03
Flavour	8.33	7.33	7.33	7.00	7.66	7.33	0.67	0.28
Tenderness	8.66[a]	7.00[a]	6.00[b]	6.66[ab]	6.00[b]	6.33[b]	0.44	0.00
Aroma	7.33	7.00	7.33	7.00	7.33	6.67	0.47	0.93
Overall acceptability	8.33[a]	8.33[a]	7.66[ab]	7.33[ab]	7.33[ab]	7.00[b]	0.62	0.01

ab = means in the same row carrying different superscript are significantly ($p<0.05$) differe

Conclusion

1. Feeding rabbits solely on concentrate or inclusion of 60% groundnuts haulms to concentrate have similar feed intake, body weight gain, final body weight and feed conversion ratio.
2. Carcass parameters such as carcass weight, dressing percentage, neck length, cervico-thoracic region weight, tail length, heart weight and spleen weight of animals fed only concentrate and those fed with concentrate along with groundnut haulms up to 80% or solely on groundnut haulms were similar. Improvement was observed in lungs weight, kidney weight and intestine length the rabbits were fed groundnut haulms included diets than when fed solely on concentrates.
3. Sensory characteristics such as colour, flavor, juiciness and aroma are similar between the treatment diets. Additionally, acceptability of rabbit meat fed only concentrate and those fed concentrate along with up to 80% groundnut haulms are similar.

REFERENCES

Adeyemo, A. A., Adeyemi, O. A., Ekunseitan, D. A. and Taiwo O. S. (2013). Effect of concentrate to forage ratio on the performance and haematological parameters of growingrabbits. *Global Journal of Biology Agriculture and Health Sciences*, 2 (2)

Apata, E.S., Soniran. A.G., Ikudoro, F.O., Akinteru, O., Osineye, F. and Doherty, F. (2005). Taste panel socio-economic characteristics and the organoleptic properties of rabbit cooked by five different methods. *Journal of Agriculture, Forestiy and the Social science***. 32j. 139-146.**

Bamghose. A.M., Akinnusi. F.A.O and Adegbenro, *K.A.* (2003). Growth response of weaner rabbits fed concentrates/forage supplement based diet.*Proceeding 18th Annual Conference an/Il/al Science Association of Nigeria. September J6'*]8th,2003, Federal University of Technology, Minna, Nigeria, **98-99.**

Cheeke, P. R. and Patton, A. F. (1983). The significance of fibre in rabbit production. *Journal of Applied Rabbit Research.* **3(3): 20-23.**

Egbo, ML., Doma, U. D and Lacdaks, A. B (2001). Characteristics of small-scale rabbit production and management in Bauchi metropolis.*Proceedings of the 26th Annual Conference of Nigerian Society of Animal production.* March 18th-21st Ahmadu Bello University Zaria,

F.A.O (2004). Food and Agricultural Organization. Year Book, Rome.

Houndonougbo, M. F., Chrysostome, C. A. A. M., Attakpa, S. E., Sezan, A., and Dehou, H. B. (2012). Growth Performance of Rabbits Fed Palm-Press Fibres-Based Diets. *ISRN Veterinary Science*, **1–5**. doi:**10.5402/2012/915729**

Isikwenue, J.O., Akpodiete O.J., Omoye, S.I. &Okagbare, G.O. (2010).The effect of replacing groundnut cake with urea-Treated and fermented brewers dried grain on nutrient digestibility, retention and carcass characteristic of broiler finisher. *Nigeria Journal of Animal products,* **37(1)1-12.**

Iyeghe-Erakpotobor, G. T. (2002). Effect of concentrate and forage type on performance digestibility of growing Rabbits under sub-humid tropical condition. National Animal Production Research institute Ahmadu Bello University. Shika-Zaria *Asian Journal of Animal and veterinary Advances,* **2(3) 125– 132.**

Maidala, A., Bello, I.B. &Jarmari, S.M. (2016) Comparative Responses of Weaner Rabbits to Concentrate Diets Supplemented with Different Forages. *Journal of Biology and Genetic Research 2 (3): 2545 – 5710*.

Makinde, O.J., Enyigwe, P.C., Babajide, S.E., Atsumbe, J.A., Ibe, E.A. and Samuel, I. (2014). Growth performance and carcass characteristics of Finisher broilers fed rice offal based diets supplemented with exogenous enzyme.*Greener Journal of Agricultural Sciences*. **4(4): 144 -149.**

Malik, A. A.,Balogun, O.O. and Dikko, A.H. (2015). An evaluation of the effect of storage of a locally Produced natural vitamin premix on the performance of laying hens. *Journal of Agriculture, Foresty and Social Science*, **8 (1): 208-214.**

Raïssa1 W.L.M.F., Athanase, O.K., Frank, Y.K. and Sébastien,N. (2018). Effect of mixing two leafy vegetables on the quality of rabbit meat. *European Journal of Biotechnology and Bioscience*, **6(6): 30-36.**

Shiawoya, E.L. & Musa J.A. (2006). Evaluation of the feeding potentials of mango leaves *(Man gfèraindica)* Banana *(Musa spp)* foliage and tridax*(Tridaxprocumbens)* as supplemented to conventional feeds for growing rabbits. *Journal of Agricultural Research and Development*, **5 (1): 1-6.**

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PERFORMANCE OF BROILER CHICKEN FED DIETS CONTAINING COWPEA MILLING WASTE AND PLANTAIN PEEL MEAL MIXTURE

***A. J. MOHAMMED, A. A. MALIK AND Y. S. KUDU**

Department of Animal Production, Federal University of Technology, P.M.B. 65, Minna, Niger State
**Corresponding author's e-mail: abdullahijiya1968@gmail.com*
Phone: 08036492798

Abstract
This study was carried out at the Poultry Unit of the Department of Animal Production Teaching and Research Farm, Federal University of Technology, Minna Nigeria. A total number of 144 day old chicks were used for the study. The birds were randomly allotted into four treatments of three replicates each consisting of 12 birds per replicate in a completely randomized design (CRD) model. The treatments were T_1 (birds fed control diet), T_2 (birds fed 10 % mixture of cowpea milling waste(CMW) and plantain peel meal (PPM)), T_3 (birds fed 20 % CMW & PPM), and T_4 (birds fed 30 % CMW & PPM). The result showed that the feed intake, body weight gained and final body weight were influenced (P>0.05) by the inclusion of mixture of cowpea milling waste and plantain peel meal (CMW & PPM). The results of the total feed intake showed that birds fed on CMW & PPM 0 % (control group) had significantly (P<0.05) higher feed intake of 1023.7g while birds on CMW & PPM 20 % (T_3) had Significantly (P<0.05) lower feed intake of 750.56 g. However, mortality rate was significant at finisher phase. Broiler on T_1 (0 % CMW & PPM) and T_2 (10 % CMW & PPM) had significantly (P<0.05) higher mortality. It was concluded that CMW & PPM mixture in the diets of broiler chicken should not exceed 20 % for optimum growth performance and feed conversion.

Keywords: *Performance, broiler chicken, cowpea milling waste, plantain peel meal*

Introduction

The search for alternative feedstuffs for monogastric animals has challenged animal nutritionists in Nigeria since the past two decades. The search was necessitated by the high cost of the conventional feeding stuffs, which are also in high demand by human beings (Onyimonyi and Okeke, 2008). Feed supply, according to Ameafule *et al.* (2004) has remained a major constraint in animal production due to the ever increasing cost of conventional feedstuffs, due to the competition between man and livestock for cereal grains. Hence, the need to search for alternative feed sources that are cheap, readily available and less competed for by man and industries (Akinmutini, 2004). The need to harness the potentials of the numerous agro industrial by-products and the house hold wastes as part of replacement for the very expensive ones have been advocated (Umoh, 1984). Going by the fundamental role of energy in animal nutrition, it constitutes 35-60 % of rations for different species and classes of livestock. In developing countries, feeding, to a large extent, depends on the availability of the dietary energy source used in compounding concentrate rations for various classes of livestock. Hence, efforts are being made by animal nutritionists to obtain readily available, cheaper but qualitative feedstuffs that can serve as substitutes to the expensive and conventional energy and protein sources.

Materials and Methods

This research study was conducted at the Teaching and Research Farm of the Department of Animal Production, Federal University of Technology, Minna, Gidan Kwanu Campus, Niger State, Nigeria. It is located within latitude 09° 31´ 18.2´´N and longitude 6° 27´ 40´´E with an elevation that ranges from 230-250 m. The area lies within the Southern Guinea Savanna Zone of Nigeria. The sub-humid climate of the region has an average yearly rainfall of 1338 mm, dry season of about five (5) months and average temperature of about 30°C (FUTMIN, 2012). A total of one hundred and forty four (144) day old Ross 308 were sourced from DHAMAS Hatchery Farm Nigeria Limited Ibadan, Oyo State, Nigeria and were used for the study.

A mixture of cowpea milling waste and plantain peel meal were used at 0 %, 10 %, 20 % and 30 % to form treatments T_1, T_2, , T_3 and T_4 respectively. The birds were randomly allotted to the treatment

groups; each treatment was assigned 36 birds and further divided into three replicates of 12 birds per replicate in a completely randomized design (CRD) model. The experiment lasted for eight (8) weeks.

Results and Discussion

At the starter phase, results (Table 1) showed that initial weight, final weight average body weight gain, total body weight and feed conversion ratio were not significantly affected (P>0.05). However, the total feed intake and mortality were significantly (P<0.05).affected. The results of the total feed intake showed that birds fed on CMW & PPM 0 % had significantly (P<0.05) higher feed intake of 1023.7 g while birds on CMW & PPM 20 % (T_3) had significantly (P<0.05) lower feed intake of 750.56 g. There were no significant (P>0.05) differences in total feed intake between birds fed CMW & PPM 10 % and CMW & PPM 30 %. The results obtained from this experiment at the starter phase was in agreement with the results of Hamzat *et al.*(*2*019) who reported that inclusion level of 15 % plantain peel meal in the diet of broiler chicken tends to improve weight gain and FCR Though their research results did not involve inclusion of CMW The results at finisher phase showed that there were no significant differences (P>0.05) in all the parameters measured across the treatment groups.

Table 1: Growth performance of broiler chickens fed diets containing cowpea milling waste and plantain peel meal mixture at the starter phase

Parameters	T_1	T_2	T_3	T_4	SEM	*P-VALUE*
INI WT(g)	64.93	65.30	64.96	64.69	0.50	0.94
FIN WT(g)	459.70	440.73	430.56	463.33	17.40	0.80
TFI(g)	1023.7[a]	838.40[b]	750.56[c]	834.63[b]	43.05	0.13
AFI(g)	36.56[a]	29.94[b]	26.80[c]	29.81[b]	1.53	0.13
TBWG(g)	394.76	375.43	365.60	398.66	17.30	0.84
ABWG(g)	14.10	13.40	13.05	19.69	1.30	0.24
FCR	2.60	2.25	2.05	1.67	0.15	0.22
MOR %	8.33[b]	19.00[a]	0.00[c]	0.00[c]	3.01	0.05

[abc]Means on the same row bearing different superscripts are significantly different (P < 0.05).

T_1 = 0 % Cowpea milling waste and plantain peel meal mixture (Control Diet)
T_2 = 10 % Cowpea milling waste and plantain peel meal mixture
T_3 = 20 % Cowpea milling waste and plantain peel meal mixture
T_4 = 30 % Cowpea milling waste and plantain peel meal mixture

SEM = Standard error of means, P-value= probability value, INI WT = Initial weight, FIN WT = Final weight
AFI = Average feed intake , TBWG = Total body weight gain , ABWG = average body weight gain
FCR = Feed conversion ratio, MOR = Mortality, TFI = Total feed intake.

The result of the finisher phase (Table 2) showed no significant difference (P>0.05) amongst all the parameters measured, except the percentage mortality rate. Mortality rate was significantly (P>0.05) higher at finisher phase. The result from this experiment indicated that the broiler chickens could tolerate high inclusion levels of CMW and PPM with T_3 and T_4 recording the same final weight of 975.00 g and 975.26 g respectively. The result of this experiment agrees with the findings of (Ironkwe *et al*. (2011) who reported that processed CMW and PPM tend to influence positively the growth parameters of broiler chicken without any deleterious effect at starter phase. The best FCR was recorded in T_4 (1.67) although this was not translated into high weight gains. This might be attributed to larger inclusion level of the test ingredient when compared to T_1 (Control) which recorded the highest final weight with high FCR (2.60). This is in agreement with Mmereole *et al.* (2008) who reported that the nature and bioavailability of the nutrients in the test ingredient could affect FCR which ultimately affected growth.

Table 2: Growth performance of broiler chickens fed diets containing cowpea milling waste and plantain peel meal mixture for finisher phase

Parameters	T_1	T_2	T_3	T_4	SEM	*P-VALUE*
INI WT (g)	459.70	440.73	430.56	463.33	22.40	0.80
FIN WT(g)	1013.3	966.80	975.00	975.26	22.58	0.92
TFI (g)	1524.03	1545.43	1205.76	1218.76	69.45	0.13
AFI (g)	54.42	55.18	43.06	43.52	2.48	0.13
TBWG (g)	553.63	526.06	544.43	511.93	28.77	0.89
ABWG/DAY(g)	19.77	18.78	19.44	18.28	1.67	0.89
FCR	2.82	2.94	2.24	2.38	0.14	0.30
MOR %	13.90[a]	19.64[a]	0.00[b]	0.00[b]	3.07	0.02

[ab] Means on the same row bearing different superscripts are significantly different (P < 0.05)
T_1 = 0 % Cowpea milling waste and plantain peel meal mixture (Control Diet)
T_2 = 10 % Cowpea milling waste and plantain peel meal mixture
T_3 = 20 % Cowpea milling waste and plantain peel meal mixture
T_4 = 30 % Cowpea milling waste and plantain peel meal mixture

Conclussion and Recommendations

It was concluded from the experiment that cowpea milling waste and plantain peal meal mixture had effect on the total feed intake and average feed intake. 0 % cowpea milling waste and plantain peel meal mixture had significantly (P<0.05) higher feed intake compared to 20 % CMW & PPM that had significantly (P<0.05) lower feed intake. It was therefore recommended that CMW & PPM mixture in the diets of broiler chicken should not exceed 20 % for optimum growth performance and feed conversion.

References

Akinmutini, A. H. (2004). Effect of cooking periods on the nutrient composition of velvet beans (*Mucuna pruriens*). *Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production, held between March 18-21, Calabar, Nigeria*.

Amaefule, K.U., Nwaokono, C. C. and Iheukwumere, F. C. (2004). Effect of feeding graded levels of raw pigeon pea (*Cajanus cajan*) meal on the performance, nutrient retention and carcass characteristics of weaner rabbits. *Nigerian Journal of Animal Production*, 31:194-199.

Hamzat, R.A., Onwumere, C. J., Adeleye, I. O. A. (2019). Evaluation of cowpea waste meal as protein source in broiler chick ration. *ACTA Scientific Nutritional Health, Volume* 3.6:74-77.

Ironkwe, M. O. and Bamgbose, A.M. (2011). Effect of replacing maize with brewer's dried grain in broiler finisher diet. *International Journal of Poultry Science,* 10 (9): 710-712.

Mmereole, F.U.C. (2008). Effects of replacing groundnut cake with rubber seed meal on the haematological and serological indices of broilers. *International Journal of Poultry Science*, 7: 622-624.

Onyimonyi, A. E. and G. C. Okeke, (2008). Nutritional evaluation of cassava (*Mamihot esculenta* Crantz) peels in the diet of weaner pigs. Nigerian Journal of Animal Production, 35: 82-89.

Umoh, J. E (1984). The use of concentrates and by-products in beef cattle production. *Proceedings of the National Conference on Beef Production, July 27-30, Kaduna, Nigeria.*

SOCIO-CULTURAL CHARACTERISTICS OF SMALLHOLDER PIG FARMERS AND THEIR FEED INGREDIENTS USE APPROACHES AT PERI-URBAN AND RURAL FARMING LOCATIONS IN IMO STATE, NIGERIA

P.C. Moses[1], I.C. Okoli[1], C.C. Achonwa[1], A.U.C. Ohanaka[1] and A.A. Omede[2]
[1]Department of Animal Science and Technology, Federal University of Technology Owerri, Nigeria
[2]Department of Animal Science, Kogi State University Anyangba, Nigeria
Corresponding author: CC Achonwa: E-mail: chukwumachristian1@gmail.com

Abstract
This study determined the socio-cultural characteristics of smallholder pig farmers and their feed ingredients use approaches at two locations in Imo state, Nigeria. Primary data were generated with the aid of a structured questionnaires. The farmers were mostly males (93.75%) aged between 31-60 years (71%), married (78.13%) and mostly educated at secondary level (50%) and tertiary (40.63%). About 92% of these farmers were not educated in agricultural disciplines, with about 57% haven been in the business for the past 10 years on full-time basis (68.70%). Majority (65.63%) of the farmers formulated their own diets, with PKC (100%), maize offal (71.88%), maize (59.38%) palm oil sludge and cassava tuber (43.95% each) constituting the major energy feed ingredients used, while blood meal (78.32%), soybean meal (65.63%), groundnuts and cowpea (53.13% each) constituted the major protein raw material used. Popular fibre materials were cassava peels (75%), yam peels (71.88%), plantain peels (65.63%) and plant leaves (53.13%). The present results highlight the need for further studies on the local feed ingredients utilization practices of these farmers.

Keywords: feed ingredients, palm kernel cake, Pigs farmers

Introduction

Small-scale intensive pig production in Nigeria is currently being challenged by high cost of feed raw materials arising from the continued increase in the cost of conventional feedstuffs. Nigeria is however characterized with a wide range of alternative feed resources such as oilseeds, grains, forage crops, peels, animal and agro industrial by-products. These locally available feed materials have potential to sustain the piggery industry, although underutilized by farmers due to inadequate information on their location, storage and quality enhancement (Ohanaka *et al.*, 2017).

Different alternative feed raw materials abound in Imo state and are incorporated into pig feeding according to novel methods developed by the farmers (Ohanaka *et al.*, 2017). According to Wettasinha *et al.* (2008) such farmer led local experimentation is common in many regions of the world. However, these location specific innovations are usually lost with changing environmental and social needs of the innovators. Identifying, documenting and if possible, evaluating such local innovation systems provide an entry point to Participatory Technology Development (PTD) that begins with studying existing farmer approaches and practices geared towards solving local problems (Wettasinha *et al.*, 2008).

This study determined the socio-cultural characteristics of smallholder pig farmers and their feed ingredients use approaches at peri-urban and rural farming locations in Imo state, Nigeria.

Materials and Methods

The study was carried out among pig farmers in two Local Government Areas (LGAs) in Imo State, in the tropical rain forest environment of southeastern Nigeria. An informal survey was carried out prior to the actual study during which, the researcher made himself known to pig farmers and discussed the details of the work with them. The study LGAs were Owerri West LGA (OWL), a peri-urban area and Aboh-Mbaise LGA (AML) a rural area. At these locations, 25 pig farms each were purposively selected based on the willingness of their owner to participate in the study, making a total of 50 pig farmers. Primary data were collected with the aid of a well-structured questionnaire. On the whole, only 32 questionnaires were returned by the farmers (17 at OWL and 15 at AML). Data generated from the socio-cultural study were subjected to descriptive statistics, such as frequency count, mean and standard deviations.

Results and Discussion

Results in Table 1 showed that most of the farmers were males (93.75%) aged between 31-60 years (71.88%), married (78.13%) and mostly educated at secondary level (50%) and tertiary (40.63%).

Table 1: Sociocultural characteristics of small-scale pig farmers at Owerri West (n=17) and Abo-Mbaise (n=15) in Imo state

Parameters	Owerri west LGA Frequency (%)	Aboh-Mbaise LGA Frequency (%)	Overall (n=32) Mean Frequency (%)
a. Sex			
Male	15 (88.24)	15 (100.00)	30 (93.75)
Female	2 (11.77)	0(0.00)	2 (6.25)
b. Age			
20–30	1 (5.88)	3 (20.00)	4 (12.50)
31–40	5 (29.41)	4 (26.67)	9 (28.13)
41–50	3 (17.65)	3 (20.00)	6 (18.75)
51–60	4 (23.53)	4 (26.67)	8 (25.00)
Above 60	4 (23.53)	1 (6.67)	5(15.63)
c. Marital status			
Married	13 (76.47)	12 (80.00)	25 (78.13)
Single	4 (23.53)	25 (20.00)	5 (21.88)
d. Education qualification			
Primary	1 (5.88)	2 (13.33)	3 (9.38)
Secondary	5 (29.41)	11 (73.33)	16 (50.00)
Tertiary	11 (64.71)	2 (13.33)	13 (40.63)
Nil	0(0.00)	0(0.00)	0(0.00)
e. Tertiary education	(n=11)	(n=2)	(n=13)
Agriculture	0(0.00)	0(0.00)	0(0.00)
Animal science	0(0.00)	0(0.00)	0(0.00)
Animal health	1 (9.09)	0(0.00)	1 (7.69)
Others	10 (90.91)	2 (100.00)	12 92.31)
f. Years of experience			
1–5	8 (47.06)	3 (20.00)	11 (34.38)
6–10	3 (17.65)	1 (6.67)	4 (12.50)
11–15	2 (11.77)	10 (66.67)	12 (37.50)
16–20	2 (11.77)	1 (6.67)	3 (9.38)
Above 20	2 (11.77)	0(0.00)	2 (6.25)
g. Carrier type			
Full time	13 (76.47)	9 (60.00)	22 (68.75)
Part time	4 (23.53)	6 (40.00)	10 31.25)
h. Number of pigs			
1–10	0(0.00)	0(0.00)	0(0.00)
11–30	2 (11.76)	2 (13.33)	4 (12.50)
31–50	5 (29.41)	7 (46.67)	12 (37.50)
51–100	3 (17.65)	0(0.00)	3 (9.38)
Above 100	7 (41.18)	6 (40.00)	13 (40.63)

About 92% of these farmers were not educated on any agricultural discipline, with about 47% been in the business for the past 10 years on full-time basis (68.70%). Majority (40.63%) of the farmers stocked above 100 pigs, while 37.50% stocked between 31-50 pigs. Across study locations, the results showed that farmers at OWL were more educated (64.71% tertiary) than those at AML (73.33% secondary), most of the tertiary institution educated farmers (90.91 and 100% respectively)

specializing in non-agriculture related disciplines. Similar results were reported by Okoli *et al.* (2009) in the same Imo state.

Results in Table 2 showed that majority (65.63%) of the farmers formulated their own diets with PKC (100%), maize offal (71.88%), maize (59.38%) palm oil sludge and cassava tuber (43.95% each) constituting the major energy feed ingredients used, while blood meal (78.32%), soybean meal (65.63%), groundnuts and cowpea (53.13% each) constituted the major protein raw material used.

Table 2: Different alternative raw materials utilized in feeding pigs at the study location

Parameters	Owerri West LGA Frequency (%)	Aboh-Mbaise LGA Frequency (%)	Overall (n=32) Mean Frequency (%)
a. Types of feed used			
Commercial	0(0.00)	0(0.00)	0(0.00)
Farm made	6 (35.29)	15 (100.00)	21(65.63)
Both	11 (64.71)	0(0.00)	11(34.38)
b. Energy materials used			
Maize	12 (70.59)	7 (46.67)	19 (59.38)
PKC	17 (100.00)	15 (100.00)	32 (100.00)
Sorghum	3 (17.65)	1 (6.67)	4 (12.50)
Maize offal	14 (82.35)	9 (60.00)	23 (71.88)
Palm oil sludge	2 (11.77)	12 (80.00)	14 (43.75)
Cassava tuber	9 (52.94)	5 (33.33)	21 43.75)
Brewery waste	2 (11.77)	1 (6.67)	3 (9.38)
Others	1 (5.88)	0(0.00)	1(3.13)
c. Protein materials used			
Groundnut	9 (52.94)	8 (53.33)	17 (53.13)
Soy bean/cake	12 (70.59)	9 (60.00)	21 (65.63)
Beans	10 (58.82)	7 (46.67)	17 (53.13)
Blood meal	10 (58.82)	15 (100.00)	25 (78.13)
Meat offal	1 (5.88)	0(0.00)	1 (3.13)
Spent grain	2 (11.77)	0(0.00)	2(6.25)
Others	1 (5.88)	2 (13.33)	3 (9.38)
d. Fiber materials used			
Rumen digester	0(0.00)	3 (20.00)	3 (9.38)
Cassava serviette	3 (17.65)	7 (46.67)	10 (31.25)
Cassava peels	11 (64.71)	13 (86.67)	24 (75.00)
Yam peels	11 (64.71)	12 (80.00)	23 (71.88)
Plantain peels	9 (52.94)	12 (80.00)	21 (65.63)
Leaves/vegetables	9 (52.94)	8 (53.33)	17 (53.33)
Plantain/banana trunks	7 (41.18)	8 (53.33)	15 (46.88)
Others	2 (11.77)	7 (46.67)	9 (28.13)
Forages inclusion in diets			
Yes	15 (88.24)	14 (93.33)	29 (90.63)
No	2 (11.77)	1 (6.67)	3 (9.38)

Popular fibre materials were cassava peels (75%), yam peels (71.88%), plantain peels (65.63%) and plant leaves (53.13%) while majority (81.82%) of the farmers used feed additive mixes in the feed. There was a clear disparity in the choice of raw materials at the two locations with more maize, cassava tuber, maize offal and brewers waste being utilized at OWL and more palm oil sludge, blood meal, rumen digesta, cassava, yam and plantain wastes being utilized at AML indicating greater innovative use of available raw materials at the rural location. About 90% of the farmers gave a variety of forages to their pigs.

However, Table 3 showed that out of then 22 forage plants and vegetables fed to the pigs only four, water leaf (*Tanilum* triangulare), *Cetrosema pubescene,* pumpkin leaf (*Telfera occidentalis*) and pawpaw leaf (*Carica papaya*) were fed at the two location, indicating diversity of knowledge, which has also been reported by Obua *et al.* (2012).

Table 3: Forage plants and vegetables utilized in pig feeding

Owerri West LGA	Aboh-Mbaise LGA	Frequency
Water leaf (*Tanilum* triangulare)	Water leaf (*Tanilum triangular)*	2
Cetrosema pubescene	*Centrosema pubescene*	2
Pumpkin leaf (*Telfera occidentalis)*	Pumpkin leaf (*Telfera Occidentalis)*	2
Pawpaw leaf (*Carica papaya)*	Pawpaw leaf (*Carica papaya)*	2
Plantain leaf (*Musa* paradisiaca)	Awolowo leaf (*Chromlaena odorata*)	1
Banana leaf (*Musa sapiantum)*	Pineapple (*Bananas comosus*)	1
Guinea grass (*Pannicum maximum*)	Otite (*Diodia scandens*)	1
Moringa leaf (*Moringa* oleifera)	Okpete (*Castus* afer)	1
Guava leaf (*Psidium guajava*)	Udo (*Urinal lobata*)	1
Elephant grass (*Pannisetum purpuruem*)	Oha (*Pteracarpus osum)*	1
Velvet beans (*Mucuna prureans*)	Red leaf (*Althernanthera brasiliana*)	1
Bitter leaf (*Vernonia amygdalina*)	Green (*Amaranthus spinosis*)	1
Cabbage (*Brassica oleracea*)	Cucumber (*Cucumis sativus*)	1
Total 13	13	22

Conclusion

Data generated from this study shows a rich innovative local feed ingredients utilization culture among smallholder pig farmers in Imo state, who were mostly educated. The present results highlight the need for further studies on the local feed ingredients utilization practices of these farmers for documentation and extended industrial applications.

References

Obua, B.E., McAlbert, F.U., Okoro, B.O. and Efrenie, S. (2012). Survey of the diversity of forage plants used in feeding pigs in smallholder farms in southeastern Nigeria. *International Journal of Agriculture and Rural Development,* 15(3): 1310-1316.

Ohanaka, A.U.C., Nwogu, C.M., Ekenyem, B.U. and Okoli, I.C. (2017). Practical approaches to palm kernel cake utilization in pig feeding by Small – Scale farmers in Southern Nigeria. *Proceedings of First Tropisymposium, December 7th-8th 2017, Owerri, Nigeria*. Pp: 174-182.

Okoli. I.C., Alaoma, O.R., Opara, M.N., Uchegbu, M.C., Ezeokeke, C.T., Durunna, C.S., Nnadi, F.N., Iheukwumere, F.C and Okeudo, N.J. (2009). Socio-cultural characteristics of educated small scale holder pig farmers and the effects of their feeding practices on the performance of pigs in Imo state, Nigeria. *Report and Opinion,*1(4): 59-65.

Wettasinha, C., Wongtschowski, M. and Watersbayer. A. (eds.) (2008). Recognizing local innovations; Experiences of Prolinova partners. A publication in the services on promoting local innovations. Silang Caritier, The Philippines.

PERFORMANCE AND COST BENEFIT OF FNISHER BROILERS FED PROCESSED SICKLE POD (*Cassia tora)* SEED MEAL AS REPLACEMENT FOR DIETARY FULL FAT SOYA BEAN

[1]Muhammad, B. A., [2]Kawu, Y. U., [3]Yusuf, S. Z.[4]Doma, U.D., [4]Abubakar, M. and [4]Bello, K.M.

[1]Ministry of Agriculture & Animal Husbandry, Gombe State. Nigeria.

[2]Department of Agricultural Technology, Federal Polytechnic, Damaturu, Nigeria

[3]Department of Animal Science & Range Management, Modibbo Adama University of Technology, Yola, Nigeria.

[4]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi,

Nigeria,

Abstract

An experiment was conducted to assess the growth performance and cost benefit of substituting full fat soya bean (FFSB) for soaked-toasted cassia tora seed meal (STCS) in the diets of finisher broilers. Five diets were formulated in which STCS replaced FFSB at 0, 25, 50, 75 and 100% levels designated as diets 1, 2, 3, 4 and 5 respectively. Three hundred broiler chickens weighing between 850 and 869 g were randomly allotted to five diets in replicates of four containing 15 birds each in a completely randomized design. Feed and water were provided ad libitum and the experiment lasted for 28 days. Results showed that daily feed intake (79.61 – 97.01g) did not differ among diets. However, daily weight gain (17.33 – 40.11g), total weight gain (485.24 – 1123.08g) and feed conversion ratio (2.33 – 4.65) were significantly (P<0.05) affected. Broiler birds fed diets containing STCS beyond 25% level resulted in lower performance. A cost saving of ₦13.74was realized on diet 2. It was therefore concluded that soaked-toasted cassia tora seed meal can replace full fat soya bean at 25% level in finisher broiler diets without compromising performance and a reduction in feed cost.

Keywords: Finisher Broilers, performance, cost benefit, *Cassia tora*, full fat soya bean

Corresponding Author: kawuyahya@gmail.com; Phone no. 08065631979

Introduction

Protein sources are the second largest component of practical poultry diets. A limited number of ingredients are used by commercial poultry industries to supply protein. These ingredients are mostly limited in distribution and are also generally expensive than energy sources (Paul *et al.*, 2017). Soya bean seed is the main protein source used by poultry feed manufacturers. However, in Nigeria, its price is high and tends to fluctuate with changes in climatic conditions and social situations (Akande *et al.*, 2010). Accordingly, any shift in the use of ingredients other than soya bean, more especially the non-conventional ones, as plant protein sources, will greatly reduce the pressure on soya bean and reduce poultry feed cost which stands at about 70% of the total cost of intensive poultry production (Olorede and Longe, 1999; Anamayi, 2018).

Although the utilization of non-conventional plant protein sources e.g leguminous seed and leaf meals may be cost effective, their use is principally limited by the presence of anti-nutritional factors (ANFs) (Gatlin *et al.*, 2007). In order to eliminate or reduce the effect of these ANFs, several processing methods like soaking, cooking, toasting and sprouting have been identified (Torki and Farahmand-Pour, 2007 Ahamefule and Odemelam, 2008; Omoikhoje *et al.*, 2009; Buba *et al.*, 2010).

Cassia tora is an un-conventional plant protein ingredient that may be used in poultry rations. According to Ingweye *et al.* (2010), the seeds have good nutritional properties (protein 29.54%, methionine 0.92g/100g and energy 325.28 kcal/kg) but contain some ANFs (tannins, alkaloids, phytates and saponins). The aim of this study was to ascertain the performance of finisher broiler

chickens fed diets containing double stage processed (soaked and toasted) *Cassia tora* seed meal as replacement for full fat soya bean.

MATERIALS AND METHODS

The experiment was conducted at the Poultry Production unit, Ministry of Animal Husbandry and Nomadic Affairs, Gombe, Gombe State.

Soya bean was cleaned, boiled for 30 minutes using jute bags and sun-dried for 3-4 days. Similarly, mature *Cassia tora* seeds were harvested from the wild, around Tukulma village, Gombe state. The seeds were manually threshed from the pods and spread on a floor to sun-dry for two days. Thereafter, the seeds were soaked in clean water for 24 hours, sundried and toasted in a frying pan until they began to change colour. The two ingredients (soya bean and *Cassia tora*) were then crushed to 3mm particle size and kept in 50kg bags until when ready for use. Samples of *Cassia tora* were analysed for proximate composition (table 1) according to AOAC (2011).

Table 1: Proximate Composition of Soaked-Toasted *Cassia tora*.

Nutrient (%)	Level
Dry Matter	96.32
Crude protein	26.55
Crude fibre	6.92
Ether extract	5.08
Ash	8.69
Phytate (mg/100g)	117.08
Hydrocyanic acid (mg/kg)	3.52
Tannin (mg/100g)	128.43

Five isonitrogenous, isocaloric experimental diets containing 20% crude protein were formulated, with *Cassia tora* seed meal replacing full fat soya bean at 0, 25, 50, 75 and 100% levels coded as diets 1, 2, 3, 4 and 5 respectively (Table 2).

Table 2: Ingredients and Percentage Composition of Processed *Cassia tora* Seed Meal as Replacement for Full fat Soya Bean Fed to Finisher Broilers.

	DIETS				
INGREDIENT	**1**	**2**	**3**	**4**	**5**
Maize	52.10	52.10	52.10	52.10	52.10
Full-Fat Soya bean	24.40	18.30	12.20	6.10	0
Cassia tora	0	6.10	12.20	18.30	24.40
Wheat offal	15.00	15.00	15.00	15.00	15.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25
Premix*(Finisher)	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis (%)					**100.00**
ME (Kcal/kg)	2976.08	2968.34	2959.10	2947.27	2935.08
Crude Protein	20.00	20.00	20.00	20.00	20.00
Ether Extract	6.25	6.48	6.71	6.95	7.19
Crude fibre	4.37	4.08	3.80	3.52	3.36
Calcium	1.81	1.79	1.78	1.76	1.73
Phosphorus	0.86	0.84	0.83	0.81	0.79
Methionine	0.62	0.64	0.65	0.67	0.69
Lysine	1.20	1.24	1.28	1.32	1.34

ME; Metabolizable Energy*Vit/mineral premix supplied/Kg of Diet: Vit. A, 8,500IU; Vit. $D_{3,}$ 2,000IU; Vit. E, 10mg; Vit. $K_{3,}$ 1.5mg; Vit. B_1, 1.6mg; Vit. $B_{2,}$ 4mg; Niacin, 20mg; Pantothenic acid, 5mg; Vit. $B_{6,}$ 1.5mg; Vit. $B_{12,}$ 0.01mg; Folic acid, 0.5mg; Biotin, 0.75mg; Choline chloride,175mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30mg and Antioxidant, 1.25mg.

A total of three hundred (300) unsexed *Abor acres* broiler chickens weighing between 850 – 869g were used for the experiment. The birds were randomly allotted to five experimental diets in 4 replicates of 15 birds each in a Completely Randomized Design. Feed and clean drinking-water were served *ad libitum* throughout the 28-day trial period.

Daily feed intake was determined by and birds were weighed on weekly basis. Feed conversion ratio was calculated from the values of feed intake and weight gain. Mortality was also recorded as it occurred. Prices of feed ingredients were recorded as at the time of study. Data were analysed using One-way Analysis of Variance (SPSS Statistics 17.0). DMRT was used for mean separation (Duncan, 1955).

Results and Discussion

The proximate composition (Table 1) of soaked-toasted sickle pod seeds (STCS) showed that it has a dry matter content of 96.32%, crude protein 26.55%, ether extract 5.08%, crude fibre 6.92% and an ash content of 8.69%. These values were comparable to those reported by Augustine *et al.* (2017) in fermented *Cassia tora* seeds. Similarly, the result revealed that the levels of anti-nutritional factors in STCS are phytate 117.08 mg/100g, hydrocyanic acid 3.52 mg/kg and tannin 128.43 mg/100g. The tannin content is lower than 330 mg/100g reported for Mung beans (Mubarak, 2005).

Performance of finisher broilers (Table 3) fed dietary levels of STCS as replacement for full fat soya bean soya bean showed no significant difference in initial weight of birds (850 and 869 g). Final weight (1335.43 – 1975.14, P<0.05) and total weight gain (485.24 – 1123.08g, P<0.05) were influenced by diets with better values on diets 1 and 2. Daily feed intake (80.56 – 97.01g) was also not significantly influenced by the replacement of full fat soya bean for STCS in the diets. This contradicts Augustine *et al.* (2017) who reported a significantly (P<0.05) lower feed intake in broiler chickens fed differently processed *Cassia tora* seeds. However, daily weight gain of birds on diet 2 (37.38 g) compared favourably with the control (40.11g) which was significantly (P<0.05) higher than diets 3 (21.29 g), 4 (18.42 g) and 5 (17.33 g). A similar finding was reported by Emiola *et al.* (2013), who fed processed Mucuna seed meal to broiler chickens. Feed conversion efficiency decreased significantly (P<0.05) with increased STCS above 25% level in the diets. This could be as a result of the higher levels of ANF present in these diets. Feed cost per kg (₦) decreased from ₦113.78 on diet 1 to ₦73.82 on diet 5. Feed cost per kg gain ((₦) was lowest (₦252.42) on diet 1 and highest on diet 4 (₦381.92). The highest cost saving of ₦13.74 was made on diet 2.

Table 3: Performance of Finisher Broilers Fed Dietary Levels of Processed *Cassia tora* as Replacement for Full Fat Soya Bean

	DIETS					
Parameter	**1**	**2**	**3**	**4**	**5**	**SEM**
Initial weight (g)	852.06	869.63	855.11	862.47	850.19	7.20^{NS}
Final weight (kg)	1975.14^{a}	1916.27^{a}	1451.23^{b}	1378.23^{c}	1335.43^{c}	19.53*
Total weight gain (g)	1123.08^{a}	1046.64^{a}	596.12^{b}	515.76^{c}	485.24^{c}	24.98*
Daily feed intake (g)	93.53	97.01	84.72	79.61	80.56	5.23^{NS}
Daily weight gain (g)	40.11^{a}	37.38^{a}	21.29^{b}	18.42^{c}	17.33^{c}	0.83*
Feed conversion ratio	2.33^{a}	2.60^{a}	3.98^{b}	4.32^{c}	4.65^{d}	0.08*
Mortality (number)	2	1	2	0	3	

[abcd]Means bearing different superscripts within the same row differ; * = (P<0.05),

NS= Not significant; SEM = Standard Error of Mean.

Table 4: Cost-Benefit of Finisher Broilers Fed Processed *Cassia tora* Seed Meal as Replacement for Dietary Full Fat Soya Bean

Parameter	1	2	3	4	5
Total feed intake (g)	2618.84	2716.28	2372.16	2229.08	2255,68
Feed cost /kg (₦)	113.78	97.44	92.47	89.06	73.32
Total feed cost (₦)	298.10	265.03	219.15	198.60	165.70
Total weight gain (g)	1123.08	1046.64	596.12	515.76	485.24
Feed cost /kg gain (₦)	266.16	252.42	358.58	381.92	338.16
Cost saving (₦)	-	13.74	-92.42	-115.76	-72.00
Per cent cost saving	-	5.16	-34.72	-43.52	-27.05

Conclusion

Cassia tora seed meal processed by soaking followed by toasting has good nutritional potentials and can replace full fat soya bean at 25% level in finisher broiler diets without compromising performance and a cost saving of ₦13.74.

References

Ahamefule, F. O. and Odemelam, F.O. (2008). Effect of soaking duration on the proximate composition, gross energy, mineral content and some anti-nutritional properties of *Canavalia plagiosperma seed* seed. Proceedings of the 13th Annual Conference of Animal Science Association of Nigeria (ASAN), 15 – 19th September, 2008. ABU Zaria, Nigeria pp. 491- 494.

Akande, K. E., Doma, U. D., Agu, H. O. and Adamu, h. M. (2010). Major antinutrients found in plant protein sources: Their effect on nutrition. *Pakistan Journal of Nutrition*, 9(8):827-832.

Anamayi, S. E., Anamayi, R. M. and Adamu, S. (2018). Cost-benefit analysis of broiler birds fed on different graded levels of *Moringa oleifera* leaf meal, *Journal of humanities and Social science*, 23(7):32-35.

AOAC. (2011). Association of Official Analytical Chemists. Official Methods of Analysis, 18th edition, Arlington, VA

Augustine, C., Kwari, I. D., igweibuke, J. U. and Adamu, S. B. (2017). Evaluation of chemical composition of raw and processed tropical sickle pod (*Senna obtusifolia)* seed meal. *Agricultural Science and Technology*, 9(2): 110 - 113

Buba, W., Duru, S. And Shehu, B. M. (2010). The effects of cooking duration on the chemical and anti-nutritional composition of sickle pod (*Cassia tora*0 seeds. Proceedings of the 15th Annual Conference of Animal Science Association of Nigeria (ASAN), 13 – 15th September, 2010. University of Uyo, Akwa Ibom State, Nigeria.

Duncan, D.B. (1955). Multiple Range and Multiple F. Test. *Biometrics.***11**: 1-42.

Emiola, I. A., Ojediran, T. K. and Ayaji, J. A. (2013). Biochemical and haematological indices of broiler chickens fed differently processed legume seed meals. *International Journal of Applied Agriculture and Apiculture,* 1 & 2, 140-149.

Gatlin, D. M., Barrows, F. T. and Brown, P. (2007). Expanding the utilization of sustainable plant products in aqua feeds: A review. *Aquaculture Research* 38: 551- 579.

Ingweye, J. N., Kallo, G. A. Ubua, J. A. And Umoren, E. P. (2010). Nutritional evaluation of

wild sickle pod (*Senna obtusifolia*) seeds from Obanliku, South-Eastern Nigeria. *American Journal of Food Technology,* 5: 1-12

Mubarak, A. E. (2005). Nutritional composition and antinutritional factos of mung bean seeds (*Phaseolus aureus)* as affected by some home traditional processes. *Food Chemistry,* 89: 489 – 495.

Olorede and Longe (1999). Feed cost represents the annual operating coist for most commercial birds enterprises. College of Agriculture, Zimbabwe, Poultry Science and Story book.ISBN. 3425.

Omoikhoje, S. O., Etebha, E. T. E., Bamgbose, A. M. and Osifi, B. A, (2009). Performance indices of starting broiler chickens fed dietary levels of roasted fluted pumpkin pod husk waste meal. Proceedings of the 14th Annual Conference of Animal Science Association of Nigeria (ASAN), 14 – 17th September 2009, LAUTECH, Ogbomoso, Nigeria. Pp: 459 – 461.

Paul, A. I., Mehdi, T., Emmanuel, U. A. and Apeh, A. O. (2017). Alternative sources of protein for poultry nutrition. Retrieved on 8th December 2019 from http://dx.org/10.19103/AS.2016.0011.13

Torki, M. and Farahmand-Pour, M. (2007). Use of dietary enzyme inclusion and seed germination to improve feeding value of sorghum for broiler chicks. Proceedings of the 16th European symposium on poultry nutrition: Strasbourg. France. In: World Poultry Science Association pp: 643 -646.

EFFECT OF BOILING ON THE MICRO AND MACRO MINERAL COMPOSITION OF MORINGA (*Moringa Oleifera*) SEEDS

Musa J., Zakka G. C. and Kachong Y. K.
Department of Animal Science, Kaduna State University.
Corresponding Authors mail: Jacobmusa93@gmail.com.

ABSTRACT

This study evaluated the effect of boiling as a processing method on the micro and macro mineral composition of Moringa oleifera seeds as potential livestock feed. Moringa oleifera seeds were collected from Ungwan Musa, Kafanchan in Jama'a LGA of Kaduna State, Nigeria. The seeds were weighed and divided into seven (7) portions of 100g each. The first portion was left raw as treatment control, while the second, third, fourth, fifth, sixth and seventh portion were boiled for 10, 20, 30, 40, 50 and 60minutes respectively. Thereafter the micro and macro mineral compositions were evaluated in the laboratory and the results obtained were analysed using simple descriptive statistics. The results showed a decline in both macro and micro elements with successive increase in boiling duration (from 10-60mins). For Macro minerals; Sodium, Potassium, Calcium, Phosphorus and Magnesium, a declined by 1.5%, 0.9%, 0.47%, 1.08% and 1.87% respectively was recorded. Micro minerals; Iron, Copper, Manganese and Zinc decreased by 1.19%, 2.37%, 0.22% and 2.27% respectively. At 60 minutes boiling duration, Copper recorded the highest decline (2.37%), hence it was concluded that boiling Moringa oleifera seeds for 10-60minutes has no deteriorating effects on its macro and micro mineral compositions because all mineral elements considered were still within recommended amount to be fed as livestock feed.

Keywords: *Moringa oleifera*, Boiling, Macro and Micro Minerals.

INTRODUCTION

The rising cost of feeds and feedstuff in the livestock industry is a major source of concern for the industry and has remained a serious obstacle to meeting the demands of animal protein in developing countries like Nigeria. Cost of feeding has been estimated to account for about 70% of total production cost in broiler production (Adejinmi, 2000).

Livestock feed cost in developing countries is a continuing challenge. The high and increasing prices of animal feeds have compelled researchers in developing countries to direct their attention towards utilization of non-conventional feed stuff, with particular emphasis on protein substitutes (Gaia, 2005). *Moringa oleifera* Lam is one of the 13 varieties of Moringaceae, which is native to India, Red Sea and parts of Africa including Madagascar, of these, *M. oleifera* is the most widely known variety (Price, 2007). *Moringa oleifera* is among those plants that can be integrated with livestock production to increase feed quality and availability because it is a good source of cheap protein supplement to improve digestibility of other diets. All plant parts can be used to feed livestock.

Food processing transforms raw foods to edible forms. It also increases shelf-life, digestibility, flavor, nutritive value among other benefits. Various foods presuppose different processing techniques depend on the needs and end products required (Okokon, 2004). Boiling as a processing method is known to bring about high complex reactions without having direct effect on nutritional value of food (Umeh and Bassir, 1977). Therefore the aim of this study was to determine the effect of cooking time on the micro and macro mineral composition of *Moringa oleifera* seeds grown in Ungwan Musa, Jama'a Local Government Area of Kaduna State, Nigeria.

MATERIALS AND METHODS

Collection and Preparation of Samples

The seeds were collected from Ungwan Musa, Kafanchan in Jama'a Local Government Area of Kaduna State, Nigeria. The seeds were sorted and divided into seven (7) samples of 100g each at the Kaduna State University Animal Science laboratory using a 250kg manual weighing scale (spring balance).

Processing of samples

A sample of 100g was weighed, grinded into powder, sealed in a polythene bag and tagged "0" (Raw Moringa Seeds) as the treatment control. The remaining six (6) samples each containing 100g of matured Moringa Seeds were emptied into a boiling water. Clean water was used to boil the Moringa seeds. One hundred grams of Moringa seeds was collected at every 10mins interval. The last 100g of Moringa seeds was collected after 60mins of boiling. Six (6) samples in all were collected separately from the boiling water, drained, sundried for 5hours and grinded into powder. The six (6) samples were sealed in individual polythene bags and tagged 10, 20, 30, 40, 50 and 60 representing samples boiled for 10, 20, 30, 40, 50 and 60mins respectively.

Laboratory Analysis

The processed Moringa (*Moringa oleifera*) seeds were taken to the Department of Nutrition and Dietetics, Kaduna State Polytechnic for analysis. Samples were analysed to determine the effects of boiling duration on micro and macro mineral composition. The mineral contents including sodium, potassium, and calcium was determined in EPC (Extracted Pomace Cake) using flame photometry while magnesium, iron, copper, manganese and zinc contents were determined by atomic absorption spectroscopy according to A.O.A.C. (2010). A standard colorimetric method was applied for phosphorus as mentioned by Borah *et al.* (2009).

Statistical Analysis

All data collected on macro and micro mineral compositions were analysed by simple descriptive statistics. The percentage change of each treatment was calculated using the formula:

$$\%\ change\ = \frac{C - V}{C} \times 100$$

Where C = Value of Control (Raw), and V = Value for each Treatment.

RESULTS AND DISCUSSION

Table 1: Effect of Boiling Duration on the Mineral Composition of *Moringa oleifera* Seeds

Parameters	Boiling durations in minutes						
	0	10	20	30	40	50	60
Macro Minerals							
Sodium mg/100g	1470.00	1468.00	1466.00	1460.00	1455.00	1450.00	1448.00
Potassium mg/100g	1273.00	1272.00	1270.00	1268.00	1266.00	1264.00	1261.00
Calcium mg/100g	254.00	254.00	253.00	253.80	253.50	253.30	252.80
Phosphorus mg/100g	738.00	738.00	737.00	736.60	736.40	736.00	730.00
Magnesium mg/100g	64.20	64.18	64.10	64.00	63.50	63.20	63.00
Micro Minerals							
Iron mg/100g	185.20	185.00	184.60	184.60	184.50	184.00	183.00
Copper mg/100g	7.60	7.60	7.54	7.50	7.47	7.45	7.42
Manganese mg/100g	91.60	91.60	91.60	91.58	91.50	91.46	91.40
Zinc mg/100g	57.30	57.30	57.20	57.00	56.80	56.50	56.00

0 = the raw *Moringa oleifera* seed sample which signifying control, while 10, 20, 30, 40, 50 and 60 = boiling time for *Moringa oleifera* seeds in minutes.

The effect of boiling duration on the mineral composition of *Moringa oleifera* seeds is given in table 1. Macro and Micro minerals were slightly reduced with increase in cooking time contrary to the report of Mbah *et al.,* (2012) who recorded an increase in the amount of Calcium, Iron and Zinc in *Moringa oleifera* seeds boiled for 10, 20 and 30mins. David (2018) also reported a decrease in the amount of both macro and minor minerals when *Moringa oleifera* seeds were boiled for 30minutes. The values for both macro and micro minerals of Raw *Moringa oleifera* seeds recorded were similar to that given by Barakat and Ghazal, (2016). At 60mins boiling duration, the values of Ca, Na, K, and P (1448mg/100g, 252.8mg/100g, 1261mg/100g and 730mg/100g respectively) were all within the amount recommended for both Layers and Broiler birds as reported by Van der Klis and Vinyeta, (2015). The Iron concentration was found to be 183mg/100g for *Moringa oleifera* seeds boiled for

60mins. Iron is essential for haemoglobin formation and its deficiency leads to anaemia (Turan *et al.* 2003). The value of Magnesium contained in the raw *Moringa oleifera* seeds (64.20mg/100g) was lower compared to the value (677.00mg/100g) for *Moringa oleifera* leaf given by Sodamade *et al.* (2013). Magnesium is very important in calcium metabolism in bones and also involved in prevention of circulatory diseases and also helps in regulating blood pressure and release of insulin.

Table 2: Percentage Change in the Level of Mineral Composition of *Moringa oleifera* Seeds at Different Boiling Time.

Parameters	Percentage change due to different boiling time						
	0	10	20	30	40	50	60
Macro Minerals							
Sodium	-	0.14(-)	0.27(-)	0.68(-)	1.02(-)	1.36(-)	1.50(-)
Potassium	-	0.08(-)	0.24(-)	0.39(-)	0.55(-)	0.71(-)	0.94(-)
Calcium	-	-	0.39(-)	0.07(-)	0.19(-)	0.28(-)	0.47(-)
Phosphorus	-	-	0.14(-)	0.19(-)	0.21(-)	0.27(-)	1.08(-)
Magnesium	-	0.03(-)	0.16(-)	0.31(-)	1.09(-)	1.56(-)	1.87(-)
Micro Minerals							
Iron	-	0.11(-)	0.32(-)	0.32(-)	0.38(-)	0.65(-)	1.19(-)
Copper	-	-	0.79(-)	1.32(-)	1.71(-)	1.97(-)	2.37(-)
Manganese	-	-	-	0.02(-)	0.11(-)	0.15(-)	0.22(-)
Zinc	-	-	0.18(-)	0.52(-)	0.87(-)	1.40(-)	2.27(-)

(+) = % increase, (-) = % decrease.

Table 2 shows percentage change in mineral composition of *Moringa oleifera* seeds boiled at different durations. At 10mins boiling time, Potassium, Magnesium and Iron reduced by (0.08%, 0.03% and 0.11% respectively), this shows that these mineral elements are easily leached out compared to other mineral elements (Calcium, Potassium, Copper, Manganese and Zinc). It also reveals that Manganese was the most attached mineral element which was reduced by 0.02% at 30mins boiling time. At 60mins of boiling, Manganese recorded the lowest depletion (0.22%) and Copper had the highest depletion (2.37%) at the same 60mins.

CONCLUSION AND RECOMMENDATION

From the results obtained in this study, it was concluded that increasing boiling time from 0 to 60 minutes led to reduction in the concentration of mineral elements in *Moringa oleifera* seeds. The major mineral elements; Sodium, Potassium, Calcium, Phosphorus and Magnesium were lost by 1.5%, 0.94%, 0.47%, 1.08% and 1.87% respectively while the micro mineral elements; Iron, Copper, Manganese and Zinc were lost by 1.19%, 2.37%, 0.22% and 2.27% respectively. *Moringa oleifera* seeds boiled within the range of 10-60mins remain a good source of minerals because the elements considered were still within recommended amount to be fed as livestock feed and therefore a good source of livestock feed. Further research could be made in this area in order to evaluate other minerals which were not considered in this experiment and subsequently followed by a feeding trial to test for acceptability of the feedstuff and other parameters.

REFERENCES

Adejinmi, O.O., Adejinmi, J.O. and Adeleye, I.O.A. (2000). Replacement value of fish meal with soldier fly larvae meal in broiler diets, *Nig. Poult. Sci. J.* (1):52-60

A.O.A.C. (2010) Official Methods of Analysis. 18th Edition, Association of Official Analytical Chemists, Washington DC.

Barakat, H. and Ghazal, G.A. (2016). Physicochemical Properties of Moringa oleifera Seeds and Their Edible Oil Cultivated at Different Regions in Egypt. *Food. Nutr. Sci*. **7**, 472-484.

Borah, S., Baruah, A., Das, A. and Borah, J. (2009) Determination of Mineral Content in Commonly Consumed Leafy Vegetables. *Food Analytical Methods*, 2, 226-230. http://dx.doi.org/10.1007/s12161-008-9062-z

David D. J. (2018): Effect of different Processing methods on the proximate, anti-nutrients and mineral composition of *Moringa oleifera* seed. A project Submitted to the department of Animal Science, Kaduna State University (Unpublished).

Gaia, S. (2005). Wonder tree 100 facts moringa fact 04 exceptional animal feed moringa as livestock feed & pet food. Moringa Mission Trust. Available at: http://gaiathelivingplanet.blogspot.com/2005/06/wondertree-100-facts-moringa-fact-04.html (Accessed 31 October 2013)

Mbah, B., Eme, P., Ogbusu, O., (2012). Effect of cooking methods (boiling and roasting) on nutrients and anti-nutrients content of Moringa oleifera seeds. *Pak. J. Nutr*. 11, 211–215.

Okokon, J., (2004). Evaluation of indigenous foods commonly eaten in Eha-mufu community in Enugu state. *Nig. J. Nat. Prod. Med*., pp: 319-342.

Price, M.L. (2007). The Moringa Tree. Echo Technical Note. Available at: http://chenetwork.org/files_pdf/Moringa.pdf (Accessed 06 November 2013).

Sodamade A, Bolaji O.S, Adeboye O.O. (2013) ProximateAnalysis, Mineral Contents and Functional Properties of *Moringa oleifera* Leaf Protein Concentrate. *IOSR J. Int. Sci. Res. E-ISSN; 2278-5736. 4(6):47-51.*

Turan M, Kordis S, Zeyin H, Dursan A, Sezem Y. (2003) Macro and Micro minerals content of some wild edible leaves consumed in eastern Anatolia Tailors and Francis.129-130.

Umeh, L.B. and O. Bassir, 1977. Nutrient changes in some traditional Nigeria food during cooking. Part I vitamin changes. *Fd. Chem*., 2: pp 195.

Van der Klis J. D. and Vinyeta E. (2015) Nutrient requirement in poultry: Critical review of actual recommendations of FEDNA (2008) and suggestions for modifications. ResearchGate Book.

REPLACEMENT VALUE OF GROUNDNUT HUSK FOR MAIZE IN RABBITS DIETS

***N. Adamu, A. S. Aliyu, I. Sani, S. Adamu and N. A. Jama'a**

Department of Animal Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University Bauchi, Nigeria.

***Correspondence Author, email: nuratuadamu@gmail.com, 08036460634**

ABSTRACT

An experiment was conducted to evaluate the replacement value of groundnut husk for maize in rabbit diets. Groundnut husk was used at 0, 10, 15 and 20% levels to replace maize as diets 1, 2, 3 and 4 respectively. A total of sixteen rabbits of mixed breed and sex were obtained from Muda Lawan market Bauchi and allotted to four dietary treatments in a completely randomized design (CRD), and the feeding trail lasted for eight weeks. Daily feed intake (P<0.001) 38.70-46.30g and daily weight gain 4.6-10.50g (P<0.05) were affected significantly by the dietary treatments, however feed conversion ratio (4.01-3.15) was not affected significantly. The feed cost in naira per kilogram gain was relatively higher on maize (control diet) and lower on groundnut husk based diets. It can be concluded that groundnut husk can substitute maize up to 20% level of inclusion in the diets of rabbits without any adverse effect on performance.

Key words: Rabbits, Diets, Groundnut husk, Maize and Performance.

INTRODUCTION

The potential of rabbit meat as a quality or nutritious food resulted from its higher protein content, lower fat, lower sodium and cholesterol content compared to other meat sources such as beef, pork, mutton and chicken. Protein deficiency in some part of the world has reached an alarming state. It is a fact that there is an inadequate intake of animal protein in Nigeria (Ayayi *et al*., 2007). To erase this problem of low animal protein intake, there should be an expansion in the production of small highly prolific livestock with rapid turnover rate at a very low cost. Rabbits are small mammals in the family leporidae of the order lagomorpha found in many different continent and climatic zones. The prolific nature of rabbits coupled with it short gestation period and generation interval makes it the animal of choice for multiplication and a short way of increasing animal protein intake (Akinmutimi *et al*., 2008). Rabbit production in Nigeria is gaining much popularity but it is contravened by the high cost of conventional feed stuffs which producers cannot afford. Feed is one of the constraints to intensive rabbit production in Nigeria due to competition between man, industries and animals for conventional feed materials. This has led to the escalating cost of conventional ingredients and has made feed cost to account for about 70% of total cost of production (Akinmutimi, 2008). This problem has been the major stimulant for the search for alternative feed stuffs that can meet the nutritional requirement of micro-livestock, reduce the cost of feed and animal production (Oloredeet, 2011). The alternative feed material should be one that has low human food preference and of low industrial usage. Groundnut husk is the cover that is left after the fleshy groundnut seed is removed. The groundnut husk has some nutritive value and may be useful to rabbits as source of fiber (Aduku and Olukosi, 1992). There is no sufficient literature on the use of groundnut husk as feed by rabbits. Therefore, the present study will test the effect of replacing maize with groundnut husk in the diets of rabbits and to find out the economic efficiency of using groundnut husk in rabbit production.

Materials and Method

Experimental Site

The experiment was conducted at College of Agriculture farm Bauchi, Bauchi State. Bauchi is located within the Northern Guinea Savanah on latitude 10^1, 17 N and 9^0, 49^1E at altitude 690.2m above sea level (FAO, 1999). The mean annual rain fall ranges between 600mm in the north and 1300mm in the south. Bauchi has mean annual maximum and minimum indoor temperature of 32 to 41 respectively with a relative humidity of 20.00 and 67.00% respectively

Experimental Animals and their Management

A total of sixteen weaned rabbits of mixed breed and sexes were used for the study. The rabbits were between the ages of 6-7 weeks. The experimental animals were randomly distributed to four (4) dietary treatments and each treatment was replicated two (2) times and the trial lasted for eight weeks.

The rabbit's house was cleaned and disinfected before the beginning of the experiment, similarly; the cage, plastic drinker and feed containers were thoroughly washed and disinfected. The rabbits were gradually introduced to the experimental diets. Routine management was carry out on daily basis such as cleaning the cage, supplying feed and fresh water.

Experimental Diets

Four (4) diets were compounded with; 0, 10, 15 and 20% replacement levels of groundnut husk, coded as diets T1, T2, T3 and T4 respectively.

Data Collection and Statistical Analysis

Rabbits were bought from market and weighed at the beginning of the experiment after preliminary period of one week to determine the initial weight of the rabbits. Subsequently the rabbits were weighed weekly to determine the body weight changes. Feed intake was obtained by subtracting the leftover from the initial feed given which is on daily basis. Data collected was subjected to analysis of variance statistical package for social sciences and significant differences in treatment means were separated using LSD.

Results and Discussion

Performance of Rabbits

There was no significant difference ($p<0.05$) on the initial weight of the experimental rabbits this shows that all the rabbits have similar weight. There was no significant difference ($p<0.05$) on the final weight gain and feed conversion ratio. However there was significant difference ($p<0.001$) on the total feed intake. Rabbit on diet 3, consumed 5187g more feed compare to those on diet 1, with feed consumption of 4289g. This possibly was because of the level of crude protein present in the diet make the feed more palatable. Also there was highly significant difference ($p<0.001$) on the average daily feed intake. Rabbits on diet 3, consumed 47. 20g per day while rabbits on diet 1, consumed 38.70g per day. This may be as a result of higher level of forage in diet 3, because rabbits can be reared solely on forages as reported by Omole, (1992) that the basal diet for rabbits is forages but supplementation with concentrate improves the performance of the rabbits. There was significant difference ($p<0.05$) on the average daily weight gain. Rabbit on diet 4 have the highest average weight gain of 10.50g, followed by rabbits on diet 3, 2 and 1 with weights of 6.60g, 6.40g and 4.60g respectively. This finding agrees with the study of Iyeghe-Erakpotobor and Adeyegun, (2012) they reported that weight gain of rabbits increased with increase in groundnut forage meal level. The economic analysis shows that, feed cost in naira per kilogram gain seemed to be comparatively higher on maize (control diet) than the groundnut husk based diets, this trend was expected as the price of maize was higher than groundnut husk which price amount close to little or nothing and could economically replace maize. The feed cost ₦/kg gain at 20% level of inclusion of groundnut husk diet is cheaper and requires ₦260 worth of feed to provide 1kg body weight gain compare to control diet that requires ₦618.7 to produce 1kg body weight gain.

Conclusion

It can be concluded based on the results obtained, that groundnut husk could replace maize up to 20% level of inclusion without any detrimental effect on performance. The 20% level of inclusion is economically cheaper and could give a cost saving of 358.7 from each kg of feed used compare to the control diet.

The percentage composition of the experimental diets will be shown in table 1 below

Table 1: Percentage Composition of the Experimental diets fed to rabbits

	Diet%			
Ingredient	**T1(0)**	**T2(10)**	**T3(15)**	**T4(20)**
Maize	34.62	31.16	29.43	27.69
G/husk	0.00	3.46	5.19	6.92
Full fat soya	13.38	13.38	13.38	13.38
Wheat offal	48.80	48.80	48.80	48.80
Fishmeal	1.50	1.50	1.50	1.50
Bone meal	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25
	100%	100%	100%	100%
Calculated Analysis				
Crude Protein	17.97	17.86	17.80	17.75
Crude Fibre %	9.71	11.75	13.26	13.77
ME(kcal/g)	2462	2434	2420	2407

Performance of Rabbits Fed varying levels of groundnut husk (1-8 weeks)

Table 2: performance of rabbits fed varying levels of groundnut husk

Parameters	T_1	T_2	T_3	T_4	SEM	LOS
Initial weight(g)	1500	1300	950	1050	18.00	NS
Final weight(g)	2020	2020	1595	2245	6.00	NS
Average daily weight gain(g)	4.60[b]	6.40[a]	6.60[a]	10.50[a]	0.35	*
Average daily feed intake(g)	38.70[b]	44.30[a]	47.20[a]	46.30[ab]	0.30	* * *
Total feed intake(g)	4289.00	4968.00	5288.00	5187.00	14.40	* * *
Feed conversion ratio	4.01	3.35	3.40	3.15	0.27	NS
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

SEM = standard error of mean, NS = not significant , *** = significant (p<0.001),

* = significant (p<0.05), LOS = Level of significance

Table 3: Economics of rabbit production using groundnut husk based diets

	Diet %			
Parameter	**T_1**	**T_2**	**T_3**	**T_4**
Total feed intake(kg)	4.29	4.97	5.29	5.19
Feed cost(₦/kg)	75.00	67.50	63.00	59.90
Total feed cost(₦)	321.20	335.40	333.00	310.00
Total weight gain(kg)	0.52	0.72	0.64	1.19
Feed cost ₦/kg gain	618.70	465.80	520.00	260.00
Cost Saving	_	152.90	98.70	358.70

REFERENCE

Aduku, A. O and Olukosi, J. O. (1992). **Rabbit management in the tropics**. 1st edition G.U Publisher, Zaria, Nigeria.

Akinmutimi, F., Babogum, O. O ., Ovuru, S. S and Mbgere, O. O. (2008). Reproductive performance of rabbits fed maize milling waste based diets. *African Journal of Biotechnology:* 439-443.

Ayayi, K. U. and Ironkwe, M. O. (2007). Response of weaner rabbits fed graded levels of Bambaranut Groundnut (*Vigria subterranean L.)* Verde offal Diets. Nigerian Society for Animal Production 32nd Annual Conference PP. 236-239.

Iyeghe-Erakpotobor, G. T. and Adeyegun, E. S. (2012). Evaluation of growing Rabbits fed diets containing varying levels of groundnut forage meal (Arac*his hypogea*). *Journal of Applied Agricultural Research*, **4**(2): 41 – 51.

F.A.O (1999). Food and Agricultural Organization Annual Report. Animal Production and Health Series.

Oloredeet, A. D. (2011). Nutritive value of some Tropical (West African) legumes for poultry. *Journal of Applied Animal Research,* **2**: 93-104.

Omole, J. M. (1992). **Monogastric animal nutrition, Principles and Practices.** Jachem publications p.75.

GASTROINTESTINAL TRACT MORPHOMETRY AND VISCERAL ORGAN WEIGHTS OF GROWER RABBIT FED DRIED GINGER (*Zingiberofficinale*) ROOT MEAL

OCHEFU, J., EMMANUEL, B. and ONHO, S. C.

Department of Animal Breeding and Physiology, Federal University of Agriculture, Makurdi.
+234-8054565596 jochefu@gmail.com

ABSTRACT

Twenty-eight grower rabbits of mixed sexes and breeds were used in the study to determine the effect of dietary Dried Ginger Root Meal (DGRM) on gastrointestinal tract morphometry and visceral organ weights. The rabbits were assigned by weight (average weight 557.09g) to four dietary treatments in a completely randomized design. Each treatment had seven replicates. Four treatment diets; T_1, T_2, T_3 and T_4 were formulated to include 0%, 15%, 25% and 35% of DGRM respectively and were administered to the rabbits. The experiment lasted for 8 weeks. Six rabbits were randomly selected from each treatment and sacrificed and eviscerated. Results showed that mean relative weights of the stomach, oesophagus and pancreas as well as the mean lengths of the oesophagus and intestines did not show any significant ($P>0.05$) variation. It was found that significant differences ($P<0.05$) existed in the mean lengths of the proximal colon and caecum as well as the mean relative weights of the liver, kidneys, heart and lungs in rabbits fed DGRM. It can be concluded that the inclusion of DGRM in the diets of growing rabbits significantly ($P<0.05$) increased the length of the caecum and visceral organs weight.

Keywords: Rabbit, Ginger, Morphometry, GIT, Visceral

Correspondence: jochefu@ymail.com. 234-8054565596

INTRODUCTION

Physiological response of animals to feedstuff and feed additive greatly affect their productivity. Feed expenditure is an important factor in animal production to which many studies are geared in a bid to reduce the cost. Optimum productivity is also enhanced in some quarters with the use of antibiotics and synthetic feed additives (Falcão-e-Cunha *et al.*, 2007). But the use of these additives has been banned in animal feed in parts of the globe due to their residual and detrimental effect on the animals and the consumers (USDA, 2005). To this end, non-conventional alternatives which are apparently safe, cheap and can be easily sourced are being studied as a way of circumventing these challenges for the small-holder livestock producer. Muhammad *et al*. (2009) affirmed that natural additives (phytogenic feed additives) are being used in current researches to maximize the net return for the livestock producer and minimize expenditure on feed. Herbs such as ginger (*Zingiber officinale*) have been reported to possess antimicrobial, anti-inflammatory, antiparasitic and immunomodulatory properties (Muhammad *et al*., 2009). It also enhance palatability and feed intake (Horton *et al*., 1991). Onu and Aja (2011) advanced reasons for the usage of ginger in animal diets. Ginger waste meal was shown to have hypocholesterolemic and hypolipidemic activity (Omage *et al*., 2007). Adanlawo and Dairo (2007) also showed that ethanolic extract of ginger has no health challenging effect on tissue (brain, liver, stomach, small intestine, kidney and serum) of rabbits. On this note, this study was design to investigate the effect of ginger root meal inclusion in rabbit diet on gastrointestinal and visceral organs of rabbits.

MATERIALS AND METHODS

This study was conducted at the Rabbitary unit of the Federal University of Agriculture Livestock Teaching and Research Farm, Makurdi, located on latitude 7° 48′33.6″N and longitude 8° 37′12.7″E (https://www.google.com/maps). Apparently healthy, twenty-eight (28) rabbits of mixed breed and sex with average weight of 557.09g were used for the study. The 8 weeks experiment was set in a completely randomized design (CRD). The rabbits were randomized by weight into four treatments with seven (7) replicates each. Treatment one ($T_{1\ control}$) diet contained 0% DGRM. The other treatments, T_2, T_3 and T_4, had diets with 15%, 25% and 35% of DGRM inclusion respectively. The

diets were iso-caloric and iso-nitrogenous. At the end of the feeding trial, six (6) rabbits from each treatment were sacrificed according to the method recommended (Joseph *et al*., 1994). Liver, heart, lungs, kidneys, stomach were carefully harvested after evisceration and weighed as percent body weight. The length of the gastrointestinal tract organs, oesophagus, small intestine, caecum, colon was measured in centimetres (cm) using a flexible measuring tape. Data collected were subjected to analysis of variance (ANOVA), using SPSS® Version 21.0 and the means were separated using Least Significant Difference (LSD).

RESULT AND DISCUSSION

The results of relative weight and length of the gastrointestinal tract of rabbits is presented in Table 1. The results showed that the mean lengths of the proximal colon and caecum varied significantly ($P<0.05$) among the treatment means. T_4 had higher proximal colon length than the control, but it compared with T_2 and T_3. Similarly, the mean length of caecum of T_4 was higher than T_1 and T_2 but similar to T_3. Increased lengths of the proximal colon and caecum may be attributed to the increased intake of high dietary fibre causing distension in some segments of the intestine. Yu and Chiou (1997) reported that increase in feed intake will increase hindgut fermentation which may lead to the development of the caecal weights and length. The results of relative weight of the rabbits are presented in Table 2. All parameters measured varied significantly ($P<0.05$) among treatment means. Mean organ weights of the rabbits on DGRM were higher significantly ($P<0.05$) than the control. Omage *et al*. (2007) reported higher mean liver weight values (14.81 – 17.71g) than the finding of this study. The mean weights of the left and right kidneys were similar for each treatment. The significant kidney weights ($P<0.05$) of rabbits could be attributed to the diet. Significantly ($P<0.05$) higher mean heart weight may also be attributed to dietary effects. Omage *et al*. (2007) reported mean heart weight of rabbit between 0.05 – 1.01g, which varied significantly for different inclusion levels of ginger. Mean lung weight in T_4 was higher than T_1 but compared with T_2 and T_3. Increase in weights of visceral organs could have a debilitating effect on their functions (Greener, 2015). Walter *et al*. (1939) reported that increase in metabolism results to increase in organ weight.

Table 1: Relative weight (percentage of body weight) and length (cm) gastrointestinal tract of grower rabbits fed Dried Ginger (*Zingiber officinale*) Root Meal (DGRM).

	Treatment (Mean ± SEM)			
Parameters	**T_1 (0%)**	**T_2 (15%)**	**T_3 (25%)**	**T_4 (35%)**
GIT Weight				
Oesophagus	0.12 ± 0.02	0.09 ± 0.01	0.09 ± 0.02	0.11 ± 0.01
Stomach	5.23 ± 0.28	5.31 ± 0.45	4.31 ± 0.42	4.92 ± 0.25
Pancreas	0.09 ± 0.04	0.06 ± 0.01	0.04 ± 0.01	0.04 ± 0.01
GIT Length				
Oesophagus	11.88 ± 0.95	11.38 ± 0.50	11.30 ± 0.30	11.36 ± 0.61
Small intestine	280.50 ± 11.59	272.08 ± 10.96	275.50 ± 14.90	279.83 ± 4.94
Proximal colon	29.42 ± 1.97^{b}	31.75 ± 1.28^{ab}	30.60 ± 1.33^{ab}	34.33 ± 0.88^{a}
Distal colon	75.28 ± 8.87	69.67 ± 1.23	73.40 ± 5.90	79.17 ± 3.72
Caecum	44.75 ± 1.29^{b}	45.55 ± 2.10^{b}	48.30 ± 1.22^{ab}	51.17 ± 1.66^{a}

Note: T = Treatment

Table 2: Relative weights of some visceral organs of grower rabbits fed Dried Ginger (*Zingiber officinale*) Root Meal (DGRM)

Parameters	Treatment (Mean ± SEM)			
	T_1 (0%)	T_2 (15%)	T_3 (25%)	T_4 (35%)
Liver	2.42 ± 0.03[b]	2.48 ± 0.06[b]	2.77 ± 0.11[a]	2.77 ± 0.12[a]
Left kidney	0.27 ± 0.02[b]	0.33 ± 0.01[a]	0.33 ± 0.02[a]	0.32 ± 0.01[a]
Right kidney	0.26 ± 0.11[b]	0.33 ± 0.02[a]	0.32 ± 0.03[a]	0.32 ± 0.02[a]
Heart	0.18 ± 0.02[b]	0.20 ± 0.01[ab]	0.23 ± 0.02[a]	0.25 ± 0.01[a]
Paired lungs	0.39 ± 0.02[b]	0.56 ± 0.07[a]	0.53 ± 0.04[ab]	0.46 ± 0.05[ab]

CONCLUSION

It can be concluded from this study that dietary inclusion of ginger root meal in rabbit should be lower than 15% of the diet.A prolong usage of this additive in rabbit diet is not encouraged.

REFERENCES

Adanlawo, I. G and Dairo, F.A.S. (2007). Nutrient and Anti-Nutrient Constituents of Ginger (*Zingiberofficinale, Roscoe*) and the Influence of its Ethanolic Extract on some Serum Enzymes in Albino Rats. *International Journal of Biological Chemistry. 1:38-46.*

Caspar, W. (2003): Herbs and Botanicals as Feed Additives in Monogastric Animals. *Asian-Australian Journal of Animal Science, 16(2):282-289*

Falcão-e-Cunha, L., Castro-Solla, L., Maertens, L., Marounek, M., Pinheiro, V., Freire, J. and Mourão, J. L. (2007).Alternatives to antibiotic growth promoters in rabbit feeding: A review. *World Rabbit Science,* 15: 127 – 140.

Greener K. (2015): Rabbit Anatomy – Rabbit Body Systems. Just Rabbit.com https://www.justrabbits.com/rabbit-anatomy.html#urinary

Horton, G. M. J., Blethen, D. B. and Prasad, B. M. (1991): The Effect of Garlic (*Allium sativum*) on Feed Palatability of Horses and Feed Consumption, Selected Performance and Blood Parameters in Sheep and Swine. *Canadian Journal of Animal Science, 71:60-610*

Joseph K. J., Awosanya B. and Adebua B.A. (1994). The effects of pre-slaughter withholding of feed and water from rabbits on their carcass yield and meat quality. *Nigerian Journal of Animal Production* 21: 164 – 169

Muhammad, J., Durrani, F., Hafeez, A., Khan, R. and Ahmad, I. (2009): Effects of Aqueous Extract of Plant Mixture on Carcass Quality of Broiler Chicks. *Journal of Agriculture and Biological Sciences 4(1): 37-40.*

Omage, J. J., Onimisi, P. A., Adegbite, E. K. and Agunbiade, M. O. (2007): The Effect of Ginger (*Zingiberofficinale*Roscoe) Waste Meal on Growth Performance, Carcass Characteristics, Serum Lipid and serum Cholesterol Profiles of Rabbit. *Pakistan Journal of Nutrition, 6(4): 359-362*

Onu, P. N. and Aja, P. M. (2011): Growth and Haematological Indices of Weaned Rabbits Fed Garlic (*Allium sativum*) and Ginger (*Zingiber officinale*) Supplemented Diets. *International Journal of Food, agriculture and Veterinary Sciences,* 1(1):51-59.

United States Department of Agriculture (USDA) National Organic Program (2005). Official Status Listing of Organic Certification Agencies Currently under Assessment by USDA for compliance with the International Organization for Standardization (ISO) Guide 65. *http://www.ams.usda.gov/lsg/arc/iso65.htm*

Walter, F. and Addis, T. (1939): Organ Work and Organ Weight. *Journal of Experimental Medicine, 69(3):467-83.*

Yu, B. and Chiou, W. S. (1997): The Morphological Changes in Intestinal Mucosa in Growing Rabbits. *Laboratory Animals, 31:254-263.*

GROWTH RESPONSE AND CARCASS CHARACTERISTICS OF BROILER CHICKEN SERVED WITH ETHANOLOIC *Petiveria alliacae* LEAF EXTRACT

Odetola, O.M., Adekanbi, A.O., Adetola, O.O., Akingbade, O.A and Ijadunola, T.I

Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Nigeria.

Corresponding Author: Dr. Olubayo Michael Odetola, Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Nigeria. Tel; +2348060862361. E-mail: odetolabayo@yahoo.com

ABSTRACT

An experiment was conducted with three hundred day old broiler chicks to evaluate the effect of Peteveria alliacea leaf extract on growth response and carcass characteristics of broiler chicken in an 8 weeks trial. A total of one hundred and fifty (150) day old chicks of Arbor Acre strain were randomly allotted five treatment groups of 30 birds per treatment which were further divided into 3 replicates of 10 birds per replicate in a completely randomized design. The birds were brooded together for 7 days before the commencement of the experiment. Birds on treatment one (T1) were served with ordinary water, T2 were served with water containing enrofloxacin (antibiotics) at 1ml per 4 litres of water for 5 days both at the starter and finisher phase, T3, T4, and T5 were served with 0.033g of the extract/litre, 0.67g of the extract/litre and 0.10g of the extract/litre of water respectively throughout the experimental period. Parameter measured includes feed intake, weight gain, feed conversion ratio and percentage mortality while two birds per replicate making six (6) per treatment were randomly selected, slaughtered and dissected for carcass evaluation. Result obtained showed no significant (P > 0.05) difference in all growth parameters measured. All carcass parameters measured except eviscerated weight and head were not significantly (p> 0.05) influenced by the leaf extract. It can be concluded that farmers can serve their broilers with Peteveria alliacaea leaf extract up to 0.10g/litre of water as phytobiotics without any detrimental effect on the growth response and carcass characteristics.

Key words: Broiler, growth response, leaf extract, carcass and *Peteveria alliacaea*

INTRODUCTION

In modern animal feeding, the use of antimicrobial growth promoters (AGP) has led to the abandonment of herbs and spices. The benefit of AGP in improving weight gain and feed efficiency of broiler chickens are well established (Butaye *et al*., 2003). The long term side effects of these products such as microbial resistance and increased blood cholesterol level of animals led to the ban of these commercial antibiotics (Mansoub, 2010). Nevertheless, the prohibition of most AGPs has necessitated renewed interest in animal feed strategies (Charis, 2000). The positive effects of herbal plants to broilers have been reported by Tekeli *et al*, (2006). Cross *et al*. (2007) pointed out that the efficiency of phytogenic depends on differences in their chemical composition. *Petiveria alliacea*, has been found to contain a large number of biologically active chemicals including benzaldehyde, benzoic acid. The plants roots have been shown to contain cystein sulfoxide derivates that are analogous to, but different from those found in such plants as garlic and onion. These compounds serve as the precursors of several thiosulfinate such as S – (2 hydroxyethy 1) 2 – hyroxyethane) thiosulfinate, S – (2 hydroxyethyl) phenyl methane thiosulfinate, S – (benzyl 2 – hydroxyethance) thiosulfinate and S – (benzylphenylmethane thiosulfinate (petivenin). And these derivatives have been found to exhibit antimicrobial activity (Mild, 2004). Therefore, this study was carried out to evaluate performance and carcass characteristics of broiler chicken served with *petiveria alliacae* leaf extract.

MATERIALS AND METHODS

Experimental location

The research was carried out at the Poultry research unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Nigeria. The site is located in the rain forest zone of South- western Nigeria on longitude 7^0 23^1 and latitude 4^0 53^1 E and 76m above sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature of 34.7^0C, respectively. (Google Earth 6.0, 2016).

Source and Processing of Petiveria alliacea

Petiveria alliacea leaves were sourced from different locations within the Campus. The leaves were cut from the stem, cut into pieces, and 300g of it was weighed with digital scale and the leaves were mashed using mortar and pestle. It was soaked into 1liter of ethanol, and agitated manually for 7 days. After which, it was sieved manually with white cloth, the filtrate were subjected to double filtration using white man double filter paper. The filtrate was then evaporated using rotatory evaporator set at 80^0c until all the ethanol evaporated completely. The extract was then freeze dried into a paste form.

Experimental plan

A total of one hundred and fifty (150) day old chicks of Arbor Acre strain were randomly allotted five treatment groups of 30 birds per treatment which were further divided into 3 replicates of 10 birds per replicate in a completely randomized design. The birds were brooded together for 7 days before the commencement of the experiment. Birds on treatment one (T1) were served with ordinary water, T2 were served with water containing enrofloxacin (antibiotics) at 1ml per 4 litres of water for 5 days both at the starter and finisher phases, T3, T4, and T5 were served with 0.033g of the extract/litre, 0.67g of the extract/litre and 0.10g of the extract/litre of water respectively throughout the experimental period. All vaccination procedures were strictly adhered to. Feed and water were supplied *ad-libitum* throughout the experimental period.

Data collection

Growth Response: Data on feed intake, weekly weight gain, average daily feed consumed and body gain, feed-to-gain ratio were obtained to evaluate the growth response of the experimental birds.

Carcass Traits: At the end of the feeding trial, two birds per replicate were purposively selected, starved overnight, weighed to obtain the live weight and was severed through the jugular veins for carcass analysis. Internal organs like heart, liver, kidney, lungs, abdominal fat and gizzard were weighed and recorded as well as all other parts and expressed as percentages of live weight.

Statistical Analysis: Data collected were subjected to analysis of variance (ANOVA), the treatment means were separated using Duncan's Multiple Range Test using SAS,2003.

RESULTS AND DISCUSSION

Table 1: Growth response of broiler chicken served ethanoloic *Pertiveria alliacea* leaf extract.

Parameters	T_1 (0.0)	T_2 (1ml/4L)	T_3 (0.033g/L)	T_4 (0.067g/L)	T_5 (0.10g/L)	±SEM
Initial weight (g/bird)	286.00	278.70	278.30	284.70	291.70	3.78
Final weight (g/bird)	2233.30	2133.30	2220.00	2053.30	2360.00	83.08
Weight gain (g/bird)	1947.30	1854.70	1941.70	1768.70	2068.30	80.91
Feed intake g/bird	4906.70	4953.30	4820.00	4736.70	4566.30	73.18
Feed conversion ratio	2.55	2.71	2.62	2.76	2.21	0.13
Mortality(%)	6.67	3.33	6.67	0.00	0.00	1.87

Note: ^{a,b,c} means along the same row with different superscripts are significantly different ($p<0.05$)

All the growth parameters measured were not significantly ($p> 0.05$) influenced by the dietary treatments Table 1. Feed additives used as growth promoter improves palatability, nutrient utilization, stimulates appetite and increase flow of gastric juice (Odetola, *et al*, 2019). Supplementation of different levels of feed additives in broiler diets significantly improved the live weight gain and fed conversion ratio (Al-Kassie, and Jameel, 2009). Herawati (2010) recorded an increase in weight gain and improved feed conversion ratio when broiler birds were fed diets containing ginger as an additive. However, *Petiveria alliacea* leaf extract used in this study did not improve the

weight gain and feed conversion ratio of broiler bird compared to the control. This may be due to variability in the type of the leaf extract and the quantity served which may not be high enough to cause improvement in their performance. This result corroborate the study of Onibi *et al*. (2009) who reported no significant improvement in the weight gain and feed conversion ratio of broiler birds fed oregano oil and garlic as feed additive. This results also corroborate the results of earlier study by Odetola, *et al*. (2019) who reported a non significant improvement in the growth parameters when broiler birds were fed with *Petiveria alliacea* root meal. The carcass evaluation revealed that there were no significant ($p>0.05$) difference in all parameters measured except the eviscerated weight and head Table 2. The non significant effect recorded in this study indication that the leaf extract were well utilized by the broilers chickens. Cabuk *et al.* (2006) also reported that carcass characteristics of birds were not negatively affected when oregano leaf extracts were fed to birds.

Table 2: Carcass characteristic of broiler chicken served with varying inclusion levels *Petiveria alliacea* leaf extract (% of live weight)

Parameters (kg)	T_1(0.0)	T_2(1.5ml)	T_3(0.033g/L)	T_4(0.67g/L)	T_5(0.1g/L)	±SEM
Live weight	2.23	2.13	2.22	2.05	2.36	0.08
Eviscerated weight	79.49^{ab}	84.78^{a}	77.84^{ab}	73.15^{b}	83.78^{ab}	1.67
Dress weight	66.14	75.71	66.28	75.78	66.10	2.61
Thigh	18.56	21.69	19.86	17.72	13.15	1.40
Drum stick	10.21	10.86	9.95	10.67	10.18	0.21
Breast	23.15	22.29	24.38	20.58	24.71	0.64
Back	3.48	4.31	3.80	3.75	3.43	0.16
Wing	7.92	8.32	7.72	6.85	7.48	0.22
Head	2.88^{ab}	3.41^{a}	2.34^{b}	2.36^{b}	2.33^{b}	0.15
Leg	3.44	3.56	3.65	3.85	3.74	0.63
Neck	3.64	4.24	3.81	3.78	4.11	0.11
Liver	1.87	2.50	2.59	1.82	1.90	0.14
Heart	0.36	0.42	0.35	0.34	0.23	0.03
GIT	6.50	6.38	5.33	7.13	6.53	0.35

Note: a,b,c means along the same row with different superscripts are significantly different ($p<0.05$)

CONCLUSION AND RECOMENDATION

Based on the results of this study, it was recommended that farmers can serve their broilers with *Petevaria alliacaea* leaf extract up to 0.10g/litre of water as phytobiotics without any detrimental effect on the growth response and carcass characteristics.

REFERENCES

Al-Kassie, G.A.M and Y.J Jameel, (2009). The effect of adding Thyme vulgaris and Cinnamomuim zeylanicum on productive performance in broilers. Proceedings of 9th Veterinary Scientific Conference, (VSC'09), Dokki, Giza, Egypt, pp: 223-231.

Butaye, P., Devriese, L.A and Haesebrouk, F (2003). Antimicrobial growth Promoters used in animal feed: effects on less well known antibiotics on gram positive bacteria. *Clin. Microb. Rev*, 16: 175-188

Çabuk, M. Bozkurt, M. Alçiçek, Akbaş, A and Küçükyılmaz, K. (2006). Effect of a herbal essential oil mixture on growth and internal organ weight of broilers from young and old breeder flock s, *South Afric. J. of Ani. Sci*. 36 (2) 135-141

Charis, K (2000). A novel look at a classical approach of plant extracts. Feed Mix (special issue on Nutraceuticals) 19-21

Cross, D.E., Mcdevit, R.M., Hillman, K and Acamovic, T (2007). The effects of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. *Brit. Poult. Sci.* 48: 496-506.

Google Earth, (2016). http://.www.goole.earth

Herawati, (2010). The effect of feeding red ginger asphytobiotic on body weight gain, feed conversion andinternal organs condition of broiler. *Int. J. Poult. Sci.*, 9: 963-967.

Mansoub, N.H (2010). Comparison of effect of using Nettle (Urtica dioica) and probiotic on the performance and serum composition of broiler chickens. *Glob. Vet*., 8: 247-250.

Mild, C (2004). Smelly weed is strong medicine (PDF). Rio Delta wild. Retrieved 2010-04-05.

Onibi, G.E., Adebisi, O.E., Fajemisin, A.N and Adetunji, A.V (2009). Response of broiler chickens in terms of performanceand meat quality to garlic (Allium sativum) supplementation. *Afr. J. Agric. Res*., 4: 511-517.

Odetola, O.M., Adejinmi, O.O., Owosibo, O.A., Banjo O.T and Awodola-Peters, O.O (2019). Growth response, serum biochemistry and organ histopathology of broilers fed diets supplemented with graded levels of Petiveria alliacea root meal. *Int. J. Poult. Sci*., 18: 45-50.

SAS, (2003). SAS?STAT User's Guide: Version 8 for Windows. SAS Institute Inc., Cary, NC., USA

Tekeli, A., Celik, L., Kutiu, H.R and Gorgulu, M. (2006). Effects of dietary supplemental plant extracts on performance, carcass characteristics, digestive system development, intestinal microflora and some blood parameters of broiler chicks. XII European Poultry Conference, Italy, 10-14, Sep 20.

DIETRY EFFECT OF SUBSTITUTING MIXED SAW DUST FOR WHEAT OFFAL ON GROWTH PERFORMANCE OF BROILER STARTER

OGUNGBENRO, S. D., AMUSA, H. O., ADAM, T. O AND BAKO, B. A

[1]Department of Animal Health and Production Technology, Faculty of Animal and Fisheries Technology. Oyo State College of Agriculture and Technology, Igboora Oyo State, Nigeria

Corresponding Authors E- Mail: hammed4dtop@yahoo.com

Phone number: 08054146259

Abstract

The experiment was conducted using 99 broilers to determine the dietary effect of substituting mixed sawdust for wheat offal on growth performance of broiler starter. Three dietary treatments were formulated with mixed sawdust substituting for wheat offal at 0%, 35%, and 70% respectively in a completely randomized design experiment. The experiment lasted for 4weeks. Results of performance characteristics of broiler starter fed experimental diet showed that the average initial weight and mortality were not influenced by dietary treatment (p>0.05) while the average final weight, average weight gain, average feed intake and feed conversion ratio were all influenced by dietary treatment (p<0.05). The highest final live weight (1618.00g) was recorded for broiler fed diet 2 while the lowest final live weight (1536.00g) was noticed in broiler fed diet 3. Birds on diet 2 had the highest average weight (1132.00g) while the lowest of weight gain (1065.00g) was obtained in broiler fed diet 3. Birds fed diet 3 had the lowest feed intake value of (1912.12kg) while the highest feed intake (1991.21kg) was recorded for broiler fed diet 2. The best feed conversation ratio (1.76) was obtained in broilers fed (0% and 35% substitution level of mixed saw dust for wheat offal) respectively. It could be concluded that (35%) substitution level of mixed saw dust could effectively be substituted for wheat offal without adverse effect on the health status of broilers fed experimental diet.

Key words: Broiler, Mixed sawdust, Wheat offal, Performance

Introduction

A serious competition exists between the feed industry and other in the food chain (especially man) over conventional feed ingredients such as maize and soya bean. This has resulted in the high cost and scarcity of these conventional feedstuffs. Poultry feed producers are thus faced with the task of finding alternative feedstuffs that will not compromise quality. The search for such alternatives has exercised Animal Nutritionists in Nigeria for over a decade. Feeding has been recognized as an important aspect as it accounts for 70-75 percent of the total cost of poultry production, which is possible only by using locally available feed ingredients and agro industrial by-products.Also lack of good quality feeds throughout the year, which is attributed to the seasonal fluctuation in the supply of conventional ingredients, is a major problem preventing optimum performance of chicken in the tropics. Attention is, therefore, been focused on the cheap but suitable alternative feedstuffs, especially crop residues and industrial by-product, to sustain livestock industry (Alhassan, 1985). The evaluation of unconventional feed resources alongside other strategies would reduce pressure on the demand for conventional feed ingredients and accelerate the attainment of feed security for poultry. A large number of alternative feedstuffs with promise as poultry as poultry feed ingredients abound in Nigeria an example is the sawdust, a lignocellulose that is burnt away annually in industrial sites resulting in pollution thereby aggravating the existing environmental problems. Millions of tons of these lignocellulose materials, which are wasted every year, are found around industrial sites such as sugar mills saw mills (Pidgen and bender, 1975). However, scarce information exists on the ultilization of this by-product by chickens. This study, therefore focused on performance and economy of production of broiler fed mixed saw dust as a substituted for wheat offal.

Materials and methods

Experimental site: The experiment was carried out at the Teaching and Research Farm. Oyo state college of Agriculture and Technology, Igboora, Oyo State

Experimental ingredient: The saw dust used in the experiment was obtained from the local saw mill at Igboora, oyo.

Experimental bird and management: A total of 99 day old broiler chicks were obtained from zartech farm Nigeria Limited. The bird were weighed individually and allocated into 9brooding units.

Each unit housed 11 birds and was offered one of the three dietary treatments such that there were three replicate assigned to each dietary treatment. The birds were fed ad-libitum throughout the experimental period

Experimental diet: Three experimental diets were formulated for the starter phase 0-4 weeks. Experimental diet were introduced 0-4 weeks and fed for the duration of the experiment. Three substitution level of mixed saw dust substituting wheat offal at 0%, 35% and 70% levels respectively.

Parameters measured for performance of broilers fed experimental diet include: Initial weight, final live weight, average weight gain, feed intake, and feed conversion ratio.

Table 1: Gross composition of Experiment Diet (Starter phase)

Percentage	T1(0%)	T2(35%)	T3 (70%)
Ingredients			
Maize	56.00	56.00	56.00
Soya bean meal	34.00	34.00	34.00
Wheat offal	5.00	3.25	1.50
Saw dust	0.00	1.75	3.50
Lime stone	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00
Salt	0.25	0.25	0.25
DL. Methionine	0.25	0.25	0.25
L.Lysine	0.25	0.25	0.25
Broiler premix	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00
Metabolizable Energy (kcal kg)	2934.50	2957.55	2980.55
Crude protein (%)	21.75	21.63	21.53

A kg premix contains vitamin A; 110,000,000i, vitamin D; 2,500,000i, vitamin E; 20,000mg, vitamin k3; 3000mg, vitamin B3; 3.00mg, vitamin B2; 7000mg, vitamin B6; 500mg, vitaminb12; 25mg, pantothenic acid; 10,00mg, folic acid; 800mg, cobalt; 250mg, manganes; 80,000, Iron; 40,000mg, Zinc; 60,000mg, copper;800mg, Cobalt; 250mg, Iodine; 1,000mg, selenium(1%);150mg, chlorine; 200,000mg and anti oxidant;100,000mg.

Statistical analysis: Data obtained in the study were subjected to statistical analysis of variance and where mean exist were separated using Duncan multiple range test

Results and discussion

Results of performance characteristics of broiler starter fed experimental diet in presented in table 2. Result showed that the average initial weight and mortality were not influenced by dietary treatment

(p>0.05) while the average final weight, average weight gain, average feed intake and feed conversion ratio were all influenced by dietary treatment (p<0.05). The highest final live weight (1618.00g) was recorded for broiler fed diet 2 while the lowest final live weight (1536.00g) was noticed in broiler fed diet 3. The average weight gain also show significant (p<0.05) difference across the dietary treatments with the highest value (1132.00g) recorded for broiler fed diet 2 while the lowest weight gain (1065.00g) was obtained in broiler fed diet 3. The average feed intake was significantly (p<0.05) different across the dietary treatments, with the lowest value (21912.12kg) noticed in broiler fed diet 3 (70% substitution level of mixed saw dust for wheat offal). While the highest feed intake (1991.21kg) was recorded for broiler fed diet 2 (35% substitution level of mixed saw dust for wheat offal). The best feed conversation ratio (1.76) was obtained in broilers fed (0% and 35% substitution level of mixed saw dust for wheat offal) respectively.

Table 2: Performance characteristic of broiler starter fed experimental diet

Parameters	T1 (0%)	T2 (35%)	T3 (70%)	SEM
Average initial weight	506.00	486.00	471.00	10.13
Average final weight	1615.00^{ab}	1618.00^{a}	1536.00^{c}	21.92
Average weight gain	1109.00^{ab}	1132.00^{a}	1065.00^{c}	16.05
Average feed intake	1951.21^{b}	1991.21^{a}	1912.12^{c}	18.64
Feed conversion ratio	1.76^{a}	1.76^{a}	1.86^{c}	0.01
Mortality	0.00	0.00	0.00	0.00

a,b,c,d; Means on the same rows with different superscript differ significantly (P<0.05)

Discussion

The highest final live weight (1618.00) and lowest final weight (1536.00) was obtained for broiler fed diet 2 and broiler fed diet 3 respectively. The highest average weight gain (1132.00) was obtained for broiler fed (35%) substitution level of mixed saw dust for wheat offal. This result negate the finding of Ogungbenro *et al. (*2019) who reported the highest live weight and weight gain (1321.50 and 725.20) in cockerel fed diet 1 (0% substitution level of mixed saw dust for wheat offal). The result of this study reviewed that the lowest average weight gain was obtained in broiler fed 70% substitution level of mixed saw dust for wheat offal. This result confirmed the finding of Ogungbenro *et al*. (2019) who reported the lowest weight gain (668.20) was noticed in cockerel fed diet 3(40% substitution level of mixed saw dust for wheat offal. Dietary fiber is known to aids a healthier digestive process and supports the muscles and nerves. The feed intake obtained in this study showed significant (p<0.05) differences across the dietary treatments. The result of this study confirmed the findings of McLeod (1982) who reported that the proportion of dietary energy obtained from fats versus carbohydrates exert an effect on appetite through a physiological "appetite Control Centre" responsible to the blood levels of certain nutrients such as glucose and amino acids. The numerical higher feed intake observed for broiler fed diet 2 could be due to an improved palatability while high energy density of diet 3 could have slightly depressed appetite.

Conclusion and recommendation

Conclusion

It could be concluded that (35%) substitution level of mixed saw dust could effectively be substituted for wheat offal without adverse effect on the health status of broilers fed experimental diet.

Recommendation

Based on the result of this research, it could be recommended that mixed saw dust could be substituted for wheat offal in the broiler finishers ration up to (35%) substitution level. Since mixed saw dust could effectively be substituted for wheat offal in diet for broiler. The need for adoption of mixed sawdust and improvement is now glaring as the economy affects the production rate of many farmers.

Refrences

Alhassan,W.S., 1985. The potential of agro-industrial by product and crop residences for sheep and goat production in Nigeri.Proceedings of small ruminant production in Nigeria. 1:165-175

Ogungbenro, S. D., Amusa, H. O,., Oseni, T.A., Bako, B.A and Ogungbenro B. O. 2019. Economics of production of growing cockerels fed mixed saw dust as a substitute for wheat offal. Proc., 44th Annual conference of the Nigeria society for Animal Production, 17th- 21st- 2019, UNIABUJA, ABUJA. Pp. 435-438.

Pidgen, W.J. and F. Bender, 1975. Ultilization of lignocelluloses by livestock. Livestock nutrition; Selected articles from World Animal Review. FAO, Rome,pp: 30-32

Fajimi, A.O., Babatunde, G.M., Ogunlana F.F and A. Oyedeji, 1993.Comparative ultilization of rubber seed oil and palm oil by broilers in a humid tropical environment. *Anim. Feed Sci. technol*., 43: 177-188.

EFFECT OF FEEDING GRADED LEVELS OF ENZYME TREATED AND UNTREATED BAMBARA GROUNDNUT OFFAL ON DIGESTIBILITY COEFFICIENT OF BROILER CHICKENS FED MAIZE-SOYBEAN BASAL DIET

Ogwiji, O., Tarhemba, F., Famave, M.T., Agishi, S.T. and Wayo, N. S.

School of Animal Technology, Department of Animal Husbandry,Akperan Orshi College of Agriculture Yandev, Gboko, Benue State, Nigeria.

Abstract

Effect of enzyme (Natuzyme) fortification of bambara groundnut (Voandzeia subterranea L) offal diet on digestibility coefficient of broiler chickens was investigated. 216 day old commercial broiler chicks were randomly divided into 8 groups of 27 birds each. The groups were randomly assigned to diets in a 3 × 4 factorial arrangement involving four levels (0, 10, 20 and 30%) of treated and untreated Bambara groundnut offal with control diet (0) in a complete randomized design. Each treatment was replicated three times with nine birds per replicate. Increasing treated and untreated bambara groundnut offal levels depressed (P < 0.05) nutrient absorption as evidenced by significant reduction in the retention of dry matter, crude protein, crude fibre, ether extract and ash. Final body weight and average daily weight gain of control diet, feed conversion ratio at the 10, 20 and 30% treated and untreated bambara groundnut offal levels, and reduced average daily feed intake and feed cost per kg weight gain at all the bambara groundnut offal (BGO) inclusion levels. The results of the study indicate that 20% bambara groundnut offal treated and untreated can be included in broiler diet without adverse effects on broiler chickens digestibility coefficient and also to reduce cost of production.

Key words: Bambara groundnut offal, dietary enzyme fortification, broiler chickens, performance, digestibility coefficient.

Introduction

High cost of feed is a limitation to monogastric animal production in Nigeria which has been rated at 70 - 80 percent of total cost of production (Madubuike and Ekenyem, 2001). The overdependence on imported livestock products, ignorance, inadequate technical skills, diseases and parasitism, environmental stress and high cost of ingredients and competition between man and livestock for feed grains and inadequate production of farm crops to meet human and livestock needs have been implicated as remote causes of poor animal protein intake among Nigerians (Babatunde *et al.*, 1990). Consequently, the fight to reduce the cost of poultry production becomes critically urgent in order to salvage Nigerians from the scourge of sub-optimal animal protein intake and malnutrition. The poultry industry has a key role to play in many parts of the world as a most economical source of protein (Augusto *et al.*, 1999). The poultry industry is one of the fastest growing segments of the livestock industry. Poultry are highly prolific and very efficient in converting feed nutrients into high quality animal protein (Smith, 2001).

It is therefore very important to use unconventional materials such as cowpea waste, soybean waste, bambara groundnut offal, etc., that are locally available and can be obtained at lower prices. The inclusion of graded levels of raw bambara nut (*Voandzeia subterranea L*) offal in the diets of broiler chickens will help to enhance production by reducing the cost of production. Bambara groundnut is widely cultivated in the Northern and Southern States of Nigeria where the seeds are processed into flour and consumed as moi moi (Enwere, 1998). The processing of the seeds into flour results in the production of the waste that contains 16.40% crude protein (Okeke, 2000). Bambara groundnut waste has been used in the feeding of poultry and rabbits (Okeke, 2000; Ani and Okafor, 2004; Ani, 2007). However, its use in the feeding of monogastric animals is limited by the presence of high fibre and antinutritional factors (Ensminger *et al* 1996; Enwere, 1998). Poultry cannot fully utilize high fibre diets because they lack the digestive framework that can elaborately digest large amount of fibre. It becomes imperative, therefore, to incorporate exogenous enzymes into their diets in order to enhance the breakdown of the non-starch polysaccharides (NSPs) present in fibre (Doku and Karikari, 1981; Ensminger *et al.*, 1996; Enwere, 1998). Besides antinutritional factors, another limitation is its high fibre content. The enzyme being considered in this study is Natuzyme which has been shown to increase digestibility of fibrous feed ingredients by disrupting the plant cell walls, and by reducing the

viscosity of the gut contents, thereby enhancing nutrient absorption (Choct and Annison, 1992; Bedford *et al.*, 1992; Acromovic, 2001). The present study was therefore conducted to determine the effects of graded levels of raw bambara nut waste and supplementary enzyme (Natuzyme) on the coefficient of digestibility and growth performance of growing broiler chickens.

Materials and Methods

The study was conducted at the Poultry Unit of the College of Animal Science Teaching and Research Federal University of Agriculture, Makurdi, Benue State, Nigeria. The Bambara groundnut sievate was procured from a bambara groundnut processing mill in Makurdi town, Other feed ingredients used in the study were purchase from the Livestock feed stores. 216 day-old broiler chicks were obtained from a commercial farm. The birds were randomly assigned to 8 treatments and 3 replicates per treatment with nine (9) birds each. The groups were randomly assigned to diets in a 3 × 4 factorial arrangement involving four levels (0, 10, 20 and 30%) of treated and untreated Bambara grandnut offal with control diet (0) in a complete randomized design. Each treatment was replicated three times with nine birds per replicate. These chicks were weighed at the beginning of the experiment to obtain their initial weight per replicate. The chicks in each replicate were housed in clean and disinfected separated pens. The birds were brooded and vaccinated against Newcastle disease (i/o) at day old, Gumboro vaccine administer 7th and 14th days, while the Newcastle vaccine "Lasota" administered at 21st days respectively. Standard hygienic conditions and biosecurity of the environment was maintained.

Table 1: Percentage composition of broiler finisher chick diets containing different inclusion level of Bambara Groundnut Offal

Ingredients	**Treatments**			
	T_1/T_2	T_3/T_4	T_5/T_6	T_7/T_8
Maize	52.47	45.94	37.54	29.75
SBM	21.32	19.17	16.94	14.80
GNC	10.66	9.58	8.47	7.40
Maize Offal	10.00	10.00	10.00	10.00
BGO	-----	10.00	20.00	30.00
Palm Oil	1.00	2.00	2.50	3.50
Bone Meal	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Vitamin Premix	0.25	0.25	0.25	0.25
Enzymes	-/+	-/+	-/+	-/+
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis.				
CPC %	20.00	20.00	20.00	20.00
ME (Kcal/kg)	2,929.97	2,923.78	2,894.89	2,888.5
CF(%)	4.17	4.78	5.37	5.96
Ca (%)	1.36	1.37	1.37	1.37
Meth(%)	0.58	0.60	0.65	0.61
Lysine(%)	1.12	1.16	1.20	1.24
Phosphorus (%)	0.73	0.71	0.69	0.67

Vitamin-mineral premix (animal care ^{R}) will supply the following additional nutrients per kg of feed. Vitamin (1,200,000 I.U), D_3 (300,000 I.U), E (3,000mg), k_3 (250mg), folic acid (10mg), Niacin (4,000mg), Calpan (1,000mg), B_2 (500mg), B_{12} (2mg), B_1 (9,200), B_6 (350mg), Biotin (8mg), Antioxidant (12,500mg), Minerals; Cobalt (25mg), Selenium (25mg), Iodine (120mg), Iron (4,000mg), Manganese (700mg), Copper (800mg), Zinc (6,000mg), Chlorine Chloride (20,000mg, BGO-Bambara groundnut offer, SBM-Soya bean meal, GNC-Groundnut cake.*

Natuzyme (R) is added at the rate of 0 (-) or 250mg (+)/kg of diet.

Data were collected on the initial body weight, final body weight, weight gain, feed intake, feed conversion ratio and digestibility Study was done**.** At end of 8 weeks of the finisher phase, two (2) birds were selected from each of the three (3) replicate, such that the weights was determine by the average weight of the whole replicate. The birds were transferred into metabolic cages and allowed an adjustment period of three days. The birds were fed with weighed amounts of feed daily for three days. Leftover feed was weighed to determine feed intake, faecal dropping was collected on daily basis, weighed and dried to a constant weight. The faecal sample collected from each replicate were thoroughly mixed to obtain a homogenous mixture, milled and subjected to proximate composition analysis.

Results and Discussions

The effect of feeding graded levels of enzyme treated and untreated BGO in diet of broiler chicken on coefficient of digestibility is as shown in table 2.

Table 2: Treatment effect on digestibility coefficient

	Treatment						
Parameter	T_1	T_2	T_3	T_4	T_5	T_6	T_7
DM	97.10±0.34^{a}	95.50±0.29^{b}	96.33±0.39^{ab}	95.51±0.34^{b}	95.82±0.25^{b}	95.95±0.33^{b}	95.85±0.09^{b}
CP	96.66±0.45^{a}	95.29±0.16^{b}	96.06±0.38^{ab}	95.90±0.36^{ab}	95.31±0.34^{b}	95.65±0.29^{ab}	95.35±0.0.3^{b}
EE	95.88±0.28^{a}	96.87±0.17^{a}	96.40±0.57^{a}	96.36±0.34^{a}	97.83±0.38^{a}	92.76±1.28^{b}	93.60±0.21^{b}
Ash	95.49±0.43^{a}	92.79±0.32^{b}	92.39±0.78^{b}	88.47±1.73^{b}	90.45±1.06^{bc}	91.27±0.83^{b}	92.40±0.36^{b}
CF	85.23±1.78^{b}	84.71±1.20^{b}	87.56±1.59^{b}	87.81±1.37^{b}	86.47±1.80^{b}	92.77±0.55^{a}	92.17±0.17^{a}

^{abc}…Means with different superscript along the same row are significantly ($p<0.05$) different

T_1-Control T_2-0BGO+250mg enzyme T_3-10%BGO+mg enzyme T_3-10%BGO + 250mg Enzyme

T_4-20%BGO + 0mg Enzyme T_5-20%BGO +250mg Enzyme T_6-30%BGO +0mg Enzyme T_7-30%BGO +250mg Enzyme DM-Dry matter CP-crude protein EE-Ether extract CF-crude fibre.

Dry Matter digestibility (DMD) was significantly ($p<0.05$) different across the treatment groups.This similar to result other rearchers(Ani and Omeje,2012; Ani 2007) Treatments 1 which is the control had the highest value (97.10 %) of DMD while the least value (95.50 %) was observed in treatment 2. The Crude protein (CP) was significantly ($p<0.05$) different among the various treatment groups. Control group had the best CP digestibility (96.66 %) while treatment 2 had the least CP digestibility value (95.29 %). Ether extract was also significantly ($p<0.05$) across the different groups. While treatment 5 had the highest EE digestibility value (97.83 %), the least value (92.76 %) was observed in treatment 6. Digestibility of ash in treatment 1 (Control) was 95.49 % which was higher ($p<0.05$) the value of 88.47 % observed in treatment 4. Crude fibre digestibility was higher ($p<0.05$) in treatment 6 (92.77 %) with treatment 2 having the least value (84.71 %). In digestibility coefficient generally, all the birds fed the various diet containing both treatment and untreated BGO recorded high in all the parameters measured. In apparent digestibility coefficient of Dry Matter (DM), crude protein, ash and crude fibre. The results suggest that the broilers were able to digest and derive nutrients from the diets with the same level of efficiency, except EE digestibility. However, the high Crude Fibre (CF) content of the diets had the least value (84.71%). this agree with Ani (2007), poultry cannot utilize high fibre diets fully because they lack the digestive framework that can elaborately digest large amount of fibre. The recommended levels could have been responsible for the observed apparent digestibility coefficient of nutrients in this study.

Conclusion and recommendation

The result of this study showed that raw Bambara groundnut can be incorporated in broiler chicken diet at 20% inclusion level, without any deleterious effect on the coefficient of digestibility and performance of the birds. The study also showed that raw bambara groundnut offal can be used to supplement soya bean meal and maize in broiler chicken diets as in other birds and rabbit diets. Further investigation should be done in determining the proper inclusion rate of BGO as a feed resource.

References

Acromovic, T. (2001). Commercial application of enzyme technology for poultry production. World Poult. Sc. J. 57:225-242.

Ani, A.O. (2007). Effect of raw bambara groundnut (voandzeia subterranean L) waste on performance of growing rabbits. Agroscience J. Tropical Agric, Food Environ and Extension, 6 (1): 89 - 97.

Ani, A.O. and Okafor, I.C. (2004). Nutritional evaluation of raw Bambara groundnut waste (Voandzeia subterranean L) waste for weaner rabbits. Proc. 29th Ann. Conf. Nig. Soc. for Anim. Production (NSAP), March 21st – 25th 2004, Usman Danfodiyo Univ. Sokoto, Nigeria pp 183 – 186.

Ani, A.O. and Omeje, O.D. (2012) Effects of enzyme supplementation of raw bambara nut (*Vigna subterranean* (L) Verdc) waste diets on carcass and organ weights of broiler finishers. Nigerian Journal of Animal Production, 39(2):114-124.

Augusto, A.A., Cuca, C.M. and Pino J.A. (1999) Poultry Nutrition in Latin America with Special Reference to Scientific Poultry Raising In: Animal production in the Tropics. (eds) Loosli, J.K.., Oyenuga, V.A., and Babatunde, G. M. Trade Island Nigeria, Ltd, Lagos. Pp 213-226.

Babatunde, G.M., Pond, W.G. and Ped Jr., E.R. (1990) Nutritive value of rubber seed hevea brasiliences meals utilization by growing pigs fed semi-putrified diets in which rubber seed meals partially replaced soya bean meal. *Journal of Animal Science*, 51, 692-697.

Bedford, M.R. Smith, C.H.M. Veldman A, Versteng and Beynene, A.C (1992). Dietary carboxymethylcellulose with high instead of low viscocity reduces macronutrient digestion in broiler chicken. J. Nutr. 127: 483-487. Carsten, P. 2013. Reduction of anti-nutritional factors in (pre) starter feed. All About Feed (international magazine on Animal Nutrition, Processing and Feed Management). Volume 21 – No 2 – 2013. Pp 25-27.

Choct, M. and Annison, G. (1992). Anti-nutritive effect of wheat pentosans in broiler chickens. Role of Viscosity and gut microflora. Brit. Poul. Sc.33: 821-834.

Chock M. and G. Annison, (1992a). The inhibition of nutrient digestion by wheat pentosans. Br. J. Nutr., 67: 123-132.

Doku, J.A. and Karikari, O.O. (1981).Tropical Grasses. Legume Bull.31:20-27.

Ensminger, M.E, Oldfied, J.E. and Heinemann, W.N. (1996). Feeds and Nutrition. The Ensminger publishing Coy; Clovis Califomia, USA PP. 324-366.

Enwere, N.J. (1998). Foods of Plant Origin. 301 pp (Afro-orbispub. Ltd. Nsukka Nigeria).

Madubuike, F. N. and Ekenyem, B. U. (2001) Non-Ru- minant livestock production in the tropics Gust-Chuks Graphic Centre, Owerri, Nigeria, 196.

Okeke, D.P. (2000). Replacement of soybean meal with bambara waste (*Voandezia subterranea*) in broiler diets. M.Sc. Thesis Dept. of Anim. Sci. University of Nigeria, Nsukka.

Smith, A.J. (2001) Poultry. The Tropical Agriculturalist. Revised Macmillan Education Ltd. London. Pp 1.

ON FARM QUALITY EVALUATION OF FOUR COMMERCIAL PROTEINS CONCENTRATES USING BROWN EGG – TYPE LAYERS

***Ojebiyi O. O., Idowu A. O., Bakare, A. M. , Ogundokun, A. S., Hammed, M. B. and Adeyemo B. J. Department of Animal Nutrition and Biotechnology**
Faculty of Agricultural Sciences
Ladoke Akintola University of Technology, Ogbomoso
***E-mail of corresponding author:** segunojebiyi@gmail.com

Abstract
One hundred (100) 18 weeks old ISA Brown Strain of layers were used to examine the performance and some egg quality characteristics of four commercial protein concentrates. Five experimental diets were formulated for the experiment such that diet 1was the control formulated from primary ingredients while diets 2, 3, 4 and 5 were formulated using four commercial protein concentrates (CPC) labeled as CPCA, CPCB, CPCC and CPCD respectively. The birds were allotted after weight balancing into five treatments of five replicates with four birds to make twenty birds per treatment in a completely randomize design. The experiment lasted for 12 weeks. The results shows daily feed intake, feed cost /kg diet, feed: egg ratio and percentage hen day production were significantly ($p < 0.05$) affected by CPC. Control diet had the highest feed cost per kg (₦125.00) while CPCB had the least (₦107.93). Hen day egg production was highest in birds fed the control diet (89.68%) and lowest (77.94%) was recorded among birds fed CPCB. The external egg quality results shows that all parameters measured except egg mass were not significantly ($p > 0.05$) affected. Egg mass for birds fed the control diet (48.96), CPCB (47.51) and CPCD 46.87 were similar ($p>0.05$) but higher than 43.20 obtained among birds fed CPCC. Although the percentage production was highest in the control, but where and when it becomes difficult to formulate layer diet from primary ingredients and the concentrates are available any of the commercial concentrates can be used.

Keywords: Quality evaluation, internal egg quality, external egg quality, Brown egg type layers

Introduction
The poultry production systems play an important role in human nutrition, employment and income generation Alam *et al.,* (2015). According to Sleman *et al* (2015), most attention is given to protein components in poultry nutrition, due to the importance of protein as a major constituent of the biologically active compounds in the body. Protein sources are the second largest component of practical poultry diets after energy and limited number of ingredients are used by the mainstream commercial poultry industry to supply protein; these are limited in distribution and are also generally more expensive an energy sources (Iji *et al* 2017). **Animal Protein concentrate** can be defined as animal dietary supplement with very high protein content extracted or prepared from vegetable or animal source. In addition to energy and protein sources there is the need for addition of feed additives (micronutrients, minerals and vitamins) in order have a balanced feed that meets daily nutrient requirements. However, with the consistent rise in the prices of primary ingredients and the need to get quality materials, most farmers have resulted to purchasing protein concentrates to be mixed with relatively available and affordable ingredients. Poor quality feeds will lead to lower performance with a negative consequence on the income of the farmers. Since protein concentrates are expected to contain high quality protein sources, vitamins, minerals, trace elements, enzymes and additives, using them in preparing good feed becomes easier.
The aim of the experiment is to compare performance and egg quality characteristics of Brown egg – type layers fed with different Commercial Protein Concentrates (CPC).

Materials and Methods
Experimental site: - The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Faculty of Agricultural Sciences of Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
Test Ingredients: - Four commercial protein concentrates were used for the experiment which is labelled as CPCA, CPCB, CPCC and CPCD layer concentrate.
Experimental diets: - Five experimental diets were formulated (Table 1) as follows: Diet1: Direct formulation using primary ingredients (control), Diet 2: maize+ wheat offal+30% CPCA, Diet 3:

maize+ wheat offal+30% CPCB, Diet 4: maize+ wheat offal+30% CPCC, Diet 5: maize+ wheat offal+SBM+Limestone+5% CPCD.

Table 1: Gross composition of experimental diet (g/100)

Ingredients	Control	CPCA	CPCB	CPCC	CPCD
Maize	47.00	47.00	45.00	50.00	50.00
Soybean	15.40	-	-	-	20.00
Wheat offal	14.05	23.00	25.00	20.00	16.00
¶Others	23.55	-	-	-	-
Limestone	-	-	-	-	9.00
Concentrate	-	30.00	30:00	30.00	5.00
Total	**100:00**	**100:00**	**100:00**	**100:00**	**100:00**
Analysis					
Crude protein (%)	17.15	17.16	17.40	16.80	17.87
ME (KCal/kg)	2552.31	2504.10	2482.50	2600.00	2644.20
Crude fibre (%)	4.12	4.09	7.52	4.05	3.86
Crude fat (%)	3.52	3.25	5.40	3.40	3.76
Calcium (%)	4.15	3.59	3.42	3.62	4.05

M.E= Metabolizable Energy, PKC= Palm Kernel Cake, ¶others- fish meal=3.00kg, limestone =8.00kg, Bone meal = 0.75kg, salt =3.00kg, Lysine=0.3kg, methionine=0.25kg, premix =0.25kg

Experimental animals and management: - One hundred (100) point of lay (18 weeks old) ISA brown birds purchased from a reputable farm were used for the experiment. The birds were weighed prior to the commencement of the experiment and distributed randomly after weight balancing into five (5) dietary treatment groups of five (5) replicates, each replicate had four birds. The birds were managed intensively in a two-tier battery cage system and three birds were stock per cell with dimension of 42 x 42 x 36 cm. All necessary medications and vaccinations were administered and birds were fed twice daily at 7:00hours and 12:00hours. Water was supplied *ad-libitum.* Eggs were collected twice at 12:00hours and 16:00hours for the period of the experiment which is 12 weeks.

Data Collection: Data were collected on the following parameters; initial body weight, final body weight, average feed intake, egg mass, Egg weight and hen egg day production.

External and internal egg qualities: The following egg quality traits (external and internal) were examined. Egg weight (g), yolk weight (g), albumen weight (g) and shell weight (g) were measured with analytic scale with 0.01 g accuracy. To determine the proportions of egg parts, each egg was carefully broken and shell separated. Egg shell (not dried) was weighed and the relative weight calculated by relating the shell weight to the weight of the egg. An egg separator was used to separate the yolk from the albumen. Relative yolk weight was calculated in percentages by relating the yolk weight measured to the nearest gram to the whole weight of that particular egg and multiplied by 100. The albumen weight was calculated by subtracting the yolk and shell weights from the whole egg weight. The albumen weight relative to the individual egg weight was calculated. Yolk index (%) was calculated according to the formula: Yolk index = yolk height (mm) x 100% / yolk width (mm). Haugh units were calculated according to the formula (Haugh, 1937): HU = 100 log (H +7.57 -1.7 *M0.37), H – average thick white height (mm), W – egg weight (g). Eggshell thickness (mm) was measured together with shell membranes using a micrometer screw.

Laboratory analysis: The experiment diets, as well as the test ingredient were analyzed for proximate composition by the method of AOAC, (2005).

Statistical analysis: All data collected were subjected to one way analysis of variance using the GLM of SAS (2000) and the means were compared using Duncan's Multiple Range Test of the same package.

Results and Discussion

The nutrient compositions of the experimental diets were within the values recommended levels for laying hens as reported by NRC (1994). The comparative performance of brown egg-type layers fed four different commercial concentrates is presented in Table 2. Daily feed intake, feed conversion ratio and percentage hen day egg production were significantly ($p < 0.05$) influenced by the different commercial protein concentrates. This is similar with the findings of Moustafa *et al*., (2005) who reported that feed intake and FCR were significantly affected by slight variation in dietary CP levels in the diets of laying hens.

Table 2: Comparative performance of brown-egg type layers fed four different commercial protein concentrates

Parameters	Control	Biacom	Livestock	Animal care	Hendrix	SEM	P value
Initial weight (kg)	1.63	1.54	1.46	1.61	1.63	0.03	0.25
Final weight (kg)	1.66	1.58	1.49	1.65	1.66	0.03	0.23
Feed to egg ratio	0.12^{b}	0.15^{a}	0.16^{a}	0.15^{a}	0.12^{b}	0.00	0.01
Feed cost(₦/kg)	125.00^{a}	108.20^{d}	107.93^{e}	110.16^{c}	116.80^{b}	0.36	0.01
Daily feed intake (g)	104.51^{b}	106.38^{a}	106.21^{a}	107.14^{a}	105.83^{ab}	1.02	0.02
%Hen-day production	89.68^{a}	87.19^{b}	77.94^{d}	82.39^{c}	84.52^{c}	0.08	0.02

^{abcde}Means on the same similar row with superscripts are not significantly different ($P > 0.05$)

Layers fed on diets formulated from commercial protein concentrates had higher DFI compared with birds fed control diet. This may be due to the type of protein sources and amino acid profile of the commercial protein concentrates used. %HDEP (89.68) was highest in birds fed control diet. Among birds fed supplemented concentrate diets, CPCA had a better %HDEP (87.19). However, %HDEP for birds fed control, CPCA, CPCC and CPCD diets were within desirable range of ≥80% HDEP (Agritech, 2018). The external and internal egg quality parameters are presented in Tables 3 and 4 respectively. The egg size is a function of quality and quantity of feed, stage of lay and management system (Onyimonyi and Ugwu 2007) and the amount of protein in the feed (Scott *et al*, 1976). In this study the egg weights are similar across the treatments.

Table 3: External Egg quality parameters of Brown Egg type layers fed protein concentrates

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Egg weight(g)	54.80	55.21	55.85	54.78	55.20	0.18	0.34
Egg length (cm)	4.32	4.38	4.36	4.35	4.27	0.53	0.97
Egg width (cm)	3.78	3.83	3.83	3.83	3.84	0.15	1.00
Egg mass (g)	48.96^{a}	47.51^{a}	43.20^{b}	44.73^{b}	46.87^{a}	0.50	0.00
Egg shape index	0.82	0.81	0.82	0.81	0.84	0.02	0.98
Shell thickness (mm)	0.41	0.41	0.40	0.40	0.41	0.00	0.57

^{ab}Means on the same row with similar superscripts are not significantly different ($P > 0.05$)

Stadelmen and Owen, (1997) reported that shell thickness of 0.33mm is needed for egg is to have more than 50% chance of moving through normal market without breaking. The egg shell thickness obtained in this study is higher than the recommended 0 .33mm, this improvement in shell thickness may be consequence increased mineral and protein absorption.

Table 4: Internal Egg quality parameters of Brown Egg-type layer fed protein concentrates

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Albumen length (cm)	6.41	6.49	6.33	6.46	6.49	0.09	0.98
Egg weight(g)	54.80	55.21	55.85	54.78	55.20	0.18	0.34
Albumen weight (g)	37.71	36.55	36.15	37.13	37.45	0.19	0.05
Percentage albumen weight	68.99[a]	66.60[a]	64.89[b]	67.94[a]	68.19[a]	0.41	0.02
Yolk weight (g)	13.30	13.31	13.06	13.42	13.52	0.07	0.26
Yolk height (cm)	1.83	1.79	1.80	1.80	1.86	0.02	0.75
Yolk length(cm)	2.94	3.12	2.89	2.94	2.96	0.04	0.33
Yolk index	0.64[a]	0.59[b]	0.63[a]	0.66[a]	0.63[a]	0.01	0.02
Yolk percentage (%)	24.58	24.20	23.47	24.55	24.57	0.12	0.02
Haugh unit	87.97	88.45	88.02	89.39	88.82	0.32	0.61

[ab]Means on the same row with similar superscripts are not significantly different (P > 0.05)

Conclusion and recommendation

All the commercial protein concentrates used were able to meet up the nutrient requirements for layers based on their recommended mixing instructions. They can therefore be used in formulating laying diets where available and when it is relatively difficult to formulate from common fed ingredients.

References

Agritech (2018). Layer Production indices. http://www.agritech.tnau.ac.in/expert_system/poultry /layers%20production%20Indices.html

Alam, M. M., Rakib, F. K., Hasan, M. A., Hasan, M. S. and Ali, M. A. A. (2015).Effect of Neem leaf powder as a growth promoter in broilers. *International Journal of Natural and Social Science*, 2(2):22-26

Asssociation of Official Analytical Chemists (2005). Official Methods of Analysis. 19th edition, Arlington, VA, USA. 503-515

Haugh, R.R (1937). The haugh unit for measuring egg quality. (Us egg Poultry Magazine) 43:552-553 and 572-573.

Iji,P.A., Toghyani,M. , Ahiwe E. U. and A. Omede A. A. ,(2017). Alternative sources of protein for poultry nutrition http://dx.doi.org/10.19103/AS.2016.0011.13

Moustafa, M., El-Kloulb, E. K., Hussein, A. A. and Gad El-Hak, M. K. (2005). A study on the energy and protein requirement of Mamoura local strain chickens during laying period .*Egyptian Poultry Science*, 25: 637-651.

National Research Council (1994).Nutrient Requirements of Poultry.9th Revised Edition. National Academic Press, Washington, DC.

Onyimonyi, A.E and Ugwu, S.O.C, (2007). Performance of laying hens fed varying dietary levels of Bambara (Voandzeia subterrenea thouars) offals. *International Journal Poultry Science*, 6:223-226.

Statistical Analysis System (2000). SAS Statistic Users Guide, , 6th Edition. 8.2 versions SAS Institute Incorporation, carry, NC.

Sleman S.M. Beski, Robert A. Swick and Paul A. Iji. (2015). Specialized protein products in broiler chicken nutrition: A review. *Animal Nutrition*, 1: 47e53 http://dx.doi.org/10.1016/j.aninu

Scott, M.L., Neisheim, M.C. and Young, R.J. (1976). Nutrition of the chicken (2nd Edition). Scott, M.L and Associates. Ithaca, N.9.

Stadelman, W.J and Owen, J.C. (1997). Egg Sciences and Technology (2nd Edition). Avi Publishing Company INC. West port, connectticuit., Pp:29.

COMPARATIVE EVALUATION OF THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF WEANED RABBITS FED SELECTED FORAGE LEAVES

Okon, E.E.,* Ayanwale, B.A., and Jiya, E.Z

Department of Animal Production, Federal University of Technology, Minna, Niger state.

Corresponding author: email edikanituen@gmail.com**; +2347038832591**

Abstract

A 77 day feeding trial was conducted to comparatively evaluate some selected forages in combination with concentrate diet on the growth performance and carcass characteristics of weaner rabbits. A total of 36 weaner rabbits with an initial weight of 600-700g of mixed breeds and sexes, aged between 5-6 weeks, were randomly allotted to 4 dietary treatments with 9 rabbits per treatment and 3 rabbits per replicate in a completely randomised design. The rabbits were ratio 1:2 in their sex distribution (1 male and 2 female). Rabbits in T1 were fed with Tridax procumbens (coat buttons) which served as the control, T2, Senna occidentalis (Negro coffee), T3, Mangifera indica (mango) leaf and T4 with Luffa aegyptiaca (sponge gourd). The forages were fed dried and all the treatment rabbits were also fed the same concentrate diet. Growth performance result showed that final weight, weight gain, and feed conversion ratio were not significantly affected by the treatments. The carcass characteristics of the rabbits showed no significant differences among the treatment means.

It was concluded that the selected forages had no detrimental effect on the growth performance and carcass characteristics of rabbits.

Keywords: rabbit, forages, concentrate, performance, carcass

Introduction

The search for a novel, nutritionally viable, cheap and readily available source of plant nutrients, especially protein, to supplement the highly competed and demanding grains like soybeans is now a major concern in livestock production (Adeniji *et al*., 2005; Obun and Ayanwale, 2006). Gueye and Branckaert (2002) observed that in low-income food-deficit countries, surpluses of cereals are generally not available and therefore, not advisable to develop wholly grain based feeding system. They however, recommended a policy to identify and use locally available feed resources such as forages as supplements in rabbit diets with high nutritive value as an alternative and cheap source of protein for rabbits which could reduce total dependence on concentrate feeding thereby keeping the cost of rabbit production low and sustain growing interest in rabbit production (Omolade, 2016).

Forages are cheap and in abundance in tropical countries during rainy season and can be harvested and stored for use as feed materials during off seasons. Rabbits perform better when fed with a mixture of forage and concentrate (Adeyemo *et al.*, 2014). Forages such as *Panicum maximum* (guinea grass) and *Tridax procumbens* are acceptable by rabbits (Abu *et al*., 2008). The under-utilization of some forages due to inadequate information of their nutritive values and their effects on rabbit necessitated this research with the aim of comparing the performance of rabbits fed with different forage leaves as well as possibility of reducing total dependent on the conventional feed materials and the total cost of production for the small scale rabbit producers.

Materials and Methods

A total of 36 weaned rabbits of mixed sexes aged between 5-6 weeks with initial weight of 600-700g were weighed individually and randomly assigned to the 4 experimental treatments with each housing 9 rabbits and replicated 3 times with 3 rabbits in a completely randomized design (CRD). On arrival, the rabbits were given anti- stress drugs and multivitamins. Dewormer, coccidiostat and antibiotics were also administered for a healthy start. Weighed amounts of the experimental diets were given to the animals for a period of 11 weeks. Concentrate and forage were fed separately at different time interval. The concentrate diet was served between 8.00a.m–6.00p.m while the forage leaves were served between 6.00p.m–8.00a.m of the following day. The forage leaves were collected from the Poultry Production Unit premises, Minna, Niger state. They were cleaned, dried under room temperature of 35ºC and stored for use. A portion of the forage leaves were milled using 1mm sieve

and used for chemical analysis. Data was collected on growth performance (weight gain, feed intake, and feed conversion ratio) and carcass characteristics. The data collected were statistically analysed using SAS (2008).

Proximate composition: The dry matter, crude protein, ether extract and ash contents of the forage samples and the concentrate diet were determined according to A.O.A.C. (2000).

Table 1: Composition of the concentrate diet

Ingredient	(%)
Maize	50.0
Soybean meal	5.0
Maize offal	27.0
Ground nut cake	12.0
Fish meal	2.0
Bone meal	3.0
Salt	0.25
Methionine	0.25
Lysine	0.25
Vit/Min premix	0.25
Total	100

Table 2: Proximate composition of the selected forages

Parameters	T1	T2	T3	T4
Dry matter (%)	93.00	92.80	95.80	93.80
Crude protein (%)	18.38	19.85	10.85	11.62
Crude fibre (%)	18.50	14.50	27.00	13.00
Ether extract (%)	1.82	2.81	1.46	2.00
Ash (%)	19.50	16.50	13.00	25.50
NFE (%)	34.80	39.14	43.49	41.68
ME (Kcal/kg)	2062.03	2351.53	2063.61	2071.58

Means on the same row were not significantly (P>0.05) different: ME= metabolisable energy; NFE = nitrogen free extract; T1= tridax procumbens; T2= senna occidentalis; T3= manifera indica; T4= luffa aegyptiaca

Results and discussions

The result of growth performance of rabbits fed some selected forages shown in table 3 were not significantly different among the treatment means. This result was in line with the report of Adeyemo *et al* (2014). The authors concluded in their research that rabbits perform better when fed combinations of concentrates and forages. The selected forages compared well with the conventional one using *Tridax procumbens* as control. The result of carcass characteristics of rabbits fed some selected forages shown in Table 4 revealed no significant differences among the treatment means.

Table 2: Growth performance of rabbit fed concentrate supplemented with forages

Parameters	T_1	T_2	T_3	T_4	SEM	LOS
Initial weight (g)	677.78	670.00	672.22	666.67	6.34	NS
final weight (g)	1334.00	1282.67	1275.33	1291.89	59.12	NS
Total weight gain(g)	656.22	612.67	603.11	625.22	55.86	NS
weight gain/day (g)	8.52	8.96	8.50	8.85	0.65	NS
Feed intake/day (g)	41.96	41.67	44.58	43.83	1.37	NS
FCR	5.30	4.78	5.48	5.19	0.31	NS
Mortality (%)	11.11	11.11	11.11	11.11	1.98	NS

Means on the same row were not significantly (P>0.05) different; SEM = standard error of mean; LOS= level of significance; NS= not significantly different (P>0,05); T1= tridax procumbens; T2= senna occidentalis; T3= mangifera indica; T4= luffa aegyptiaca

Table 3: carcass characteristics of rabbits fed concentrate supplemented with forages

Parameters (%)	T_1	T_2	T_3	T_4	SEM	LOS
live weight (g)	1418.00	1364.00	1371.33	1358.33	24.89	NS
Dressed weight %	798.00	826.33	782.67	749.33	27.15	NS
Dressing %	55.97	60.47	57.00	55.03	0.69	NS
CTR	16.85	17.60	18.72	19.34	0.69	NS
LSR	26.61	22.14	27.27	25.83	1.34	NS
hind limb	26.15	23.71	25.48	25.04	0.69	NS
fore limb	16.71	15.60	16.64	16.93	0.48	NS
Liver	3.29	2.83	2.87	3.11	0.09	NS
Lungs	0.57	0.66	0.60	0.67	0.04	NS
Heart	0.21	0.24	0.25	0.24	0.02	NS
Kidney	0.78	0.90	0.61	0.81	0.04	NS
abd fat	0.49	1.18	1.03	0.91	0.19	NS
Intestine	14.59	13.94	11.76	14.25	0.60	NS
Head	9.38	9.26	9.32	9.00	0.11	NS
Tail	0.98	0.86	0.63	0.82	0.06	NS
Pelt	11.72	11.20	11.62	11.03	0.19	NS

Means in the same row were not significantly (P>0.05) different. SEM=standard error of mean; ; LOS= level of significance; NS= not significantly different (P>0,05) T1= tridax procumbens; T2= senna occidentalis; T3= mangifera indica; T4= luffa aegyptiaca; CTR= Cervico-thoracic region; LSR= lumbosacral region

Conclusion

It was concluded that the selected forages had no detrimental effect on the growth performance and carcass characteristics of rabbits, and that any of the selected forages could be used to feed rabbits.

References

Abu, O.A., Onifade, A.A., Abanikanda, O.T.F and Obiyan, R.I (2008). Status and promotional strategies for rabbit production in Nigeria. Management and Economy 9th World Rabbit Congress. Verona-Italy.

A.O.A.C. 2000. Official Methods of Analysis 15th edition. Association of Official Analytical Chemists, Washington D.C. Pp: 15-17.

Adeniji, C.A., Fakoye, K.A and Omamohwo, V.R. (2005). Utilization of *Amaranthus sponosus* in the diet of nile tilapia *oreochromis niloticos*. *Tropical Journal of Animal Science.* 9: 79-83

Adeyemi, O, A. and Akanji, A. O. (2012). Restricted concentrate with *ad libitum* forage feeding: effects on performance and carcass yield of growing rabbits. *Revista Cientifica UDO Agricola*, 12(3): 668-674.

Adeyemo, A.A., Taiwo, O.S. and Adeyemi, O.A. (2014). Performance and carcass characteristics of growing rabbits fed concentrate to forage ratio. *Journal of Modern Plant Sciences.* 2(1): 33-41.

Gueye, E.F and Branckaert, R.D. (2002) Employment and income generation through family poultry in low-income food deficit countries. *World's Poultry Science Journal*. 58(4):541-557

NSADP, (1995) Niger State Agricultural Development Project 30th quarterly report January - March in

Nigeria agro newsletter Vol. 3. No. 2. July - December Pp: 32-33.

Nworgu, F.C. Olupona, J.A., Olukoya, J.A and Bamgbose, A.M.(1999) Principles and procedure of statistics. A Biochem approach, 2nd edition McGraw-Hill Kogakwha Ltd, Tokyo. Pp: 20-90.

Obun, C.O and B. Ayanwale, (2006). Utilization potential of *Afzelia africana* seed meal in the diet of starter broiler chicks. Trop. *Journal Animal Science*., 9: 55-61.

Okon, B.I. and Olawoyin, O.O. (2007). Evaluation of rabbit performance fed millet as a replacement for wheat bran. *Nigerian Journal of Animal Production*. Pp: 323-325.

Omolade, E. O., and Babatunde, K. T. (2016). Feed evaluation and growth performance of rabbits fed diet containing different forages. *Vom Journal of Veterinary Science.* Volume 11: 101-111.

SAS, (2008). Statistical Analysis System User's Guide. SAS Institute Inc., Cary, N.C. 27513 U.S.A.

Yusuf, A.M., Amusa, T.O. and Olafadehan, O.A. (2011). Performance of grower rabbits fed diets containing raw, roasted, and pre roasted Afzelia Africana seed meal. Proc. Of 36th *Annual Conference Society for Animal production (NSAP),* Merit House/Raw Materials Research and Development Council, Abuja, Nigeria. March 13th -16th. Pp: 284-286

PERFORMANCE AND HEMATOLOGICAL VALUES OF RABBITS FED GRADED LEVELS OF BOILED *DELONIX REGIA* SEED MEAL

Olaiya, O.D., Aliyu, I.P., Adelowo, O.V., Aka-Tanimo, H.A., Tiffi, A.B., Peter, A.L. and Showul, R.
Department of Animal Production, Federal College of Animal Health and Production Technology N.V.R.I., Vom, Plateau State, Nigeria.
Correspondence: lolaiya96@gmail.com

ABSTRACT
Eight (8) weeks feeding trail was carried out to determine the potential effect of boiled Delonix regia in rabbits' diet. Diet formulated contained 0% (T1), 2.5% (T2), 5% (T3), 7.5% (T4) and 10% (T5) of boiled Delonix regia seed meal. A total number of 30 rabbits age ranging between 6-8 weeks were randomly allotted to (5) treatments having 3 replicates of 2 rabbit per replicate. The rabbits were fed the experimental diet over a period of eight (8) weeks. Feed intake was measure daily and the rabbits were weighed weekly. Parameters taken in this experiment were body weight, hematological values, and carcass characteristics. There was significance increase in feed intake of rabbits in T2 inclusion level of the boiled Delonix regia seed meal compared to other treatments. Whereas, there were no significant variation between TI, T4 and T5. The White Blood Cell count was observed to be within values of 2.10 – 5.43x10(ml). The result also revealed that the red blood cell (RBC) is within the recommended range (5.0-8.0). From the experiment it could be concluded that dietary inclusion of Delonix regia seeds resulted in significant improvement in growth performance of rabbit and the difference observed at 5% level of inclusion could be due to the strain of the rabbits used.

Key words: Rabbits, Delonix regia, Hematology, Growth Performance

INTRODUCTION
The intake of animal protein is low in developing countries than in developed countries. The FAO recommends a minimum of 70g of protein daily per caput out of which at least 35g (50%) should come from animal proteins. Micro-livestock such as rabbit, have been suggested as a rapid means of obtaining animal protein (Orerede *et al.,* 2000) because the daily weight gain is high in proportion to the body weight which gives them a rapid growth rate and early sexual maturity. These resulted in the rabbit reaching the weight of sexual maturity and its 30% faster than other animals (Ajayi *et al.,* 2005) which makes it suitable as meat producing small livestock, in developing countries (Argeniwa, *et al.,* 2000). *Delonix regia* is also known as Flamboyant tree, it's a tropical, ever green shrub which belongs to the family of fabacae, (Christman, 2004). It is noted for its fern-like leaves and flamboyant displays of flower. Hematological parameter is an important and reliable medium used to monitor and evaluate health and nutritional status of animals, Gupta et al. (2007). The various function of the blood is made possible by the individual and collective actions of its constituents, this study therefore investigates the performance and hematological values of rabbits fed graded levels of boiled *Delonix regia* seed meal

MATERIALS AND METHODS
The study was conducted at the teaching and research farm, Federal College of Animal Health and Production Technology, Chaha Farm, Vom. Jos South Local Government Area of Plateau State. A total of 30 Rabbits were obtained from commercial farmers within Vom in Plateau State. They were of mixed breeds and sexes and were randomly allotted into five dietary treatments with six (6) rabbits per treatment in three (3) replicates using the completely randomized design (CRD). The experimental rabbits were fed with formulated diet containing 0% (T1), 2.5% (T2), 5% (T3), 7.5% (T4) and 10% (T5) inclusion rate of boiled *Delonix regia* seed meal and the recommended management and health practices were strictly adhered to. Feed and clean water was supplied *ad-libitum*. Daily feed consumption was recorded as difference of feed offered and the left-over. Weight gain was measured weekly. Blood samples were collected from the heart and marginal vein of the ear into bottles containing EDTA as anticoagulant. The samples were taken to laboratory for analysis to determine the Packed Cell Volume (PCV), Red Blood Cell (RBC), White blood cell (WBC), Neutrophils (N), Lymphocytes (L), total protein, cholesterol and Urea. The PVC, RBC, WBC, N and L were

determined using the Wintrobe-icrohaematocrit. Neuber-haematocytocytometer and Cyano-haemoglobin Results obtained from blood parameters was subjected to analysis of variance (ANOVA) using SAS (2008) software. Means were separated with Duncan multiple range test at 5% level of significance.

RESULTS AND DISCUSSIONS

Table 1: Composition of Experimental Diet Containing Graded Levels of *Delonix regia* Seed Meal

Ingredient	0%	2.5%	5%	7.5%	10%
Maize	53.11	50.58	48.08	45.56	43.00
Maize Offal	13.28	12.64	12.02	11.39	10.76
GNC	29.26	29.89	30.55	31.20	31.85
*Delonixregi*i	0.00	2.50	5.00	7.50	10.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15
TOTAL	100	100	100	100	100
Calculated Values%					
Crude Protein	19.00	19.15	20.04	20.56	21.07
ME (Kcal/kg)	2927.20	2909.84	2894,78	2878.53	2860.08

Table 2: Haematological Analysis before Trial

PARAMETERS	A	B	C	D	E	SEM
P.C.V.(%)	35.67	30.33	34.33	34.00	29.00	1.350
WBC(x109/L)	5.43	3.07	2.67	4.13	2.10	0.535
NEUTROPHILS (%)	64.00^{a}	57.00^{a}	38.67^{b}	60.33^{a}	63.00^{a}	3.270
LYMPHOCYTES (%)	43.67^{b}	46.33^{ab}	61.00^{a}	37.33^{b}	37.00^{b}	3.330

Note: abc - means within a row with different superscripts are significantly Different (P<0.05).
PCV- packed cell volume; WBC- white blood cell; SEM- standard error mean

Table 3: Hematological Analysis after the Trial

PARAMETERS	A	B	C	D	E	SEM
PCV (%)	31.33	32.00	31.33	33.67	32.33	0.616
WBC (x 10^{9}/L)	9.30	8.13	6.17	8.36	7.50	0.588
RBC(x 10^{12}/mm3)	1.67	1.90	1.67	2.10	1.90	0.096
Neutrophils (%)	29.67	32.00	31.00	41.67	32.67	2.380
Lymphocytes (%)	66.67	69.00	62.00	59.00	36.67	2.670

Note: abc - means within a row with different superscripts are significantly Different (P<0.05).
PCV- packed cell volume; WBC- white blood cell; SEM- standard error mean

Table 4: Serum Analysis

Parameters	A	B	C	D	E	SEM
Total protein	58.95^{a}	59.69^{a}	51.52^{b}	51.41^{b}	50.91^{b}	1.320
Cholesterol	0.69^{ab}	0.75^{b}	0.55^{b}	0.64^{ab}	0.51^{b}	0.033
Urea	7.39^{bc}	6.13^{c}	7.81^{bc}	9.00^{ab}	10.56^{b}	0.509

Note: abc -means within a row with different superscripts are significantly Different (P<0.05).

Table 5: Growth Performance of Rabbits fed boiled *Delonix regia* Seed Meal

Parameters	0%	2.5%	5%	7.5%	10%	SEM
Initial weight (g)	190	170	150	180	255	1.59
Final weight (g)	420	390	425	415	495	0.05
Weight gain (g)	230[a]	220[b]	235[a]	235[a]	240[a]	2.00
Total feed intake (g)	1059.9	1098.9	735.4	1016	1036.3	10.45
Feed conversion ratio	4.61[a]	4.90[a]	3.13[c]	4.32[b]	4.32[b]	0.54

Note: abc -means within a row with different superscripts are significantly Different (P<0.05)

The Table 5 above shows the performance of the rabbits fed graded levels of *Delonix regia* seed meal, at 5% with the feed conversion ratio and feed intake observed to differ significantly from other treatments 0%, 25%, 75% and 10% respectively. But the weight gain obtained at 10% inclusion rate was higher and this corresponded with the investigation made by Fatufe (2009) who also fed diet containing *Delonix regia* seed meal at 5% and 10% and discovered it has no adverse effect on body weight and carcass evaluation of the rabbits. Although, at 5% inclusion level, two (2) mortality were recorded with stunted growth, which could be attributed to the strain and type of the rabbit used for the experiment since the rabbits were obtained from different commercial farmers. From the result, the Packed Cell Volume (PCV) obtained fell within the range of 31.0-48.6%. Hence, the higher packed cell volume (PCV) obtained from the results shown a better nourishment of these diets on the rabbits during the trials. Also, the result of white blood cell count (WBC) values shows that the defensive system of the rabbit selected was not affected before and after the trial. The White Blood Cell count was observed to be within values of 2.10 – 5.43x10ml. The result also further revealed that the red blood cell (RBC) is within the recommended range (5.0-8.0). This implies that the seeds did not cause any inflammatory and allergic reactions to the rabbits, at 10% inclusion rate. Treatment with 10% dietary inclusion of cooked and fermented *Delonix regia* seed meal gave promising results which was comparable to the control (maize and Soybeans diets), thus, it is recommended for adoption by farmers.

CONCLUSION

The research shows how efficient *Delonix regia* is to the nutrition of rabbits and other livestock, it can be used to replace Soya beans in a diet. The results from the study is an indication that *Delonix regia* seed meal diets could be fed to rabbit from 2.5% - 10% inclusion without causing any side effect, thus providing a cheaper source of feeding. The study has shown that raw and processed *Delonix regia* seeds contain anti nutrients hence the need for detoxification before feed to the animal.

REFERENCES

Ajayi, F.O., Balogun, O.O., Overu, S.S., Mgbere, O.O., (2005). Reproductive performance of Rabbits fed milling waste-based diets. *African Journal of Biotech*, **4** (5), 439-443.

Argeniwa, A., Otaikhian, S O., maseuan, J.A., (2000). Performance of weaner rabbit fed grower supplemented with different grass legunes ratios In: Proc. 5th Annual conference of Animal Science. Ass. Nig. (ASAN), 2000 September, 103-105.

Christian, A. (2004). Fluted pumpkin (*Telfaria occidentalis* hood F.) Seed: A nutritional assessments. *Electr. J. Environ Agric, Food Chem*. 6(2): 1787-1793.

Fatufe, A. A (2009). Evaluation of Flamboyant seed meal as alternative feedstuffs protein source for livestock feeding. http://uyo cima.org.

Gupta, A.R., Putra, R.C., Sani, M., Swarupa, D. (2007). Haematology and Serum Biochemistry of Chital (Axis axis) and Backing Deit (Muntiacus Muntiyax) Reared in semi-capitivity. Veterinary Research Communication, 3 1:801-808

Orerede, F. A., Balogun, O. O., Johnson. (2002). Performance of weaner rabbits fed different levels of grass legumes rations in Proc. 6th Annual Conference of Animal Sci. Nig. (ASAN). 2000 September, 111-115.

EFFECT OF DIETARY MULTI-ENZYME COMPLEX AND FIBRE SOURCES ON PERFORMANCE AND NUTRIENT DIGESTIBILITY OF GROWING PIGS

***Omidiwura, B. R. O, Agboola, A. F, Oshai, B, I, Olomola, O. O and Iyayi, E. A**
Department of Animal Nutrition, Department of Animal Science, University of Ibadan, Nigeria
**Corresponding author: richardwura@gmail.com ; +234-708-207-7886*

ABSTRACT

Six dietary treatments were formulated. Diet 1, 2 and 3 contained 200g kg-1 soya bean meal (SBM), wheat bran (WB) and rice bran (RB), respectively. Diets 4, 5 and 6 were the same as 1,2 and 3 but contained a multi-enzyme complex supplemented at the rate of 4g kg-1 diet. Each dietary treatment was fed to three weaner pigs and each pig served as a replicate for 42 days with daily performance measurement. Faecal sample were collected and analysed for nutrient digestibility calculations using standard procedures. Data were analysed using descriptive statistics and ANOVA at α0.05. Irrespective of enzyme addition or not, FI and feed efficiency of pigs on the SBM and WB diets were similar (P>0.05). Pigs on the RB diet had significantly higher FI than those on the SBM and WB diets. Enzyme supplementation had no effect on FI and feed efficiency. Daily weight gain was similar in pigs on the 3 diets without enzyme. Enzyme supplementation resulted in significantly higher daily weight gain in pigs on the RB diets compared to those on the SBM and WB diets. Crude fibre digestibility was significantly higher in pigs on the RB diet with or without enzyme supplementation. SBM resulted in significantly higher digestibility of ether extract with or without enzyme supplementation while similar results were obtained for CP and ash digestibility in RB diet. The use of exogenous multi-enzyme supplementation in rice bran diet can be recommended as alternative to soya bean meal diet.

Key words: Enzyme, Fibre sources, Growth, Nutrient Digestibility, Swine

INTRODUCTION

Pork production is a major segment of animal husbandry which involves the raising and breeding of pigs principally for food and sometimes for their skin. Pigs have short generation interval with rapid fecundity and good carcass yield of about 70% as compared to other livestock such as cattle, sheep and goats. Pigs have 15000 taste buds as against 9000 in humans (Ikani *et al.,* 1976) enabling them to eat everything edible including higher levels of dietary fibre diets. This has greatly expanded the range of feed resources for pigs (Ikani *et al.,* 1976). This new development also poses a new challenge in the level of nutrient availability to pigs as these dietary fibre contain antinutritional factors known as Non-starch polysaccharides (NSPs).

Soluble non- starch polysaccharides (NSP) have been reported to have antinutritional effect and cannot be degraded by young pigs due to their inability to synthesize NSP enzymes (Omogbenigun *et al*., 2004). These NSPs are prevalent in most of the conventional feed stuffs such as wheat, barley, rye, corn and soybean used in pig feed. Non-starch polysaccharides such as α-galactomanans and α-1,6-galactosides are antinutritional compounds in soya bean meal, which are still present even after heat processing. Arabinoxylan is the antinutritional compound found in maize while hemicellulose and hexosane are present in wheat, barley bran, cereals and legumes. Owing to decreased fibre content and high nutrient digestibility, it has been more challenging to obtain beneficial effect for corn and soya bean meal diets through the use of exogenous enzyme supplementation. Graham *et al.* (1988) suggested that a combination of different enzyme activities is required for the degradation of complex NSP and improve nutrient utilization. The objective of this study was to investigate the effect of an exogenous multi- enzyme supplementation in the diet of grower pigs containing soya bean meal (SBM), wheat bran (WB) and rice bran (RB).

MATERIALS AND METHODS

The experiment was carried out in the piggery unit of the Teaching and Research farm of the University of Ibadan, Ibadan. Nigeria. Eighteen large white weaner pigs of approximately 6kg initial weight were sourced from the farm. The pigs were de-wormed and other routine vaccination given to them. They were weighed and randomly distributed into pens with three pigs per treatment and one pig per pen serving as replicate in a completely randomized design

The experimental diets comprised of 6 treatments. Diet 1 was a corn soyabean meal (SBM)-based diet which served as the control and without enzyme supplementation. Diets 2 and 3 contained wheat bran (WB) and rice bran (RB) respectively also without enzyme supplementation. Diets 4, 5 and 6 contained SBM, WB and RB as in the first 3 diets but with a multi-enzyme (α Amylase 800,000 UA/Kg, Protease 8,000,000 U.P/Kg, Xylase 500,000 U.X/Kg, β-Glucanase 300,000 BG/Kg, Cellulase 700,000 U.C/Kg, Lipase 20,000 U.C/Kg, Fructo oligosaccharides (FOS) 1,000g and Moisture 5%) which was added at the rate of 4 g/kg diet. The nutrient composition of the experimental diets is shown in Table 1. Clean water and feed were provided *ad libitum* for 42 days.

Table 1: Nutrient composition of experimental diets (g/Kg DM) fed to weaner pigs for 42 days

Nutrient	Without Enzyme			With Enzyme		
	Soya bean meal	Wheat bran	Rice bran	Soya bean meal	Wheat bran	Rice bran
Metabolisable Energy, kcal/kg	2907.55	2587.15	2889.55	2906.21	2585.81	2888.21
Crude Protein, g/kg	172.82	158.82	163.57	172.78	158.78	163.83
Calcium (Ca), g/kg	6.89	6.92	6.86	6.89	6.92	6.86
Total Phosphorus (P), g/kg	5.18	6.62	7.43	5.18	6.62	7.43
Non-Phytate (NPP)	2.43	2.52	2.62	2.43	2.52	2.62
Ca:P	1.33	1.04	0.92	1.33	1.05	0.92
Ca:NPP	2.83	2.74	2.62	2.83	2.74	2.62
Crude Fibre	24.38	40.62	41.93	24.37	40.61	41.92

One kilogram of feed was measured to each pig across treatments daily. For daily feed intake determination, the left over per day was subtracted from the one kilogram of feed fed. Average daily weight gain was obtained by dividing the average final weight of the pigs by the duration of the trial (42 days).. The feed efficiency was calculated by dividing the total weight gain by the total feed intake. During the last 5 days, faeces were collected from each pig kept individually in metabolic cages for proximate analysis and calculation of nutrient digestibility.

Data obtained were analysed using the General Linear Model (GLM) procedures of SAS (2008) and means were compared using Duncan's multiple range test of the same package at α0.05.

RESULTS AND DISCUSSION

Growth performance of weaner pigs fed soya bean meal, wheat bran and rice bran diets with or without multi-enzyme

The results of the performance of the pigs are presented in Table 2. For both the group with and without enzyme inclusion, similar trend was recorded as feed intake of pigs fed rice bran (RB) diets was observed to be significantly higher than in those on the soyabean meal (SBM) diets though both were statistically similar to the feed intake of pigs fed wheat bran (WB) diets. The feed efficiency of pigs fed SBM diet with enzyme inclusion was significantly higher than those fed WB diet with enzyme inclusion. but both were similar to the feed efficiency recorded for pigs on other four diets. Similar observation was noted for the average daily weight gains of the pigs fed the experimental diets. The weight gains of pigs fed RB diet with enzyme, SBM diet with enzyme, RB diet without enzyme and WB diet without enzyme were observed to be significantly higher than those fed SBM diet without enzyme and WB diet with enzyme. The results showed that there was no significant difference in feed intake among the treatments but only in the fibre source. Rice bran among the three fibre sources was significantly consumed above SBM but there was no significant difference between RB and WB. This might be due to the desire of the pigs to meet their energy demand. The results also showed that there was no significant difference in the weight gain of the pigs in the six dietary treatments for the six-week trial. This is in line with the findings of Shyama *et al.* (2011) who found no significant difference in weaner pigs fed phytase- supplemented diets. Morcherla (2013), also observed no significant weight gain of grower pigs after substituting xylanase and phytase in their diet. Increased average daily weight gain as a result of enzyme supplementation has been reported by Omogbenigun *et al*. (2004). Conversely, Cervantes *et al*. (2004) reported no significant difference

between SBM diet and WB diet supplemented with enzyme on average daily weight gain of weaner pigs.

Table 2: Growth performance of weaner pigs fed soya bean meal, wheat bran and rice bran diets with or without multi-enzyme

Parameters (Kg)	Without enzyme			With enzyme			SEM
	Soya bean meal	Wheat bran	Rice bran	Soya bean meal	Wheat bran	Rice bran	
Initial body weight	6.33	6.67	6.67	6.00	6.00	5.67	0.52
Feed intake	33.6^{b}	36.3^{ab}	39.4^{a}	32.9^{b}	33.0^{ab}	38.6^{a}	1.44
Feed efficiency	0.41^{ab}	0.43^{ab}	0.39^{ab}	0.48^{a}	0.37^{b}	0.42^{ab}	0.02
Average daily weight gain	0.33^{b}	0.37^{a}	0.37^{a}	0.38^{a}	0.30^{b}	0.42^{a}	0.03

Nutrient Digestibility of weaner pigs fed soya bean, wheat bran and rice bran with or without enzyme supplementation

The results of nutrient digestibility are presented in Table 3. There was a significant difference ($P<0.05$) in crude protein (CP) digestibility among the treatments. Rice bran had the highest CP digestibility which was significantly higher than values for the other diets. Crude fibre digestibility of rice bran diet without enzyme was significantly higher when compared to other diets. Digestibility of ether extract in soyabean meal with or without enzyme was higher than in rice bran but similar to that of wheat bran. The ash result also showed a significant difference in digestibility of mineral among the treatments without enzyme supplementation over the enzyme supplemented diets. Energy digestibility was neither affected by diet type nor enzyme supplementation.

Table 3: Nutrient Digestibility of weaner pigs fed soya bean, wheat bran and rice bran with or without enzyme supplementation

	Without enzyme			With enzyme			SEM
	Soya bean meal	Wheat bran	Rice bran	Soya bean meal	Wheat bran	Rice bran	
Crude Protein	69.4^{b}	70.6^{b}	72.9^{a}	67.8^{c}	59.8^{d}	74.0^{a}	0.83
Crude Fibre	24.4^{b}	12.7^{c}	41.9^{a}	11.2^{c}	10.0^{c}	25.3^{b}	2.63
Ether Extract	76.3^{a}	72.9^{ab}	71.6^{b}	81.9^{a}	78.3^{ab}	70.4^{b}	1.52
Ash	36.9^{ab}	29.3^{b}	42.0^{a}	10.0^{c}	11.0^{c}	14.2^{c}	2.75
Energy	92.1	91.9	92.0	91.6	91.9	91.9	0.09

The result of CP digestibility is in line with Traylor *et al*. (2001) and Cervantes *et al.* (2004) who found no significant difference in crude protein digestibility after substituting the diet with enzymes. Crude fibre (CF) digestibility also did not follow a regular pattern across the treatment but CF digestibility was significant in diets without enzyme supplementation above each alternative diet with enzyme supplementation. This may be due to incompatibility of the enzyme to the fibre sources thereby resulting in a negative digestibility of CF. Soyabean meal showed a significant ether digestibility above RB. This may be due to a more soluble ether from SBM above RB. Energy digestibility was high and not significant across the treatments. This might be attributed to the high soluble energy diet used.

CONCLUSION

From the present study, exogenous multi-enzyme supplementation has succeeded in increasing the average daily weight gain of the weaner pigs but has also not succeeded in making any significant increase in the nutrient digestibility of the conventional feedstuff used in this experiment. Considering the result of this study and alternative fibre source for low cost production, the use of exogenous multi-enzyme supplementation in rice bran diet can be recommended.

REFERENCES

Cervantes, M., Yanez, J., Barrera, M. A., Figueroa, J. L., Torrentera, N. and Sauer, W. (2004). Ileal amino acid digestibility and performance of pigs fed grain sorghum-based diets supplemented with phytase. *Inci*. 29.9

Graham, H., Lowgren, L., Petterson, D., and Aman, P. (1988). Effect of enzyme supplementation on digestion of a barley/pollard based pig diet. *Nutr. Rep. Int*. 38:1073-1079

Ikani, I. E. and Dafang, I. I.. (1976). 'Pig production technology for piggery Farmers' . National ` Agricultural Extension and Research Liaison Services Ahmadu Bello University, Zaria . Extension Bulleting No. 25 *Livestock series No. 1*

Mocherla, V. A. and Suryanarayana, N. (2013). Performance and total tract digestibility responses of probiotic, xylanase and phytase in the diets of grower pigs. *Journal of Agric. And sustainability.* ISSN 2201-4357. Volume 2, number 1,86-97

Omogbenigun, F. O., Nyachoti C. M. and Slominski B. A. (2004). Dietary supplementation with multienzyme preparations improves nutrient utilization and growth performance in weaned pigs. *J. Anim. Sci*. 82:1053-1061

Shyama, K., Mercy A. D. and Gangadevi, P. (2011). Effect of Phytase supplementation on growth and nutrient digestibility in swine. *Thrissur, Kerala Mannuthy*-680 651,

GROWTH RESPONSE OF BROILER CHICKS FED FRIED COOKIES (CHINCHIN) WASTE MEAL AS REPLACEMENT FOR MAIZE

Onigemo M. A., Agbalaya K. K., Oso Y. A. A., Anjola A.O. J., Tijani L. A., Agunbiade M. A., Agbaye P. F., Osupe D. U., Lawal A. A., Adebayo G. B., Adetilewa O. D. and AbdulAzeez M. S.
Department of Animal Production Technology
Lagos State Polytechnic, Ikorodu, Nigeria.
maonigemo@gmail.com

Abstract
The increasing price and seasonal scarcity of maize, a major conventional livestock feedstuff in Nigeria, has prompted research into the possibility of replacing it with potential feed resources such as chinchin waste, that are of little or importance to humans. The feed intake (FI), weight gain (WG), feed conversion ratio (FCR), protein efficiency ratio (PER), specific growth rate (SGR) of one hundred and fifty-day old broiler chicks fed diets containing chinchin waste meal (CWM) was investigated for thirty-five days in a completely randomized design. CWM was fed at 0%, 12%, 24%, 36% and 48% levels of inclusion as a replacement for maize. Each dietary level of inclusion represented a treatment and replicated three times. Results revealed that CWM significantly (P<0.05) depressed FI, but had no significant (P>0.05) influence on WG, FCR, PER, and SGR of the birds. Hence, CWM can replace maize in the diets of broiler chicken without compromising their growth. Birds fed diets containing 36% CWM had the best performance, therefore, the inclusion of CWM at 36% level is hereby recommended.

Keywords: Chinchin waste meal, broiler chicken, growth response, substitute, maize.

Introduction

Poultry production is a vital and extremely important aspect of livestock production which deals with the raising of domesticated birds such as chicken, turkey, duck and guinea fowl, for their meat and eggs. It is an important subsector in agriculture that accounts for 25% of the agricultural Gross Domestic Product (GDP) of Nigerian economy (FAOSTAT, 2007). Poultry production is one of the major sources of animal protein (meat and eggs) to man; it is also a source of employment and income, source of manure useful for crop production as well as for research purpose (Atteh, 2004).

Broiler production is a fast growing poultry enterprise in the country accounting for about 35% of the meat consumed by man in the world (Esonu *et al.*, 2006; Sharif *et al.*, 2012). Broiler production takes the second position in the worlds volume just after pork (Yang and Jiang, 2005), and due to its short growth interval, has imparted so greatly on the supply of protein (Oluyemi and Robert, 2000). Poultry farmers have been challenged over the years by various production problems, among which are disease outbreak, poor biosecurity measures, resistance of livestock to drugs and many more, but the most challenging problem is high feed cost, as it covers over 70% of the total cost of production, hence it is a major determinant of profit in poultry industry (Lawrence *et al*., 2008).

Maize is the major source of energy in livestock feed but it is expensive due to its seasonal availability and its increasing use as food, feed and industrial raw material (Dairo, 2008). Therefore, extra effort should be made by researchers to source for other feed resources that are of little or no importance for use by man and thereby reducing the feed cost in the process (Onigemo and Anjola, 2013). Chin-chin is a fried snack well known in West Africa. It is a crunchy doughnut like baked or fried dough of wheat flour and other customary baking items such as butter, milk and eggs (Akubor, 2004). It is a traditional snack in Nigeria made mainly of wheat flour and its other ingredients to form a stiff paste thereby attaining the chosen shape (slant cylindrical or crumb) afterwards fried into a golden brown crisp (Adegunwa *et al*., 2014). It is mainly eaten for pleasure instead of nutritive purpose (Matz, 1993).

Chin-chin waste is a waste generated in the process of production and comprises particles that dissociate from dough and/or fried mixture immersed in the oil used for frying the products which is suggestive of high energy value. This project was therefore designed and executed to evaluate the growth performance of broilers fed chin-chin waste in a bid to determine its suitability as alternative feed resource in poultry production.

Materials and Methods

The study was carried out at the teaching and research farm of the Animal Production Technology Department, Lagos State Polytechnic, Ikorodu. Chin-chin wastes were obtained from a major distributor in Ikorodu, Lagos State and mix with other feedstuff in a pre-formulated manner as shown in Table 1. The experimental diets were fed to broiler chicks in a completely randomized design feeding trial with five treatments, T1(Maize Control diet), T2 (12% CMW), T3 (24% CMW), T4 (36% CMW) and T5 (48% CMW). One hundred and fifty (150) day-old broiler chicks of average weight of 37.5±1.06g were randomly assigned to the five dietary treatments replicated three times with ten birds per replicates. Prior to the arrival of the birds, the brooder house was washed, fumigated and sealed with polythene sheet and litter materials (wood shavings) was spread on the floor of the brooder house and pre-heated. The feeders and drinkers were washed with antiseptic, rinsed and shade dried. The birds were brooded intensively in deep litter pens under the same experimental condition and fed *ad-libitum* with the respective experimental diets for five weeks. All necessary management, medication and vaccination practices were strictly observed throughout the five weeks of the study. Data on feed intake and weight gain were collected weekly. Specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER) were determined as follows:

i. $$SGR = \frac{\text{Naturaln log of final weight} - \text{Naturaln log of Innitial weight}}{\text{Time}}$$

ii. $$FCR = \frac{Average\ feed\ intake}{Average\ body\ weig\ ht\ gain}$$

iii. $$PER = \frac{\text{Weight gain (g)}}{\text{Protein intake (g)}}$$

Table 1: Composition of experimental diet

Feed Ingredient	Experimental diet				
	T1	T2	T3	T4	T5
Maize	48	36	24	12	0
Chinchin	0	12	24	36	48
Corn offal	18	18	18	18	18
Full fat soya	7	7	7	7	7
Fishmeal	2	2	2	2	2
Groundnut cake	18	18	18	18	18
Blood meal	5	5	5	5	5
Bone meal	1	1	1	1	1
Limestone	0.4	0.4	0.4	0.4	0.4
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Detoxyzme	0.1	0.1	0.1	0.1	0.1
Determined analysis					
Gross energy (Kcal/kg)	3855.44	4526.83	4613.71	4689.60	4828.78
Dry matter	87.50	88.50	89.50	88.00	89.00
Crude protein	22.43	22.68	22.87	23.23	23.58
Ether extract	6.00	16.00	17.00	20.00	21.00
Ash content	4.00	5.00	3.50	5.00	4.00
Crude fibre	3.22	2.89	2.57	2.24	1.92
Nitrogen free extract	41.85	42.43	43.56	38.03	38.50

The proximate analysis of the feed was determined using the methods of AOAC (2010), while the gross energy was determined using IKA® WERKE Calorimeter system, C 2000 control high pressure bomb calorimeter.

All data collected were subjected to analysis of variance (ANOVA) and significantly different means were separated using the multiple range test of Duncan. All statistical analysis was done using Assistat-Statistical Assistance 7.6 Beta software developed by Silva and Azevedo (2016).

Results and Discussion

Table 2 shows the performance of broiler chicks fed with chinchin waste based diet. The statistical analysis revealed that there was significant difference (P<0.05) in the level of feed consumed. Birds fed with experimental diet T2 consumed (59.91g) more than those on other diets while diet T5 consumed the least (50.28g). The significantly lower feed intake by T5 may be due to higher energy content in the feed, since, feed consumption is negatively correlated with metabolizable energy content of the diet (Nahashon, *et al*., 2006; Ball, *et al*., 2013; Zhai, *et al*., 2014). The weight gains of the birds fed with the experimental diets was not significantly (P>0.05) different, birds in T1 (21.07g) having the highest weight gain followed by birds on diets T2, T3, T4 and T5. The lowest weight gain observed in T5 might be due to the lowest feed intake recorded in this group of birds. Reduced feed intake has been reported to reduce weight gain in broilers birds (Leeson *et al*., 1996; Zhai, *et al*., 2014). Statistical analysis shows that there was no significant difference (P >0.05) in the feed conversion ratio among the birds. The feed conversion ratio of birds fed with T2 (2.92) had the highest numerical value followed by T4 (2.88), T5 (2.77), and T1 (2.71) while T3 (2.68) has the lowest. Statistical analysis revealed that there was no significant difference (P>0.05) between the protein efficiency ratio of the birds. The lowest protein efficiency ratio was observed among the birds in T4 (1.49) while the highest was found among birds on T1 (1.66). Statistical analysis revealed that there was no significant difference among the treatments for specific growth rate, the T4 birds (6.78) had the highest growth rate followed by T3, T5 while T1 and T2 has the lowest. Growth has been reported to be a function of feed consumption and increase in weight gain in broiler chicken (Carre and Meda, 2015).

Table 2: Growth Performance of Broilers Fed with Chinchin Waste Meal (0-6 Weeks)

Variables	Experimental diets					SEM
	T1	T2	T3	T4	T5	
Feed intake (g/bird/day)	56.73[a]	59.91[a]	54.52[ab]	57.27[a]	50.28[ab]	1.6
Weight gain(g/bird/day)	21.07	20.62	20.31	20.14	18.61	0.42
Feed Conversion Ratio	2.71	2.92	2.68	2.88	2.77	0.05
Protein Efficiency Ratio	1.652	1.52	1.61	1.49	1.54	0.03
Specific Growth Rate	6.53	6.52	6.59	6.78	6.55	0.05

NB: T1→ Maize Control diet, T2 →12% CMW, T3→24% CMW, T4→36% CMW, T5→ 48% CMW.

Conclusion and Recommendation

Chinchin waste significantly (P < 0.05) depressed the feed consumption of the birds fed with varying levels of chinchin waste, however, the weight gain, feed conversion ratio, protein efficiency ratio, and specific growth rate of the birds were similar to the maize based control diet. Therefore, chinchin waste could completely replace maize in the diets of broiler chicken without compromising their growth and its use in broiler diets is hereby recommended.

References

Adegunwa, M. O., Ganiyu, A. A., Bakare, H. A. and Adebowale, A.A. (2014). Quality evaluation of composite millet-wheat Chinchin. Agriculture and Biology Journal of North America, 5(1): 33-39.

Akubor, P.I. (2004). Protein content Physical and Sensory properties of Nigeria snack foods (cakes, chinchin, puff-puff) prepared from cowpea-wheat flour blend. *International Journal of Food Science and Technology*, 39,419-424. 10.1111/ Ifs. 2004, 39. Issue-4.

AOAC (2010). Official Method of Analysis. 16th Ed. Association of Official Analytical Chemist. Washinton DC, USA.

Atteh, J.O. (2004). Romancing the chicken 68th Inaugural lecture, University of Ilorin. Published by Unilorin press.

Ball, M. E. E., Owens, B., and McCracken, K. J. (2013). Chemical and Physical Predictors of the Nutritive Value of Wheat in Broiler Diets. *Asian-Australasian Journal of Animal Sciences*, 26(1): 97–107.

Carre, B. and Meda, B. (2015). Cross relationships between growth performance, growth composition and feed consumption in broiler chicken, calculated from published data. *Poultry Science* 94:2191-2201.

Dairo F. A. S. (2008). Performance and haematological evaluation of weaner rabbits fed loofah gourd seed meal (*Luffa cylindrica* M.J. Roem). *African Journal of Food, Agriculture, Nutrition and Development*, 8(4): 451 – 463.

Esonu, B. O., Ogbonna, U. D., Anyanwu, G. A., Emenalom, O. O., Uchegbu, M. C., Etuk, E. B. and Udebibie, A. B. I. (2006). Evaluation of performance, organ characteristics and economic analysis of Broiler finisher fed dried rumen digesta. *International Journal of Poultry Science*, 5: 1116-1118.

FAOSTAT, (2007). Food and Agriculture Organization Statistical databases. CDROM.

Lawrence, J. D., Mintert, J., Anderson, J. D. and Anderson, D. P. (2008). Feed Grains and Livestock: Impacts on Meat Supplies and prices. *CHOICES*.23 (2): 11-15.

Leeson, S., Caston, L. and Summer, J. D. E. (1996). Broiler response to diet energy. *Poultry Science Journal*, 75(4): 529-535

Matz, S. A. (1993). Snacks Food Technology (3 Ed). New York. *Van Nostrand Reinhold*.

Nahashon, S. N., Adefope, N., Amenyenu, A. and Wright, D. (2006). Effect of varying metabolizeable energy and crude protein concentration in diets of pearl gray guinea fowl pullets. Growth performance. *Poultry Science Journal*, 85: 1847-1854.

Oluyemi, J. A. and Roberts F. A. (2000). Poultry production in wet climates. 2nd edition. *Spectrum Book limited, Ibadan Nigeria*. Page 244.

Onigemo, M. A. and Anjola, O. A. (2013). Growth and Reproductive Performance of Pigs Fed with Raw and Differently Processed Velvet Beans (*Mucuna pruriens*) as Partial Replacement for Soya Bean Meal. *OIDA International Journal of Sustainable Development,* Vol. 6, pp. 71-76.

Sharif, M., Shahzad, M. A., Rehman, S., Khan, S., Ali, R., Khan, M. L. and Khan, K. (2012), Nutritional Evaluation of distillery sludge and its effect as a substitute of canola meal on Performance of Broiler chickens. *Asia Australasian J. Animal science*, 25: 401-409

Silva, F. A. S. and Azevedo, C. A. V. (2016). The Assistat Software Version 7.7 and its use in the Analysis of experimental data. *Afr. J. Agric. Res*. 11(39): 3733-3740.

Yang, N. and Jiang, R. S. (2005). Recent advances in breeding for quality chickens. *World point Sci J*., 61:373-382.

Zhai, W., Peebles, E. D. Mejia, L., Zumwalt, C. D. and Corzo, A. (2014). Effects of dietary amino acid density and Metabolizable energy level on the growth and meat yield of summer-reared broilers, *The Journal of Applied Poultry Research*, 23 (3): 501–515.

DIETARY EFFECT OF MIXED SAW DUST AS A SUBSTITUTE FOR WHEAT OFFAL ON INTERNAL ORGANS OF GROWER RABBIT FED EXPERIMENTAL DIET

OSENI, T. A., AMUSA, H. O., OGUNGBENRO, S. D AND AMOO, T. A.

[1]Department of Animal Health and Production Technology, Faculty of Animal and Fisheries Technology. Oyo State College of Agriculture and Technology, Igboora Oyo State, Nigeria

Corresponding Authors E- Mail: hammed4dtop@yahoo.com

Phone number: 08054146259

Abstract

A total of 18 grower rabbits were allotted to 3 dietary groups of six (6) animals in a completely randomized design (CRD) to determine the dietary effect of mixed saw dust as a substitute for wheat offal on organ weight changes of grower rabbits. Each group was replicated thrice consisting of two animals per replicate. Sawdust was substituted with wheat offal at 0% 5% 10% respectively. The result showed that they were significant (P<0.05) differences in the value of live weight, lungs and heart while there were no significant (P>0.05) differences in liver, kidney and testicle across the dietary treatments. However, the highest value of liver (1887) was recorded in diet 2 while the lowest live weight (1288g) was recorded in diet 3. The value obtained for liver, kidney and testicles followed a similar pattern across the dietary treatments. Rabbits on diet 1 recorded the highest value (1.15g) of lungs while the lowest value (0.70g) of lungs was recorded in diet 3 (10% substitution level). The highest (0.37g) of heart was recorded in diet 2 while the lowest value (0.23g) of heart was recorded in diet 3. The highest value of kidney (0.70g) and liver (3.77g) were recorded in diet 3 while the lowest value of kidney (0.60g) and liver (2.54g) were recorded in diet 1(control) and diet 2 respectively. It could be concluded that mixed sawdust is good alternative feed resources that could be effectively used in diet grower rabbits and at 10% conclusion level without adverse effect on the internal organs of the rabbit

Introduction

The increasing demand for animal protein coupled with more stringent economic conditions have encouraged greater interest in fast growing animals with short generation interval. Fetuga, (1997) reported on the disappointing rate and level of performance in the livestock industry in Nigeria. Thus he attributed, among other factors, to high cost of feeds arising largely from fluctuations in feed supplies, rising prices of ingredients, poor quality feeds, inefficiency in production and distribution in the feed industry. One of the cheapest producers of meat that can easily fit into the wider segment of the population but which has been neglected in Nigeria is the rabbit. The rabbit has the ability to convert feedstuff such as forages, most agricultural by-products, kitchen waste etc. that human being cannot consume directly into highly nutritious meat. Rabbits are highly prolific, cheap to feed because they can utilize roughage feeds, they have rapid growth rate, high dressing percentage, short gestation period and low purchasing price. However, efficient rabbit production is largely dependent upon adequate and correct nutrition (Standford, 1979). . In recent years, there have been renewed interests in the use of non-conventional ingredients in feeds formulation for livestock. Standford, (1979) reported that, there is a wide range of feedstuff on which rabbits can live on. Therefore, alternative feed sources need to be investigated such as, sawdust. However, its potentials as an animal feed supplement have not been properly documented in Nigeria. Studies in the management of sawdust as waste are not new in Nigeria, but most of these studies have had their focus on utilizing the waste as a soil amendment material, with promising results. Ibrahim, (2001) had attempted a study on exploring the potentials of sawdust as a livestock feed, and the results have been encouraging.

Materials and methods

Experimental site: The experiment was carried out at the Teaching and Research Farm, Oyo State College of Agriculture & Technology Igboora, Nigeria. Which is located within 7° 15° North and 3° east of the equator with annual temperature of 27°c (Sanusi, 2011).

Experimental Ingredient: The saw dust used in the experiment was obtained from the local saw mill at Igboora, Oyo State.

Experimental Design

A total of 18 grower rabbits were allotted to 3 dietary group of six (6) animals in a completely randomized design (CRD), each group was replicated thrice of two animals per replicate. Sawdust were substituted with wheat offal at 0% 5% 10% respectively.

Table 1: GROSS COMPOSITION OF EXPERIMENTAL DIET

INGREDIENTS	T1 (0%)	T2 (5%)	T3 (10%)
Maize	20.00	20.00	20.00
SBM	16.00	16.00	16.00
C/Bran	39.00	39.00	39.00
W/O	20.00	19.00	18.00
MSD	0.00	1.00	2.00
Bone meal	2.00	2.00	2.00
Limestone	2.00	2.00	2.00
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Grower Premix	0.25	0.25	0.25
Total	**100**	**100**	**100**

Key: SBM= Soya bean meal, C/BRAN= corn bran, W/O = wheat offal, MSD= mixed sawdust. **Internal organs** evaluation: At the end of the 8th weeks of the experiment, two rabbits per treatment were selected in each treatment and used for international organs evaluation. The animals were slaughtered via the neck region; it was defured, detached, dressed and cut into parts each of the weight part were recorded. Internal organs measured were liver, kidney, heart, lung, spleen and stomach.

Statistical Analysis: Data obtained in the study were subjected to statistical Analysis of Variance, mean value of variables showing significant ($P<0.05$) difference were separated using Duncan's multiple range test (Duncan; 1955)

Results and discussion

Results

The result showed that they were significant ($P<0.05$) difference in the value of live weight, lungs and heart while there was no significant difference in liver, kidney and testicle across the dietary treatment. However, the highest value of liver (1887) was recorded in diet 2 while the lowest live weight (1288g) was recorded in diet 3. The value obtained for liver, kidney and testicles follow a similar pattern across the dietary treatments. Rabbits on diet 1 recorded the highest value (1.15g) of lungs while the lowest value (0.70g) of lungs was recorded in diet 3 (10% substitution level). The highest (0.37g) of heart was recorded in diet 2 while the lowest value (0.23g) of heart was recorded in diet 3. The highest value of kidney (0.70g) and liver (3.77g) were recorded in diet 3 while the lowest value of kidney (0.60g) and liver (2.54g) were recorded in diet 1(control) and diet 2 respectively.

Discussion

There were significant difference (P<0.05) in the value recorded for internal organ of grower rabbit across the dietary treatments. The result negate the finding of Ogungbero *et al*., (2016) which reported that there were significant (P<0.05) difference in all internal organs of broiler fed experimental diet except liver which showed that the rabbit fed (10% mixed sawdust) recorded the highest value (3.77g) of liver. This result support Akinwusi *et al*., (2017) who reported an increased organ weight in rabbit fed 10% cashew nut meal based diet. The grower rabbit fed diet 1 recorded the lowest kidney value (0.60g) while the highest value (0.70g) was obtained in grower rabbit fed diet 3. This can be attributed to the increased in the activity of kidney enzymes to detoxify the available anti-nutritional factor present in the text ingredient.

Table 2: Internal organ of rabbit fed mixed saw dust as a substitute for wheat offal

Parameters	T_1 (0%)	T_2 (5%)	T_3 (10%)	SEM
Live weight	165.53^{ab}	1653^{ab}	1288^{bc}	144.19
Kidney	0.60	0.68	0.70	2.53
Liver	2.96	2.54	3.77	2.70
Lungs	1.15^{a}	0.95^{ab}	0.70^{a}	1.05
Testicles	0.12	0.10	0.15	1.23
Heart	0.24^{c}	0.37^{a}	0.23^{bc}	3.59

Conclusion and recommendation

Conclusion

Based on the result of this research, it could be concluded that mixed sawdust is good alternative feed resources that could be effectively used in the diet of grower rabbits and at 10% conclusion level without adverse effect on the internal organs of the rabbit.

Recommendation

Based on the result of this research, it could be recommended that: mixed sawdust be included in the rabbit ration up to 10% replacement levels. Since sawdust could effectively replace wheat offal in diets for grower rabbits. Which is an unconventional feed resource to enhance high profitability of the business.

References

Fetuga, B. L. (1997). Animal Production in Nigeria and Feed Supplies. Nig. J. Anim. Prod. 4(1): 19-41.

Standford, J. I. (1979). The Domestic Rabbit 3rd Edition London. Granada Publishing Co. Ltd.

GROWTH PERFORMANCE AND HAEMATOLOGICAL INDICES OF WEANER RABBITS FED DIETS SUPPLEMENTED WITH *SACCHAROMYCES CEREVISIAE*

Osita, C. O., Ani, A.O., Udeh, F. U., Udeh, V. C., and Ezewuzie, V.

Department of Animal Science, University of Nigeria, Nsukka, Nigeria;

Corresponding author: Osita, C. O.; E-mail: charles.osita@unn.edu.ng; Telephone: 08037410712

Abstract

A study was conducted to evaluate the growth performance and haematological indices of weaner rabbits fed varying levels of Saccharomyces cerevisiae. Thirty two weaner rabbits were weighed and randomly allocated into four treatment groups (T1, T2, T3 and T4) having eight rabbits per treatment. Each treatment was replicated four times with two rabbits per replicate. Treatment 1 served as the control and did not contain Saccharomyces cerevisiae supplement, while treatments 2, 3 and 4 contained 1, 1.5 and 2 g/kg of basal diet respectively of Saccharomyces cerevisiae supplement. The experiment lasted ten weeks. Results showed that there were no significant (p>0.05) differences among treatments in initial body weight and feed conversion ratio while average daily feed intake (ADFI), and average daily weight gain (ADWG) were significantly (p<0.05) affected. The study revealed significantly (P < 0.05) higher ADWG in the rabbits of treatment groups T2, T3 and T4 compared to the control group (T1). Lowest ADFI and haemaglobin concentration were recorded in T1. The packed cell volume of rabbits in T3 and T4 are significantly (p<0.05) higher than those of T1 and T2. The red blood cell count of rabbits in T4 was significantly (p<0.05) higher than those of other treatment groups. The total white blood cell count of rabbits in T2, T3 and T4 were significantly (p<0.05) higher than that of T1. The mean corpuscular volume, mean corpuscular haemaglobin, and mean corpuscular haemaglobin concentration were not significantly (p>0.05) affected. In conclusion dietary inclusion of Saccharomyces cerevisiae had effect on the rabbits. Based on the results obtained 2g/kg of Saccharomyces cerevisiae is recommended.

Keywords: *Saccharomyces cerevisiae*, growth performance, haematological indices, rabbits.

Introduction

The increasing demand for animal protein in Nigeria has stimulated great interest in the rabbit as a fast growing animal with short generation interval (Aduku and Olukosi, 1990). It has also been reported that rabbit meat plays an important role in the prevention of vascular disease due to extremely low cholesterol and sodium levels (Aduku and Olukosi, 1990).

Low level of antibiotics has over the years been used in rabbit production as growth promoters and prophylactic agents against diseases (Falcão-E-Cunha *et al*., 2007). However, the unreasonable use of antibiotics as a growth additive has given rise to a fear of the development of resistant bacteria (Aarestrup *et al*., 1998) that may lead to the transfer of resistant bacteria and its resistant factors from animals to humans (Stanton, 2013). Hence, non-antibiotic alternatives like *Saccharomyces cerevisiae*, a probiotic are being used in rabbit feed to improve growth and production performance.

Inclusion of live yeast in animal feed has been shown to improve the digestibility, efficiency of feed utilization, and performance of animals (Martin *et al*., 1989). Blood parameters are major indices of physiological, pathological and nutritional status of livestock. Haematological components are of great diagnostic importance in monitoring feed toxicity, especially feed constituents that may affect the formation of blood. The study was designed to evaluate the effect of dietary inclusion of *Saccharomyces cerevisiae* on growth performance and haematological indices of weaner rabbits.

Materials and Methods

The study was carried out at the Rabbit unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. The study lasted ten weeks. Thirty two weaner rabbits were used for the study. The rabbits were weighed and randomly allocated into four (4) treatment

groups having eight (8) rabbits per treatment in a completely randomized design. Each treatment was replicated four (4) times with two (2) rabbits per replicate. Treatment 1 served as the control and did not contain any *Saccharomyces cerevisiae*, while treatments 2, 3, and 4, contained 1, 1.5, and 2 g/kg of basal diet. The weaner rabbits were fed with a formulated ration of 16% CP. The percentage composition of the formulated ration is shown in table 1. Clean water and feed were provided *ad libitum*. The rabbits were housed in individual cages.

The rabbits were weighed at the beginning of the experiment to determine their initial body weights. Body weights of the rabbits were measured on a weekly basis. Daily feed intake was obtained from the difference between the quantity of feed offered and that of the left over from the previous day divided by the number of rabbits per replicate. Feed conversion ratio (FCR) was then calculated as quantity (gram) of feed consumed per unit (gram) weight gained over the same period.

At the end of ten weeks of the experiment, four rabbits were randomly selected from each treatment. Five mls of blood was collected from the ear vein of each rabbit using a sterilized syringe and emptied into sterilized sample bottles containing the anti-coagulant Ethylene Diamine tetra acetic acid (EDTA) for laboratory analysis to determine hematological indices. The packed cell volume (PCV) was determined by the microhematocrit method (Thrall and Weiser, 2002). The haemoglobin concentration (HB) was determined by the cyanomethaemoglobin method (Higgins *et al*., 2008). The red blood cell (RBC) and the total white blood cell (WBC) counts were determined by the haemocytometer method (Thrall and Weiser, 2002). The mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated using the standard formula (Schalm *et al*., 1975).

Data collected were subjected to analysis of variance in a completely randomized design as described by Steel and Torrie (1980). Significant differences between treatment means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Table 1: The percentage composition of the formulated diet

	% composition			
Ingredients	T1 (control)	T2 (1 g/kg)	T3 (1.5 g/kg)	T4 (2 g/kg)
Maize	36.9	36.9	36.9	36.9
Wheat offal	27.9	27.9	27.9	27.9
Soybean meal	10.57	10.57	10.57	10.57
Palm kernel cake	8.10	8.10	8.10	8.10
Oyster shell	4	4	4	4
Bone meal	2	2	2	2
Brewers dry grain	10	10	10	10
Vitamin premise	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100

Results and Discussion

The effects of different levels of dietary inclusion of *Saccharomyces cerevisiae* on growth performance of weaner rabbits are shown in Table 2. Significant ($p<0.05$) differences existed in the average daily weight gain (ADWG), and average daily feed intake (ADFI) while there were no significant ($p>0.05$) differences among the treatments in initial body weight, and FCR. The study revealed significantly ($P < 0.05$) higher ADWG in the rabbits of treatment groups T2, T3 and T4 compared to the control group (T1). Rabbits in T2, T3 and T4 had similar ADWG. The ADFI of rabbits in T3 and T4 are similar but these were significantly ($p<0.05$) higher than those of T1 and T2. Lowest ADFI was recorded in T1.

Table 2: Growth performance of rabbits fed varying dietary levels of *Saccharomyces cerevisiae*

PARAMETERS	T1 (control)	T2 (1 g/kg)	T3 (1.5 g/kg)	T4 (2 g/kg)	Probability
Initial body weight(g)	661	674	682	701	0.85
Average. daily weight gain (g)	12.93 [b]	14.82[a]	15.10[a]	15.93[a]	0.04
Average. daily feed intake (g)	51.71[c]	60.01[b]	67.16[a]	68.19[a]	0.03
Feed conversion ratio	3.99	4.01	4.45	4.28	0.10

[abc]Means on the same row with different superscript are significantly different ($p<0.05$).

The result is in agreement with the findings of Onafide *et al* (1999) who observed higher feed intake and weight gain between *Saccharomyces cerevisiae* treatment groups and control group. The result of the present study is in conformity with Chang *et al*. (2001) who reported increased weight gain in *S. cerevisiae* supplemented group compared with control group. The improved weight gain in the present study could be attributed to enhanced feed consumption and absorption of nutrients due to addition of *S. cerevisieae* (Chiofalo *et al*., 2004).

The effects of different levels of dietary inclusion of *Saccharomyces cerevisiae* on haematology of weaner rabbits are shown in Table 3. Significant ($p<0.05$) differences existed in the HB, PCV, RBC and Total WBC count while there were no significant ($p>0.05$) differences among the treatments in MCHC, MCH and MCV. The HB of rabbits in T3 and T4 are similar but these were significantly ($p<0.05$) higher than those of T1 and T2. Lowest HB was recorded in T1. The PCV of rabbits in T3 and T4 are similar but these were significantly ($p<0.05$) higher than those of T1 and T2. The RBC of rabbits in T4 was significantly ($p<0.05$) higher than those of other treatment groups. Lowest RBC was recorded in rabbits in control group. The total WBC count of rabbits in T2, T3 and T4 were similar but these were significantly ($p<0.05$) higher than that of T1.

Table 3: Haematological indices of weaner rabbits fed varying dietary levels of *Saccharomyces cerevisiae*

PARAMETERS	**T1 (control)**	**T2 (1 g/kg)**	**T3 (1.5 g/kg)**	**T4 (2 g/kg)**	**Probability**
HB (g/dl)	10.13[c]	10.70[b]	11.60[a]	11.57[a]	0.03
MCHC(g/dl)	32.23	31.13	34.21	33.25	0.97
MCH(pg)	19.55	19.55	19.86	23.04	0.55
MCV(fl)	70.87	70.55	70.56	70.88	0.65
PCV (%)	34.67[b]	35.33[b]	37.33[a]	38.00[a]	0.02
RBC ($x10^6$/µl)	5.16 [c]	6.22 [b]	6.19 [b]	7.37 [a]	0.03
Total WBC count($x10^9$/L)	6.15 [b]	7.82 [a]	7.42 [a]	7.90 [a]	0.04

PCV= packed cell volume, MCV= mean cell volume, MCH= mean corpuscular haemoglobin MCHC= mean corpuscular haemoglobin concentration, HB= Haemoglobin concentration, RBC= Red blood cell count, WBC= White blood cell count

[abc]Means on the same row with different superscript are significantly different ($p<0.05$)

The increase in PCV and WBC are in agreement with the findings of Aathour *et al* (2002). The result also conforms to Onifade *et al* (1999) who observed that the RBC, WBC, and PCV of rabbits fed diet supplemented with *Saccharomyces cerevisiae* had a significantly ($p<0.05$) higher value than that of the control group. Increased WBC counts might be related to the production of more immune cells (and thus antibodies) that play an important role in defending the biological system against different diseases. However, the result obtained in this study is in contrast with Shehu *et al*. (2013) who reported that yeast inclusion in the diet of weaner rabbits did not affect HB, RBC and PCV.

Conclusion and Recommendation

In conclusion dietary inclusion of *Saccharomyces cerevisiae* had effect on the rabbits. Based on the results obtained in this study T4 (diet containing 2g of *Saccharomyces cerevisiae* /kg of the diet) was recommended as the most favourable diet.

REFERENCES

Aarestrup, F. M., Bager, F., Jensen, N. E., Madsen, M., Meyling A. and Wegener H. C. (1998). Surveillance of antimicrobial resistance in bacteria isolated from food animals to antimicrobial growth promoters and related therapeutic agents in Denmark. APMIS:106(6):606-22.

Aathour, N., Bouras, M., Tome, D., Marcos, A. and Lemonnier, D. (2002). Oral ingestion of lactic acid bacteria by rats increases lymphocyte proliferation and interferon production. *Br. J. Nutr.* 87 (4):367–373.

Aduku, A.O. and Olukosi, J.O. (1990) Rabbit Management in the tropics. Living book series. G. U. Publications, Abuja, Nigeria. pp 5-20.

Chang, Y.H., Kim, J.K., Kim, H.J., Kim, W.Y., Kim, Y.B. and Park, Y.H. (2001). Selection of a potential probiotic Lactobacillus strain and subsequent in-vivo studies. Antonne Van Leeuwenhoek.80:193-199.

Chiofalo, V., Liotta, L. and Chiofalo, B. (2004) Effects of the administration of lactobacilli on body growth and on the metabolic profile in growing Maltese goat kids. *Reprod. Nutr. Dev.* 44:449–457

Duncan, D.B (1955). Multiple Range and Multiple F-test, Biometrics, 11: 1-42

Falcão-E-Cunha, L., Castro-Solla, L., Maertens, L., Marounek, M., Pinheiro, V., Freire, J. and Mourão, J.L. (2007):Alternatives to antibiotic growth promoters in rabbit feeding: a review. *World Rabbit Sci*. 15 : 127-140

Higgins, T., Beutler, E. and Doumas, B. T. (2008). Measurement of haemoglobin in blood. . In: Schalm, O. W., Jain, N. C. and Carol, E. J. (1975). Veterinary Haematology. 3rd Edition, Lea and Febringer, Philadelphia, USA.

Martin, S.A., Nisbel, B.J. and Dean, R.F. (1989). Influence of a commercial yeast supplement on the in-vitro ruminal fermentation. *Nutr. Rep. Int.* 40:395–403

Onifade, A.A., Obiyan, R.I., Onipede E., Adejumo, D.O., Abu O.A.and Babatunde G.M. (1999). Assessment of the effects of supplementing rabbit diet with a culture of "Saccharomyces cerevisiae" using growth performance, blood composition and clinical enzyme activities. *Anim. Feed Sci. Technol.* 77: 25- 32.

Schalm, O. W., Jain, N.C and Carrol, E.J. (1975). Veterinary Haematology, 3rd Edn., Lea and Febiger, Philadelphia, pp. 197-199

Shehu, B. M., Ayo, J.O., Ayanwale, B.A., Ijaiya, A.T. and Uchendu, C. (2013). Haematological Profile Of weaner Rabbits Fed Diets Supplemented with Varying Levels of Baker's Yeast (*Saccharomyces cerevisiae*). *J. Anim. Prod. Res.* 25: 10-16.

Stanton,T.B. (2013). A call for antibiotic alternatives research. *Trends Microbiol.* 21 (3):111–113

Steel, R.G.D. and Torrie, J.H. (1980). *Principles and procedures of statistics*. McGraw-Hill Book Co. Inc. New York.

Thrall, M.A and Weiser, M.G. (2002). Haematology. In: Laboratory procedures for veterinary technicians Hendrix CM, editor. 4th Ed, Missouri: Mosby Inc, pp. 29–74.

GROWTH PERFORMANCE OF CROSSBRED LOCAL (INDIGENOUS) CHICKENS FROM HATCH TO MATURITY

Rabiu A. K/bai

Department of Agric Education, F.C.E., Katsina
Email; rabiukofarbai@gmail.com
(08061548455)
Engr. Abdul-azeez Yusuf
Department of Agric Education, F.C.E., Katsina
Email; babanlaila@gmail.com
(08024346075)

Abstract
Two popular strains of crossbred local chickens were used in the study for the purpose of establishing the fundamental growth information, from hatch to the age of sexual maturity at 22 weeks. A total of 200 birds comprised of equal number of males and females were used. Similar sigmoid growth curves and patterns were exhibited in their growth performance. A phase of accelerated growth observed reached a point of inflection (POI) at the ages of between 8 and 9 weeks. The POI coincides with the maximum growth rate which then starts to decline until maturity. Male birds were observed to be significantly superior to females from week 8 onwards, the superiority being most apparent between weeks 9 and 15 when significant differences in body weight gains were also observed. Two factorial designed was used, and ANOVA was the statistical tool.

Key words: crossbred**,** growth performance, local chicken, Point of inflection, popular strains,

Introduction

In poultry species, the phases of growth are generally characterized by an accelerating growth phase following hatch, a point of inflection (POI) coincide with maximum growth rate, a growth phase of declining rate, and a limiting mature weight which is approached asymptotically (Anthony *et`al* 1991). Within this general growth pattern, most of the differences in the shape of the growth curve among common poultry species such as the quail, chicken and turkey occurred between hatching and the POI (Anthony *et`al* 1991).

Engku azahan *et`al*. (2006) identified four phases of growth over a growth period of 16 weeks for the relatively slow-growing meat-type local (Village) chicken, based on body weight and feed conversion ratio. In breeding works, growth and growth rate would also provide useful information on the timing of selection studies (Mignon-Grasteau *et`al* 2000; Deeb and Lamont, 2002, Sengul and Kiraz, 2005). This study was carried out with the main objective of gathering fundamental growth information on the current strains of indigenous chicken, whilst concurrently evaluating differences between sexes.

Material and Methods

A total of 200 newly-hatched crossbred local chicks from two strains, Zaria in Kaduna and Wurno in Sokoto, were used in the study. Commercial feeds and water were provided ad libitum. Brooding heat was provided by kerosene stove for the first two weeks. The birds were weighted on day one for their initial weight; they are also weighted weekly until the age of 22 weeks when all pullets had laid at least an egg. This age was regarded as the age of sexual maturity for both male and female birds. Individual weekly body weight gains were calculated together with data on body weight. Two factorial designed was used, and ANOVA was the statistical tool.

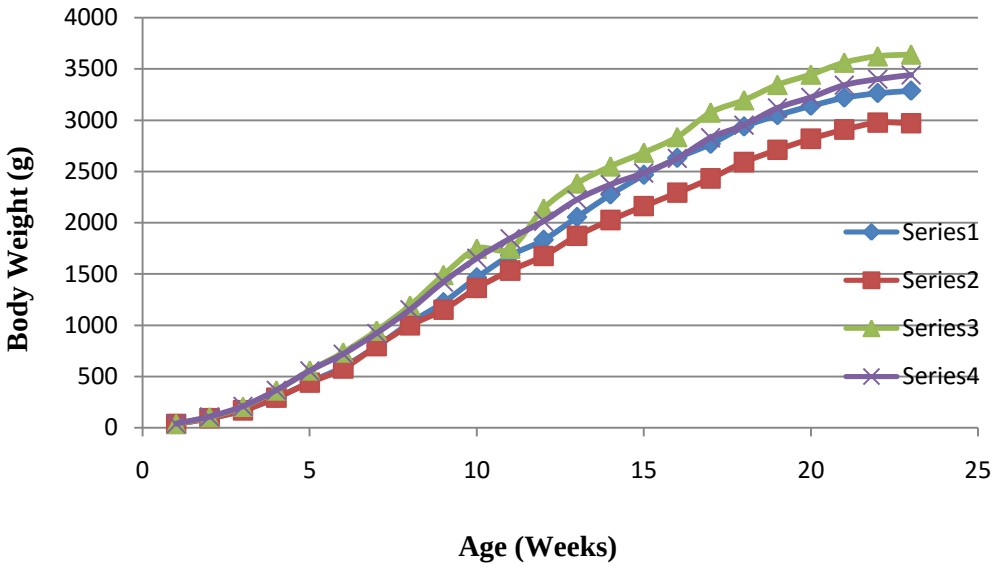


Figure 1. Growth curve of ِenous (local) chicken

Results and Discussion

In the research sigmoid curve of the growth pattern as described by Brody (1945) was observed for both strains of local chickens (Figure 1). After hatching, a period of accelerating growth was exhibited until the POI which was reached at between the 8th - 9th weeks, which coincide with the maximum growth rate. Growth rate was then seen to decline until all birds reached the age of sexual maturity at 22 weeks. The shape of the curves for the two local chicken strains was similar, although for different poultry species this could be markedly different (Knizetiva *et`al,* 1995). A difference in the shape of the growth curves was observed to be noticed mainly between hatching and POI (Tzeng and Becker 1981; Zelenka *et`al* 1986). The age of the POI was observed to be constant in both sexes of the chicken. In fast growing and early maturing poultry and chicken strains the POI may be reached at much younger ages. For chickens, turkeys, geese and ducks POI at ages of 21.1, 25.5, 47.7 and 74 days, respectively, have been reported (Knizetovo *et`al* 1995). For both strain and sex, a continuous increased in body weight were observed from day one until week 21-22. In the first seven weeks there was no any apparent superiority of one sex over the other but from eight weeks onwards, males were observed to be heavier ($p<0.05$) than females for both strains (Table 1). Similar reports of male superiority had been observed for Japanese native chicken breeds (Goto *et`al* 2010). This indicated the effect of sex-linked growth genes in chickens as similarly observed in geese (Knizetovo *et`al* 1994). Weekly growth rate increased gradually from week 1 until week 8, reaching peak at the 8th week for both strains. After the POI, growth rate was immediately observed to decline and was relatively stable from week 10 until the birds reached maturity age at 21-22 weeks. A common feature observed for the two strains was that from weeks 9-15, males gained significantly more than females except in week 11 when the difference was not significant.

Conclusion and Recommendations

Indigenous (local) chickens exhibited growth curves which were typically sigmoidal. The point of inflection coincides with maximum growth. In terms of body weight, males were significantly superior to females from week 8 onwards, the superiority being most apparent between week 9 and 15 when significant difference in body weight gain were also observed. It is recommended that more research to be conducted on the same breed and strain on their egg production performance.

Table 1: weekly body weight (g/bird) of two strain of indigenous chicken from hatch until sexual maturity (means ± std. error).

	Zaria strain		Wurno strain	
Age	Male	Female	Male	Female
Day-old	39.8± 0.2	40.2 ±0.2	40.1± 0.3	40.6± 0.2
Week1	94± 1	95±1	105±2	108±1
Week 2	171 ±3	172±3	207±3	210±2
Week 3	292 ± 7	296± 6	366±6	367±4
Week 4	448 ±11	442± 10	561±9	556±7
Week 5	595 ±13	579±13	736±11	720±9
Week 6	797±28	797±27	949 ±20	923±19
Week 7	1024±35	999±35	1194± 28	1152±26
Week 8	1224±26	1152±25*	1491±25	1422±20*
Week 9	1466±30	1364±29*	1748±31	1653 ±25*
Week 10	1682±35	1535±33*	1748±31	1846±29*
Week 11	1833±38	1677±36*	2140±41	2015±32*
Week 12	2055±43	1873±40*	2384±47	2225±37*
Week 13	2275±49	2027±43*	2550±53	2372 ±40*
Week 14	2466±53	2162±45*	2684±56	2486±43*
Week 15	2631±57	2293±48*	2836±60	2627±46*
Week 16	2768±60	2432±50*	3075±66	2829±48*
Week 17	2937±62	2592 ±51*	3195±67	2953±50*
Week 18	3048±64	2712±52*	3344±68	3119±50*
Week 19	3139±64	2819±54*	3445±67	3223 ±50*
Week 20	3219±65	2909±55*	3561±66	3342±49*
Week 21	3263±65	2976±55*	3623±65	3400±51*
Week 22	3286±67	2971±59*	3640 ±66	3441±55*

*within strain, differences between sexes were significant at $p<0.05$

References

Anthony, N.B, Emmerson, D.A Nestor, K.E, Bacon, W.L, Siegel, P.B and Dunnington, E.A. (1991). **Comparison of growth curves of weight selected populations of turkey, quail, and chickens**. *Poultry. Science. 70: 13 – 19.*

Brody, S. (1945). **Bioenergetics and growth**. Reinhold Publ. Corp., New York, USA. pp. 14 - 21

Deeb, N. and Lamont, S.J (2002). **Genetic architecture of growth and body composition in unique chicken population**. *Journal of Hereditary* . 93: 107 -118.

Engku Azahan, E.A., Marini, A.M and Noraziah, M. (2000). **Evaluation on the effects of sex on growth and carcass characteristics of broilers.** *Tropical Agriculture and Food Science*. 35 (2): 313 -318.

Engku Azahan, E.A, Noraziah, M. and Sarah, R. (2006). **Identification of growth phases of commercial Kampung (Village) chickens in Malaysia**. *Proceeding of. 2nd International Conference on Animal Nutrition. 2006* (ICAN). Pp. 191-192.

Goto, T., Goto, N., Shiraishi, J., Bungo, T. and Tsudzuki, M. 2010. **Comparison of growth curves of four breeds of Japanese native chicken**, Onage-Dori, Toa-Jidori, Ukokkei and Hinai-Dori. *Journal of Animal Vetrenary Advanment.* 9(9): 1362-1365.

Knizetova, H. Hyanek J. Hyankova, L. and Belicek, P. (1995). **Comparative study of growth curve in poultry.** *Genetic Selection and Evolution. 15:533- 558.*

Mignon-Grateau, S., Piles, M., Varona, L., Poivey, J.P., de Rochambeau, H., Blasco, A. and Beaumount, C., (2000). **Genetic analysis of growth curve parameters for male and female chickens resulting from selection on shape of growth curve**. *Journal of Animal Science. 78: 2515-2524.*

Sengul, T. and Kiraz, S. (2005). **Non-linear models of growth curve in Large white turkeys**, *Journal of Veterenary and Animal Science. 29: 331-337.*

Tzeng, R.Y. and W.A. Becker, W.A (1981). **Growth patterns of body and abdominal fat weight in male broiler chickens.** *Poultry. Science. 60: 1101-1106.*

Zelenka, D.,J, Dunningtomn, E.A and Siegel, P.B. (1986). **Growth to sexual maturity of dwarf and non dwarf white Rock Chickens divergently selected for Juvenile body weight**. *Applied Genetics, 73:61-65.*

RESPONSE OF BROILER CHICKENS TO DIETARY LEVELS OF MAIZE OFFAL

Rabo, S. T., Doma U. D and Bello K. M
Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi state, Nigeria
*Corresponding author's Email; esteerabo@yahoo.com

ABSTRACT

A study aimed at investigating the response of broiler chickens fed dietary levels of maize offal at both starter and finisher phase. Proximate analysis were conducted and the results reveal that maize offal contain ME - 3253.11 Kcal/kg, DM - 10.46, CP - 10.98, CF - 8.68, EE - 3.10, Ash - 3.19, and NFE-72.08%. Five diets were formulated in which maize replaced wheat offal at 0, 25, 50, 75 and 100% levels designated as T1, T2, T3, T4 and T5 respectively. Throughout the experimental period, birds were fed ad libitum. Two hundred and fifty day old Anak 2000 breed of broiler chickens were used for the experiment. The feeding trial indicated that birds fed diet 1 had a significantly (P>0.05) lower average daily weight (27.19g) than other treatments at the starter phase but no significant (P>0.05) difference were observed on daily feed intake, and feed conversion ratio. At the finisher phase, there was no statistical (P>0.05) difference on daily feed intake, daily weight gain and feed conversion ratio of the birds. The feed cost in naira per kg and feed cost per kg decreases with increased level of maize offal. Diet 5 recorded the least feed cost of N112.09/kg and the highest cost savings of N103.60. It can therefore be concluded that, maize offal can replace wheat offal in the diets of broiler chickens at 100% level without adverse effect on performance, with a notable reduction in feed cost by 32.4 %.

INTRODUCTION

An advanced knowledge of poultry nutrition is not, by itself alone, an assurance that the management of poultry will be profitable. However, a fair knowledge of poultry nutrition will definitely promote the efficiency of management operations and in fact, many cases of business failure can be traced to poor feeding of the birds (Oluyemi and Roberts, 2013). Poultry birds especially broilers plays a significant role in the provision of animal protein required by man to meet his daily protein intake (Maidala and Istifanus, 2012). Daily protein intake in Nigeria is 6.5 grams per capital per day (Marquist, 1985) Maximum production of mono-gastric animals like poultry, which does not require a long period of time to mature with minimum space can meet this requirement. High cost of conventional feed stuff most especially protein and energy sources has been one of the major challenges of intensive poultry production in developing countries like Nigeria (Ani, 2008). The purpose of the study was to assess the replacement value of maize offal for wheat offal.

MATERIALS AND METHODS

Site of study: This study was conducted at the Abubakar Tafawa Balewa university Poultry Teaching and Research Farm Bauchi, Bauch state. Nigeria.

Chemical Analysis

A sample of maize offal was analysed for proximate composition according to the methods of the Association of Official Analytical Chemists (AOAC,2004) for determination of
ME Kcal/kg, and percentage CP Ash, EE,CF and NFE. The result is on table 3..

Experimental Birds and Management

Two hundred and fifty day old Anak 2000 breed of broilers were used for the study. The chicks were brooded for 4 weeks and vaccinated against Gumboro and New castle diseases. At first week, the birds were fed with commercial diet. On the 8th day, the birds were randomly alloted into 5 dietary treatments described as treatments l, 2, 3, 4 and 5 (0, 25, 50, 75 and 100% maize offal respectively, consisting of 50 birds per treatment and each treatment had 3 replicates, consisting of 16 or 17 birds per replicate.. Throughout the experimental period, feed and water were provided ad libitum

Experimental Diets:

Five experimental diets were formulated, and maize offal replaced wheat offal at 0, 25, 50, 75 and 100% level called diets 1, 2. 3, 4 and5 respectively. The ingredients used for the experiment were locally procured. The composition of starter and finisher diets are presented on table 1 and 2.

Table 1 Ingredients and Calculated Analysis of Starter Diet (week 1-4)

Ingredients	**DIETS**				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%	T5 (100%)
Yellow Maize	48.3	47.9	47.47	47.07	46.63
Full fat soya bean	22.30	22.70	23.13	23.53	23.97
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Maize offal	0.00	2.50	5.00	7.50	10.00
Wheat offal	10.00	7.50	5.00	2.50	0.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25.	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	1000
Calculated Analysis					
Crude protein	23.00	23.00	23.00	23.00	23.00
ME (kcal/kg)	2987.56	3002.78	3017.96	4720.68	3048.35
Ether Extract	7.12	7.15	7.17	7.19	7.21
Crude fibre	3.60	2.74	3.80	3.89	4.00
Calcium	1.64	1.69	1.68	1.68	1.67
Phosphorus	0.61	0.78	0.61	0.60	0.59
Lysine	1.22	1.22	1.22	1.21	1.21
Methionine	0.40	0.40	0.39	0.40	0.40

Bio- organic broiler starter premix containing vitamin A- 10,000,000.00 mu, Vitamin D3- 2000,000.00 mu, Vitamin E-
20,000.00mg, Vitamin K3-2,000.00mg, Vitamin B1- 3000.mg, Vitamin B2- 5000.00 mg,Niacin-45,000.00 mg, Calcium paratotheunate-10,000.00 mg, Vit. B6- 4000.00 mg, Vit B12- 20.00 mg, Choline chlorate-300,000.00mg, Folic acid
1000.00mg,Biotiotin 50-.00mg Manganese;-300,000.00 mg, Iron- 120,000.00 mg, Zinc- 80,000.00 mg, Copper-8500.00, Iodine- 1500.00 mg, Cobalt-3000.00 mg, Selenium- 120.00 mg, Anti-oxidant-120,000 mg was added.

Table 2 Ingredients and Calculated Analysis of Finisher Diets (week 5-8)

	DIETS				
Ingredients	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%	T5 (100%)
Yellow maize	54.30	57.90	57.47	57.07	56.63
Full fat Soya bean	11.3	12.70	13.13	13.53	13.97
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Maize offal	0.00	2.50	5.00	7.50	10.00
Wheat offal	15.00	7.50	5.00	2.50	0.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated analysis					
Crude protein	20.00	20.00	20.00	20.00	20.00
ME (kcal/kg)	2830.48	3625.81	3031.02	3046.38	3061.55
Crude fibre	3.54	3.55	3.80	3.54	3.65
Ether extract	5.51	5.76	5.77	5.79	5.82
Calcium	1.67	1.65	1.66	1.65	1.68
Phosphorus	0.58	0.55	0.56	0.55	0.54
Lysine	0.99	1.02	0.97	0.96	0.95
Methionine	0.35	0.34	0.35	0.35	0.34

A bio-organic nutrient PREMIX containing Vit A -3600,000 iu, Vit.D3 - 600000 iu, Vit.E- 400 mg, Biotin – H- 2300 mg, Vit B1-640 mg, Vit. B2- 1600 mg, Vit k3-600mg, panthothenic acid – 2000mg, folic acid -200mg, Cholin chloride -70000 mg, Cobalt – 80mg, Cupper – 1200mg, Iodine – 400mg,Iron -800mg, Manganese – 1600mg, Solenium – 80mg, Zinc – 12000mg,Anti-oxidant 120000mg was added.

Data Collection

Data were collected on growth performance (Daily feed intake, Daily weight gain and Feed conversion ratio)

RESULTS

It was observed that birds fed died 5 had better performance than the control in terms of daily feed intake, daily weight gain and feed conversion ratio at both starter and finisher phase

Table 3; Proximate Composition of Maize Offal

Parameters	Values (%)
Dry matter	10.46
Crude Protein	12.98
Ether extract	3.10
Crude fibre	8.68
Ash	3.19
Nitrogen Free Extract	72.05
Metabolizable Energy (Kcal/kg0)	3253.11

Table 4. Performance of Broiler Chickens fed Dietary Levels of Maize Offal

	DIETS					
Parameters	1	2	3	4	5	SEM
Initial weight(g)	104.00	98.00	100.00	102.94	101.96	10.27^{NS}
Body weight at 4th week(g)	1116.91	1131.13	1153.55	1064.71	1119.73	3383.00^{NS}
Final weight (g)	2600.00	2510.00	2700.00	2880.00	2760.00	0.04^{NS}
Total weight gain (g)	2496.00	2412.00	2600.00	2777.06	2658.04	201.90^{NS}
Starters Phase (1 – 4 weeks)						
Daily feed intake (g)	57.01	56.98	58.04	56.04	55.12	5.59^{NS}
Daily weight gain (g)	27.19^{b}	37.50^{a}	36.66^{a}	35.86^{a}	35.57^{a}	14.08*
Feed conversion ratio	2.1-	1.52	1.59	1.56	1.55	0.11^{NS}
Mortality (Number)	0	0	1	0	1	-
Finisher Phase (5 – 8 weeks)						
Daily feed intake (g)	136.25	126.75	123.32	129.17	133.31	232.5^{NS}
Daily weight gain (g)	43.80	48.76	53.03	53.93	62.31	66.47^{NS}
Feed conversion Ration	3.11	2.60	2.33	2.39	2.14	0.21^{NS}
Mortality (Number)	1	1	3	2	-	-
Overall Performance (1 – 8 week)						
Daily Feed intake (g)	96.63	91.87	90.69	92.61	94.22	47.45^{NS}
Daily weight gain (g)	35.50	43.13	44.85	44.90	48.95	201.90^{NS}
Feed conversion ratio	2.72^{c}	1.98^{b}	1.96^{b}	2.06^{b}	1.85^{a}	0.06*
Mortality (Number)	1	1	4	3	1	-

SEM = Standard Error of Mean, NS = Not Significant, ^{abc} means bearing different superscripts within same row are statistically (P>0.05) different

Table 5; Cost benefit of using maize offal as replacement for wheat offal

Parameters	**DIETS**				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%	T5 (100%)
Total Feed intake (kg)	5.41	4.88	5.08	5.19	5.28
Feed Cost(₦/kg)	120.32	116.29	114.89	113.49	112.09
Total feed cost((₦)	636.00	567.50	583.64	589.01	591.84
Total weight gain (kg)	1.99	2.42	2.52	2.51	2.74
Feed cost/kg gain (₦)	319.60	234.50	231.60	234.67	216.00
Cost saving (₦)	0.00	85.10	88.00	84.93	103.60

CONCLUSION

Base on the results obtained in the experiment, the following conclusions were drawn:

The replacement of wheat offal for maize offal in broiler's diets improved feed utilization and did not in any way compromise performance, with a reduction in feed cost.

REFERENCES

Ani, A.O (2008). The feeding value of processing velvet beans for food. *Environment and Extension* 7 (2) 149- 155.

AOAC (1990) **Official method of the Association of Official Analytical Chemist**. 12th edition. Washington D.C. 125

Maidala, A. and Istifanus, J.A.(2012).The role of micro Livestock in Alleviating Protein Deficiency and Poultry Production in Nigeria. *Proceeding of 2nd Annual conference*, Azare.

Oluyemi, J.A. and Roberts, F.A (2013) Poultry Production in warm wet climate. Rev ed. Spectrum book limited Ibadan, Nigeria. 256.

GROWTH PERFORMANCE, ORGANS, CARCASS CHARACTERISTICS AND MEAT QUALITY OF BROILER FED BITTER LEAF (*Vernonia amygdalina*) AND CATMINT (*Nepeta racemosa*) LEAF MEAL SUPPLEMENTS

***Rafiu T. A., Sagoniyi O., Adewale A. A. and Raheem N. O.**
Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.
***corresponding Author:** tarafiu@lautech.edu.ng*

Abstract
A 49 days study was conducted to examine the impact of Bitter leaf (Vernonia amygdalina) and Catmint leaf (Nepeta racemosa) meal supplement on performance, organ, carcass characteristics and meat quality of broiler from day old. 150 day old unsexed Abor-Acer broiler chicks were randomly allotted into five dietary treatments using completely randomized design experiment (CRD). Each treatment was replicated thrice with 10 chicks per replicate. Five experimental diets were formulated such that Diet 1 contained neither bitter leaf nor catmint leaf meal, diet 2 contained 5g of catmint leaf meal per kg feed, Diet 3 contained 5g of Bitter leaf meal per kg of feed, Diet 4 contained 2.5g each of bitter leaf and catmint leaf meal per kg of feed while Diet 5 contained 5g each of both bitter leaf and catmint leaf meal per kg of feed. The result of performance characteristics showed significant differences (P<0.05) only at feed intake and feed conversion ratio. No significant difference (P>0.05) was observed on the carcass parameters except at the thigh proportion, while proventiculus, pancreas, spleen and liver were significant (P< 0.05) among the organs. The meat quality was significantly (P<0.05) decreased in term of Colour, Flavour, Juiciness, Tenderness and General acceptability, only bitter leaf compete well with the control. It could therefore be concluded from the study that Bitter leaf and its mixture with catmint leaf meals can be included as supplements in broiler diet up to 5g/1kg at both the starter and finisher phase.

Key words: Catmint, Bitter leaf, Supplement, Broiler

Introduction
Feed additives are ingredients added to poultry diets to enhance feed utilization, improve health, promote growth and reduce morbidity as well as mortality (FAC, 1998). Hence, feed additives are added to diets for reasons other than supply of nutrients to the animals. The economic benefit of plant based feed additive has been the lowering of production cost as a result of their availability in our natural ecosystem and their affordability. These plant materials with bioactive ingredients could be used in diverse forms. Recently, plant based feed additives also known as phytogenic have been advocated to be included in broiler feed as growth promoting feed additives since they do not have residual effects (Ndelekwute *et al*.,2015). Phytogenic can improve the consumption and conversion of feed, the digestibility and weight gain of broiler chickens (Cardoso *et al*., 2012). Bitter leaf (*Vernonia amygdalina*) is a shrub or small tree that grows throughout tropical Africa. It is popularly called bitter leaf because of its abundant bitter principle (Ekpo *et al*., 2007). Proximate composition of *Vernonia amygdalina* shows a chemical composition of 527.83 ME kal/kg, 86.40% DM, 21.50% CP, 13.10% CF, 6.80% EE, 11.05% Ash and the result composition of mineral indicate that *Varnonia amygdalina* has 3.85% Calcium, 0.40% Magnesium, 0.03% Phosphorus, 0.06% Iron, 0.33% potassium and 0.05% sodium (Owen 2011). Research has shown that *Varnonia amygdalina* has some beneficial effects in disease management of poultry, such as anti-coccidiosis, anti-bacteria and anti-parasitic (Dakpogan, 2006), also as an anti-oxidant (Erasto *et al*., 2017) and as a growth promoter by enhancing the gastro intestinal enzymes thus increasing feed conversion efficiency (Huffmum *et al*., 1996; Olobatoke and Oloniruha, 2009).
Catmint (*Nepeta racemosa*) contains about 150 species and is largely in the horticulture as ornamental plant. A short essential oil of catmint containing *Nepeta lactonces* is largely responsible for the plants biological activities including lived perennial herbaceous plant, is perhaps the best known species, long recognized as the plant that induces a state of euphoria and stupor in domesticated cats (Clapperton *et al*. 1994; Herron 2003). Catmint has many reported benefits as herbal supplements for both lives stock and man; some of these include treatment for anxiety, insomnia, Coccidiosis and antistress (Debborm *et al*., 2016). The two beneficial plants were therefore investigated to determine their potential as feed supplements and growth promoters in broiler production.

Materials and Method

The experiment was carried out at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria and lasted for 49 days. The catmint leaf (*Nepeta racemosa*) and bitter leaf (*Vernonia amygdalina*) were sourced from Ladoke Akintola University of Technology, Ogbomoso's farm. The leaves were rinsed with clean water in order to remove foreign materials, and were air dry on a drying slab for 7 days and slightly sundried for 30 minutes, then ground into meal. The meals were kept in air tight containers till commencement of the experiment. A total of one hundred and fifty (150) day old unsexed Abor-Acre broiler chicks were brooded for 10 days and randomly divided into 5 dietary treatments of three replicates per treatment in a completely randomized design. Each replicate had 10 chicks. The chicks were managed on deep litter pens for seven weeks by providing *ad-libitum*, fresh and clean water and weigh quantity of feed when necessary. All routine and occasional management practices were strictly adhered except medication activity that was ceased for those on supplements. The control diet (T1) contained no bitter leaf and catmint leaf meal while diets 2, 3, 4 and 5 (T2, T3, T4 and T5 respectively) contained bitter leaf and catmint leaf meals at 5g of catmint leaf meal (CLM) per kg feed, 5g bitter leaf meal (BLM) per kg feed, 2.5gBLM + 2.5g CLM per kg feed and 5gBLM + 5g CLM per kg feed. Data were collected at the end of every week. Daily feed consumption, body weight gain and feed conversion ratio were monitored. At the end of the experiment the birds were weighed and two birds per replicate were slaughtered for carcass evaluation. Data collected were subjected to analysis of variance (ANOVA) using the general linear model of SPSS, 2010.

Results and Discussion

The performance of experimental birds was presented in Table 1. There were significant difference ($P<0.05$) in mean values obtained from the total feed intake, the average daily feed intake and feed conversion ratio while other growth parameters were not significantly influenced ($P>0.05$) however, only T3 (5g/kg bitter leaf) had feed conversion ratio compare favorably well to control and was in agreement with the report of Tangka (2003). Mohammed and Zakariya'u (2012) used bitter leaf meal at varying levels ranging from 300g to 900g per 100kg from starter phase and reported no significant difference in live weight and the bitter leaf significantly reduced feed intake which was attributed to the high level of the bitter leaf which could have made the feed unpalatable. Similar weight gain at a reduced feed intake resulted to various better feed conversion ratio reported.

Table 1: Growth performance of Broiler Chicken fed with bitter leaf and catmint leaf meal Supplement

PARAMETERS	T1	T2	T3	T4	T5	SEM
Total Feed Intake (g)	4323.35^{b}	4348.83^{b}	4200.69^{ab}	4621.64^{b}	4476.19^{ab}	57.79
Average Weight Gain (g)	1705.03	1676.54	1687.07	1704.46	1615.96	32.44
Average Daily Feed Intake (g)	88.23^{b}	89.73^{b}	85.71^{ab}	94.31^{a}	91.35^{ab}	1.18
Average Daily Weight Gain (g)	36.28	35.67	34.47	36.27	34.38	0.69
Feed Conversion Ratio	2.43^{a}	2.51^{b}	2.48^{ab}	2.68^{b}	2.66^{b}	0.05

^{ab} means along the same row with different superscripts are significantly different ($P<0.05$)

T2; 5g of catmint/kg feed, T3; 5g of Bitter leaf/kg, T4; 2.5g/kg each catmint and bitter leaf, T5; 5g/kg each of catmint and bitter leaf.

Table 2 show the carcass characteristics of broiler chicken fed experimental diets supplemented with bitter leaf and catmint leaf meals. All parameters measured under carcass characteristics were not significantly ($P>0.05$) different except proportion of thigh. The proportion of primal cuts was numerically enhanced by the bitter leaf meal supplement (breast proportion). Combination of catmint and bitter leaf at 2.5g/kg of feed gave the best live weight. This is in line with the report that inclusion of bitter leaf in broiler diets leads to improvement in body weight, dressing percentage and carcass quality (Chiemela *et al*., 2015). The hypolipidaemic effect of bitter leaf that ensured the development of leaner meat, could be responsible for better conversion of feed nutrients to meat (Vivian *et al* 2015), as it was observed in the proportion of breast meat of this finding.

Table 2: Carcass characteristics of broiler chicken fed with Bitter leaf and Catmint Supplement

PARAMETERS	T1	T2	T3	T4	T5	SEM
Live weight	1816.33	1768.75	1857.75	1892.75	1748.00	32.43
Carcass weight	1393.00	1218.50	1326.75	1231.25	1167.33	26.20
Carcass (%)	76.52	68.89	71.42	70.34	66.78	0.61
Neck (%)	4.07	5.01	4.03	4.59	4.46	0.14
Wing (%)	13.25	12.93	12.75	12.49	12.82	0.22
Drum stick (%)	15.71	15.59	15.26	15.10	15.32	0.22
Breast (%)	30.51	29.85	31.18	30.96	30.84	0.62
Back (%)	18.42	20.16	19.66	20.82	20.38	0.24
Thigh (%)	18.53^{a}	17.19^{b}	17.12^{b}	16.01^{c}	16.42^{c}	0.24

[ab] means along the same row with different superscripts are significantly different (P<0.05)
T2; 5g of catmint/kg feed, T3; 5g of Bitter leaf/kg, T4; 2.5g/kg each catmint and bitter leaf, T5; 5g/kg each of catmint and bitter leaf.

Table 3 showed the organ parameters of birds fed with different supplements at varying levels. Significant differences (P<0.05) were recorded from mean proportions of Proventiculus, Spleen, Liver and Pancreas. Others (lungs, Hearth and gizzard) were not (P>0.05) significant. The variation or increase in their size recorded from organs, (especially liver at T2) obtained from treatments with supplements may be as a result of extra activities of the organ, like detoxification process to get read of excess phyto-chemical compounds inherent in the materials.

Table 3: Organ characteristics of broiler chicken fed with Bitter leaf and Catmint supplements.

Parameters	T1	T2	T3	T4	T5	SEM
Proventiculus(%)	0.482^{c}	0.767^{a}	0.583^{bc}	0.690^{ab}	0.591^{bc}	0.28
Gizzard (%)	3.089	3.785	3.093	3.428	3.386	0.116
Spleen (%)	0.103^{ab}	0.124^{a}	1.131^{a}	1.075^{b}	0.071	0.007
Liver (%)	2.937^{a}	3.069^{a}	2.767^{b}	2.932^{a}	2.534^{c}	0.118
Pancreas (%)	0.250^{bc}	0.296^{b}	0.226^{c}	0.383^{a}	0.271^{bc}	0.013
Kidney (%)	0.432	0.434	0.408	0.415	0.371	0.026
Lung (%)	0.535	0.522	0.511	0.537	0.491	0.02
Heart (%)	0.432	0.453	0.462	0.483	0.423	0.012

[abc] means within row having different superscripts are significant different (P<0.05)
T2; 5g of catmint/kg feed, T3; 5g of Bitter leaf/kg, T4; 2.5g/kg each catmint and bitter leaf, T5; 5g/kg each of catmint and bitter leaf.

Colour, Flavour, juiciness, Tenderness and General acceptable were significant (P< 0.05). The two additives did not support meat quality and only T3 was less affected and similar (P<0.05) to the control in term of meat colour, tenderness and general acceptability. Meat quality was significantly (P<0.05) affected by feed supplementation with catmint and bitter leaf meals (Table 4). All birds placed on catmint (either only or together with bitter leaf) were more affected in term of meat quality measured. Among those fed with supplements, only 5g/kg of feed, bitter leaf had similar quality with the control, indicating that these leaf supplements had negative impact on the organoleptic properties of chicken meat.

Table 4: Meat Quality of broiler chicken fed with Bitter leaf and Catmint supplements.

Parameters	T1	T2	T3	T4	T5	SEM
Colour	7.20^{a}	4.60^{c}	7.20^{a}	5.90^{b}	5.50^{bc}	0.177
Flavour	7.30^{a}	5.10^{b}	6.00^{b}	5.20^{b}	5.00^{b}	0.190
Juiciness	6.50^{a}	6.00^{ab}	6.50^{a}	6.10^{ab}	5.20^{b}	0.159
Tenderness	6.10^{ab}	5.30^{b}	6.50^{a}	6.70^{a}	5.60^{ab}	0.171
General acceptable	7.50^{a}	6.00^{bc}	6.70^{ab}	6.30^{bc}	5.20^{c}	0.193

[abc] means along the same row with different superscripts are significant different (P<0.05)
T2; 5g of catmint/kg feed, T3; 5g of Bitter leaf/kg, T4; 2.5g/kg each catmint and bitter leaf, T5; 5g/kg each of catmint and bitter leaf.

Conclusion and Recommendation

The result of this study has shown that catmint leaf and bitter leaf meal could be used to substitute antibiotics. However, catmint and bitter leaf meal supplement only numerically enhance(s) the growth rate of birds and can be utilized as natural growth promoters because of its non-residual effects. Addition of 5g/kg of bitter leaf meal to diets of broilers positively influenced growth and feed intake,

improve the carcass, organs and meat quality of broiler chicken. However, higher utilization level of Catmint leaf meal and Bitter leaf meal supplements above 5g/kg can be investigated in the broiler diet. This will help establish their potentials in reducing the production cost with normal medication potential.

REFERENCES

Cardoso, V.D., Lima, C.A.R., Lima, M.E.F., Dorneles, L.E.G and Danelli, M.G.M. (2012). Piperine as a phytogenic additive in broiler diets. *Pesq. Agropec. Bras. Brasilia*, 47 (4)489-496.

Chiemela, P. N., Nwakpu, E. P., Oyegu, C. E. and Obi, C. L. (2015). Effect of *Vernonia amygdalina* (Bitter leaf) extract on growth performance, carcass quality and economics of production of broiler chicken. *International Journal of Agriculture and Earth Science,* vol, No 5: 1-14.

Clapperton, B.K., C.T. Eason, R.J. Weston., A.D Woolhouse, and D. Morgan. (1994). Development and testing of attractants for feral cats, felis-catus L. *Wildlife Res.* 21(4): 389-399.

Dakpogan,H.B. (2006) Free range chicks survivability in improved conditions and effects of 3 medicinal plants on eimeria tenella.M.SC thesis, *department of veterinary Pathobiology,the Royal Veterinary and Agricultural University, Denmark*.

Ekpo, A., Eseyin, O.A. Ikpeme, A. O. and Edoho, E.J. (2007). Studies on some Biochemical effects on *Vernonia amygdalina* in Rats. *Asia Journal of Biochemistry*; 2 (3): 193-197

Erasto, P., Grierson, D.S. and Afolayan, A.J. (2007) Evaluation of anitoxidant activity and the fatty acid profile of the leaves of *Vernonia amygdalina* growing in south Africa. *Food Chem*; 104: 636-642.

FAC (1998) Feed Additive Compendium Miler Publishing Co, USA, 56P.

Herron, S.(2003). catnip, Nepeta cataria, a morphological comparison of mutant and wild type specimens to gain an ethnobotanical perspective. *Econ. Bot* 57(1):135-142

Huffmam, M.A., Koshimizu, K. and Ohigashi, H. (1996). Ethobotany and Zoopharmacognosy *Vernonia amygdalina*, A medicinal plant used by Humans and chimpanzees in the wild. In composite: Biology and utilization, caligari P.D.S and D.J.N. Hind (Eds). *The Royal Bot. Garden, kew*; 351-360

Mohammed, A.A and Zakariya'u A.S. (2012). Bitter leaf (*Vernonia amygdadlina*) as a feed additive in broiler diet. *Research journal of Animal Science*. 6(3): 38-41.

Ndelekwute, E.K., Enyenihi, G.E., Assan, E.D., Ufot, U and out, O. (2015). Lime (*Citrus aurantifelia*) juice a natural source of organic acids can improve the growth of broiler chickens. Avances in Animal Biosciences, science with impact. *Proc. of the British society of Animal science*, 14-15 April, 2015, Chester, UK. 220p.

Olobatoke R.Y. and Oloniruha J.A. (2009). Hematological assessment of bitter leaf (*Vernonia* amygdalina) efficiency in reducing infection in cockerels. Africa Journal of Traditional, Complementary and alternative medicines. Abstracts of the world congress on medicinal .

Owen, O.J, (2011). Proximate composition energy content and mineral profile of *Vernonia amygdalina* (Bitter leaf) meal, *Advance in food and Energy Security*; 1:36-39.

Tangka, J.K (2003). Analysis of the thermal energy requirements for extraction of leaf protein concentrate of some green plants. *Biosystem Engineering*. 86:473-479.

Vivian, U.O., Harriet, M.N., Solomon, O.O. Joseph, O.U. (2015). Evaluation of growth performance, Haematological and Serum Biochemical Response of Broiler Chickens to Aqueous Extract of Ginger and Garlic. *Journal of Agricultural Science Vol 7, (4): 263 – 270.*

EVALUATION OF VARYING LEVELS OF SUNDRIED CASSAVA STARCH EXTRACT PULP ON SERUM ENZYMES OF BROILER STARTER

Raji, M.O., Akinosun, A.A., and Mosobalaje, M.A
Department of Animal Health and Production Technology, Oyo State College of Agriculture and Technology, PMB 10, Igboora
Correspondence Author: papat4u@gmail.com 08052433781 and 07087089847

A feeding trial was conducted for four (4) weeks to evaluate the effect of feeding varying levels of sun dried cassava starch extract pulp on serum enzymes of broiler starter. It was carried out at Teaching and Research Farm, Oyo State College of Agriculture and Technology Igbo-ora, Nigeria. Two hundred (200) day-old cobs 500 were randomly allocated to five dietary treatments designated as (T1 (0%), T2 (10%), T3 (20%), T4 (30%), and T5 (40% respectively) of 40 birds each, replicated four (4) times with 10 birds per replicate in a completely randomized design (CRD). At three weeks of feeding trials, 3 ml blood was collected per replicate into plane bottle and transferred to the laboratory for assay, thereafter, it was subjected to statistics analysis. The result obtained showed that there were no significant differences (P>0.05) in Aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alanine phosphate (ALP). AST ranged between 175.67 to 189.33U/l, ALT ranged between 19.00 to 26.00 U/l while ALP gave values between 199.00 to 290.33U/l. Conclusively, Sun dried cassava starch pulp can be included to replace maize as source of energy in broiler diets without affecting serum enzyme of broiler. Base on outcome of this study, s Sun dried cassava starch pulp can be recommended to replaced maize up to 40% inclusion levels in the broiler diets and higher level of inclusion of sun dried cassava starch pulp above 40% can be carried out to ensure at what maximum level it can be included in broiler diets.

Keywords: Broiler, cassava starch pulp, serum enzymes, energy and inclusion

Introduction

As cassava starch production increases, a large volume of waste by-product like cassava starch pulp is also generated. Cassava starch pulp is the solid, moist by-product of cassava starch manufacture and comprises approximately 10-15% of the original root weight. The pulp is reported to contain between 1.7-2.8%, 1.6-2.0%, 13.6-27.8 and 0.1% ash, crude protein, crude fibre and ether extract respectively (Khempaka *et al*., 2014). The fibre of CP exists mainly as insoluble fibre. Suksombat *et al*. (2007) reported 36.7% neutral detergent fibre, 9.8% acid detergent fibre and 3.9% acid detergent lignin in CP. Kosoom *et al*. (2009) The high starch content of cassava pulp would make it a useful alternative energy source for poultry feedstuff. It's extremely low protein, bulkiness, dustiness and high fiber content may be the main factors that currently limit its use in poultry feed. Khempaka *et al*. (2009) reported that although dried cassava pulp can constitute up to 80 g/kg of broiler diets, the higher levels result in decreased growth performance and nutrient digestibility. Therefore, the objective of this study is directed toward investigating effect of varying levels of sun dried cassava starch extract pulp on serum enzyme of broiler starter.

Materials and methods

The experiment was carried out at the poultry unit, Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora, Oyo State Nigeria, latitude $7^{o}15`N$ and longitude $3^{o}30`E$ with average annual rainfall of 1278mm and average temperature of $27^{o}C$ (Sanusi, 2011). The fresh cassava starch pulp was procured from Saltry starch processin industry, along Iseyin-Maya road, Oyo State. It was sundried on polythene nylon for 5 days and then taken to the laboratory for laboratory assay. The chemical composition of sundried cassava starch extract pulp was determined in the laboratory by using (AOAC, 2010) method. The metabolizable energy was calculated as described by Puazenga (1985), (37 x CP) + (81.8 x CF) + (35.5 x NFE). Nitrogen free extract (NFE) was calculated using the following formula; 100 – (CP – CF – Fat – Ash - MC). CP= Crude protein; CF= Crude fibre; NFE= Nitrogen free extract; MC = Moisture content.

Experimental diets

The birds were given formulated feed from day 1-8 before experimental diets. Thereafter, five diets were formulated having percentage crude protein that ranged between 20.70% - 22.15% with energy ranged between 2893.35ME kcal/kg – 2979.30ME kcal/kg. Maize was the main energy source for the control diet while the other four dietary treatments 2, 3, 4 and 5 was substituted with sundried cassava starch extract pulp at 10%, 20%, 30% and 40% nutrient to nutrient inclusion rates respectively.

Experimental birds and management

The 200 birds were randomly allocated to five dietary treatments, 40 birds per treatment consisting of 4 replicates with 10 birds each in a completely randomized design (CRD). The birds were fed *ad-libitum.* The dietary treatment was at inclusion levels of 0%, 10%, 20%, 30%, and 40% inclusion rate and designated as T1, T2, T3, T4 and T5 respectively. T1 was the controlled diet while the T2, T3, T4 and T5 were maize and sundried cassava starch extract pulp diet.

Statistical analysis

Data collected were subjected to analysis of variance (SPSS, 2012). Means were separated by using Duncan multiple range test of the same software

Table 1: Percentage composition of broiler starter (day 7-5 weeks)

Ingredients (kg)	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)
Maize	51.00	45.90	40.80	35.70	30.60
SDCSP	0.00	5.10	10.20	15.30	20.40
Soybean meal	35.00	35.00	35.00	35.00	35.00
Maize bran	10.00	10.00	10.00	10.00	10.00
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Premix (B)	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	2.00	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Energy ME (kcal/kg)	2979.30	2933.09	2919.85	2906.60	2893.35
Crude protein (%)	22.15	21.70	21.37	21.03	20.70
Ether extract (%)	3.43	3.23	3.03	2.83	2.62
Crude fibre (%)	1.53	1.63	1.73	1.83	1.93
Calcium (%)	1.12	1.12	1.10	1.08	1.06
Phosphorus (%)	0.62	0.62	0.62	0.62	0.62
Ash (%)	0.59	0.67	0.61	0.54	0.48
Lysine (%)	1.38	1.33	1.32	1.31	1.29
Methionine (%)	0.63	0.55	0.54	0.53	0.52

SDCSP : sundried cassava starch extract pulp

Result: The results were on Table 3. There were no significant differences (P>0.05) in Aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alanine phosphate (ALP). AST ranged between 175.67 to 189.33U/l with least value of 175.33 in treatment five (40SDCSP %) while highest value was obtained in treatment four (30SDCSP%). ALT ranged between 19.00 to 26.00 U/l with least value of 19.00 from treatment five (40% SDCSP) while highest value of 26.00U/l was obtained from treatment four (30% SDCSP). ALP gave values between 199.00 to 290.33U/l, least value (199.00) of ALP was obtained in the treatment five (40% SDCSP) while highest value of 290.44U/l was recorded from treatment three (20% SDCSP).

Table 3: Serum enzyme of broiler starter fed dried cassava starch pulp (0-5 weeks)

Parameters	TI (0%)	T2 (10%)	T3 (20%)	T 4 (30%)	T5 (40%)	SEM
AST (U/l)	176.33	187.00	182.33	189.33	175.67	0.33
ALT (U/l)	21.67	24.67	21.33	26.00	19.00	0.00
ALP (U/l)	247.33	264.67	290.33	230.00	199.00	13.65

a,b,c mean with different superscript in a row are significantly different (P<0.05)

AST= Aspartate aminotransferase ALT= alanine aminotransferase ALP= alanine phosphate

Discussion: AST, ALT and ALP were analyzed to determine the toxicology of liver. The values found in this study were within the normal value reported by Coles, 2007. Thrall *et al*,. 2004 reported that an activity of AST greater than 800U/l indicated an sign of severe liver damage The normal range of AST, ALT and ALP in most birds is between 52 – 270 and 65 – 263 U/l respectively (Coles, 2007). These values can vary considerably according to animal species, sex, age and the environment (Coles, 2007). No significant differences among treatment found in this study and the values were in the normal range for poultry ALT is a more specific criterion of liver disorder than AST since the liver is the main tissue (King, 1965). Therefore, this suggests that sundried cassava starch pulp can be used in broiler diets without causing toxicity.

Conclusion: Conclusively, Sun dried cassava starch pulp can be included to replace maize as source of energy in broiler diets without affecting serum enzyme of broiler.

Recommendation: Sun dried cassava starch pulp can be used up to 40% inclusion levels in the broiler diets to replace maize as energy source.

Higher level of inclusion of sun dried cassava starch pulp above 40% can be carried out to ensure at what maximum level it can be included in broiler diets.

References

A.O.A.C. 2010. Association of Official Analytical Chemists. Official Methods of Analysis
Coles, B.H. 2007. Essential of avian medicine and surgery. Blackwell publication, Oxford.

Khempaka S, Molee W and Guillaume M. 2009. Dried cassava pulp as an alternative feedstuff for broilers: effect on growth performance, carcass traits, digestive organs, and nutrient digestibility. *Journal of Applied Poultry Research*, 18: 487-493.

Khempaka, S., R. Thongkratok, S. Okrathok and W. Molee, 2014. An evaluation of cassava pulp feedstuff fermented with *A. oryzae*, on growth performance, nutrient digestibility and carcass quality of broilers. J. Poult. Sci., 51: 71-79.

King, J. 1965. Practical clinical enzymology. Publication Van Nostrand, D. Company, Limited Canadan.

Pauzenga, U. 1985. Feeding parent stock. *Journal of Zootecnica Technology International*. Pp 22-24.

Statistical Package for Social Students (SSPS). 21.0 Version© 2012.

Suksombat, W., P. Lounglawan and P. Noosen, 2007. Energy and protein evaluation of five feedstuffs used in diet in which cassava pulp as main energy source for lactating dairy cows. Suranaree J. Sci.

HAEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF BROILER FINISHER FED GRADED LEVELS OF MAGGOT MEAL

S. U. Ilo[1], Ogbu, O. C.[2]
[1]Department of Animal Science, University of Nigeria Nsukka Enugu State
Department of Agricultural Technology, Federal Polytechnic Oko Anambra state, Nigeria.
Corresponding author: S. U. Ilo; E-mail: stanley.ilo@unn.edu.ng; Tel: 07036885828

Abstract
A 56-day study was carried out to determine the haematological and biochemical characteristics of one hundred and twenty (120) broilers finisher fed varying levels of maggot meal (MM). The experiment was carried out in a completely randomized design (CRD) in which the birds were randomly grouped into four treatments and further replicated three times with ten birds per replicate. Four finisher broiler diets were compounded, incorporating (MM) at 0%, 50%, 75% and 100% respectively. The diets were designated T_1, T_2, T_3 and T_4, respectively, T_1 served as the control (with no MM). The birds were given feed and water ad-libtum and were subjected to similar sanitary and husbandry conditions throughout the experimental period. Data were collected for haematological and biochemical analysis. Statistics result revealed that only red blood cell (RBC), mean corpuscular haemoglobin concentration (MCHC), albumin, urea, aspartate aminotransferase (AST) and creatinine showed significant ($P<0.05$) differences, while others showed non-significant ($P>0.05$) differences. Result indicates that maggot meal can completely replace fish meal as a protein source as the birds are physiologically stable.

Keywords*:* Haematological, Biochemical, Maggot Meal and Broilers

Introduction

Nigeria is abundantly blessed with different varieties of animal protein sources yet there is the challenge of insufficient production and supply of animal protein to the fact that daily consumption is less than 10g against minimum requirement. FAO (2006) gave a daily protein requirement of an average adult as 65g/caput/day, of which 35g is expected to be of animal origin. Egbewande (2010) reported that in Nigeria, the available protein is given at 45g/caput/day with animal protein accounting for 8g/caput/day, representing a short fall of about 77% in animal protein recommended by FAO (2006). To bridge the gap, poultry production in general and broiler particularly is a sure way. Broilers have a fast growth rate, better feed conversion ratio; rapid return on investment, the meat contains more protein and essential amino acids than other meats and low in cholesterol content. Feeding alone accounts for 60-70% of the total production cost in modern poultry production systems (Wilson and Beyer, 2000).Conventional energy and protein sources used are heavily competed for, by other livestock, humans, and industries thereby leading to their high prices and minimal returns. Competition for conventional protein sources has prompted researchers to embark on research for alternatives like MM that are cheaply available and comparable to FM. The crude protein content of maggots is high (39-63%) (Aniebo and Owen, 2010) and akin to that of fish meal (Veldkamp *et al*., 2012). Both haematological and biochemical analyses of blood is of great importance in assessing the nutritional effect of feedstuffs on the animals. They serve as diagnostic tools and physiological indicators in birds has been documented (Harr, 2002; Hauptmanova *et al*., 2006). However, these parameters are greatly affected by sex, age and season (Fudge, 2000; Kececi and Col, 2011).This study, therefore, was designed to investigate the haematology and biochemical characteristics of broiler finisher fed different levels of maggot meal.

Materials and Methods

The research was carried out at the poultry project site of the Federal College of Agriculture, Ishiagu Ebonyi State. The maggot used for this experiment was cultured from fresh chicken manure. After about 5 days, larvas of maggots were produced. They were harvested, oven dried at 55^0C for one day and were grinded into maggot meal and were incorporated at different inclusion levels in the diets of broilers. One hundred and twenty (120) day old chicks were used for the experiment. They were randomly allocated into four treatment diets with thirty birds each and were replicated three times with 10 birds per replicate in a Completely Randomized Design (CRD). Four levels of diets were formulated 0%, 50%, 75% and 100% representing T_1, T_2, T_3 and T_4 respectively.

Blood Collection for Hematological and Biochemical Analysis.

At the end of the feeding trial, about 5mls of blood sample was collected for the analysis. The blood samples were taken from the wing vein of the bird using disposable needle and syringe. Blood samples were collected from two (2) birds per replicate ie six birds per treatment. For haematological analysis, about 2mls used for analysis was stored in a bottle containing anticoagulant, ethylene diamine tetra acetic acid (EDTA) to prevent clotting and subsequently analyzed to determine RBC, white blood cell(WBC), packed cell volume(PCV), haemoglobin(Hb), mean corpuscular volume(MCV) and MCHC. For serum biochemical analysis, about 3mls was used. It was store without anticoagulant, after coagulation it was separated and the harvested sera were used to determine the following parameters urea, total protein, albumin, AST, alanine aminotransferase (ALT) and creatinine.

Data Collection and Analysis

Data collected for haematological and biochemical parameters were analyzed using analysis of variance (ANOVA) as described by Steel and Torrie (1980) and differences among means were separated using least significant differences (LSD).

Statistical Model

The statistical model for CRD is shown below

Yij = μ□ + ti + eij□

μ□ = overall mean effect

ti = true effect of the ith treatment

eij = error term of the jth unit receiving ith treatment

Table 1: Composition of Experimental Diet

Ingredients	T_1 (0%)	T_2 (50%)	T_3 (75%)	T_4 (100%)
Maize	60.40	60.40	60.40	60.40
Maize offal	13.00	13.00	13.00	13.00
Fish meal	6.00	3.00	1.50	0.00
Maggot Meal	0.00	3.00	4.50	6.00
Blood meal	2.00	2.00	2.00	2.00
Soya bean meal	16.30	16.30	16.30	16.30
Bone meal	1.00	1.00	1.00	1.00
Limestone	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Vit/min premix	0.25	0.25	0.25	0.25
Total	100	100	100	100

Results and Discussion

Table 2: Haematological Parameters of Broiler Finisher Fed Different Levels of Maggot Meal

Parameters	T_1 (0%)	T_2 (50%)	T_3 (75%)	T_4 (100%)	SEM
Hb (g/dl)	8.16	7.80	10.77	11.50	9.17
PCV (%)	24.50	23.40	32.33	34.50	6.92
WBC ($x10^3$mm)	6.93	7.27	7.87	6.67	0.69
RBC ($x10^6$μl)	3.20^a	3.20^a	2.90^c	3.10^b	0.32
MCV (fl)	76.67	72.00	111.33	111.00	27.10
MCHC (g/dl)	32.90^b	33.10^a	32.70^{cd}	32.83^c	0.61

Table 2 showed the haematological characteristics of broiler finisher fed different levels of maggot meal. MCHC and RBC showed significant differences ($p<0.05$), while Hb, PVC, WBC and MCV showed non-significant differences ($p>0.05$). The effect of diet on haematological parameters of broilers as reported in Table 2 showed that treatment groups had significantly higher values at 75% and 100% inclusion of maggot meal for Hb, PCV and MCV. Furthermore, the RBC result showed that

birds fed control diet (T_1) and 50% (T_2) had significantly ($p<0.05$) higher values than others. MCHC result showed that birds on 50% (T_2) had significantly ($p<0.05$) higher values when compared to other treatments. Furthermore, all the values obtained for the haematological parameters in this study were within their normal range (Bounous and Stedman 2000) except for WBC values that falls slightly below the normal range (12-30 x 10^3µl). The WBC values reported is at variance with that (53.25-56.00 10^3L) of Mahmud *et al.* (2016).

Table 3: Biochemical Characteristics of Broiler Finisher Fed Different Levels of Maggot Meal

Parameters	T_1 (0%)	T_2 (50%)	T_3 (75%)	T_4 (100%)	SEM
Total protein (mg/dl)	3.73	2.80	3.40	3.13	0.52
Albumin (mg/dl)	1.57^a	1.30^c	1.43^b	1.43^b	0.16
AST (Iu/l)	297.00^a	286.00^b	275.67^c	211.67^d	75.35
ALT (Iu/l)	47.00	24.33	16.67	20.33	18.08
Urea (mg/l)	2.90^a	2.57^c	2.03^{cd}	2.80^b	3.68
Creatinine (mg/dl)	1.03^c	1.07^b	1.07^b	1.13^a	0.30

Table 3 showed the biochemical characteristics of broiler finisher fed different levels of maggot meal. Albumin, AST, urea and creatinine showed significant differences ($p<0.05$), while other parameters total protein, globulin and ALT showed non-significant differences ($p>0.05$). Albumin, AST and urea results showed that birds on control diet T_1hadhighly significant values ($p<0.05$) than others. The highest value (3.73g/dl) of total serum protein was observed in T_1 (0%) inclusion of MM, while the least value (2.80g/dl) was obtained in T2 (50%) inclusion. Serum protein values fluctuate across the treatments. Albumin, AST and urea values differed significantly ($P<0.05$) higher among the treatments. Albumin, AST and urea highest values (1.57g/dl, 297.00 Iµ/l and 2.90 mg/l) observed in T_1 (0%) inclusion of MM while the least values were obtained in T_2, T_4 and T_3 respectively. Creatinine differed significantly higher ($P<0.05$) among treatment groups. Furthermore, the highest value (1.13mg/dl) was observed in T_4 (100%) inclusion of MM, while T_1 (0%/ control diet) had the least value. The result followed an increasing trend as the level of MM increases. The result agrees with the findings of Ayorinde *et al.* (2017) that reported (0.89-1.56 mg/dl). Values of both haematological and biochemical parameters obtained in this study were within the normal range. Graded levels of maggot meal did not have deleterious effect on the health of the birds. Maggot meal can completely replace fish meal as the physiological profiles of the birds are stable.

REFERENCES

Aniebo, A. O. and Owen, O. J. (2010).Effects of age and method of drying on the proximate composition of housefly larvae (*Musca domestica)* meal (HFLM).*Pakistan Journal of Nutrition,* 9 (5): 485-487.

Ayorinde, D. A., Olusegun, M. O. I., Abimbola, O O., Olajide, M. S., and Oladapo, O. O. (2017).Haematological and serum biochemical parameters of broiler chickens fed varying dietary levels of fermented castor oil seed meal (*Ricinus communis*L.) and different methionine sources in South Western Nigeria. *Journal of Poultry Research* 14(1): 5-12.

Bounous D and Stedman N. (2000). Normal avian hematology: chicken and turkey. In: Feldman BF, Zinkl, J.G. and Jain, N.C. editors. Schalm's Veterinary hematology. New York: Wiley;. p.1147-1154.

Egbewande, O. O. (2010) A Survey on Consumption of Meat and Meat Products in Niger State, Nigeria.*Nig. J.Anim. Sci.* Vol.12, Pp. 175-183.

FAO (2006).Food and Agricultural Organization of the United Nations.Bulletin of Statistics, 2 (2); 2006.

Fudge, A.M., (2000). Laboratory Medicine: Avian and Exotic Pets. W.B. Saunders Company, Philadelphia.

Harr, K.E. (2002). Clinical chemistry of companion avian species: A review. *Vet. Clin. Pathol.*, 31: 140-151.

Hauptmanova, K., Maly, M. and Literak, I. (2006). Changes of haematological parameters in common pheasant throughout the year. *Vet. Med.*, 51: 29-34.

Kececi, T. and Col, R. (2011). Haematological and biochemical values of the blood of pheasants (*Phasianus colchicus*) of different ages. Turk. *J. Vet. Anim*. Sci., 35: 149-156.

Mahmud, M., Maidala, A., Dantata, I. .J., and Turaki, H. (2016).Blood profile and serum biochemical parameters of broiler chickens fed three local sorghum varieties grown in Bauchi State. *International Journal of Chemistry and Chemical Processes* Vol. 2 No.1 ISSN 2545-5265.

Steel, R. G. and Torrie, J. H. (1980).Principles and Procedures of Statistics. A biometric Approach.2nd Edn. McGraw-Hill Brook Co.

Veldkamp, T., van Duinkerken, G., van Huis, A., Lakemond, C., Ottevanger, M. M., Bosch, E. G. and Van Boekel, M. A. J. S. (2012). Insects as a sustainable feed ingredient in pig and poultry diets-a feasibility study. Wageningen UR Livestock Research and Central Veterinary Institute of Wageningen UR (University and Research Centre).Wageningen.

Wilson, K. J. and Beyer, R. S. (2000).Poultry Nutrition Information for the Small Flock. Kansas State University Agricultural Experiment Station and Cooperative Extension Service.http://www.oznet.ksu.edu.

PERFORMANCE OF BROILER CHICKENS FED VARYING LEVELS OF LOCAL FISH MEAL AS REPLACEMENT FOR IMPORTED FISH MEAL

By

SA'IDU, I.* YAKUBU, N. AND SHARHUDDEN, Y.

Department of Animal Production Technology
Bauchi State College of Agriculture, Bauchi

***Corresponding Author: idrissaidu1967@gmail.com, Phone: 08027961671**

ABSTRACT

A fourty nine days experiment was carried out at poultry unit of Bauchi State College of Agriculture to evaluate the performance of broiler chickens fed varying levels of local fish meal (LFM) diets. Five experimental diets were formulated for both starter and finisher phases. Coded as diets 1 (0%), 2(25%), 3(50%), 4(75%) and 5(100%). Two hundred and ten (210) broiler chickens were randomly allotted to five dietary treatments in completely randomized design. Each treatment was replicated three times with fourteen birds per replicate. The result of this study indicated most of the performance attributes at both starter and finisher phases as well as the overall performance were not significantly influenced by the dietary levels of LFM. However starter phase final weight (575.09-779.65g) were significantly (P<0.05) influenced by the dietary levels of local fish meal. It can be concluded that LFM can completely replace imported one with no adverse effect on the performance attributes.

Key Words: Broiler Chicken, Imported Fish Meal, Local Fish Meal, Varying levels

INTRODUCTION

Poultry production forms an important component of livestock subsector as a provider of employment and income (Eduvie, 2002). Ogundipe and Sanni (2002) reported that, the primary purpose of keeping poultry in all parts of Nigeria is for both dietary and economic reasons. Kekeocha (1994) defined poultry as those species of birds that render economic services to man and produce freely under his care. Animal protein requirement in the developing countries including Nigeria has become critical due to rapid population growth (FAO/WHO, 1973), Yusuf *et al.* (2008) reported that the population in Nigeria is increasing at a rate much higher than that of food production especially with regards to the production of animal protein. The development of poultry industry has been described as the fastest way of ameliorating the animal protein deficiency in the 3rdworld countries due to the short generation interval of domestic fowl, their high feed utilization efficiency, ease of management and small space requirement (Depeolu *et al.*, 2004). Nworgu *et al*. (2000) and Rultu (2004) reported that the current acute shortage of animal protein in Nigeria and the rapidly increasing demand for livestock products could be alleviated through broiler production. Broiler chicken are fast growing strain of birds that are specifically produced for

their meat (Onibi and Bamigboye, 2000). Kosden (2010) described the term broiler as fast growing birds which reach market weight of 1.6 to 2.50kg at 8 weeks. High cost of inputs, most especially feeds and day old chicks limit opportunity and advantages of poultry production in Nigeria as feed utilization accounts for over 70% of the total cost of broiler production (Afolayan *et al*., 2002). The high cost of feed could be attributed partly to animal protein source of which imported fish meal (IFM) is the most common (NSA *et al.*, 2016). The importance of fish meal as feed ingredient, in poultry production is quite enormous. Among the animal protein sources fish meal is particularly suited to meet all the nutrients requirement of animals (Ijaiya and Eko, 2009). The conventional animal protein source (imported fish meal) is expensive and sometimes is unavailable. There is little or no information on the status of performance of broiler chickens fed with local fish meal diets. Therefore, there is needs towards looking for other unconventional animal protein source that could meet the nutritional requirement of the birds, with similar or better performance like local fish meal (LFM).

MATERIALS AND METHODS

Study area

The experiment was conducted at Bauchi state college of agriculture, poultry research unit of the Department of Animal Production Technology, Bauchi. Five (5) experimental diets were formulated for both starter and finisher phases respectively. Local fish meal was included at 0, 25, 50, 75 and 100% replacement levels coded as diets 1,2,3,4 and 5 respectively to substitute the conventional animal protein source (imported fish meal).

Experimental birds

Two hundred and ten (210) day-old broiler chickens were procured from Zartech Company, Ibadan Nigeria. The birds were randomly assigned to five dietary treatments. Each treatment was replicated three (3) times with fourteen (14) birds per replicate in completely randomize design (CRD). Feed and water were given *ad libitum.* All vaccination schedules for broiler chickens were given at appropriate time.

Data collection

Parameters measured were feed intake, weight gain and mortality. Feed conversion ratio was also computed. All the data generated for both starter and the finisher phases were subjected to analysis of variance (ANOVA) as outline by (Steel and Torrie, 1984). Where significant difference was observed, Duncan Multiple Range Test (DMRT) was used to separate the means. Table 1 and 2 shows the percentage and calculated proximate composition of the experimental diets at starter and finisher phases respectively.

Results and Discussion

The performance of broiler chickens at the starter phase presented in table 3 shows that birds on diet 5 (100%LFM) recorded significantly (P>0.05) higher final live weight. Daily feed intake, daily weight gain and feed conversion ratio were not affected by the dietary

treatments similar trend was observed at the finisher phase (Table 4). The results of this study are in agreement with the reports of Ojewola *et al*. (2005) who reported that, there was no significant influence among broiler chickens fed locally processed and imported fish meal diets in relation to performance attributes. The overall performance indicate significant ($P<0.05$) difference in relation to initial weight. This could be due to the significant influence observed at the starter final weight. Overall daily weight gain, feed intake and feed conversion ratio were not affected by the graded levels of local fishmeal in the diets. This findings also agreed with the reports of Ojewole *et al.* (2005) reported no significant difference was observed among broiler chickens fed with locally processed and imported fish meal. Similar results were also obtained by (Akpodiete and Inoni 2000; Ijaiya and Eko, 2009).

Conclusion and Recommendation

This result conclude that local fish meal can replace imported fishmeal up to 100% with better effect on performance attributes. Therefore, it is recommended that farmers should include LMF in formulating their diets to reduce cost of production.

Table 1: Ingredients percentage composition of local fish meal based diets fed to broiler chickens at the starter phase. (1-4 weeks)

	Diets				
Ingredients	**1 (0%)**	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**
Maize	45.35	45.35	45.35	45.35	45.35
Soyabean	33.25	33.25	33.25	33.25	32.25
Wheat offal	12.00	12.00	12.00	12.00	12.00
Imported fish meal	5.00	3.75	2.50	1.25	0.00
Local fish meal	0.00	1.25	2.50	3.75	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated analysis					
Crude protein	23.01	22.83	22.64	22.45	22.26
ME (Kcal/kg)	2949.39	2949.38	2949.39	2949.39	2949.39
Crude fibre	4.32	4.31	4.32	4.32	4.32
Ether extract (%)	7.78	7.77	7.75	7.77	7.78
Calcium (%)	1.71	1.71	1.71	1.71	1.71
Phosphorus	0.76	0.79	0.95	0.89	0.96
Methionine (%)	0.65	0.45	0.63	0.62	0.63
Lysine (%)	1.56	4.49	1.57	1.58	1.56

Table 2: Ingredients percentage composition of local fish meal based diets fed to broiler chickens at the starter phase. (4-8 weeks)

	Diets				
Ingredients	**1 (0%)**	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**
Maize	50.46	50.46	50.46	50.14	50.14
Soyabean	28.14	28.14	28.14	28.14	28.14
Imported fish meal	2.00	1.50	1.00	0.50	0.00
Local fish meal	0.00	0.50	1.00	1.50	2.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated analysis					
Crude protein	20.00	19.92	19.85	19.78	19.70
ME (Kcal/kg)	2907.45	2987.65	2907.65	2907.65	2907.45
Crude fibre (%)	4.44	4.44	4.45	4.44	4.44
Ether extract (%)	7.14	7.14	7.13	7.14	7.14
Calcium (%)	1.55	1.54	1.53	1.54	1.55
Phosphorus	0.88	0.90	0.87	0.90	0.88
Methionine (%)	0.56	0.55	0.54	0.55	0.56
Lysine (%)	1.31	1.32	1.32	1.31	1.31

Table 3: Performance of broiler chickens fed different replacement levels of local fish meal based diets at the starter phase.

	Diets					
Parameters	**1 (0%)**	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	**SEM**
Initial weight (g)	124.39	128.05	129.90	120.97	126.50	5.09NS
Starter final weight(g)	575.09^{c}	694.60^{ab}	649.38^{bc}	684.14^{abc}	779.65	34.90*
Feed intake (g)	57.43	65.55	63.17	70.10	64.32	2.73NS
Daily weight gain (g)	16.09	20.23	19.27	20.12	23.32	1.49NS
Feed conversion ratio	3.61	3.26	3.36	3.23	2.77	0.27NS

abc = Means within the same row with different superscripts were significantly different (P<0.05)
NS = Not significant
SEM = Standard Error of the mean

Table 4: **Performance of broiler chickens fed different replacement levels of local fish meal based diets at the finisher phase.**

	Diets					
Parameters	**1 (0%)**	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	**SEM**
Initial weight (g)	575.09[c]	694.60[bc]	649.38[bc]	684.14[abc]	779.65 [c]	86.58*
Final weight (g)	1133.4	1329.40	1235.60	1418.40	1552.20	91.96NS
Daily feed intake (g)	98.54	100.65	100.36	103.07	99.76	1.32NS
Daily weight gain (g)	27.92	32.33	32.81	37.21	38.63	4.72NS
Feed conversion ratio	3.54	3.46	3.32	2.83	2.64	0.49NS

abc = Means within the same row with different superscripts were significantly different (P<0.05)
NS = Not significant
SEM = Standard Error of the mean

Table 5: Overall performance of broiler chickens fed graded levels of local fish meal diets. (1-8 weeks)

	Diets					
Parameters	**1 (0%)**	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	**SEM**
Initial weight (g)	349.75[c]	411.33[ab]	399.14[b]	402.56[abc]	453.08[a]	18.94*
Overall final weight (g)	1025.80	1012.00	997.50	1051.30	1165.90	74.52NS
Daily feed intake (g)	79.32	83.10	81.76	86.59	82.04	1.67NS
Daily weight gain(g)	22.01	26.28	26.04	28.66	30.98	2.28NS
Feed conversion ratio	3.57	3.36	3.34	3.03	2.70	02.2NS

abc = Means within the same row with different superscripts were significantly difference (P<0.05)
NS = Not significant
SEM = Standard Error of the mean

REFERENCES

Afolayan, S.M., Bawa, G.S,Sekoni, A.A. and Abeke F.O (2002). Performance of pullet chicks fed graded levels of locust bean palp as a source of energy. Proceeding 17th Annual Conference of Animal Science Association of Nigeria Abuja 2002 9 – 13, Pp 394 –395

Akpodiete, O.J. and Inoni, O.E. (2000). Economics of production of broiler chickens fed maggot meals as replacement for fish meal. *Nigerian Journal of Animal Production* **27** (1):59-63

Edunvie, I. O, (2002). **A Training manual, poultry production in Nigeria**, National Animal Production Research Institute, Shika, Ahmad Bello University, Zaria Nigeria.

FAO/WHO (1973). **Energy and protein requirement:** Report of a joint FAO/WHO adhoc Expert Committee WHO.Technical report series NO. 522 and FAO Nutrition meeting series No. 522, Geneva Switzerland.

Depeolu, M.A., Adebayo, A.J. and Oke, O.M. (2004). Residues of streptomycin antibiotic in commercial layers in Abeokuta and Ibadan metropolis. *Nigerian Journal of Animal Production* **31**: 130–134.

Ijaiya, A.T. and Eko, E.O, (2009). Effect of replacing dietary fishmeal with silk worm (*Anapheinfecta*) caterpillar meal on growth digestibility and economics of production of broiler chickens. *Pakistan journal of nutrition* **8**: 845–849.

Kosden, B.Y, (2010). Response of broiler chickens to different levels of roasted *bambaragroundnut (Voandzeiasubterranean (L)*Thouar) meal. Unpublished M. Sc. Thesis. Abubakar Tafawa Balewa University Bauchi, Nigeria.

Kekeocha, C. C. (1994.) Biochemical evaluation of some oil seed cake and their utilization in poultry in ration PhD Thesis University of Ibadan Nigeria (unpblished)

Nsa, Ee.,Wogar, G.S.I And Etianam–Umoh, S.I (2016). Growth performance of broiler chickens fed increasing levels of *Limicolariaaurora* (Garden snail) as replacement for fish meal. *Journal of Agriculture and Ecology Research International*. **71** (1): 1 – 8.

Nworgu, G.N., Egbonsike, J.B., Fapohunda, F.L., Ogundola, A.J., Omole G.E, Ogbesuka and Okepeze, G.N. (2000). Performance of broiler chickens fed full fat extruded soyabean meal. Book of proceedings 25thAnnual NSAP Conference 19 – 23 March 2000. Umudike Pp 135 – 136.

Ojewola, G.S., Okoye, F.C. and Ukoha, O.A. (2005.) Comparative utilization of three animal protein sources by broiler chickens. *International Journal of Animal Science*. **4** (7): 462 – 467.

Ogundipe, S.O. and Sanni, S.A. (2002.) Economic of poultry production in Nigeria. A Training manual. Poultry production in Nigerian. National Animal Production Research Institute (NAPRI) Ahmadu Bello University Zaria. Pp 27 – 30.

Onibi, G.E, and Bamigboye, A. (2000). Relative susceptibility of broiler chickens parts to lipid per oxidation. Book of proceedings 25thAnnual NSAP Conference 19– 23 March 2000. Umudike Pp. 205–208.

Rultu, H.R. (2004). Effect of dietary wood charcoal to broiler ducks. *Animal Science journal* **90**: 213 – 226.

Steel, R.G.D. and Torrie, J.H. (1984). **Principals and procedures of statistics: A Biometric Approach**. 2nd edition MCGraw-hill books compare inc. New York. U.S.A.

Yusuf, N.D., Ogah, D.M., Hassan, D.I., M.M. and Doma, U.D (2008). Effect of decorticated fermented *Prosopis* seed meal (*Prosopis africana*) on growth performance of broiler chickens. *International Journal of Poultry Science*, **7**(11): 1054– 1057.

INFLUENCE OF CASTRATION AND DIFFERENT DIETS ON GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEANER RABBITS

Saheed, S., Tsado, D. N., Tiamiyu, S. A., Habu, T., and Habu, T.

DEPARTMENT OF ANIMAL PRODUCTION

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

ABSTRACT

Twenty four castrate and non-castrate weaner rabbits fed different diets were investigated to determine the growth performance and nutrient digestibility. The rabbits were assigned randomly to four treatments, each with three replicates and two animals per replicate. One hundred grams of feed were offered per rabbit/day and their body weight were taken on weekly basis. Other parameters measured were initial weight, final weight, total body weight gain, average body weight gain, average feed intake and feed conversion ratio. The results shows that castrates had significantly higher values in all growth performance parameters. Apparent digestibility coefficient values shows that castrates had significantly higher values of all parameters measured over the control. It was concluded that castration had significant effect on growth performance and nutrient digestibility of weaner rabbits.

Key words: Rabbits, Castration, Different diets, Performance.

INTRODUCTION

Rabbits are pseudo ruminant animals that do not compete with man for food. The potential of rabbits can be fully maximized in areas where forages are readily available. Forage and cereal by-products can be utilized as the primary source of protein and energy with high level of production (Cheeke, 1986). Rabbits have been reported to be prolific with short gestation period of 30-32 days, producing 4-5 litter per year that consists of 6-8 kitten on the average (Biobaku, 1997). Animal protein supply and consumption is low in Nigeria especially among the low income and nonwage earners (Iyange&Orewa, 2009). The average estimated crude protein requirement of an adult Nigerian is between 65 and 85g per person daily, 35g of which should come from animal source (Adetunji and Adepoju, 2011). Atsu, 2002, put the average consumption of animal protein at 4.5g/head/day as against the 35g/head/day. Castration is one of the management activities practiced in different part of the country. Castrates have better meat quality and they grow faster than entire males. Castration can also be employed in controlling the rapid breeding capacity of rabbits whenever there is a female rabbit as well.

MATERIALS AND METHODS

Experimental location

The study was carried out at Teaching and Research Farm of Department of Animal production Federal University of Technology, Gidan Kwano Campus Minna. Minna is located in the North central zone of Nigeria with the geographical coordination of 9^0 37' North 6^0 33' East. Minna has land area of 6784 km and it is located at the latitude of 1475 m above the sea level in the southern guinea savanna vegetation of Nigeria. Minna is characterized with two different seasons which are the wet season (April to October) and dry season (November to March). The average annual rainfall is between 1100 and 1600 mm and mean ambient temperature ranges from 21°C to 36°C latitude and longitude (Ovimap, 2015).

Experimental Diet

The diets used for the experiment comprise of maize, GNC, maize offal, rice bran, bone meal, Methionine, lysine, premix and salt which are purchased from the local market in Minna town also known as Kure market. *Tridax procumbens* and milk weed was used as part of the experimental diet and was sourced around the Research farm.

Experimental Animal and Design

Twenty four (24) weaner rabbits with an average weight of 960.5gram aged between 10 – 12 weeks were used. The animals were randomly assigned to 4 treatments with 6 rabbits per treatment and 3 replicate with 2 rabbits per replicate. Some of the experimental rabbits were castrated using open castration method. Rabbits in treatment (T_1) were non-castrate and fed concentrate and roughage, T_2 were castrates fed concentrate only, T_3 were castrates fed roughage only, T_4 were castrates fed concentrate and roughage. The animals were sourced from Naij Integrated concept, Oshogbo in Osun state of Nigeria.

Management of animals

The animals were managed under intensive management system in hutches and two animals were kept in a hutch. Concentrate and forage were the main diet offered to animals in each replicate and one hundred grams of feed was served to each rabbit in a day with half ($1/2$) served between 7 – 8am daily and the remaining half was served between 3 – 4 pm daily. Water was also offered ad-libitum throughout the experiment period. Digestibility study was carried out at the end of the experiment.

Data analysis

All the data collected were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980) using statistical package for social science version 20 (SPSS).

RESULTS AND DISCUSSION

The growth performance characteristics of the experimental rabbits are presented in table 1

The values of final body weight gain of castrates fed concentrate only differ significantly from those of non-castrates (control). Similarly, castrates fed concentrates and forages differ significantly from the control in term of total body weight gain and average body weight gain. In average feed intake, castrates fed forages only differ significantly from those fed the control diets. Castrates generally recorded significant difference in their favour in feed conversion ratio compared to the non-castrates The better performance of castrates over non-castrates in most parameters measured could be as a result of castration. Higher average feed intake obtained by castrates fed roughages only over non-castrates in this study could be attributed to the type of diet and castration. In contrast to this Bello and Adama (2012), reported that the mean feed intake recorded for castrates (goat) was significantly ($p<0.05$) higher than the intact males (1107.1 vs. 1071.2g).

Table 2 showed that Dry matter and crude protein digestibility of castrates are significantly better than the non-castrates. Crude fibre and ash content values of castrates differ significantly from those of non castrates. The nitrogen free extract and total digestible nutrients of castrates fed concentrates only differs significantly from those of non-castrates (control). This agrees with the work of Bello and Adama (2012), who reported that castrates shows higher digestibility value in DM, CP, EE, ASH, and NFE but not in CF. This also agrees with the findings of (Muhikambele*et al*, (1994) who reported that castration significantly affects digestibility.

Table 1: Growth performance of castrate and non- castrates fed different diets

Parameters	T_1	T_2	T_3	T_4	SME	LSD
Initial weight (g)	891.50	1005.50	984.33	918.33	23.64	NS
Final weight (g)	1095.80^{b}	1308.80^{a}	1163.80^{ab}	1122.70^{ab}	32.69	*
Total wt. gain (g)	204.33^{b}	303.33^{a}	179.50^{b}	304.33^{a}	20.43	*
Average wt. gain (g/w)	25.54^{b}	37.92^{a}	22.44^{b}	38.04^{a}	2.55	*
AFI (g/w)	572.12^{b}	343.02^{c}	640.44^{a}	564.35^{b}	34.33	*
FCR	21.52^{b}	9.05^{d}	28.54^{a}	14.84^{c}	2.76	*

^{a,b,c,d} means along the same row with the same superscript are not significantly different ($p<0.05$) SME- Standard error of the mean, AFI – Average feed intake, FCR- Feed conversion ratio, LSD- Level of significance, NS- No significant difference, * - Significance difference.

Key

T_1= Non-castrates fed concentrate and forages., T_2= Castrates fed concentrate only,T_3= Castrates fed forages only. T_4= Castrates fed concentrate and forages

Table 2. Nutrient Digestibility of Castrates and Non-castrates rabbits fed different diets.

Parameters	T_1	T_2	T_3	T_4	SEM	LS
Dry matter (%)	80.93^{c}	93.86^{a}	90.93^{a}	84.77^{b}	1.95	*
Crude protein (%)	84.87^{c}	96.87^{a}	92.27^{b}	91.47^{b}	1.64	*
Crude fibre (%)	75.82^{b}	84.45^{ab}	88.19^{a}	84.10^{ab}	2.03	*
Ether extract (%)	88.16^{b}	94.54^{a}	93.25^{a}	87.911^{b}	1.15	*
Ash (%)	40.83^{c}	86.11^{a}	90.71^{a}	55.66^{b}	7.95	*
NFE (%)	91.71^{b}	96.19^{a}	91.65^{b}	90.07^{b}	0.89	*
TDN (%)	90.20^{b}	97.09^{a}	67.15^{c}	93.13^{ab}	4.43	*

^{a,b,c} means along the same row with the same superscript are not significantly different ($p<0.05$), NFE- Nitrogen free extract, TDN- Total digestible nutrient, SEM- Standard error of the mean, LS- Level of significance, *- Significance difference

Key

T_1= Non-castrates fed concentrate and forages.,T_2= Castrates fed concentrate only.,T_3= Castrates fed forages only., T_4= Castrates fed concentrate and forages.

Conclusion

It can be concluded based on the results of this work that:

Castrated rabbits are superior to non-castrates in final body weight gain, total body weight gain, average body weight gain and apparent nutrient digestibility.

Recommendation

From the results gotten from this study, it is recommended that male rabbits not required for breeding programme should be castrated for optimum growth performance and nutrient digestibility.

REFERENCES

Adetunji, M.O andA.AAdepoju (2011) Evaluation of household protein Arthur, P.F., Archer, J.A., Johnston, D.J., Herd, R.M., Richardson, E.C. and Parnell, P.F. (2001) *J. Animal Scence.* **79**: (In Press).

Bello, A and T. Z. Adama (2012) Studies on Body Weight and Linear Body Measurements of Castrates and Non-Castrate Savannah Brown Goats. *Asian Journal of Animal Sciences* 6(3):140-146

Biobaku, W. O. and E. B. Oguntona. 1997. The effects of feeding multi-nutrient miniblocks and pelleted diet on the growth of rabbits. *Nigerian. Journal . Animal. Production*. 24: 147-249.

Cheeke, P. R., Grobner, M. A. and Patton, M. M. (1986). Fibre digestion and utilization in rabbits. *Journal Applied Rabbit Research* 9:25-30

http://www.maplandia.com/nigeria/kwara/ilorinwe/oke-oyi/.Retrieved on 30/12/2019

Iyange, C., & Orewa, S. (2009). Determinant of Daily Protein Intake among Rural and Low Income Urban Households in Nigeria. *American Eurasians Journal of Scientific Research*, 290-301.

Muhikambele, V.R.M., L.A. Mtenga, E. Owen, G.C. Kifaro and D.S.C. Senda *et al*., (1994). Effect of castration and diet on performance and feed utilization in Saanan goats. Proceedings of the Biennial Conference of the African Small Ruminant Research Network on Small Ruminant Research and Development in Africa, Kampala (Uganda), December 5-9, 1994, ILRI, Kenya, pp: 221-224.

Ovimap, (2015). Ovi location map: Ovi Earth Imagery Data.

SPSS (Statistical Package for Social Sciences). 2006. Version 15.0, SPSS Inc., USA.

Steel, R. G. and Torrie, J. H. 1980. Principles and procedures of statistics. A biometrical approach . 2nd ed. McGraw-Hill. New York.

PROXIMATE COMPOSITION OF *BRACHIARIA RUZIZIENSIS-MUCUNA PRURIENS* MIXTURES AND RELATIVE FEED INTAKE OF GROWER RABBITS FED MIXTURE HAY WITH CONCENTRATE

Sani I.[1], **Anyebe O. W.**[1], **Adamu, N.**[1], **Amodu, J. T.**[2], **Hassan, M. R.** [3]**and Tanko, R. J.**[2]
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.
[2]National Animal Production Research Institute, Shika, Ahmadu Bello University, Zaria, Nigeria
[3]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria

Abstract
Brachiaria ruziziensis and *mucuna pruriens* were used as the basal diet for grower rabbits, the forages were finely chopped and fed to rabbits. *Brachiaria ruziziensis* which served as the source of energy to the rabbits was fed at different proportions (100, 75, 50 and 25%) and *Mucuna puriens*, the main protein source in the experimental diet was fed at (0, 25, 50, 25 and 75%) across the four treatments. The feed was given in the morning and at evening and the feed intake was measured by subtracting feed given from left over. Proximate composition of the sole hay and mixtures showed 75:25 *B. ruziziensis* and *M. Pruriens* mixture had crude protein (24.98%) with *B. ruziziensis* having the least crude protein value (10.89%). The consumption of forage at different proportions in the four treatments shows that there is acceptance of *Brachiaria ruziziensis* and *Mucuna pruriens* at a high rate by rabbits. Experimental diet with 50:50 mixture of *B. ruziziensis* and *M. Pruriens* had the highest (74.28g) feed intake ($p<0.01$) when compared to other treatment diets. It is therefore recommended that *B. ruziziensis* and *M. pruriens* be mixed at 50:50 for optimum performance in rabbits.

Keywords: *Brachiaria ruziziensis, Mucuna pruriens, Mixture, Rabbits, Forages*

Correspondence: Sani I., **email**: saniibrahimnamei@yahoo.com, isani@atbu.edu,ng
Phone number :08038056113, 08072448533

Introduction
The uses of forages in rabbit feeding is normal practice and rabbit producers are advised to feed forages as a supplement to a basic concentrate diet in order to meet the fiber and some of the vitamin requirement, cost of grains and their by-products have increased dramatically and are often scarce (Nakande *et al*., 2015). Though optimum rabbit production has not been sustained on forages alone using most tropical forages, it is possible to reduce the cost of concentrates in the rations by utilizing forages that are nutrition's and palatable, to achieve a compromise between level of production and cost that is acceptable to producers.

(Aduku *et al*., 1989) conducted some studies on preference of rabbits for different forges, but the vast range of forage species in the tropics has not been properly harnessed for the purpose. Since legumes are high in protein, they have potential to reduce the quality and cost of concentrates for rabbits. However, for rabbits to perform well on forages diets, they need to consume the forages in significant amounts (Amaefule, 2004). This study was undertaken to evaluate the voluntary intake and performance of rabbit fed grass-legume levels of grass-legume mixtures.

Materials and methods
Experimental Site
The research was conducted at the Research and Teaching farm of the Department of Crop production, Faculty of Agriculture, Abubakar Tafawa Balewa University, Bauchi, Yelwa Campus. *Brachiaria ruziziensis* and *Mucuna pruriens* forages were harvested at week 8 from the pasture plot of the experimental site.

Experimental design and Animal management
Twelve (12) rabbits of similar age, breeds and sexes were purchased from Muda Lawal market, Bauchi, Bauchi state. The rabbits were randomly allotted into four (4) dietary treatment groups with three (3) replicates per treatment in a Completely Randomized Design (CRD). The rabbits were individually housed in cages measuring 40 x 40 x 60 cm^3. All the rabbits were given prophylactic

against internal and external parasites (Ivomec® ivermectin at 0.2ml/rabbit) and broad-spectrum antibiotic. The rabbits were provided feed and fresh, clean water *ad libitum* throughout the experimental period which lasted for eight (8) weeks, while feed intake was measured for 7 weeks. Forages offered to the rabbits were chopped into smaller sizes then mixed thoroughly with other ingredients. The experimental diets fed to rabbits were balanced across treatments to meet the minimum crude protein requirement (15%CP) for grower rabbits (Aduku, 1993).

Table 1, shows the percentage of legume and grasses and various composition of feed ingredients. The rabbits were given 100 grams of the experimental diet which was finely chopped to enhance palatability. In treatment 1 (T1) the rabbits were given 100% of *B. ruziziensis*, while in treatment 2 (T2) they were given *B. ruziziensis* 75% and 25% *Mucuna pruriens* also in Treatment 3 (T3) were given 50% proportion of Brachiaria and Mucuna mixture (50.50). In treatment 4, rabbits were fed 100% *Mucuna pruriens* in the experimental diet was chopped and mix with other fixed ingredients

Table 1. Levels of *Brachiaria ruziziensis* and *Mucuna pruriens* in the diet mixtures of Grower rabbits

Ingredients	**T1**	**T2**	**T3**	**T4**
B. ruziziensis	100	75	50	0
M. pruriens	0	25	50	100
Bone	2.5	2.5	2.5	2.5
Salt	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Methionine	0.15	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25	0.25
Total	100	100	100	100

T1 = Treatment 1**, T2** = Treatment 2**, T3** = Treatment 3**, T4** = Treatment 4

Feed intake was in the morning and left over were weighted every day. Feed intakes were evaluated by subtracting the left over from the amount of feed offered. The feed convention ratio of daily feed conversion ratio was calculated as the ration of daily feed intake to unit weight gain by grower rabbit. Data for voluntary intake was collected for seven days using the weight scale balance. The feed intake was collected by subtracting the left over from feed offered to get the daily feed intake.

Result and discussion

The various proximate composition of grass and legume as shown in Table 2, indicates that dry matter in *Brachiaria ruziziensis* is 88.93% while the dry matter for *M. puriens* is 92.9%. The crude protein level indicated for the grass *(B. ruziziensis*) is 10.89% and for the *Mucuna pruriens* 24.98%. The table also shows that, the crude fiber for *B. ruziziensis* is 31.63% and for *Mucuna pruriens* as 10.73%. The nitrogen free extract (NFE) for *B.ruziziensis* is 38.56% and *Mucuna puriens* as 50.77%. The ash composition for *B. ruziziensis* is 9.46% while for *M. puriens* is 3.13%.

Table 2: Proximate composition of *Brachiaria ruziziensis* and *Mucuna pruriens* hay

Parameters (%)	***B. ruziziensis***	***M. pruriens***	**75:25**	**50:50**	**25:75**
Dry matter	88.93	92.9	90.1	91.3	92.8
Crude protein	10.89	24.98	22.1	18.2	12.5
Crude fiber	31.63	10.73	28.2	29.5	30.5
Ash	9.46	3.13	12.3	9.8	10.7
Nitrogen Free Etract	38.56	50.77	38.3	45.2	49.1

Table 3**,** shows the feed intake of *B. ruziziensis* and *M. pruriens* by the rabbits for seven weeks (49 days). In treatment one, the quantity consumed by the rabbit has an average intake of 57.86g when fed *Brachiaria ruziziensis* at 100g. Rabbits in Treatment 2 fed with *Brachiaria ruziziensis* at 75% and *Mucuna puriens* 25% had average intake of 61.42 grams and when fed *Brachiaria ruzuziensis* and

Mucuna puriens at 50:50, rabbits in Treatment three (3) consumed 74.2g which had the highest value compared to other treatment diets. In Treatment 4, rabbits fed 25% of *Brachiaria ruziziensis* and 75% *Mucuna puriens* had a relative intake of 55g.

The result obtained in T1 (57.86g) was significantly different from the intake in T2 and T3 but was statisitically at par (P>0.01) with value obtained in treatment (T4). The value for intake was highest in Treatment 3 (74.28g) and lowest in treatment 4 (55g) and was similar to the result obtained by (Iyeghe-Erakpotobo, 2008), in a similar study, but was lower than 120g reported by Aduku (1993) for daily intake of grower rabbits.

Table 3. Feed intake of *Brachiaria ruziziensis* and *Mucuna puriens* by rabbit when offered 100 grams in one allocation for seven (7) weeks

	Relative intake (g) in Weeks							
Feed offered (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Mean**
Brachiaria ruziziensis 100:0 (T1)	30	40	60	80	55	65	75	57.86[c]
Brachiaria + Mucuna 75:25 (T2)	50	30	40	80	75	80	75	61.42[b]
Brachiaria + Mucuna 50:50 (T3)	80	50	75	90	80	75	70	74.28[a]
Mucuna pruriens 0:100 (T4)	70	60	80	30	40	55	70	55.00[c]

[a,b,c]= Means with different superscript are significantly different **, T1 =** Treatment 1**, T2 =** Treatment 2**, T3 =** Treatment 3**, T4 =** Treatment 4

Conclusion and Recommendation

This study shows that experimental rabbits have preference for the grass-legume mixture in Treatment 3 when the forage mixture was at equal proportion of *Brachiaria ruziziensis* and *Mucuna pruriens* (50:50). The rabbits had the highest feed intake in Treatment 3, compared to other treatment diets. It is therefore recommended that *Brachiaria ruziziensis* and *mucuna pruriens* should be mixed in the diets of grower rabbit at 50:50 ratio for best feed quality and intake in Rabbits.

References

Aduku, A. O., Dim, N. I., Hassan, W. (1989). Evaluation of Tropical green forages for dry season feeding of Rabbits. *Journal of Applied Rabbit Research*., 12 (2): 113-115

Aduku, A. O. (1993). Tropical Feedstuff Analysis Table. Notes on the Feedstuffs Analysis Table.

Amaefule, K. U, Okechukwu, S. O., Ukachukwu, S. N., Okoye, F. C. and Onwudi, O. C. (2004). Digestibility and Nutrient utilization of pig fed graded levels of brewers' dried grain-based diets. *Journal of Livestock Research for Rural Development*. 18 (20). Pp64-68.

Iyeghe-Erakpotobo, G.I.., Aliyu, U and Ujuru, J. (2008) evaluation of concentrate. Grass and legumes combinations on performance and nutrient digestibility of grower rabbits under tropical condition. *African Journal of Biotechnology*. 4 (20) pp 204-208

Nakande, O. J., Ibe, E. A., Ajibade, A. J. (2015). Response of growing rabbits to concentrate diets supplement of *leucaena leucocephalla* and *Siratro macropticum* leaves. *Journal of Biology and Health care*. 17 (2). www.iitse.ors.

PERFORMANCE OF BROILER CHICKEN FED SUN-DRIED PINEAPPLE (*Ananas comosus*) AND ORANGE (*Citrus sinensis*) PEELS WASTE BASED DIETS UNDER SINGLE PHASE FEEDING

* M. J Shaibu, A. Aremu and O.J Alabi

Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, P.M.B 65, Minna, Niger State, Nigeria.
Corresponding authors E-mail: shaibu4sahlah@gmail.com
Phone number 2348067621967

Abstract:

This study was conducted to determine the effect of orange(OP) and pineapple(PP) peel wastes as replacement for maize in poultry diets. The peels were collected from retailers and sun-dried until a 10 % moisture was obtained. Thereafter, the peels were grounded and mixed with other feed ingredients. The experiment lasted for 70days. One hundred and sixty (160) days old broiler chicks were allocated into four different treatments with four replicates and ten birds (10) each in a complete randomized design. Four diets containing pineapple and orange peels wastes were formulated to replace maize at 0 % (control), 5 % (PP), 5 % (OP) and 5 % (MPO) mixtures respectively. Data on growth performance such as weight gain, feed intake and feed conversion ratio were measured and apparent nutrient digestibility was also determined. Data were subjected to one-way Analysis of Variance (ANOVA); significant means were separated by Duncan's Multiple Range Test at (p<0.05) as contained in the SAS package (2015) version 15.0. The results showed that only the feed conversion ratio (FCR) was influenced by the peels based diets. The dry matter, crude protein, ash, nitrogen free extract and ether extract digestibility were significantly affected (p < 0.05) by the peel-based diets. Birds on the MPO compared favourably with the control in all digestibility parameters measured. It was concluded that broiler birds could tolerate up to 5 % dietary levels of OP, PP meal and their mixture (MPO). without adverse effect.

Keywords – Pineapple peel, orange peel, performance, poultry, digestibility.

INTRODUCTION

In the recent years, crop residue and agro-industrial by products are being evaluated to access their nutritive potential to support poultry productivity (Oluremi *et al*., 2007). A number of agro-industrial by-products are generated from fresh citrus and pineapple after the main products of interest have been removed or extracted during processing or peeled for direct human consumption as it occurs in the developing countries (Oluremi *et al*., 2007). Citrus and pineapple waste disposal is a problem for agro-industrial manufacturing companies. Some of the wastes from fruits processing may be good sources of essential nutrients and, therefore, could be utilized as part of the feed ingredients. If these wastes are properly processed and incorporated in poultry animal rations, these agro-wastes can serve useful purposes by imparting nutrients as well as flavour to the ration and hence increase its palatability and utilization, besides lowering the cost of feed. In Nigeria, all the varieties of orange and pineapple are consumed on a high scale, and the peels are usually considered as wastes and are seen littering the streets and roadsides. As such, orange and pineapple peels have become an environmental problem. It is on this note that Ipinloju (2000) suggested that rather than discarding these peels, they can be sun-dried and then milled to obtain fine-particles of orange and pineapple peel meals which can be included in poultry diets. Some studies were conducted to develop a procedure for converting pineapple waste into animal feed (Sruamsiri, *et al*., 2007; Makinde, *et al*., 2011). Problems related to the fresh form were overcome by the sun drying technique of pineapple peels developed by Aboh, *et al*. (2004) which gave dried peels of good quality.

Objective of the study. To investigate the performance of broiler birds fed sun-dried orange(OP) and pineapple(PP) peels wastes based diets.

METHODOLOGY

The research was carried out at the Poultry Unit of Department of Animal Production Teaching and Research Farm of School of Agriculture and Agricultural Technology, Gidan kwano campus Minna, Niger state. Niger state is located on latitude 10˚00 N and longitude 6˚01 E. Niger State experiences distinct dry and wet seasons with annual rainfall of 1400 mm. The rainy seasons last for about 120 150 days. The temperature is between 30˚C minimum and 34˚C maximum; the humidity is about 53.5

% while the altitude is about 299 m above sea level. Presently, the state covers a total land area of 76,363.0 km ^{2} (Afolayan *et al.*, 2012).

Diet preparation

Pineapple and orange peels were collected from retailers sell points in Minna metropolis, where the retailers peel the fruit for consumers and discard the peels. The peels were sun-dried to attain 10% moisture and milled to obtained pineapple and orange peels meals which were used to replace maize at 0 % (Control) 5 % pineapple peel (PP), 5 % orange peel (OP) and 5 % each of pineapple and orange peels (MPO). The other feed ingredients: soya bean, fishmeal, bone meal, limestone, maize offals, groundnut cake were purchased from Sammy Agro Venture, Nigeria limited, located at U.K Bello way Minna, Niger State. Maize, palm oil and salt were purchased from Central Market Minna, Niger State. The composition of the experimental diets and the nutritive value of the test materials is presented in Table1.and Table 2 respectively.

The Experimental Birds, Design and Managements

One hundred and sixty (160) day old (Ross 308) broiler chicks were purchased from a reputable hatchery (Agrited) in Ibadan which were used for the experiment. The experimental birds were randomly allocated into four dietary treatments namely, T1 (control), T2 (5 % pineapple peels meal), T3 (5 % orange peels meal), and T4 (2.5 % each of orange and pineapple peels meals) at the rate of 40 birds per treatment. Each dietary treatment was replicated four times and had 10 birds per replicate using a completely randomized design. The birds were raised on a deep litter system. Before the commencement of the feeding trial, the Poultry Unit was washed thoroughly with disinfectant (Vinkokill 150ml/25 litres of water) and allowed to dry to prevent the spread of diseases from the previous research. The experimental birds were subjected to brooding with kerosene lamp and charcoal as sources of illumination and heat respectively. Treatment diets and water were administered *ad-libitum*. Routine management practice such as vaccination, drug administration and cleaning of the pens and equipment were carefully applied.

Data Collection

Initial weights were determined at the start of the experiment with the aid of salter weighing scale (SGF 400) balance and thereafter at weekly intervals. The final weight was also taken by weighing the birds in each replicate on the last day of the experiment using the same weighing balance. The weight gain was calculated by subtracting the initial weight from the final weight. In addition, the feed intake was calculated by subtracting the feed remaining from the total feed supplied each day before serving fresh one. The feed conversion ratio was also calculated by dividing feed intake by weight gain. In the last week of feeding trial, a nutrient digestibility trial was conducted using the total collection method. This was done in specially designed metabolism cages having separate watering and feeding troughs. One bird per replicate was selected and placed in a metabolism cage. The birds were allowed to adjust to the conditions in the cages for three (3) days after which total faecal collection was carried out for four days. Dietary feed was weighed and water was served *ad-libitum* daily for 4 days. Total droppings were collected for four days and oven dried daily at 80° C using hot air oven (Gallenkamp 300-inch series) until a constant weight was obtained. The faeces from each treatment were bulked and used for proximate analysis at the Department of Animal Production Laboratory using the procedure of AOAC (2000).

Data Analysis. All data generated were analysed using one-way analysis of variance (ANOVA) and where significant differences occurred, the means was separated using Duncan Multiple Range Test as contained in the SAS package (2015), version 15.0.

RESULTS AND DISCUSSION

The results of the effect of replacement of maize with sun- dried pineapple and orange peels meal-based diets was presented in **Table 3.** The results showed that only the feed conversion ratio (FCR) was influenced ($p<0.05$) by the peel meal-based diets. The feed conversion ratio results showed that birds on T1, T2 and T3 treatments has similar ($p>0.05$) values. Birds on T2, T3 and T4 treatments also had similar ($p>0.05$) values. However, bird on T1diet had better ($p>0.5$) feed conversion ratio than those of T4 treatment. The utilization of sun-dried orange and pineapple peels as a replacement for maize depressed growth of broiler chickens and this negative effect showed that sweet orange and pineapple peels as processed in this study still have a low feed value. It had been reported that sweet

orange and pineapple peels has higher crude fibre content than maize (Oluremi *et al*., 2007). In addition, Nicolakakis, *et al, (*1999) and Ahaotu and Ekenyem (2009) observed that higher dietary fibre depresses weight gain in broiler chickens. The results of the effect of the experimental diets on nutrient digestibility of broiler chickens is presented in **Table 4.** The results showed that dry matter, ash and NFE (Nitrogen free extract) digestibility were influenced ($p<0.05$) by the peels bases diets. However, the crude fibre digestibility was not influenced ($p<0.05$) by the dietary treatments. The dry matter digestibility results showed that birds on T2 and T3 diets had similar ($p>0.05$) values. Birds on T4 treatment had highest dry matter digestibility (83.55 %) value, the least was recorded by birds on T3 diet (78.78 %). The crude protein digestibility values ranged between 69.39 % and 76.22 %. The birds on T1, T3 and T4 had similar ($p>0.05$) values. Similarly, birds on T2, T3 and T4 also had similar ($p>0.05$) values. However, birds on T1 diet had higher ($p<0.05$) CP digestibility. The ash content digestibility ranges from 44.52 % and 64.01 %. The ash content digestibility results showed that birds on T1 and T4 diets had similar ($p>0.05$) values; birds on T2 and T3 diets also had similar. However, birds on T1 and T4 had higher ($p<0.05$) ash digestibility value than birds on T2 and T3 diets. The NFE digestibility results showed that birds on diet T4 had the higher ($p<0.05$) value as compared to others treatments Birds on T1 and T2 had similar ($p>0.05$) values, however, they had higher value than bird on T3 diets. The ether extract digestibility result ranges between 87.57% and 89.51%. Birds on T1, T3 and T4 diets had similar ($p>0.05$) values, birds on T2, T3 and T4 diets also had similar ($p>0.05$) values. However, birds on T1 diet had the highest EE while the least was recorded by birds on T2 diet The result of this study is in line with the observation of several researchers (Rao *et al*., 2001; Adeyemi *et al*., 2008) who observed significant differences in the digestibility of all nutrients when fed maize, millet and sorghum as the main source of energy in broilers diets. However, it does not agreement with the report of Hon *et al*. (2009), which stated no significant difference was found in growth performance after 20% dried sweet orange (Citrus sinensis) pulp meal was added in rabbit feeds

Table 1. Composition of Experimental Diets for Broiler Birds Under a Single Phase feeding.

Ingredients	T1(kg)	T2(kg)	T3(kg)	T4(kg)
Maize	51.00	46.00	46.00	46.00
Maize offal	9.00	9.00	9.00	9.00
Ground nut cake	17.00	17.00	17.00	17.00
Full fat soya	14.00	14.00	14.00	14.00
Fishmeal(imported	3.00	3.00	3.00	3.00
Orange peel	0.00	0.00	5.00	2.50
Pineapple peel	0.00	5.00	0.00	2.50
Limestone	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Palm oil	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
*Vit/min Premix	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25
Dl-Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
% Crude protein	20.52	20.07	20.07	20.07
ME/Kcal/kg	3089.37	2917.02	2917.02	2917.02
% Ether extract	7.00	6.81	6.81	6.81
% Crude fibre	4.05	3.94	3.94	3.94
% Calcium	1.45	1.45	1.45	1.45
% Phosphorus	0.45	0.45	0.45	0.45
% Lysine	1.12	1.12	1.12	1.12
% Meth + Cys	0.61	0.59	0.59	0.59

Vitamin and mineral premix. Vitamin A 1500 IU, Vitamin D 300 IU, Vitamin E 3.00, Vitamin K 0.25 g, Thiamine 0.2 mg, Riboflavin 0.6mg, Pantothenic acid 1.00 mg, Pyridoxine 0.4999 mg, Niacin 4.00 mg, Vitamin B12 0.002 mg, Folic acid 0.10 mg, Biotin 0.008 mg, Choline chloride 0.05g, Antioxidant 0.012 g, Manganese 0.0096 g, Zinc 0.0060 g, Copper 0.0006g, Iodine 0.006 g, Iodine 0.00014 g, Selenium 0.024, Cobalt 0.004 mg.
Keys: T1= Control, T2 = Pineapple peels waste, T3 = Orange peels waste and T4 = Mixtures of orange and pineapple peels waste
ME = Metabolizable energy, meth = methionine and cys = cystein)

Table 2 Proximate Composition of Orange and Pineapple Peels

Parameters	SDOP	SDPP	MPO
Moisture content	9.20	8.20	8.50
Ash Content	6.01	6.10	6.00
Crude Fibre	2.10	3.50	1.50
Crude Protein	7.00	5.60	6.90
Ether Extract	5.00	3.00	5.00
NFE	70.69	74.60	72.10
Energy(Kcal/kg)	3138.15	3061.20	3183.80

SDOP (Sun-dried orange peel), SDPP (sun-dried pineapple peel) MPO (Mixture of pineapple and orange peels) and NFE (nitrogen free extract)

Table 3. Growth Performance of Broiler Chicken Fed Sun-dried Orange and Pineapple Peels Based Diets Under Single Phase Feeding regime

	Treatments					
Parameters	T1	T2	T3	T4	SEM	LS
Initial Weight (g)	37.83	38.30	38.03	37.95	0.114	Ns
Final Weight (g)	1041.25	997.08	916.42	967.19	25.253	Ns
Total Weight (g)	1003.43	958.78	878.40	929.24	25.251	Ns
Daily Weight (g)	14.33	13.70	12.55	13.28	0.361	Ns
Daily Feed Intake(g)	33.38	34.21	32.41	35.04	0.705	Ns
FCR	2.34^{b}	2.52^{ab}	2.58^{ab}	2.64^{a}	0.456	*

[ab] Means on the same row having different superscripts are significantly different (P<0.05)
SEM: = Standard Error of Mean, LS=level of significant, FCR = (Feed conversion ration).

Table 4. Apparent Nutrient Digestibility of Broiler Chicken fed Sun-dried Orange and Pineapple Peels Based Diets Under Single Phase Feeding

	Treatments (%)					
Parameters	T1	T2	T3	T4	SEM	LS
Dry Matter	83.03^{b}	78.96^{c}	78.78^{c}	83.55^{a}	0.839	*
Crude Protein	76.22^{a}	69.39^{b}	74.10^{ab}	71.53^{ab}	1.087	*
Ash	59.12^{a}	44.52^{b}	47.91^{b}	64.01^{a}	3.119	*
Crude Fibre	63.30	54.86	62.12	56.28	1.623	Ns
NFE	93.26^{b}	92.83^{b}	88.26^{a}	95.89^{c}	1.063	*
Ether Extract	89.51^{a}	87.57^{b}	89.04^{ab}	88.78^{ab}	0.312	*

[abc] Means on the same row having different superscripts are significantly different (P<0.05)
SEM: = Standard Error of Mean,
NFE: = (Nitrogen free extract)

CONCLUSION: Base on the result of this study, the dietary inclusion of pineapple(PP) and orange(OP) peels does not depress growth below the acceptable range of weight. It was concluded that broiler birds could tolerate up to 5 % dietary levels of OP, PP meal and their mixture (MPO). without adverse effect. However, further research is needed to assess the effects of SDOP (Sun-dried orange peel) and SDPP (Sun-dried pineapple peel) to improve it suitability as feed resource.

REFERENCES

Aboh, A. B., Zoffoun, G. A., Djenontin, A. J. P., Babatounde, S., and Mensah, G. A. (2013). Effect of graded levels of dry pineapple peel on digestibility and growth performance of rabbit. *Journal of animal production.*

Adeyemi, O.A., Eruvbetine, D., Oguntona, T., Dipeolu, M. and Agunbiade, J.A. (2008). Feeding broiler chicken with diets containing whole cassava root meal fermented with rumen filtrate. *Archivos de zootecnia*, 57:218. Pp.248.

Afolayan, S.O., Makinde, A.A., Shuaib, M., Idris, B.A., Yaduma, J.J.& Yau, M. G. (2012) rainfall harvesting, a sustainable water management alternative for food security in Nigeria, *science journal of agricultural research and management* 276-636

AOCA (2000). Official Methods of Analysis, Associations of Official Analytical Chemists.16th Edition. Washington D.C. USA.

Hon, F.M., Oluremi, O.I.A., and Anugwa F.O.I. (2009). The effect of dried sweet orange (Citrus sinensis) fruit pulp meal on the growth performance of rabbits. *Pakistan Journal of animal Nutrition*. 8:1150–1155.

Ipinjolu, J.K. (2000). Performance of juvenile orange koi carp (*Citrus carpio leanneaus*) fed diets supplemented with Sweet orange peel meal: Body composition, Nutrient utilization and skin pigmentation. *Sokoto Journal of Veterinary Science*. 2000: 228-229

Makinde, O.A., Odeyinka, S. M., and Ayandiran S. K. (2011). Simple and quick method for recycling pineapple waste into animal feed. *Livestock Research for Rural Develo*pment, 23 (9) Art. #188. Retrieved September 26, 2012, from http://www.lrrd.org/lrrd23/ 9/maki23188.htm

Nicolakakis, I., Dotes, D and Imamidou, A. (1999). Digestibility and energy value of pig diets containing different levels of dried citrus pulp with enzymes. *Epitheorese Zootehnikes Epistemes,* 26, 43-54.

Oluremi, O.I.A., Ngi, J., and Andrew, I.A. (2007). Evaluation of the nutritive potential of the peels of some Citrus fruit varieties as feedstuff in livestock production. *Pakistan Journal of animal Nutrition*. 6(6): 653-656.

Rao, S. V., Shyam Sunder, G.I., Reddy, M. R., Praharaj, N. K., Raju, M.V. and Panda, A. K. (2001). Effect of supplementary choline on the Performance of broiler breeders fed on different energy sources. *Journal of British Poultry Science*, 42: 362-367.

SAS (2015). Statistical Analysis System, Computer Software, SAS/STAT User's Guide Version 9. *Statistical Analysis Systems Institute,* Cary, North Carolina 27513, USA.

EFFECTS OF REPLACING MAIZE WITH PROCESSED MANGO SEED KERNEL MEAL ON PERFORMANCE, NUTRIENTS DIGESTIBILITY AND ECONOMIC OF PRODUCTION OF WEANER RABBITS

[1]Shuaibu, U. S., [1]Bello, K. M. [1]Mancha, Y. P. [1]Jatutu, S. S. [1]Shuaibu, B. and [2]Muazu, M. S.
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi,
[2]Department of Animal Production, Bauchi State Collage of Agriculture, Bauchi, Bauchi State, Nigeria.

Corresponding author email: umarlutiatbu@gmail.com

+ 2347065267274

ABSTRACT

This experiment was conducted to determine the effect of replacing maize with processed mango seed kernel meal (PMSKM) in the diets of weaner rabbit on performance, nutrient digestibility and economic of production. A total of thirty two (32) mongrel rabbits (8 rabbits per treatment, 2 per replicate) were randomly allotted to four experimental diets in which processed mango seed kernel meal replaced maize at 0, 20, 40 and 60% level designed as diets 1, 2, 3 and 4 respectively. The experiment lasted for eight weeks. The result showed that the Average initial weight (500.00-518.75), average final weight (1393.75-1412.50), average daily feed intake (52.98-55.05), average daily weight gain (15.74-16.19) and feed conversion ratio (3.29-3.48) obtained were not significantly (P<0.05) affected by the dietary levels of processed mango seed kernel meal. All the digestibility parameters analyzed were significantly (P<0.05) affected by the graded level of inclusion of the PMSKM. The lowest feed cost per kg weight gain was recorded in rabbits fed die 3(40%). Similarly, the rabbits fed diet 3 (40%) showed higher/better cost saving of ₦22.34. It was therefore concluded that processed mango seed kernel meal can replace maize at 40% level in the diet of weaner rabbit with better performance and tremendous reduction in feed cost.

Keywords: Mango seed kernel, Maize, Digestibility, Economic of production, Weaner rabbits

Introduction

Feed is one of the constraints to intensive rabbit production in Nigeria due to competition between man, animals and industries for conventional feed materials. This has lead to the escalating cost of conventional feed ingredients and has made feed cost to account for about 70% of total cost of production Akinmutimi (2008). This problem has been the prime stimulant for the continues search for alternative feed stuffs that can meet the nutritional requirement of micro-livestock, reduce the cost of feed and animal production (Olorede *et al*., 2011). It is recommended that such a feed stuffs should be one that has low human food preference and of low industrial usage.

Mango seed kernel meal (MSKM) has been reported to be a good non conventional ingredient. Faniyi (1997) reported its importance in poultry production while Arogba (1997) provided the physical, chemical and functional properties of Nigerian mango *(Mangifera indica)* kernel and it processed flour. Chemical analysis and metabolizable energy of mango seed kernel meal as determined by Arogba (1997) revealed that it contains Tannin an astringent compound, thus necessitate processing the seed before it could be safely fed to animals. The nutrient composition of Mango seed kernel on dry matter basis was estimated in Nigeria to be 6.16% crude protein, 13.63% ether extract, 2.23% ash and 73.35% nitrogen free extract (Farinu *et al.* 1999) while EI-Alaily *et al.* (1996) reported that the gross energy is 4.7Kcal/g. This study was designed to evaluate the growth performance, nutrient digestibility and economic of production of weaner rabbits fed diets containing processed mango seed kernel meal.

Materials and Methods

Experimental Site:

The experiment was conducted at the Rabbitery Unit of Bauchi State College of Agriculture Teaching and Research farm, Bauchi State. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East.

Collection and Processing of Mango Seed into Mango Seed Kernel Meal

The mango seeds were collected at Bauchi town and surroundings villages during the peak of its production period. They are readily available in the area of study. The collection was done during the months of April and May which represents the peak of the mango season in Bauchi town. The kernel were obtained by cutting the seed coat using a knife or crushed with a stone. The Mango Seed Kernel (MSK) obtained was then processed through soaking and boiling

Soaking of Mango Seed Kernel for 24 Hours

Mango Seed Kernel was soaked in water for 24 hours at the rate of 100g per liter of water in containers. There was change of water at regular intervals of 8 hours for 1 day. The Mango Seed Kernels were then removed and boiled.

Boiling of Mango Seeds Kernel

The Mango Seeds Kernel was then put in boiling water at the rate of 100g per litre of water at 100°C temperature for 30 minutes. The Mango Seed Kernel was then removed, drained, sun dried, and milled before incorporation into the diets.

Experimental Diets

Four diets were compounded manually. The diets contain 0, 20, 40, and 60% replacement level of proceed mango seed kernel meal for maize coded diets 1, 2. 3 and 4 respectively. The feed were prepared by mixing the various ingredient together at Abubakar Tafawa Balewa University feed mill.

Experimental Design and Management of Birds

A total of thirty two weaner rabbits were used for the experiment. They were randomly assigned into four dietary treatment groups of 8 rabbits per group in a completely randomized design (CRD) consisting of four replicates of 2 rabbits each. Feed and water were provided *ad libitum*

Digestibility Trial

During the seven weeks of the experiment, the weights of the rabbits were measured and a known quantity of feed was given to them. Total droppings from each treatment were collected on daily basis. The digestibility trial lasted for one week. From the total droppings voided, samples were taken for proximate analysis.

Economic analysis

The economics of production of weaner rabbits on the experimental diets were calculated base on the price of the ingredients in the market as at the time of the experiment

Determination of the Proximate Composition of Mango Seed Kernel

The proximate composition (Table 2) was obtained by analyzing the different samples of Mango seeds kernel according to the methods described by AOAC(1990).

Results and Discussions

Proximate Composition of Processed Mango Seed Kernel

The proximate composition of the test ingredients is presented in Table 2. The PMSKM used in the study contained 89.61, 2.23, 5.39, 9.62 and 3.87% for dry matter, ash, crude protein, ether extract and crude fibre respectively This contradict the values reported by Faniyi (1997) and El-Alail *et al*. (1976).

Performance of Weaner Rabbit Fed PMSKM Based Diets.

The results of performance of Weaner rabbits fed processed mango seed kernel meal (PMSKM) as replacement for maize were as presented in table 3. The performance characteristics in this experiment revealed that the replacement of maize by processed mango seed kernel meal at 0, 20, 40 and 60% recorded on average daily feed consumption of 52.98, 53.06, 54.45 and 55.05 (g) for treatment 1, 2, 3 and 4 respectively. There was no significant different amongst the treatment means. This agrees with the finding of Saleh *et al.*, (2015) and Shitu et al., (2013). They reported that the average daily feed intake were not significantly different (P<0.05) for weaner rabbit feed mango seed kernel meal and for growing crossbreed rabbit fed PMSK meal respectively. The result also revealed that there was no significant different (P>0.05) in the average daily weight gain of rabbits fed PMSKM as replacement for maize. The values ranged from 15.74-16.19g obtained in this study is higher than 10.1g reported by Adama and Nma (2002) when groundnut leaves were fed to rabbits. This also confirms the report of (Saleh *et. al*., 2015) and (Fayeye and Joseph, 2004). Shitu *et.al*; (2013) reported no significant effect on growing crossbreed rabbits fed processed mango seed kernel meal. The non significant effect of processed mango seed kernel meal based diets on feed conversion ratio among the treatments means contradicts the findings of Diarra *et.al;* (2004) but similar to the finding of Saleh *et al*., (2015).

Nutrient Digestibility of Rabbits Fed PMSKM Based Diets

The results of nutrients digestibility of weaner rabbits fed processed mango seed kernel meal (PMSKM) as replacement for maize were as presented in table 4. The dry matter digestibility varied from 69.09% to 72.37% in diet 1 and 4 respectively. All the DMD observed were significantly difference (P>0.O5) among the treatments. Also crude protein digestibility, there was significant difference (P>0.O5) between the treatments. The highest CPD of 81.13% was obtained in diet 3 and the lowest of 79.07% in diet 2. For ether extract digestibility also there was significant difference (P>0.O5) among the treatments. The highest EED of 97.28% was obtained in diet 4 and the lowest of 96.94% in diet 1. There was significant difference (P>0.O5) among the treatments. Highest CFD of 57.82% was obtained in diet 4 and lowest of 50.36% in diet 1. However, the ash digestibility observed range between 79.28% and 81.51% in diets 3 and 4 respectively. Also there was significant difference (P>0.O5) among the treatments. Although the digestibility values are too close to each other, the significant differences among the dietary treatment may be due to the variation of inclusion level of mango seed kernel meal in the diets.

Economic Analysis of Weaner Rabbit Fed PMSKM Based Diets.

Economic analysis of weaner rabbit fed varying level of processed mango seed kernel meal shown in table 5. Feed cost (₦/kg) decreased with increasing level of processed mango seed kernel meal in the diets, the values range from ₦87.50/kg for diet 1 (0% PMSKM) to ₦83.75/kg for 4 (60% PMSKM). This showed that mango seed kernel meal based diets are cheaper than the control diet. This also confirms the report of (Saleh *et. al*., 2015) reported decreased in feed cost (₦/kg) with increasing level of mango seed kernel meal for maize. The cost (₦) of total feed consumed equally decreased with increasing level of processed mango seed kernel meal from ₦269.50 in control diet to ₦252.42 in diet 3. The feed cost (₦/kg gain) was found highest in diet 1 (0% PMSKM) having ₦302.81 and lowest in diet 3 (100% MSKM) having ₦280.47. This showed that feed cost decreased per kilogram gain with increasing level of mango seed kernel meal for maize up to 40% level of inclusion. This also agreed with the finding of Shitu *et.al;* (2013) which reported similar trend on rabbits. However, highest cost saving was recorded in diet 3 (40% PMSKM).

Conclusion and Recommendation

It can be concluded that processed mango seed kernel meal can be use to replace maize in the

diet of weaner rabbits up to 40% level of inclusion as an energy source without any negative effect on their performance and nutrients digestibility with concomitant reduction in cost, thereby reducing competition and improving consumer access to animal protein.

Table 1: Ingredients and Percentage Composition of Experimental Diets

	Diets			
Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**
Maize	31.32	25.06	18.79	12.53
Soya bean	17.98	17.98	17.98	17.98
MSKM	0.00	6.26	12.53	18.79
Maize brand	25.00	25.00	25.00	25.00
Groundnut hay	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25
Total (%)	**100**	**100**	**100**	**100**
Calculated composition (%)				
Crude protein	18.00	17.85	17.69	17.55
Crude fiber	9.33	9.46	9.49	9.57
ME (kcal/kg)	2552.66	2542.84	2532.99	2523.16

Table 2: The Proximate Composition of Mango Seed Kernel Meal

Parameters (%)	**Mango Seed Kernel Meal**
Dry matter	89.61
Ash	2.23
Crude protein	5.39
Ether extracts	9.62
Crude fibre	3.87

Table 3: Performance of Weaner Rabbit Fed Processed Mango Seed Kernel Meal Based Diets

	Dietary treatment					
Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**	**SEM**	**LOS**
Average initial weight (g)	500.00	500.00	512.50	518.7	61.18	NS
Average final weight (g)	1393.75	1400.00	1412.5	1406.25	21.35	NS
Total weight gained (g)	893.75	900.00	900.00	887.50	20.40	NS
Average daily feed intake (g)	52.98	53.06	54.45	55.05	1.57	NS
Average daily weight gain (g)	15.74	15.96	16.07	16.19	0.75	NS
Feed conversion ratio	3.29	3.31	3.45	3.48	4.51	NS

LOS: Level of significance

NS: Non significance difference (P<0.05)

Table 4: Nutrient Digestibility of Rabbits Fed Processed Mango Seed Kernel Meal Based Diets

	Dietary Treatment					
Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**	**SEM**	**LOS**
Dry matter Dig. %	69.09^{d}	71.67^{b}	71.37^{c}	72.37^{a}	0.07	*
Crude protein Dig. %	79.38^{c}	79.07^{d}	81.13^{a}	79.82^{b}	0.07	*
Crude fiber Dig. %	50.36^{d}	57.30^{b}	56.42^{c}	57.82^{a}	0.09	*
Ether extract Dig. %	96.94^{c}	97.13^{b}	96.89^{d}	97.28^{a}	0.06	*
Ash Dig. %	80.15^{b}	79.28^{d}	81.51^{a}	79.41^{c}	0.07	*

^{abc}: means within the same row bearing different superscript are significantly different (P<0.05)

SEM: Standard Error of Mean

LOS: Level of significance

Table 5: Economic Analysis of Weaner Rabbit Fed Processed Mango Seed Kernel Meal Based Diets

Parameters	**T_1 (0%)**	**T_2 (20%)**	**T_3 (40%)**	**T_4 (60%)**
Total feed intake (kg)	3.08	2.96	2.97	3.05
Feed cost (₦/kg)	87.50	86.25	84.99	83.75
Total feed cost (₦)	269.50	255.30	252.42	255.44
Total weight gain (kg)	0.89	0.90	0.90	0.89
Feed cost (₦/kg gain)	302.81	283.67	280.47	287.01
Cost saving (₦)	-	19.14	22.34	15.80

References

Adama, T. Z. and Nma Y. B. (2002). An evaluation of feeding value of five types of forages fed to growing rabbits. *Journal of sustainable Tropical Agricultural Resources*. **4**: 45-49.

Akimmutimi, A. H. (2008) Evaluation of sword bean (canbaliaaladiate) as an alternative feed Resources for broiler chickens**.** Ph.D. thesis Michael okpara University of Agriculture Umudike, 10-26.

AOAC (1990). Official Methods of Analysis (15th Edition). Association of official analytical chemist,Washington D.C, USA.

Arogba, S. S. (1997). Physical chemical and functional properties of Nigerian Mango *(Mangifera indica)* kernel and its processed flour. J SL: Food Agric. **73**: 321-328.

Diarra, S. S., Saleh, B., Kwari, I. D and Igwebuike, J. U (2004). Evaluation of boiled mango kernel as energy source by broiler chickens in the semi-arid zone of Nigeria. *International Journal of Science and Nature* **2**(2): 270-274.

El Alaily, H. A., Anwar, A., El Banna, I. (1996). Mango seed kernel as an energy source for chicks. *Broiler Poultry Science*. **17**:129-133.

Faniyi, G. F. (1997). Effect of Including rarrciled mango seed kernel meal in broiler starter. *Journal of Proffesional Teacher trainers*. **2** (1): 62-68.

Farinu, G. O, Odunsi A. A. and Togun V.A. (1999). Effect of varying levels of mango-seed kernel meal on growth performance, nutrient digestibility and blood components of weaner Rabbits. *Tropical Journal of animal science.* **3**: 119-125.

Fayeye, T. R. and Joseph, K. (2004). Effect of Dietary Dehulled, Sundried Mango kernel meal on Growth and Carcass Characteristics of Fryer Rabbit. *Journal of Agricultural Research and Development* **3**: 129-137.

Olorede, B. R., Sadu, I., Abdurahim, O. P., Ajagbonna and Akinloye, O. A. (2011). Bloodchemistry and histopathology of cockerel fed cassava flour ASAN Proceeding of the 8th World rabbit conference, 7-10.

Saleh, N., Bello K. M., and Muhammad A. S. (2015). Effects of Replacing Maize with Mango Seed Kernel Meal on Performance, Carcass Characteristics and Economic of Production of Weaner Rabbits. *International Journal of Geology, Agriculture and Environmental Sciences.*3:

Shittu , M. D., Olabanji R. O., Ojebiyi O. O., Amao O.A. and Ademola S.G. (2013). Nutritional Evaluation of Processed Mango *(Mangifera Indica* - Kent) Seed Kernel Meal as Replacement for Maize in the Diet of Growing Cross bred Rabbits. *Online Journal of Animal and Feed Research.* **5**: 210-215.

Taiwo, A. A., Adejuyigbe, A. O., Asebowale, A. E., Oshotan, J.S. and David O.O. (2005). Performance and Nutrient digestibility of weaned rabbits fed forage supplemented with concrete. *Nigerian Journal of Animal Production* **32** (1):74 – 78

Pig population and distribution pattern in Ibadan/Ibarapa area of Oyo state

Sosina, Adedayo Olalekan
Department of Animal Science, University of Ibadan, Ibadan
Corresponding Address: dayososina@gmail.com

Abstract

Pig production in the rural areas has not been linked with the market thus affecting pig business enterprises adversely. Many had opined that the various challenges confronting pig production to inadequate capital, land, etc. However, information on pig population and distribution is scanty, thus the need to investigate pig population and distribution in the Ibadan/Ibarapa area of Oyo state. A three-stage sampling technique was used to purposively select 180 respondents, nine respondents per village, three villages per cell and three cells randomly selected in the study area were evaluated. Parameters measured were average litter size (Tropical Livestock Unit, TLU), the pig distribution pattern of pigs across Oluyole, Ona-ara, Akinyele, Egbeda, Ido and Ibarapa East locations. The ARC-GIS software processed the Global Positioning Systems (GPS) data of the pig population using the ARC-GIS model 10.0. Data analyzed with descriptive statistics. The mapping of the pig farmers' distribution was done using the spatial analytical tool of the GIS. The farmers' average litter size of pigs (TLU) ranged 2 (Ona ara and Akinyele) to 100 (Egbeda). The average litter sizes (TLU) were 5, 20 and 40 in Oluyole, Ibarapa East and Ido, respectively. Only Egbeda had big piggery farms with an average size ranged above 20 piglets. The large pig production in Egbeda was influenced mainly by the abundance of agro-industrial by-products and feed resources. Off-takers of pig production value chain should focus on Egbeda for the supply of pigs with the advantage of resources and other production factors.

Key Words: Bioinformatics, ecological zones, marketing, population, pig distribution

Introduction

Sourcing for pigs is a major challenge to business thus adversely affecting marketing and profitable production, especially in the rural areas. There is a serious disconnect between production and marketing in the pig value chain system. There was no concerted effort towards the linkage of production to market to stimulate production efficiency among pig farmers in the Ibadan/Ibarapa area of Oyo state. The spatial distribution and population of these farmers make access to market a herculean task thus making the study relevant. There is a need to identify the location of the livestock producers for effective agricultural planning and policy implementation. Geographic Information System (GIS) is a computerized database management system for capture, storage retrieval, manipulation, analysis and display of spatial information (Gebber and Adamchuk, 2010). Information on the location and livestock production can be collected using spatial analytical tools of GIS (Sosina, 2017). Also, it forms a reliable data for agricultural planning and policy formulation (Rilwani and Ikhuoria, 2006).

In Nigeria, the relevance of space technologies in technological advancement becomes more pronounced after the launch of Nigeria SAT-1 in March 2003 in Siberia, Russia (Nigeria Sat 1 report, 2003). The high-resolution satellite was only useful in taking landmarks and settling boundary disputes (PrecisionAg.com.Org.2003). However in the launch of the low-resolution satellite of Nigeria, SAT-2 in 2005 in Siberia was more relevant to Agriculture (Oyinloye and Oloukosi, 2013). The spatial analytical tool of GIS was used to map poultry farmers in southwestern, Nigeria (Omodele and Okere, 2014) and its relevance in animal production management in Ibadan/Ibarapa area, Oyo state (Sosina, 2017). Olugaza *et al*. (2014) reported the relevance of bioinformatics in diseases epidemiology study among farmers in a rubber plantation in Liberia, Forest Resources (Olatoye and Odutaru, 2013), Land resources (Rilwani and Ikhuoria 2006), Nutrient evaluation for fertilizer application (PrecisionAg.com.Org.2003), Feed Resource management (Babayemi *et al*., 2014) and spatial patterns in crop-livestock evolution pathways in West Africa (Rilwani and Gbekeji, 2009).

It is necessary to provide (production) information about pig business enterprises in Nigeria. Such information is needed for proper planning and regulation of the industry in Nigeria (Rilwani and Ikuoria, 2006). Available data on the current entrepreneurial characteristics and constraints to the robust development of pig business enterprises in Southeastern Nigeria are scanty (RIM, 2010). Hence, the study tries to map the pig production business using the spatial analytical tool to identify the location and population of pigs among farmers in the Ibadan/Ibarapa area of Oyo state.

Materials and Methods

The study took place in the Ibadan/ Ibarapa Area of Oyo State of Nigeria, the area is ethnically heterogeneous with a high concentration of smallholder crop and livestock farmers. Oluyole, Ona-ara, Akinyele, Egbeda, Ido and Ibarapa East LGA locations were purposively selected for the study. The Global Positioning Systems (GPS) of the farmers' location, livestock population, and distribution were recorded. The recorded GPS data of pig respondents were transferred into the ARC-GIS. The ARC-GIS software processed the data into location using the ARC-GIS model 10.0 from the GIS unit of the Department of Geography, University of Ibadan. Data analyzed using descriptive statistics.

Results

The pig farmers' locations were mapped using the spatial analytical tool of the GIS (as in Fig.1) and the average litter size of pigs both indigenous and improved strain kept. The average litter size of pigs among respondents ranged from 2 to 100 as shown in Fig.2. Egbeda had the highest average litter size of 100 while the lower values were found among farmers in Ona-ara and Akinyele. Although, the average litter sizes of 5, 20 and 40 were found among farmers in Oluyole, Ibarapa East and Ido, respectively. The large population of pig farmers was attributed to other production factors aside from pig's omnivorous nature. The study showed that piggery business thrived best in Egbeda probably due to the presence of big agro-industrial companies that produce major feed ingredients for pig production. With the little sales from rural markets and patronage from eateries, pig business is on the increase in the urban areas which slightly favored Egbeda.

Discussion

The pig distribution patterns across the study areas result could be due to the management systems adopted by farmers of the semi-intensive and extensive systems of production practice. This agreed with Bolorunduro *et al.* (2004) who supported commercial pig production in the humid tropics. The population, distribution patterns, breeds and classes of the pigs identified could be important for policy framework. This agreed with Gebber and Adamchuk (2010), Oyinloye and Oloukosi (2013) and Olugaza *et al*. (2014) that reported relevance of bioinformatics data in livestock production. Moreover, off-takers of the pig production value chain should look in the direction of Egbeda for the supply with favorable climate and other production factors. The government should plan for policies and programs that could enhance the increase in the production of pigs in the study areas. Also, it will assist with interventions necessary to sustain the pig value chain program through increased funding and livestock extension. This agreed with Babayemi *et al*. (2014) that reported the need for more agricultural interventions.

Conclusion

The use of bioinformatics can link pig farmers to market easily and interventions from the government and policy makers reach farmers efficiently.

References:

Babayemi, O. J., A. Samireddypalle, A.O. Sosina, A. A. Ayantunde, I. Okike, and A. J. Duncan

(2014) Characterization of farming and livestock production systems using the feed assessment tool (FEAST) in selected local government areas of Osun State, Nigeria. Research program on integrated systems for the humid tropics ILRI Technical Report, December 2014

Bolorunduro, P.I, I.E.J. Iwuanyanwu, S.O. Aribido and A.O.K. Adesehinwa (2004) Effectiveness of extension dissemination approaches and adoption levels of livestock and fisheries technologies in Nigeria Food, Agriculture and Environment Vol.2 (1): 298-302.

Gebber, R. and V. I. Adamchuk (2010) Precision Agriculture and Food Security Science: 327-828.

NigeriaSat-1 (2003): Images and Operations of Nigeria earth observations satellite: NigeriaSat 1.

Olatoye, T.A, and G.O.Odularu (2013) Applications of remote sensing and geographic information systems technologies in livestock management. A paper presented at the Conference of the International Livestock Research Institute (ILRI), held at Hotel Africana Conference Centre, Kampala, Uganda on September 9-11, 2013.

Olugasa, B. O., J.B. Dogba, B. Ogunro, E. A. Odigie, J. Nykoi, J. F. Ojo, O. Taiwo, A. Kamara, C. K. Mulbah and A. J. Fasunla (2014) The rubber plantation environment and Lassa fever epidemics in Liberia, 2008–2012: A spatial regression Spatial and Spatio-temporal Epidemiology.11.pp163- 174

Omodele, T. and I. A. Okere (2014) GIS application in poultry production: Identification of layers as the major commercial product of the poultry sector in Nigeria Livestock Research for Rural Development, 26(5) pp.122-124

Oyinloye, R.O, and J. O. Oloukosi, (2013) Spatio-temporal assessment and mapping of the Land use Land cover Dynamics in the Central Forest Belt of Southwestern Nigeria. Res. J. Environmental Earth Sci.4. (7):720-730

PrecisionAg.com.Org (2003).Introduction.fromPrecisonag.com/htm1/introduction.html

Rilwani, M. L. and I. A. Ikhuoria (2006) Precision Farming with Geoinformatics: A New Paradigm for Agricultural Production in a Developing Country. Transactions in GIS, 10 (2): 177 – 197

Rilwani, M. L. and J. O. Gbakeji (2009) Geo-informatics in Agricultural Development: Challenges and Prospects in Nigeria J Soc Sci, 21(1): pp 49-57

RIM (2010) RIM (Resource Inventory and Management), Nigerian National Research Survey (Vol 4). Report by Resource Inventory and Management Limited (RIM) to FLD, Abuja, Nigeria

Sosina, A.O. (2017) Assessment of crop residues as feed resources for crop-livestock production Systems in the Ibadan/Ibarapa area of Oyo State, Nigeria. A Ph.D. thesis submitted to the Department of Animal Science, University of Ibadan, Nigeria.

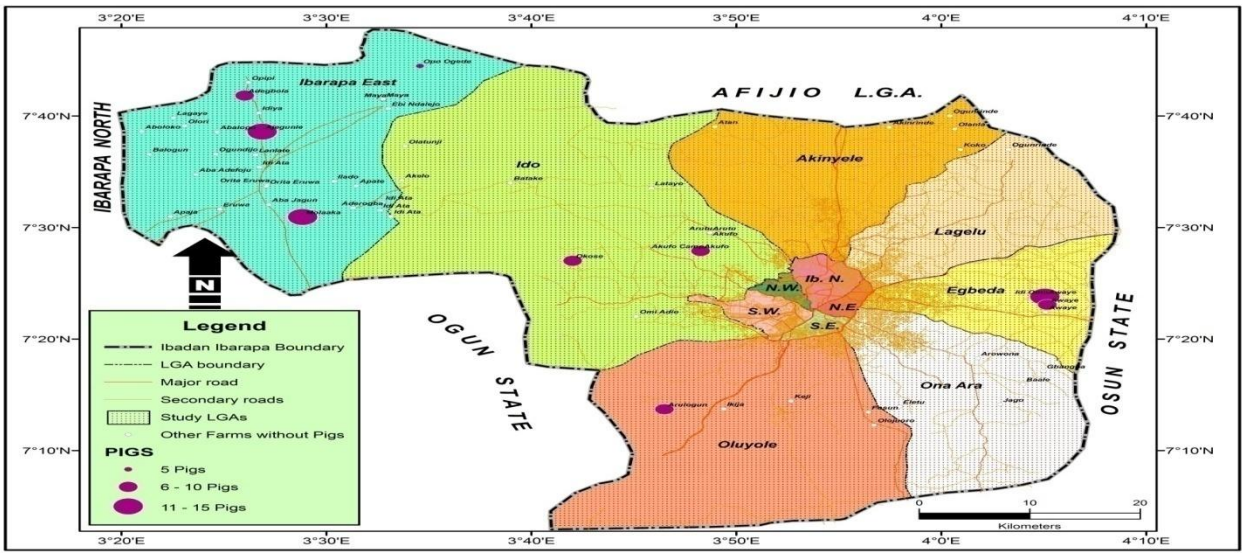


Fig. 1: GIS mapping of pig population and distribution in Ibadan/Ibarapa area

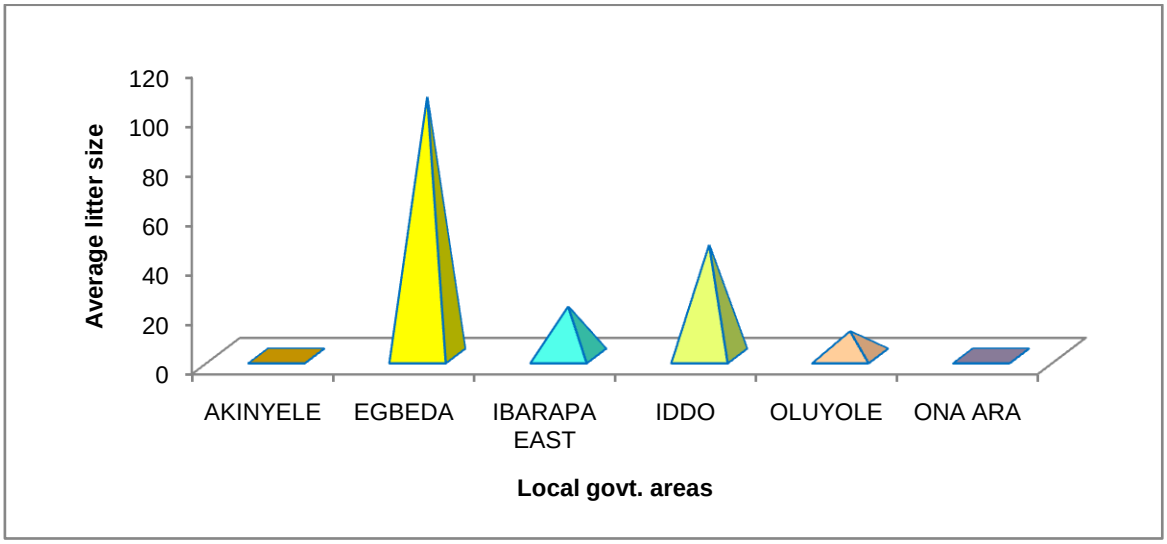


Fig.2: Graphical representation of pig production distribution in Ibadan/Ibarapa area

Growth Performance of Male Grower Rabbits Fed Diets with Iburu offal Replacing maize as energy Source

Sudik, S. D., Bagudu, I. A., Maidala, A. and Lawan, A.
Department of Animal Science, Federal University, Gashua, Yobe State, Nigeria
Corresponding author: davidsudik@fugashua.edu.ng Mobile No: +2348065633451

Abstract
A six week experiment was conducted to determine the growth performance of male grower rabbits fed diets with iburu offal replacing maize as energy source. Five diets were formulated with iburu offal (IO) replacing maize by 0%, 15%, 30%, 45% and 60%, respectively. Fifty (50) male grower rabbits were allotted to the 5 diets, 10 rabbits per diets replicated 10 times, and each replicate had one rabbit. The design used was a completely randomized design. The results showed that rabbits fed 30% and 45% IO had higher (p<0.05) total weight gain (2.10±0.12 and 2.08±0.08kg, respectively) *and better (p<0.05) FCR (2.20±0.18 and 2.16±0.10, respectively) similar to those fed 0% IO (2.18±0.27) while rabbits fed 15% and 60% IO had* lower total weight gain (1.68±0.12 and 1.68±0.09kg, respectively) and *poor FCR (2.33±0.13 and 2.66±0.13,* respectively). *It can be concluded that IO can replace maize in male grower rabbit's diets at 30-45% without negative effect on performance.*

KEYWORDS: Rabbits, Iburu offal, Maize, Performance

Introduction
In a quest to reduce the high cost of feed with the resultant high cost of livestock production, many agro-by-products have been used to substitute the conventional ingredients in the diets of rabbits (Safwat *et al*., 2014). Sudik *et al*. (2019) tested soybean curd residue up to 15%, Lounaouci-Oyed *et al*. (2008) used brewer's dried grains up to 30%, Onakpa *et al*. (2006) used maize bran up to 35% and Bhatt *et al*. (2005) used rice bran was used at 5%, without negative effect on performance of rabbits. However, many more alternative ingredients have not been identified as animal feed resources. One of such is iburu offal (IO), a by-product obtained from the milling of iburu gains. Iburu (black fonio) belongs to the family *Poaceae* and genus *Digitaria*. It is a popular staple food grown across West Africa and in Nigeria it is grown in the central zone and dominantly in Plateau and Bauchi States (Gyang and Wuyep, 2005). Iburu offal has been reported to be is rich in nutrients such that for 100g it contains 6.52% DM total ash, 12.49% DM crude protein, 4.15% DM ether extract, 10.54% DM crude fibre, 66.30% DM nitrogen free extract, 0. 05% calcium, 0.09% phosphorus, 3.25g/16gN lysine and 3.60g/16gN methionine (Sudik, 2016). Despite its high nutrient content, it is usually thrown as waste untapped. Incorporating IO into animal feeds will not only provide alternative feed resources or increase value-added-chain but also, help cleaning the environment. The objective of this paper was to determine the performance of male grower rabbits fed diets with IO replacing maize as energy source.

Materials and Methods
Location of the study
The experiment was conducted at the Rabbitry Unit of the Livestock Farm Complex, College of Agriculture, Garkawa, Plateau State, Nigeria. Garkawa lies within latitude 8.8955^{o}N and longitude 9.4537^{o}E. The annual average temperature is usually about 27.7^{o}C and annual average precipitation is usually about 1178mm (Wikipedia, 2019).

Formulation of experimental diets
A basal diet (D1) with 16.54% crude protein meeting the nutrient requirements of male grower rabbits as described by Szendro and Dalle Zotte (2011) was formulated. Thereafter, 4 other diets (D2, D3, D4 and D5) were formulated replacing maize with IO by 15%, 30%, 45% and 60%, respectively (Table 1).

Table 1: Gross composition and calculated values of the experimental diets

Ingredients	D1 0% IO	D2 15% IO	D3 30% IO	D4 45% IO	D5 60% IO
Maize	13.06	11.10	9.14	7.18	5.22
Iburu offal	0.00	1.96	3.92	5.88	7.84
Rice offal	3.73	3.73	3.73	3.73	3.73
Palm kernel meal	2.5	2.5	2.5	2.5	2.5
Soybean meal (42)	2.5	2.5	2.5	2.5	2.5
Groundnut cake	1.38	1.38	1.38	1.38	1.38
Fish meal	0.5	0.5	0.5	0.5	0.5
Bone meal	0.63	0.63	0.63	0.63	0.63
Oyster shell	0.25	0.25	0.25	0.25	0.25
Premix	0.06	0.06	0.06	0.06	0.06
Methionine	0.03	0.03	0.03	0.03	0.03
Lysine	0.03	0.03	0.03	0.03	0.03
Salt	0.08	0.08	0.08	0.08	0.08
Soy oil	0.25	0.25	0.25	0.25	0.25
Total	25.00	25.00	25.00	25.00	25.00
Crude protein	16.54	16.89	16.94	17.08	17.31
Energy (kcal/kg)	2830.12	2824.24	2800.1	2790.11	2776.01
Calcium	1.03	1.04	1.04	1.05	1.05
Average phosphorus	0.66	0.66	0.67	0.67	0.69
Lysine	1.27	1.29	1.3	1.35	1.35
Methionine	0.74	0.74	0.75	0.75	0.75
Crude fibre	5.02	7.11	8.45	9.19	9.76

IO = iburu offal

Experimental design

The design used was a completely randomized design (CRD).

Source and management of experimental rabbits

Fifty (50) male grower rabbits about 5 weeks of age were purchased from a reputable Farm in Jos, Plateau state. Immediately the rabbits arrived at the farm glucose was added to their drinking water and a plain food mainly of maize and fresh leaves of *Moringa oleifera* and *Tridax procumbent* were given to them for three days to reduce the stress incurred from transportation and to acclimatize them to the environment. Thereafter, they were randomly allotted into 5 dietary treatments, group weight were balanced to ensure similar weight between treatments. Each dietary treatment had 10 rabbits and each served as replicate unit. They were individually kept in a hutch equipped with feeder and drinker. Feed and water were provided *ad libitum*. Antibiotics, coccidiostats and anti-stress were occasionally administered as prophylactic measures. The experiment lasted for 6 weeks.

Data collection

At the beginning of the experiment, each rabbit was weighed to determine the initial weight and thereafter, they were weighed weekly to monitor weight changes. Total weight gain (TWG) was calculated by subtracting the initial weight from the final weight. Average daily weight gain (DWG) was calculated by dividing the TWG by 42 days (experimental period). Feed consumption was determined daily by subtracting feed leftover from feed supplied. Total feed intake (TFI) was the

cumulative of daily feed consumed. Average daily feed intake was calculated dividing TFI by 42 days. Feed conversion ratio (FCR) was calculated by dividing feed consumed by weight gain.

Data analysis

Data generated were subjected to Analysis of Variance (ANOVA) using SAS (1999) Statistical Package Version 9 and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955) at 5% level of probability.

Results

Table 2 shows the growth performance of male grower rabbits fed diets with iburu offal. Rabbits fed 30% and 45% IO significantly ($p<0.05$) had higher total weight gain (2.10±0.12 and 2.08±0.08kg, respectively) and better FCR (2.20±0.18 and 2.16±0.10, respectively) compared with those fed 0% IO (2.10±0.18kg and 2.18±0.27, respectively) while rabbits fed 15% and 60% IO significantly ($p<0.05$) had lower total weight gain (1.68±0.12 and 1.68±0.09kg, respectively) and poor FCR (2.33±0.13 and 2.66±0.13, respectively). Other parameters were not significantly ($P>0.05$) affected.

Table 2: Performance of male grower rabbits fed diets with soybean curd residue

Parameters	D_1 0% IO	D_2 15% IO	D_3 30% IO	D_4 45% IO	D_7 60% IO
initial weight (kg)	0.73±0.02	0.78±0.02	0.75±0.02	0.76±0.02	0.74±0.02
Total weight gain (kg)	2.10±0.18^{a}	1.68±0.12^{b}	2.10±0.12^{a}	2.08±0.08^{a}	1.68±0.09^{b}
Daily weight gain (kg)	0.05±0.00	0.04±0.00	0.05±0.00	0.05±0.00	0.04±0.00
Total feed intake (kg)	4.58±0.70	4.61±0.30	4.62±0.04	4.60±0.04	5.00±0.03
Daily feed intake (kg)	0.11±0.00	0.11±0.00	0.11±0.00	0.11±0.00	0.13±0.00
Feed conversion ratio	2.18±0.27^{b}	2.33±0.13^{ab}	2.20±0.18^{b}	2.16±0.10^{b}	2.66±0.13^{a}
% Mortality	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Values are average of 10 male grower rabbits. IO = iburu offal

Column with difference superscripts are significance difference ($P<0.05$).

Discussion

The higher growth weights and better FCR observed between rabbits fed 30%-45% IO and those of control (0% IO) indicates that both rabbits were exposed to similar dietary nutrient composition while the poor FCR observed in rabbits fed 15% and 60% may probably means the diets were not well equipped to support proper growth rate. In the case of the rabbits fed 60% IO the poor FCR may be attributed to the higher fibre content (Table 1). Even though there was no significant difference in feed intake, however, the rabbits fed 60% IO were probably eating more feed to gain weight. This result agrees with Aduku (1993) who reported that higher fibre content in diets reduces nutrients availability to animals thereby animals tend to eat more feed to meet up energy requirements.

Conclusion

In this study maize was replaced with IO in male grower rabbits' diets up to 60% and the rabbits fed 30-45% IO had similar total weight gain and feed conversion ratio with those fed control (0% IO), therefore 30-45% IO is recommended for male grower rabbits.

References

Aduku A.O. 1993. Tropical feedstuffs analysis table. Department of Animal Science, Faculty of Agriculture, Alhmadu Bello University, Zaria pp: 1-2

Bhatt R.S., Shama S.R., Singh U., Kumar D. Risam K.S. 2005. Effect of substituting groundnut cake with different levels of rice bran on growth and wool production of German Angora rabbits. *World Rabbit Science*, 13:179-187.

Duncan O.B. 19955. Multiple Range Test F-tests. *Biometrics*, 11: 1-42.

Gyang, J. D. and Wuyep, E. O. (2005). Acha: The grain of life. A Bi-annual publication of the Raw Materials Research and Development Council, 6 (1): 39-41.

Lounaouci-Oyed G., Lakabi-Ioualitene D., Berchiche M., Lebas F. 2008. Field beans and brewers's grains as protein source for growing rabbits in Algeria: first results on growth and carcass quality. 9th World Rabbit Congress – June 10-13, 2008-Verona- Italy: 723-727.

Onakpa M.M., Onuh F. Gode D.S. 2006. Effect of graded levels of maize bran on the growth and carcass characteristics of weaned rabbits, *ARPN J. Agric. Biol. Sci*., 6 (5): 45-48.

Safwat A.M., Sarmiento-Francoa I., Santos- Ricalde R.H. 2014. Rabbit production using local resources as feedstuffs in the tropics. *Tropical and Subtropical Agroecosystems*, 17 : 161-171.

SAS Institute. SAS START Users Guide: Statistics; Version 9 Edition. SAS Institute, Inc., Cary, North Carolina, U.S.A.1999

Sudik S.D. 2016. Nutrient distributions and biochemical studies of acha (*digitaria spp*) in infant weaning foods and poultry diets. Ph. D Thesis, Federal University of Technology, Akure, Nigeria, pp. 1-306.

Sudik, S. D., Ajiji, I. and Amaza, I. B.(2019). Response of grower rabbits fed soybean curd residue-based diets. *ASN 53rd Annual Conference Proceedings* Building a Resilient and Sustainable Economy through Innovative Agriculture in Nigeria" 53th Annual Conference of Agricultural Society of Nigeria, pp. 156-159.

Wikipedia. 2019. https://en.climate-data.org/africa/nigeria/plateau/garkawa-399975/

PERFORMANCE CHARACTERISTICS OF BOILER CHICKENS FED DIET CONTAINING DIFFERENT OIL TYPES.

Tauhid, G.., Y.S. Kudu.., and B.A. Ayawale.

Department of Animal Production Technology
Federal University of Technology, P.M.B 65 Minna, Niger State

ABSTRACT

This study was carried out at the poultry unit of the Teaching and Research Farm, Department of Animal Production, Federal University of Technology Minna, Nigeria. A Total number of 180 day old chicks were used for the experiment. The birds were randomly allotted into five treatment of three replicate consisting of 12 birds in a complete randomized design (CRD). T_1 (birds fed control diet), T_2 (were birds fed 4% palm oil), T_3 (were birds fed 4% palm kernel oil), T_4 (were bird fed 4% ground nut oil) and T_5 (were bird fed 4% shea butter oil). The experiment lasted for 8 weeks. The result showed that at starter phase the final weight, body weight gained and feed intake were influenced (P<0.05)by the inclusion of oils while feed conversion ratio, protein and energy efficiency ratio were not significantly affected (P>0.05). The inclusion of 4% groundnut oil and shea butter oil (T_4 and T_5) showed significantly better growth performance in terms of final weight (214.43g) and (237.43g) compare to T_3 (203.0g). At the finisher phase no significant (P>0.05) difference was recorded in final weight, body weight gain, feed conversion ratio, protein and energy efficiency ratio with exception of the average feed intake which was significantly (P<0.05) affected by the inclusion of oils, with control and treatment T_5 showed best result (488.15g) and (453.74g) compare to those in treatment 3 and 4 (418.06g) and (441.96g). It can therefore be concluded that broiler chicken could tolerate 4% inclusion level of the various types of oil used in this research work without any adverse effect on their growth performance.

Key Words: Broiler chicken, palm oil, palm kernel oil, groundnut oil and shea butter oil.

INTRODUCTION

Poultry feeding is one of the most important aspect of production because feed cost alone account for 65 - 75% of the total cost of egg and meat production (McNab, 1999). Therefore, for profitable poultry rearing, provision of economical and balance diet is must. Use of oil as a source of energy on broiler fed has many advantages such as increasing the energy content of diet, addition of oil in broiler diet also provides increase growth rate, increase rate of gain, increases feed efficiency and also minimized the dustiness of feeds. Poultry farmers in Nigeria continue to experience a rise in the production cost due to the continuous increase in feed cost. (Ajighjigh *et al., 2018*). The insufficient know – how and the lack of alternatives and a more cost efficient feed stuff as well as the struggle between man and animals for most traditional feed stuff has been established as the main cause of increase in cost of production (Afolayan *et al., 2012*). This current study was therefore carried out to examine the effect of supplementing broiler chickens diets with different oil types at the same level of inclusion on the performance of broiler chickens.

MATERIALS AND METHODS

The research was conducted at Teaching and Research Farm, Federal University of Technology Minna, Gidan Kwano Campus Niger State. Minna located within the Latitude 09^0 31' 18.2"N and Longitude $6^0$27'40'E with an elevation that ranges from 230 – 250 m. The area of study lies within the Southern Guinea Savanna of Nigeria. The sub humid climate of the region has an average yearly rainfall of 1338mm, dry season of about 5 month and average temperature of about 30^0 c (FUTMIN, 2012). A total of 180 day old Ross 308 chicks were sourced from Agrited Farm Limited Ibadan, Oyo State and were used for the study. Five (5) nitrogenous and isocaloric diets were formulated using different oil types at 4% inclusion levels T_1 (0% oil), T_2 (4% palm oil), T_3 (4% palm Kernel oil), T_4 (4% groundnut oil) and T_5 (4% shea butter oil). The birds were randomly allotted to the treatment groups Each treatment was assigned 36 birds with three replicate of 12 birds in a complete randomized design (CRD) arrangement and The experiments lasted for eight (8) weeks.

RESULTS AND DISCUSSION

At the starter phase (table I) the result showed no significant difference (P>0.05) in initial body weight, protein and energy efficiency ratio and feed conversion ratio. The birds fed 4% shea butter oil (T_5) showed significance difference (P<0.05) over those fed 4% palm kernel oil (T_3) in the body

weight gain (155.97g) and average daily body weight gain (5.57g) but (T_5) 4 % shea butter oil was statistically the same with control (T_1) and those fed 4% groundnut oil (T_4). This result agree with the report of Harms e*t al.,* (2000) who reported that addition of 3% - 6% shea butter oil in broiler diet increases growth performance.

There was no significance different (P>0.05) between T_2 and T_5 in (Table 1) with reference to body weight gain, this agree with Ayed *et al.,* (2015) who reported that addition of palm oil to broiler diet increases their body weight gain, similar report has been documented by Yamany *et al.*,(2008) that 4% inclusion of shea butter oil tend to improve weight gain in broiler chickens as reported in this experiment. There was no significance difference (P>0.05) observed at the finisher phase of the experiment in average body weight, final body weight and feed conversion ratio, the only difference observed was at the average feed intake (Table 2) T_3, 4% palm kernel oil diet recorded the lowest value of feed intake (418.06g) which does not reflect on the feed conversion ratio. The non significance difference (P>0.05) observed at finisher phase may be due to ability of chickens to utilize dietary oil in diets which support the study of Firman *et al.,* (2008) who compared oils source such as soy bean oil, yellow grease and palm oil in ratio of broilers from hatch to market and reported that older chickens digest more dietary oil than the younger chickens.

It can therefore be concluded that broiler chicken could tolerate 4% inclusion level of the various types of oil used in this research work without any adverse effect on their growth performance.

Table 1: performance characteristics of broiler chickens fed diet containing different oil types at starter phase.

	TREATMENTS						
Parameters	T_1	T_2	T_3	T_4	T_5	SEM	LS
Initial Body weight (g)	46.47	46.77	47.53	46.90	47.73	0.28	NS
Final Body Weight (g)	229.74^{ab}	217.70^{ab}	203.0^{b}	214.43^{a}	237.43^{a}	4.46	*
Body Weight Gain (g)	183.28^{a}	170.93^{ab}	155.97^{b}	167.20^{ab}	189.70^{a}	4.39	*
Average weekly body weight gain	45.82^{a}	42.73^{ab}	38.99^{b}	41.80^{ab}	47.43^{a}	1.10	*
Average daily body weight gain	6.55^{a}	6.11^{ab}	5.57^{b}	5.97^{ab}	6.77^{a}	0.16	*
Average feed intake (g)	146.06^{b}	138.80^{bc}	135.02^{c}	138.02^{c}	155.45^{a}	2.21	*
Feed conversion ratio (g)	3.19	3.25	3.47	3.32	3.30	0.05	NS
Protein efficiency ratio	1.48	1.49	1.39	1.46	1.47	0.02	NS
Energy efficiency ratio	0.10	0.10	0.09	0.09	0.10	0.00	NS

Key: a,b,c mean on the same row with different superscript differ significantly (p<0.05)
SEM = standard error of the mean, LS = Level of significance, NS = No Significance,
* = significance difference

Table 2: performance characteristic of broiler chicken feed diet containing different oil types at finisher phase.

	TREATMENTS						
Parameters	T_1	T_2	T_3	T_4	T_5	SEM	LS
Initial Body weight (g)	229.74[ab]	217.70[ab]	203.50[b]	214.10[ab]	235.43[a]	4.46	*
Final Body Weight (g)	1430.80	1522.40	1386.12	1531.47	1340.13	33.15	NS
Body Weight Gain (g)	1201.06	1304.70	1182.62	1317.37	1102.70	34.19	NS
Average weekly body weight gain	167.92	164.06	149.96	155.72	141.48	4.73	NS
Average daily body weight gain	22.99	23.44	21.42	22.24	20.21	0.68	NS
Average feed intake (g)	488.15[a]	443.22[ab]	418.06[b]	441.96[b]	453.74[ab]	7.98	*
Feed conversion ratio (g)	2.93	2.70	2.83	2.88	3.21	0.08	NS
Protein efficiency ratio	1.72	1.90	1.83	1.81	1.60	0.05	NS
Energy efficiency ratio	0.11	0.12	0.11	0.11	0.10	0.00	NS

Key: a,b,c = mean in the same row with different superscript are significantly different ($p<0.05$).

CONCLUSION AND RECOMMENDATION

It can be concluded from the experiment that the inclusion of the four oil types at 4% significantly affected ($p<0.05$) all the growth parameters at starter phase except feed conversion ratio, protein and energy efficiency ratio. While at finisher phase the initial weight and average feed intake were significantly affected. However final weight, body weight gain, feed conversion ratio, protein and energy efficiency ratio were not significantly affected.

It can therefore be recommended that farmers can use shea butter oil at 4% inclusion in the diet of broiler chickens for better growth performance at starter phase.

REFERENCE

AFOLAYANI, S.B., Dafwang, 1.1., Tegbe, T.S.B.& Sekoni, A. (2012) Response of boiler chickens fed on maize – based diets substitude with Graded levels of sweet potato meal. *Asian Journal of poultry science, 6, 15-22*

Ajighjigh, D.T., Mahmud, M. & Waziri D. (2018) Growth performance and Economics of production of broiler chickens fed Agro Industrial by-products. IOSR *Journal of Agricultural and Veterinary Science 11 (10), 87-92*

Ayed, B.H., Hamadi, A. and Monia, E. (2015). Effect of oil supplemented diet on growth performance and meat quality of broiler chickens. *Advance Technical Biology*, 4:1.

El Yamany, A.T., Hewida, M.H., Abdel-Samee, D. & EL-Ghamry, A.A. (2008). Evaluation of using different levels and sources of oil in growing Japanese quail diets. *American- Eurasian Journal of Agricultural Environment*, 3:577-582.

Federal University of Technology, (2012) postgraduate school prospectus federal University of Technology, Minna Niger State

Firman .D. Jeffre, Heinz Leigh and Kamyab, (2008). Comparison of Fat Sources in Rations of Broilers from Hatch to Market Department of Animal Sciences, University of Missouri-Columbia, Campus Drive, 920 E. Columbia, MO 65211, USA. *International Journal of Poultry Science*, 7 (12): 1152-1155, 2008 ISSN 1682-8356.

Harms, R.H., Russelll, G.B., and Sloan, D.R.., (2000). Performance of four strains of commercial layers with major changes in dietary energy. *Journal Application Poultry Reserve*. 9: 535-541.

Mc Nab, J. (1999). Advance in poultry nutrition in the world. In: *proceedings of the seminar and international poultry show. World poultry science association Bangladesh Branch, P-52.*

EFFECT OF REPLACING WHEAT OFFAL WITH RICE BRAN ON CARCASS CHARACTERISTIC AND COST BENEFIT OF BROILER CHICKENS

[1]Usman, Y., [2]Egbo, L.M., [2]Abdulkarim, M.,[2]Doma, U.D.
[1]Department of Animal Health Technology, Bauchi State College of Agriculture, Bauchi State
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

ABSTRACT
A trial was carried out to evaluate the effects of replacing wheat offal with rice bran on the growth performance and carcass characteristics of broiler chickens. The study was conducted at the experimental Unit Poultry Farm of Bauchi State College of Agriculture, Bauchi. A total of two hundred (200) day old broiler chicks were randomly allotted to five (5) dietary treatments containing 0%(T1), 25%(T2), 50%(T3), 75%(T4) and 100%(T5) level of inclusion of rice bran as a replacement to wheat offal. Each treatment was replicated three times with thirteen (13) birds per replicate in a Completely Randomized Design. Feed and water were supplied ad libitum and the experiment lasted for eight (8) weeks. The result show that carcass characteristics, significance difference(P<0.05) existed in live weight (1.59-1.91kg), pluck weight (1.35-1.73kg), eviscerated weight (1.13-1.38kg), carcass weight (0.94-1.28kg), intestinal length (166.67-217.17cm) and pancreas (0.16-0.67g) while dressing percentage and other gut characteristics does not differ. The feed cost in naira/kg body weight gain decreased with increased level of rice bran there by reduced the cost of production up to 20.06%, with the highest cost saving on (T5) 100% inclusion levels (₦52.21). From the experiment conducted, it is therefore concluded that dressing percentage and others gut characteristics were not influenced by the dietary levels of rice bran while Carcass weight, live weight, pluck weight, eviscerated weight, pancreas and intestinal weight were significantly (P<0.05) affected, feed cost in naira per kg body weight gain decreased with an increased levels of Rice bran.

Keywords: broiler chickens, rice bran, cost benefit, carcass

INTRODUCTION
There has been a steady increase in the cost of conventional feed ingredients such as maize, groundnut cake, soybean meal and fish meal in the past years and this has led to increase in the prices of animal protein sources (Adejinmi *et al*., 2007). Several workers have emphasized the need for utilizing alternative feed ingredients removed from human and industrial uses (Fanimo *et al*., 2007; and Nsa *et al*., 2007). There is, therefore, a dire need for the animal nutritionists to seek for alternatives to the inadequate and expensive conventional feedstuffs to forestall an impending serious food crisis. Some workers (Kwari *et al*., 2004; Okah, 2004) have stressed the need for utilization of alternative feed ingredients. To avert the problem of low animal protein deficiency, the production of animals with short generation interval such as poultry is needed. Among the different kinds of livestock that are produced in Nigeria, animal scientists generally agreed that developing the poultry industry is one of the fastest ways of bridging the protein deficiency. According to Ogundipe and Sanni (2002) and FAO (2006) reports poultry is considered to be a mean of livelihood and a way of achieving a certain level of economic independence of Nigeria. This study aimed at evaluating the effect replacing wheat offal with rice bran on Carcass Characteristic and cost benefit of Broiler Chickens.

Materials and Methods
The experiment was conducted at the Poultry Unit of Bauchi State College of Agriculture Bauchi Teaching and Research farm. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East (BSD, 2009).

The room was washed, disinfected and the cemented floor was covered with saw dust. A total of 200 day old chicks were used. The chicks were brooded for seven (7) days. After the brooding period, the chicks were randomly allotted to five experimental treatments, and replicated three times with thirteen (13) birds per replicate. Feed and water were supplied *ad-libitum*. The necessary vaccine such as Infectious bursal disease vaccine (IBDV) and Newcastle disease vaccine (NDV) was carried out at appropriate time.

Five (5) diets were formulated and designed as diets A, B, C, D and E. Diet A was the control (no rice bran). While diets B, C, D and E contain rice bran as replacement for wheat offal at 25, 50, 75 and 100% at level of inclusion respectively. The various diets were compounded manually. The formulated diet contains 23 and 20% crude protein at starter and finisher respectively. The percentage

composition and calculated analysis of experimental diets are shown in Tables 1 and 2. The experimental design adopted was a completely randomized design (CRD). The four diets formed the treatments and each treatment was replicated three times and had 13 birds per replicate.

The carcass evaluation was done at Poultry Farm of the Department of Animal Health and Production, College of Agriculture Bauchi, Bauchi State. At the end of the finisher phase (8 weeks), two chickens were randomly taken from each treatment, fasted for 12 hours and weighed. They were slaughtered by making a clean cut through the carotid arteries and jugular veins in the neck with a sharp knife and allowed to breed completely. They were defeathered, eviscerated, and cut into legs, head and the visceral organs (liver, intestine, lung, kidney, pancreases, and gizzard).

Results and Discussion

Results of carcass characteristics are shown in Table 3. The results show significant differences ($P > 0.05$) between treatments for the live weight, carcass weight, pluck weight, eviscerated weight, intestinal length and pancreases weight, this could be due the different levels of inclusion of rice brand. This report is not in harmony with the observation of Abdulraheem *et al*. (2006) who observed no significant differences between treatments when rice bran was used to replace maize in broiler chicken diets. However, dressing percentage and others gut characteristics did not differ significantly ($P < 0.05$) between treatments, this could also be as a result of quality ingredients used and utilization of diets across all the treatments. The results obtained in this study agreed with those of Amaefule *et al*. (2006) who observed no significant differences in carcass and organ characteristics of broiler chickens fed RMW-based diets**.**

The highest feed cost (98.46₦/kg) was observed in diet 1 control (wheat offal based diet) while the lowest value (73.1₦/kg) was recorded in diet 5 (rice offal based diet), total feed cost was also higher (364.30₦/kg) in diet 1 control (wheat offal based diet) while the lowest value (255.85₦/kg) were recorded in diet 5 (Rice offal based diet). This could be attributed to difference in prices of these Agro industrial by-products as of the time of experiment. Higher feed cost ₦ per kg gain (260.22₦/kg) was observed in diet 1 (Wheat offal) based diet compared to diet 5 (Rice bran) based diet which recorded the lowest value (208.01₦/kg. These values were higher than those (82.62-113.02₦/kg and 157.18-179.75₦/kg) reported by (Grace *etal*.,2007; Ezieshi *et al.* 2011) on broiler chickens fed diets containing maize replaced with wheat offal and varying levels of palm kernel cake with maize offal respectively. However, the total feed cost ₦/kg (73.10-98.46 ₦) obtained in this study were at variance to (628.04 -771.24₦/kg) those reported by (Odeh, *et al*., 2016; Nnenna, *et al.,* 2006) when broiler chickens fed graded levels of rice milling waste and maize offal based diets supplemented with Roxazyme G Enzyme.

Conclusion and Recommendation

Dressing percentage and others gut characteristics were not influenced by the dietary levels of rice bran while Carcass weight, live weight, pluck weight, eviscerated weight, pancreases and intestinal weight were significantly ($P<0.05$) affected. The use of rice bran in poultry nutrition particularly broiler chickens should be encouraged where the feed ingredient is available to help reduce feed cost which accounts for 70- 80% of the cost of production.

Table 1: Composition of experimental diets at starter phase

Ingredients	**Diet 1 (0%)**	**Diet 2 (25%)**	**Diet 3 (50%)**	**Diet 4 (75%)**	**Diet 5 (100%)**
Yellow sorghum	52.46	52.46	52.46	52.46	52.46
Soya bean	18.14	18.14	18.14	18.14	18.14
GNC	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Wheat offal	10.00	7.50	5.00	2.50	0
Rice bran	0	2.50	5.00	7.50	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude protein (%)	23.00	22.93	22.85	22.78	22.70
Metabolizable energy (kcal/kg)	2780.70	2767.90	2753.20	2725.35	2789.70
Crude fibre(%)	4.78	4.78	4.45	4.97	4.96
Ether extract(%)	3.83	4.07	4.29	4.51	4.73
Ash (%)	3.89	3.98	4.07	4.16	3.89

Table 1: Composition of experimental diets at finisher phase

Ingredients	**Diet 1 (0%)**	**Diet 2 (25%)**	**Diet 3 (50%)**	**Diet 4 (75%)**	**Diet 5 (100%)**
Yellow sorghum	55.40	55.40	55.40	55.40	55.40
Soya bean meal	13.20	13.20	13.20	13.20	13.20
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Wheat offal	15.00	11.25	7.50	3.75	0
Rice bran	0	3.75	7.50	11.25	15.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated Analysis					
Crude protein (%)	20.00	19.89	19.78	19.67	19.55
Metabolizable energy (kcal/kg)	2736.10	2747.00	2765.00	2762.00	2736.10
Crude fibre(%)	4.20	3.52	4.84	4.52	4.20
Ether extract(%)	33.65	3.99	4.33	4.65	3.63
Ash (%)	3.48	3.42	3.75	3.89	4.02

Table 6: Carcass yield and gut characteristics (% body weight) of broiler chicks fed varying levels of rice bran

Parameters	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)	SEM
Live weight (kg)	1.91[a]	1.79[b]	1.59[c]	1.45[d]	1.57[c]	0.13*
Plucked weight (kg)	1.73[a]	1.63[b]	1.49[c]	1.35[c]	1.45[d]	0.11*
Eviscerated weight (kg)	1.38[a]	1.25[b]	1.25[b]	1.04[d]	1.13[c]	0.11*
Carcass weight (kg)	1.28[a]	1.14[b]	1.05[c]	0.94[e]	0.98[d]	0.09*
Dressing percentage (%)	67.19	63.67	66.09	63.72	63.12	5.58[NS]
Gizzard (%)	1.79	1.62	1.98	1.81	1.82	0.24 [NS]
Liver (%)	2.14	2.39	2.72	2.37	2.2	0.26 [NS]
Spleen (%)	0.11	0.12	0.12	0.06	0.10	0.04 [NS]
Kidney (%)	0.72	0.72	0.41	0.45	056	0.13 [NS]
Abdominal fat (%)	1.09	1.43	1.28	1.34	1.62	0.33 [NS]
Intestinal length (cm)	204.17[b]	217.17[a]	171.50[d]	166.67[e]	186.67[c]	13.19*
Intestinal weight (%)	3.78	3.93	4.00	3.87	3.74	0.48 [NS]
Ceacal weight (%)	0.93	1.10	1.02	1.00	1.00	0.11 [NS]
Head (%)	2.85	2.80	3.11	2.67	3.11	0.26 [NS]
Legs (%)	3.71	3.89	4.40	3.92	4.08	0.37 [NS]
Pancreas (%)	0.23[b]	0.27[a]	0.16[c]	0.12d	0.16[c]	0.05*
Lungs (%)	0.70	0.68	0.59	0.50	0.55	0.11 [NS]
Heart(%)	0.48	0.44	0.51	0.32	0.40	0.07 [NS]

NS= Not significant, SEM= Standard error of mean

Table 7: Economic analysis of broiler chicks fed varying levels of rice bran

Parameters	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)
Total feed intake (kg)	3.70	3.50	3.3 8	3.4	3.50
Feed cost (₦/kg)	98.46	95.89	82.21	70.37	73.10
Total feed cost (₦)	364.30	335.62	277.87	270.37	255.85
Total weight gain (kg)	1.40	1.48	1.28	1.24	1.230
Feed cost/weight gain (₦/kg/gain)	260.22	226.77	217.09	218.04	208.01
Cost saving	-	33.45	43.13	42.18	52.21

References

Abdulraheem, A.O., Abubakar, A. and Yahaya, U.K. (2006). Influence of rice bran on growth performance of broiler chickens *FCET JOVATEB.*vol.**1** (1):87-92

Adejinmi, O.O., Hamazat, R.A. and Fapohunda, J.B. (200)7. Performance and nutrient digestibility of rabbits. *Nigerian Journal for Animal Production,***34**(1):63-68.

Amaefule, K. U., Iheukwumere, F. C, Lawal, A. S. and EzeKwonna, A. A. (2006). Effect of treated rice milling waste on performance, nutrient retention, carcass and organ characteristics of finisher broiler. Nig. *Journal. Animal Production.* **5**:51-55.

Bauchi state agricultural development project. (BSADP). (1994). Annual report for the National fadama development project. Bauchi PME Unit.

Ezieshi, E.V., Obazele, O.M. and Olomu, J.M. (2011). Performance and energy metabolism by broiler chickens fed maize and millet offals at different dietary levels. *Journal of Agriculture and Social Research* (JASR).**1**(11):14-21.

Fanimo, A.O., Adebayo, A.J., Oduguwa, O.O. and Biobaku, W.O. (2007). Feeding value of cashew testa for broiler chickens. *Nigerian Journal of Animal Production,* **34**(1): 83-93

FAO, (2006). Food and Agriculture Organization of the United Nations. Village chicken production system in Rural African House, Food Security (edns). Agricultural Department, FAO corporate Document Repository. Pp: 9-11.

Grace, I.C., Samuel, O. and Idion, C.I. (2007). Effect of replacing maize with wheat offal in broiler finisher diets on Performance and feed cost. *Journal of Central European Agriculture.* **8**:1, 33-38.

Kwari, I.D., Igwebuike, J.U., Bello, N., Rabo, S.T. and Birma, M. (2004). Replacement of groundnut cake with sorrel (Hibiscus sabdariffa) seed meal in broiler chicken finisher diets. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria (ASAN) 13th-16th Sept., 2004, Abakaliki, Ebonyi state, Nigeria. Pp: 5-7.

Nnenna., O.P., Emaka, N.P. and Okpoko, C.L. (2006). Performance of broiler chicks (Gallus domesticus) fed maize offal-based diets supplemented with Roxazyme G Enzyme. *International Journal of Poultry Science*.**5**(7): 607-610

Nsa, E.E., Okereke, C.O. and Okon, B. 2007. Effects of supplementary green feedstuffs on growth performance, internal organs development and abdominal fat deposition in finisher broiler chickens. Proceedings of the 32nd Annual Conference of Nigerian Society for Animal Production (NSAP), 18th-21st March, 2007. University of Calabar, Cross River State, Nigeria. Pp: 230-233

Odeh, M.O. Igwebuike, J.U. Ubosi, C.O. Akwukwaegbu, S.O. (2016). Performance, Carcass Characteristics and Cost Benefit Analysis of Broiler Chickens Fed Graded Levels of Rice Milling Waste. *Journal of Biology, Agriculture and Healthcare.* **6**(19): 16-20

Ogundipe, S.O. and Sanni, S.A. (2002). Economic of poultry production in Nigeria. A Training Workshop Manual. National Animal Production Research Institute, ABU, Zaria. Pp: 27-45

Okah, U. (2004). Effect of dietary replacement of maize with maize processing waste on the performance of broiler chicken starter. Proceedings of the 29th Annual Conference of Nigeria Society for Animal production (NSAP), March, 21st-25th 2004, Usman Dan Fodio University, Sokoto, Nigeria. Pp: 220-224.

CARCASS CHARACTERISTICS AND ECONOMIC BENEFITS OF USING SUPER SOSAT MILLET (*Pennisetum glaucum)* IN BROILER CHICKENS DIETS

Yakubu[1],N. ; U. D. Doma[2]; D. J. U. Kalla[2]; Saidu[1], I. and Ahmed[1], I. A.
1 Bauchi State College of Agriculture, Bauchi: Department of Animal Health and Production.
2 Abubakar Tafawa Balewa University, Bauchi. Department of Animal Production

ABSTRACT

Experiment was conducted at the Bauchi State College of Agriculture, Bauchi Poultry Farm to evaluate carcass characteristics and economic benefits of broiler chickens fed graded levels of Super SOSAT millet (SSM) based diets. Four experimental diets were formulated and designated as diets 1 (0%), 2 (33%), 3 (66%) and 4 (100%) SSM inclusion levels. A total of 208 day-old unsexed Marshal broiler chicks were randomly allotted to four dietary treatments of 52 birds per treatment in a completely randomized design. Each treatment was replicated four times with thirteen birds per replicate. At the end of the feeding trial, representative samples of the birds from each replicate were randomly selected. A total of thirty-two (32) birds with two (2) birds from each replicate were slaughtered, scalded plucked and eviscerated. Live weight of each bird was taken before slaughtering. Live, plucked, eviscerated and dressed weights were determined. Dressing percentage and gut organ's weight were expressed as percentage of live weights. The result revealed that most of the carcass characteristics were not affected except liver (1.81-2.37%), lungs (0.48-0.59%) and intestinal (6.62-9.02%) weights (P<0.05). Abdominal fat (1.17-2.24%) and pancreas (0.29-0.38%) were also affected at ((P<0.001; P<0.01 respectively). Both the feed cost (₦/kg) and feed cost in naira per kg body gain decreased with increasing levels of SSM. It can be concluded that SSM can completely replace maize as dietary energy source in the diets of broiler chickens with no adverse effect on carcass yield as well as reduction in feed cost.

Keywords: Super SOSAT millet, carcass yield, economic benefits.

Corresponding Author: ynginzum@gmail.com; phone no. 08074988525

Introduction

One of the major suspects in food crises in most African countries including Nigeria is protein in adequacy in diets especially the animal protein (Nwokoro *et al.,* 2000). The average animal protein intake in Nigeria is less than the FAO/WHO recommended (35g) (Ngele *et al*., 2008). The average protein intake in Nigeria is 34.6g of which only 10.6g (19.4%) is of animal origin. (Ajimohun *et al.,* 2012). The current acute shortage of animal protein in Nigeria and the rapidly increasing demand for livestock could be alleviated through broiler production (Nworgu *et al.,* 2000). In many parts of the world, broiler production offers the most rapid and cost effective means of making available high quality animal protein to man (Egbo *et al.*, 2000; Dafwang, 2002). In poultry production, it is known fact that feeding alone accounts for 70 – 80% of the total cost of production in Nigeria (NSA *et al., 2016).* Maize, the most expensive feed ingredient accounts for the largest proportion of about 50 – 55% of the poultry diets. (Ijadunola *et al.*, 2012). The demand for maize (the chief energy source for poultry) by man as food and other industrial uses coupled with low production locally has placed additional constraints on its continual use in poultry diets (Adamu *et al.,* 2012). There is the need to evaluate other grains like pearl millet (*Pennissetium glaucum*) of Super SOSAT variety as an alternative to maize in broiler chicken diets. Any reduction in the cost of feed will extensively reduce the overall cost of production and increase the profit margin of the farmer.

Materials and Methods

This study was conducted at poultry research unit of the Department of Animal Health and Production, Bauchi State College of Agriculture, Bauchi. Two hundred and ten (210) unsexed marshal day old broiler chicks were procured from chi-chicks hatchery at Ibadan, Nigeria. The birds were reared on deep litter system from1-7days they were fed commercial broiler starter diet (Hybrid feed) during this period. Four experimental diets were formulated for the

starter (23% CP) and finisher (20% CP) phases. Super SOSAT millet was included at 0, 33, 66, and 100% levels coded as diet 1, 2, 3, and 4 respectively as presented in tables 1 and 2.

Table 1: Ingredients and percentage composition of dietary levels of SSM fed to broiler chickens at the starter phase (2 – 5 weeks).

Ingredients	Diets			
	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Maize	47.27	31.67	16.07	0
Millet	0	15.60	31.20	47.27
Soya bean	33.43	33.43	33.43	33.43
Fish meal	5.00	5.00	5.00	5.00
Wheat offal	10.00	10.00	10.00	10.00
Lime stone	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude Protein (%)	22.99	23.30	23.61	23.93
ME (kcal/kg)	2996.14	2925.94	2855.74	2844.02
Crude fibre (%)	4.19	5.02	5.83	6.69
Ether extract (%)	7.82	7.27	7.84	7.82
Calcium (%)	1.72	1.73	1.73	1.73
Phosphorus (%)	0.95	0.91	0.95	0.95
Methionine (%)	0.43	0.67	0.66	0.66
Lysine (%)	1.46	1.49	1.52	1.53

ME: Metabolizable energy

Table 2: Ingredients and percentage composition of dietary levels of SSM fed to broiler chickens at the finisher phase (5 – 9 weeks).

Ingredients	Diets			
	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Maize	50.60	33.91	17.20	0
Millet	0	16.69	33.40	50.60
Soya bean	28.10	28.10	28.10	28.10
Wheat offal	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude Protein (%)	20.01	20.33	20.67	21.02
ME (kcal/kg)	2910.94	2835.84	2800.65	2783.24
Crude fibre (%)	4.45	5.34	6.21	7.13
Ether extract (%)	7.13	7.14	7.14	7.14
Calcium (%)	1.53	1.54	1.54	1.55
Phosphorus (%)	0.90	0.89	0.90	0.90
Methionine (%)	0.56	0.56	0.56	0.57
Lysine (%)	1.22	1.25	1.27	1.29

After a week of brooding period, about 208 broiler chickens were randomly allotted to four dietary treatments. Each treatment was replicated four times and for every treatment there were fifty two birds with thirteen birds per replicate in a Completely Randomize Design (CRD). The initial weight of the birds was taken for every replicate and average weight per bird was also determined. The bird's weights were recorded on weekly intervals thereafter. Experimental diets and clean water were given *ad libitum.* Feed intake was also recorded. At the end of the feeding trial representative samples of the birds from each replication were randomly selected. A total of thirty two (32) birds, two (2) birds from each replication were slaughtered, scalded plucked and eviscerated. Live weight of each bird was taken before slaughtering. Plucked, eviscerated dressed weights were measured in kilograms. Dressing percentage and gut organ's weights were expressed as percentage of live weight. Data on feed cost for each treatment were also evaluated. All the data generated were subjected to Analysis of variance (ANOVA) using special statistical package (SPSS). Where significant difference between means was observed, New Duncan Multiple Range Test (DNMRT) was used to separate the means.

Results and Discussion

The results of this study (Table 3) indicated live weight (2.16 – 2.49kg), plucked weight (2.06 – 2.35kg), eviscerated weight (1.51 – 1.85kg), dressed weight (1.39 – 1.79kg) and dressing

Table 3: Carcass characteristics and organs weight (% body weight) of broilers fed graded levels of SSM based diets

Parameters	Diets				
	1 (0%)	2 (33%)	3 (66%)	4 (100%)	SEM
Live weight (kg)	2.34	2.46	2.16	2.49	0.14^{NS}
Plucked weight (kg)	2.14	2.34	2.06	2.35	0.13^{NS}
Eviscerated weight (kg)	1.68	1.77	1.51	1.85	0.11^{NS}
Dressing weight (kg)	1.54	1.64	1.39	1.71	0.10^{NS}
Dressing percentage (%)	65.59	66.35	64.43	68.68	1.60^{NS}
Gizzard (%)	3.49	2.98	3.15	2.88	0.21^{NS}
Heart (%)	0.50	0.47	0.49	0.51	0.04^{NS}
Spleen (%)	0.14	0.14	0.15	0.14	0.02^{NS}
Liver (%)	2.37^{a}	2.08^{ab}	2.02^{b}	1.81^{b}	0.11^{*}
Lungs (%)	0.52^{ab}	0.48^{b}	0.59^{a}	0.59^{a}	0.03^{*}
Abdominal fat (%)	1.18^{b}	1.17^{b}	2.24^{a}	1.94^{ab}	0.20^{***}
Intestine (%)	6.62^{b}	7.75^{ab}	9.02^{a}	7.34^{b}	0.52^{*}
Pancreas (%)	0.29^{b}	0.31^{b}	0.34^{ab}	0.38^{a}	0.02^{**}
Head and legs (%)	6.05	5.51	5.73	5.57	0.29^{NS}

ab = Means within the same row with different superscripts were significantly different. (*P<0.05, ** = P<0.01, *** = P<0.001);

SEM = Standard Error of the Mean, NS = Not Significant

percentage (64.43 – 68.68%) were not influenced by the graded levels of super SOSAT millet (SSM) based diets. These observations were similar to the findings of Davis *et al.* (2003) which stated that pearl millet inclusion in broiler chicken diets resulted in performance and carcass characteristics similar to or better than corn based diets. This could be due to higher oil content in millet diets and better nutrient utilization than other cereal grains in the diets which has been reported to enhance growth and feed conversion ratio due to improve appetite (Moran, 1996).

Organs weight like gizzard (2.58 – 3.49%), heart (0.47 – 0.51%), spleen (0.14 – 0.15%), head and legs (5.51 – 6.05%) were also not affected. However, liver (1.81-2.37%) lungs (0.48-0.59%) and intestine (6.62-7.75%) (P<0.05) were all influence by the dietary treatment. Similar trend was observed in abdominal fat (1.17-2.24%) (P<0.001) and pancreas (0.29-0.38%) (P<0.01). These findings agreed with the report of Adamu *et al.* (2000) in which pearl millet was fed to broilers at different levels as substitute for maize and reported that organ's weights were significantly (P<0.05) affected by the dietary treatments with the millet fed group recorded higher weights.

Financial Analysis of Broiler Chickens Fed Varying Levels of Super SOSAT Millet (SSM) Based Diets

The financial benefit of using SSM for broiler feeding is presented in table 4. The highest feed cost in naira per kg (₦ 67.31/kg) was found in diet 1 (0% SSM) and the lowest value (₦ 59.09/kg) was observed in diet 4 (100% SSM) based diet). The feed cost decreases with an

Table 4: Financial analysis of the experimental diets fed to broilers chickens

	Diets			
Parameters	**1 (0%)**	**2 (33%)**	**3 (66%)**	**4 (100%)**
Total feed intake (kg)	5.12	5.51	5.32	5.59
Feed cost (₦/kg)	67.31	64.59	61.88	59.09
Total feed cost (₦/bird)	344.63	355.89	332.29	330.31
Total weight gain (kg)	1.46	1.76	1.51	1.78
Feed cost ₦/kg weight gain	236.05	202.21	211.60	185.57
Cost Saving (₦)	0.00	33.84	24.45	50.48
Percent Cost Saving (%)	0.00	14.34	10.36	21.39

increasing level of SSM in the diet. This could be due to differences in prices of these grains as at the time of purchase. This is in agreement with the findings of Clement *et al.* (2010) which reported the lowest cost of feed/kg in millet based diet, followed by high tannin sorghum, then low tannin sorghum and maize diets. Similar report was made by Yunusa *et al.* (2015) in which the lowest feed cost in naira/kg was observed on gero millet diet when compared to dauro, sorghum and maize diets.

The cost of total feed intake per/bird also decrease with increasing level of SSM in the diet. Although the highest total feed cost per bird (₦ 355.89) was found in diet 2 (33% SSM) while the lowest (₦ 330.31) obtained in diet 4 (100% SSM). This could be attributed to high price of maize and its inclusion level in this diet as well as the rate of feed consumed by the birds. Highest feed cost in naira per kg weight gain of ₦ 236.05 was obtained on diet 1 (control) while the lowest (₦ 185.57) was recorded on diet 4 (100% SSM). The result obtained in this study conformed with the findings of Ibe *et al.* (2014) and Yunusa *et al.* (2015). They reported that gero millet based diet seems to be most economical for broiler feeding as the best and economical feed cost in naira per kg was found in this diet when compared to other common cereal grains.

Conclusion

It can be concluded that SSM can completely (100%) replace maize as dietary energy source in the diets of broiler chickens with no adverse effect on carcass yield as well as reduction in feed cost.

REFERENCES

Adamu, M. S., Kubkomawa, H. I., Doma, U. D. and Duduwa, A. T. (2012). Carcass and gut characteristics of broilers fed diets containing yellow sorghum (*Sorghum bicolor*) variety in place of maize: *International Journal of Sustainable Agriculture,* **4** (1): 8 – 11.

Adamu, S. B., Yaya, N. and Alade, N. K. (2000). Comparative study of three energy sources on performance and carcass characteristics of broilers under Sudano-sahelian environment. Proceedings of 6th Annual Conference of Animal Science Association of Nigeria, 17th – 19th September, 2000. Akure – Nigeria. Pp. 67 – 70.

Adamu, S.B., Geidam, Y.A., Muhammad, G. and Oladimeji, O.R. (2012). Replacement value of baobab (*Adansonia digitata*) leaf meal for soybean meal in the diet of broiler

chicks. Proceedings 17th Annual Conference of the Animal Science Association of Nigeria 9 – 13, 2012 Abuja, Nigeria. Pp. 391 – 393.

Ajimohun, F. F., Yisa, A. G., Ajibola, H. O., Adeleke, M. A., Oyawoye, E. O. and Doma, U. D. (2012). Effect of varying level of *Moringa oleifera* leaf meal on performance of weaner rabbits. Proceedings of the 17th animal conference, Animal Science Association of Nigeria. 9 – 13th September, 2012 Abuja, Nigeria, 267 – 270.

Clement, I., Ibrahim, D. K., Joseph, J., Iro, N., Ibrahim, D. M. and Bruce, H. (2010). Performance and economics of production of broiler chickens fed sorghum or millet as replacement for maize in the semi-arid zone of Nigeria. *Agricultural and Biology Journal of North America,* 2151 – 7517.

Dafwang, I.I. (2002). Broiler and Broiler production in Nigeria. **A training manual, poultry production in Nigeria** National Animal Production Research Institute, Shika Ahmadu Bello University Zaria. Pp. 95 – 105.

Davis, A.J., Dale, N. M and Ferreira, F.J. (2003). Pearl millet as an alternative feed ingredient in broiler diets. *Journal of Applied Poultry Research,* **12**: 137 – 144.

Egbo, M. L., Doma, U. D. Bamgbase, A. M., Abdullahi, U. S. and Abdullahi, I. R. (2000). Utilization of Sorghum Mill Waste in the Diets of Broiler Chickens. Proceedings of the 25th NSAP Annual conference. Umudike University, Umuahia, Nigeria. 19 – 23 March, 2000. Pp. 211 – 220.

FAO/WHO, (1973). **Energy and protein requirement**: Report of a joint FAO/WHO Ad-hoc Expert Committee. WHO Technical report series No. 522 and FAO Nutrition Meeting series No. 522, Geneva Switzerland.

Ibe, E. A., John, O. M., Samson, O. O., Samuel, D., Sola, E. B. and Isaac, S. (2014). Growth performance and carcass characteristics of broiler chickens fed two varieties of guinea corn and millet as replacement for dietary maize. *World Journal of Lifescience and Medicine Research,* **3** (2): 46 – 48..

Ijadunola, T. I. and Adejoro, F. A. (2012). Growth response and carcass characteristics of broiler chickens feed graded levels of soaked wild cocoyam (*Colocasia esculenta*) as partial replacement for maize. Annual Conference Animal Science Association of Nigeria 9 – 13, 2012 Abuja. Pp. 315 – 317.

Moran, E. T. (Jr) (1996). Production and carcass quality responses of early and late marketed large toms to dietary fat during the finishing period. *Poultry Science,* **61**: 919 – 924.

Ngele, G.T., Oyawoye, E.O and Doma, U.S (2008) Overall performance and carcass characteristic of broilers fed raw and toqsted sesame seed meal. *Journal of League of Researchers in Nigeria,* **9** (2): 120 – 12

Nwokoro, S.O., Orheruata, A. M. and Paul, I.O. (2000) Replacement of maize with cassava sievates in cockerel starter diets: **Effect on Performance, Carcass Characteristics and some Blood Metabolites**. Book of proceedings, 25th Annual NSAP Conference, Held at the Federal University of Agriculture, Umudike. Pp. 234 – 235.

Nworgu, G.N., Egbunsike, J.B., Fapohunda, F.L .Ogundola, A.J. Omole G.E., Ogbosuka and Okpeze G.N. (2000). Performance of broiler chicks fed full part extruded soya bean meal. Book of proceedings 25th Annual NS AP Conference, 19 -23 March, 2000 Umudike. Pp. 135 – 136.

SPSS (1996). Statistical Package For Social Sciences Version 7.5.

Yunusa, Y. Doma, U. D., Zaharadden, D., Abubakar S. B., Umar, A. and Isa, A. (2015). Performance and economics production of broiler chickens fed different dietary energy sources. *Asian Journal of Poultry Science,* **9**: 41 – 49.

UTILIZATION OF DIETARY LEVELS OF SUPER SOSAT MILLET (*Pennisetum glaucum)* BY BROILER CHICKENS

Yakubu[1],N., Doma[2], U. D., Kalla[2], D. J. U., Saidu[1], I. and Ahmed[1], I. A.
1 Bauchi State College of Agriculture, Bauchi: Department of Animal Health and Production.
2 Abubakar Tafawa Balewa University, Bauchi. Department of Animal Production

Abstract

Fifty-six (56) days experiment was conducted at the Bauchi State College of Agriculture, Bauchi, Poultry Farm to evaluate the performance of broiler chickens fed graded levels of Super SOSAT millet (SSM) based diets. Four experimental diets were formulated and designated as diets 1 (0%), 2 (33%), 3 (66%) and 4 (100%) SSM inclusion levels. A total of 208 day-old unsexed Marshal broiler chicks were randomly allotted to four dietary treatments of 52 birds per treatment, replicated four times with thirteen birds per replicate in a completely randomized design. The results revealed that most of the performance attributes at starter and finisher phases as well as overall performance were significantly influenced by the dietary levels of SSM. At the starter phase: initial weights (IWT) (119.24-127g) were statistically similar. However, starter final weight (FWT) (555.61-705.99g); daily feed intake (DFI) (61.80-67.79g), and feed conversion ratio (FCR) (3.27-4.09) were significantly (P<0.05) affected. Daily weight gain (DWG) (15.27-20.75g) was also affected at (P<0.01). Similar trend was observed at the finisher phase: initial weight ranged from (555.61-705.99g), FWT (1592.10-1899.50g) and DFI (121.27-131.93g) were significantly (P<0.05) influenced by the dietary treatments. However, DWG (37.02- 43.40g) and FCR (3.04-3.34) were not affected. The overall performance indicated (IWT) (341.75-415.53g), FWT (1073.86-1302.75g), DWG (26.15-31.69g) was significant at P<0.05. DFI (91.39-99.86g) and FCR (3.19- 3.72) were significantly (P<0.01) influenced by the dietary levels of SSM. In most of the parameters measured, the best performance was obtained in broiler birds fed diet 4. It can be concluded that SSM can completely replace maize as dietary energy source in the diets of broiler chickens with no adverse effect on performance.

Key words: Super SOSAT millet, performance, broiler chickens, dietary treatments.
Corresponding Author: ynginzum@gmail.com; phone no. 08074988525

Introduction

Poultry in Nigeria had undergone tremendous changes over the past four decades, both in genotypes, management and technological advancement (Adejoro, 2000). Poultry production forms an important component of livestock subsector as a provider of employment and income (Eduvie, 2002). Ogundupe and Sanni (2002) reported the primary purpose of keeping poultry in all parts of Nigeria is for both dietary and economic reasons.

Animal protein requirement in the developing countries has become critical due to rapid population growth, this creates adverse consequences on food security and has resulted in high incidence of hunger and malnutrition (Yusuf *et al*., 2008). About 10g of animal protein on average is consumed in Nigeria per day which is a shortfall of 25g of the 35g recommended by FAO (Oke *et al.*, 2012). The current acute shortage of animal protein in Nigeria and the rapidly increasing demand for livestock could be alleviated through broiler production (Nworgu *et al.*, 2000). The demand for maize (the chief energy source for poultry) by man as food and other industrial uses coupled with low production locally has placed additional constraints on its continual use in poultry diets (Adamu *et al.*, 2012; Summan, *et al.*, 2017).

Nigeria is an important millet producing country, ranks second after India in global millet production. At the national level, millet ranks third after maize and sorghum among cereal food crops (Adamu, 1998). Summan (2017) reported the pearl millet crude protein ranging from 10-16%. Millet is superior to maize and sorghum in protein content and quality. Ibitoye *et al*., 2012). It does not contain any condensed polyphenols such as the tannins in sorghum that can interfere with or slow down digestibility (Olomu, 1995). Out of the 4.6 million tonnes of millet produced in Nigeria in 1992 – 1994 only 0.1 million tonne was used as feed.

(Aminu-Kano *et al.*, 1998). There is the need towards looking for cheap, easily available energy sources that are less or no industrial uses. At the same time could help to meet the nutritional requirements of the birds.

Materials and Method

Four experimental diets were formulated for both starter (23% CP) and finisher (20% CP) phases. Super SOSAT millet was included at 0, 33, 66 and 100% levels coded as diets 1, 2, 3 and 4 respectively, as presented in Tables 1 and 2.

Table 1: Ingredients and percentage composition of dietary levels of SSM fed to broiler chickens at the starter phase (2 – 5 weeks).

Ingredients	Diets			
	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Maize	47.27	31.67	16.07	0
Millet	0	15.60	31.20	47.27
Soya bean	33.43	33.43	33.43	33.43
Fish meal	5.00	5.00	5.00	5.00
Wheat offal	10.00	10.00	10.00	10.00
Lime stone	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude Protein (%)	22.99	23.30	23.61	23.93
ME (kcal/kg)	2996.14	2925.94	2855.74	2844.02
Crude fibre (%)	4.19	5.02	5.83	6.69
Ether extract (%)	7.82	7.27	7.84	7.82
Calcium (%)	1.72	1.73	1.73	1.73
Phosphorus (%)	0.95	0.91	0.95	0.95
Methionine (%)	0.43	0.67	0.66	0.66
Lysine (%)	1.46	1.49	1.52	1.53

ME: Metabolizable energy

Table 2: Ingredients and percentage composition of dietary levels of SSM fed to broiler chickens at the finisher phase (5 – 9 weeks).

Ingredients	Diets			
	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Maize	50.60	33.91	17.20	0
Millet	0	16.69	33.40	50.60
Soya bean	28.10	28.10	28.10	28.10
Wheat offal	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude Protein (%)	20.01	20.33	20.67	21.02
ME (kcal/kg)	2910.94	2835.84	2800.65	2783.24
Crude fibre (%)	4.45	5.34	6.21	7.13
Ether extract (%)	7.13	7.14	7.14	7.14
Calcium (%)	1.53	1.54	1.54	1.55
Phosphorus (%)	0.90	0.89	0.90	0.90
Methionine (%)	0.56	0.56	0.56	0.57
Lysine (%)	1.22	1.25	1.27	1.29

ME = Metabolizable Energy

Two hundred and ten (208) unsexed marshal day old broiler chicks were procured from chi-chicks hatchery at Ibadan, Nigeria. The birds were brooded for one weeks on deep litter and they were fed commercial broiler starter diet (Hybrid feed) during this period. After a week brooding period, they were randomly allotted to four dietary treatments in a Completely Randomize Design (CRD). Each treatment was replicated four times and for every treatment there were fifty-two (52) birds with thirteen birds per replicate. Initial weight of the birds was taken for every replicate and average weight per bird was also determined. The bird's weights were recorded on weekly intervals thereafter. Experimental diets and clean water were given *adlibitum.* Feed intake per each replication and per bird were determined. Feed conversion ratio were also computed. Data generated were subjected to analysis of variance((ANOVA) using spss, where different exist among means DMRT was used to separate the means.

Results and Discussion

The daily feed intake (DFI) at the starter (61.80 – 67.79g) and finisher phase (121.27 – 131.93g) phases were significantly (P<0.05) affected as well as the overall (DFI) (91.39 – 99.86g) was also significantly ((P<0.01) influenced by the dietary levels of super SOSAT millet (SSM) as presented in tables 3, 4 and 5.

Table 3: Performance of broiler chickens fed graded levels of SSM based diets at the starter phase (2 – 5 weeks)

	Diets				
Parameters	**1 (0%)**	**2 (33%)**	**3 (66%)**	**4 (100%)**	**SEM**
Initial weight (g)	127.89	122.12	119.24	125.00	4.79^{NS}
Starter final weight (g)	555.61^{b}	664.83^{a}	635.18^{ab}	705.99^{a}	27.20^{*}
Daily feed intake (g)	61.80^{b}	65.32^{ab}	63.98^{ab}	67.79^{a}	1.25^{*}
Daily weight gain (g)	15.27^{b}	19.38^{a}	18.43^{ab}	20.75^{a}	0.92^{**}
Feed conversion ratio	4.09^{c}	3.39^{bc}	3.49^{bc}	3.27^{a}	0.16^{*}
Mortality (Number)	4	3	3	4	-

abc = Means within the same row with different superscripts were significantly different. (*P<0.05, **P<0.01).

NS = Not Significant, SSM = Super SOSAT Millet, SEM = Standard Error of the Mean

Table 4: Performance of broiler chickens fed graded levels of SSM based diets at the finisher phase (5 – 9 weeks)

	Diets				
Parameters	**1 (0%)**	**2 (33%)**	**3 (66%)**	**4 (100%)**	**SEM**
Initial weight (g)	555.61^{b}	664.83^{a}	635.18^{ab}	705.99^{a}	27.20*
Final weight (g)	1592.10^{b}	1880.10^{a}	1692.90^{ab}	1899.50^{a}	70.40*
Daily feed intake (g)	121.27^{b}	131.54^{a}	127.74^{a}	131.93^{a}	2.06*
Daily weight gain (g)	37.02	43.40	37.78	42.38	2.36^{NS}
Feed conversion ratio	3.34	3.04	3.43	3.11	0.19^{NS}
Mortality (Number)	0	0	0	0	0

ab = mean within the same row with different super scripts were significantly different. (*P<0.05)

NS = Not Significant, SSM = Super SOSAT Millet, SEM = Standard Error of the Mean

Table 5: The Overall Performance of broiler chickens fed graded levels of SSM based diets (2 – 9 weeks)

	Diets				
Parameters	**1 (0%)**	**2 (33%)**	**3 (66%)**	**4 (100%)**	**SEM**
Initial weight (g)	341.75	393.48	377.21	415.53	4.97*
Final weight gain (g)	1592.10^{b}	1880.10^{a}	1692.90^{ab}	1899.50^{a}	70.40*
Daily feed intake (g)	91.39^{b}	98.43^{a}	95.86^{ab}	99.86^{a}	1.49**
Daily weight gain (g)	26.15^{b}	31.39^{a}	28.10^{ab}	31.69^{a}	1.22*
Feed conversion ratio	3.72^{b}	3.22^{a}	3.47^{ab}	3.19^{a}	0.09**
Mortality (Number)	4	3	3	4	-

ab = Means within the same row with different superscripts were significantly different. (*P<0.05, ** = P<0.01)

NS = Not Significant, SSM = Super SOSAT Millet, SEM = Standard Error of the Mean

These findings agreed with the report of Ibitoye *et al.* (2012) which stated that millet did not impairs feed intake when compared to maize based diet. Kawu (2010) reported significant difference (P<0.01) when gayamba millet was fed as energy source to replace maize in broiler chicken diets at the starter phase. This could be due to high fat content of millet as compared with maize which has been reported to improve appetite (Moran, 1996).

Daily weight gain (61.80-67.79g) at the starter phase and overall gain (26.15-31.69g) were significantly (P<0.05) affected by the dietary levels of SSM table 3 and 5. The body weight gain at the finisher phase ranged from (37.02-42.39g) however, they were not affected by the dietary treatments (table 4). The results of this study are in agreement with the reports of Luis *et al.* (1980) who stated that broil*er* chickens fed millet diets performed better than the maize and sorghum groups. (Kawu, 2010 and Afsharmanesh *et al.,* 2016) reported that broiler chickens fed millet based diets gave higher average body weight than those on diet containing maize. Ibitoye *et al.* (2012) reported similar findings in broiler chicken at the finisher phase.

Feed conversion ratio (3.27-4.09) were significantly (P<0.05) affected at the starter phase. Similar trend (P<0.01) was obtained at the overall conversion ratio table 3 and 5. However, the conversion ratio (3.04-3.43) at the finisher phase were not affected (Table 4). The best conversion ratio was observed in birds fed 100% SSM based die. These findings are in agreement with the reports by (Afsharmanesh *et al.,* 2016) that better feed conversion ratio was obtained in birds feed millet based diets.

Mortality recorded during the experiment was 14. Four birds for diets 1 (100% maize) and 4 (100% super SOSAT millet). Diets 2 (33% SSM) and 3 (66% SSM) had three each (Table 3). The mortality occurred at the first and second day of the experiment due to sudden change in weather condition. Abeke (2002) reported that chicks are very susceptible to environmental temperatures because they are born naked. Too low or high temperatures especially at the brooding period can accounts for up to 50% of the chick's mortality.

Conclusion

It was concluded that super SOSAT millet (SSM) can completely replace maize in the diets of broiler chickens with no adverse effects on growth performance.

REFERENCES

Abeke, F. O. (2002). **Management of Chicks and Growers: In Poultry Production in Nigeria. A Training Manual.** NAPRI/ABU, Zaria. Pp. 77 – 87.

Adamu, A. (1998). **Pearl millet in Nigerian Agriculture. Production,** processing and Research priorities. Lake Chad Research Institute Maiduguri and National Agricultural Research Project, Abuja, Nigeria.

Adamu, M. S., Kubkomawa, H. I., Doma, U. D. and Duduwa, A. T. (2012). Carcass and gut characteristics of broilers fed diets containing yellow sorghum (*Sorghum bicolor*) variety in place of maize: *International Journal of Sustainable Agriculture,* **4** (1): 8 – 11.

Adamu, S.B., Geidam, Y.A., Muhammad, G. and Oladimeji, O.R. (2012). Replacement value of baobab (*Adansonia digitata*) leaf meal for soybean meal in the diet of broiler chicks. Proceedings 17th Annual Conference of the Animal Science Association of Nigeria 9 – 13, 2012 Abuja, Nigeria. Pp. 391 – 393.

Adejoro, S. O. (2000). **A Handbook for Poultry Practitioners and Consultants** (layers). Publication of Jilog Nigeria company. Pp. 1 – 29.

Afsharmanesh, M., Ghorbani, N. and Mehdipour, Z. (2016) Replacing corn with pearl millet (raw and sprouted with and without enzymes in Broiler chicken's diets. *Journal of Animal Nutritional*, **100**: 224-228.

Aminu-Kano, M., Ajayi, O. Ikwele; M.C, and Anaso A.B (1998). Trends in millet production in Nigeria. **In: Pearl millet in Nigeria Agriculture: Production; utilization and research priorities.** Proceeding of the pre-season national coordination and planning meeting of the nationally coordinated research programme on pearl millet in Maiduguri Nigeria 21 – 24 April 1997, 41 – 49.

Eduvie, L.O (2002). **A Training manual, Poultry production in Nigeria**. National Animal Production Research Institute, Shika Ahmadu Bello University Zaria, Nigeria.

Ibitoye, E. B., Olorede B.R., Jimoh, A.A. and Abubakar, H. (2012) Comparative performance and organ relative weight of broiler chickens fed three sources of energy diet. *Journal of Animal Production Advances,* **2** (5): 233 -238.

ICRISAT/FAO, (1996). The world sorghum and millet economizes facts, trends and outlook. **A Joint Study by Food and Agricultural Organization of the United Nations and International Crops Research Institute for the Semi-arid Tropics**. Pearl millet in Nigerian Agriculture. Production, processing and research priorities. Pp. 41 – 46.

Kawu, Y. U. (2010). *Replacement value of gayamba millet variety for maize in broiler diets.* Unpublished Master's Thesis, Abubakar Tafawa Balewa University, Bauchi Nigeria.

Luis, E. S., Sullivan, I. W. and Nelson, I. A. (1980). The nutritive value of three varieties of proso-millet and bird resistant sorghum for poultry. *Poultry Science,* **59**: 11632 – 11634.

Moran, E. T. (Jr) (1996). Production and carcass quality responses of early and late marketed large toms to dietary fat during the finishing period. *Poultry Science,* **61**: 919 – 924.

Nworgu, G.N., Egbunsike, J.B., Fapohunda, F.L .Ogundola, A.J. Omole G.E., Ogbosuka and Okpeze G.N. (2000). Performance of broiler chicks fed full part extruded soya bean meal. Book of proceedings 25th Annual NS AP Conference, 19 -23 March, 2000 Umudike. Pp. 135–136.

Ogundipe, S.O and Sanni, S.A. (2002). **Economics of poultry production in Nigeria. A Training Manual**, Poultry production in Nigeria. National Animal Production Research Institute, (NAPRI) Ahmadu Bello University Zaria. Pp. 27 – 30.

Ogundipe, S. O. (2002). Techniques of Ratio Formulation for Poultry. **A Training Manual**, Poultry Production in Nigeria. NAPRI. Ahmadu Bello University, Zaria. Pp. 115 – 119.

Oke, M.O., Apata, E.S., Eniolorunda, O.O. and Oke, D. (2012) Implication of replacing fishmeal with fortified dried layers droppings meal (DLDM) in broiler diets on protein quality indices. Proceeding 17th Annual Conference of Animal Science Association of Nigeria 9 – 13th September, 2012 Abuja, Nigeria. Pp. 346 – 348.

Olomu, J. M. (1995). **Monogastric Animal Nutrition Principles**. A Jachem Publication. Pp. 108 – 121.

Suman, B., R.K. Sharma, Nazam, K. Ankur, R and Zulfqanir, H. (2017) performance of broiler chickens as affected by replacement of maize with pear millet and broken rice mixture Indian Journal of Animal Nutrition. 34(4) 437 – 446.

SPSS (1996). Statistical Package For Social Sciences Version 7.5.

Yusuf, N.D., Ogah, D.M., Hassan, D.I., Musa M. M. and Doma, U.D. (2008). Effect of decorticated fermented prosopis seed meal (*Prosopis africana*) on growth performance of broiler chicken. *International Journal of Poultry Scie nce,* **7** (11): 1054 – 1057.

HAEMATOLOGICAL PROFILE OF WEANER RABBITS FED DIETS CONTAINING DRIED SCENT LEAF (*Ocimum gratissimum)* MEAL

[1§]Yashim, S.M., [1]Ahmad, A., [2]Makama, R.S. and [3]Ephraim, F.Y.
[1]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Animal Science, Kaduna State University, Kafanchan Campus
[3] Department of Education Technical, Kaduna Polytechnic, Kaduna, Nigeria

[§]Corresponding author: yashimms@gmail.com

ABSTRACT
A study was conducted to evaluate the effect of feeding scent leaf oscimum gratisimum meal on haematological profile of weaner rabbits. Thirty (30) mixed breeds of weaner rabbits with an average weight of 1675g were used to investigate the haematological profile of rabbits fed diets containing different inclusion levels (0, 5, 10, 15 and 20%) of scent leaf Ocimum gratissimum meal. The rabbits were randomly assigned to five dietary treatments comprising of six rabbits per treatment, in a completely randomized design (CRD), the study lasted for 72 days. The rabbits were individually housed in iron gauze cages. Diet was formulated to contain 18% CP, and the controlled diet was free of O. gratissimum. Feed and clean water were provided ad libitum. Blood samples were collected for haematological profile analysis after the feeding trial. The inclusion of scent leaf O. gratissimum in the diets significantly (P<0.05) influenced haematological profile of the rabbits. The Packed Cell Volume (PCV) values ranged from 27-38g/dl and was significantly higher (P<0.005) for rabbits fed diet containing 5% O. gratissimum meal. Haemoglobin (Hb) values were highest (P<0.05) for rabbits fed diet containing 5% O. gratissimum meal (38.333) but ranged from 27-38g/dl in the animals. Rabbits fed diet with 0% level of inclusion of O. gratissimum had the highest white blood cells count (WBC). All the haematological profile obtained were within the normal range of healthy rabbits, thus the scent leaf had no detrimental effect on the haematological profile of the rabbits.

Keywords: Haematology, rabbits, *Ocimum gratissimum*, scent leaf

INTRODUCTION
The growing interest in the use of natural herbs and medicinal plants as alternative feed additives in rabbit diets has led to evaluation and use of bio-active botanicals. Such alternatives are currently being promoted as prebiotics, probiotics, organic acids, essential oils, and other medicinal plants products (Charles and Simon, 1992). Phytochemical analyses of these botanicals have shown the presence of essential oil and phytochemicals that improve performance and reduces bacterial load in non-ruminant livestock (Poole, 1987), *Ocimum gratissimum* is one of such plants. Scent leaf possesses all the potentials of an effective natural growth promoter which can safely replace antibiotic growth promoters. From enhancing growth and productive performances, to influencing carcass traits and improving blood profile of the rabbits (Poole, 1987; Yashim, *et al.* 2017).

Blood is an important reliable medium for assessing the health status of an individual animal. Gupta *et al.*, (2007) reported that blood constituents are used to monitor and evaluate health and nutritional status of animals. It is a medium through which nutrients are conveyed to various parts of the body system of an organism. A readily available and fast means of assessing clinical and nutritional status of an animal on a feeding trial is by the use of blood analysis (Yashim *et al.*, 2016). Therefore, this study was carried out to evaluate the haematological profile of weaned rabbits fed diets containing scent leaf (*Ocimum gratissimum*).

MATERIALS AND METHODS

The experiment was conducted in the Department of Animal Science teaching and research Farm, Ahmadu Bello University Zaria, Kaduna State. The experimental material *Ocimum gratissimum* (Scent leaf) leaves were locally sourced, milled and stored in jute bags until it was used. Thirty mixed-breeds weaned rabbits with an average weight of 1.53 kg were randomly allocated to five dietary treatments in a completely randomized design with 6 rabbits per treatment, the study lasted for 8 weeks.

The rabbits were kept individually in all-wire metabolic cages which has a provision for feeder, drinker and for easy collection of urine and faeces. Five iso-nitrogenous diets were formulated to contain 18% CP with *Ocimum gratissimum* at inclusion levels of 0, 5, 10, 15 and 20% (Table 1). The cages were properly disinfected using Morigald® before the commencement of the study. The animals were prophylactically treated for internal and external parasites using subcutaneous injection of Ivomec® and a broad-spectrum antibiotic (Oxytetracycline 10%) was administered intramuscularly at the manufacturer's recommended rate. Fresh and clean drinking water was provided to the rabbits daily *ad libitum* as well as the experimental diets. Blood samples were collected using blood sample collection techniques for rabbits as described by Yashim (2017). Data collected from this study were subjected to statistical analysis and significant means were compared (SAS, 2002).

RESULTS AND DISCUSSION

The result of the haematological indices of weaner rabbits fed diet containing different inclusion levels of *Ocimum gratissimum* was shown in Table 2. The inclusion of *O. gratissimum* significantly ($P<0.05$) affected all parameters measured. Packed cell volume (PCV) was significantly ($P<0.05$) affected, with 5% inclusion level having higher value (38.33%) and the least value (27.07%) in 20% inclusion. The observed PCV values in this study were within the normal range of healthy rabbit as reported by Hillyer (1994). Haemoglobin (Hb) ranged from 9.20 to 12.63g/dl with the higher ($P<0.05$) values observed at 5% inclusion (12.63 g/dl) while 20% had the least value of 9.20g/dl. The haemoglobin concentration compared favourably with the values of 10.00 to 15.00g/dl reported by Hellyer (1994); 9.10-15g/dl by Njidda *et al.* (2014) and 11.86 to 13.91g/dl by Yashim *et al.* (2017). The white blood cell (WBC) count in this study ranged from 4.46-7.03 x 10^9/l, the values compared favourably with the normal values of 4.71 to 9.23 x 10^3/mm^3 in healthy rabbits (Yashim *et al*., 2017). These results indicated that the animals were healthy at the beginning of the experiment, because decrease in number of WBC below the normal range could be an indication of allergic conditions, anaphylactic shock and certain parasitism. While elevated values (leukocytosis) may indicate the existence of a recent infection, usually with bacteria (Poole, 1987). Neutrophils and Lymphocyte values also differed ($P<0.05$) across treatment groups. Animals on 10% inclusion had higher concentration of lymphocytes. The observed values were within normal range of 40-80% reported by Poole (1987) and Yashim *et al.* (2017).

Table 1: Percentage ingredient Composition of the experimental diet

Ingredient	Inclusion level of scent leaf *Oscimum gratissimum* (%)				
	0	5	10	15	20
Groundnut cake	12.50	13.50	14.50	15.50	16.50
Soybeans cake	10.00	10.00	10.00	10.00	10.00
Dried Scent leaves	0	5	10	15	20
Maize offal	61.00	55.00	49.00	43.00	37.00
Rice Bran	11.25	11.25	11.25	11.25	11.25
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.25	0.25	0.25	0.25	0.25
Common salt	1.50	1.50	1.50	1.50	1.50
Methionine	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
ME (Kcals/kg)	2648.96	2687.05	2725.14	2763.14	2801.32
Crude Protein	17.58	17.63	17.74	17.79	17.79
Ca	1.23	1.22	1.22	1.22	1.22
P	0.59	0.58	0.57	0.57	0.56
Meth	0.45	0.45	0.44	0.44	0.44
EE	0.46	0.75	1.04	1.33	1.62
CF	11.82	11.85	11.89	11.92	11.96
Feed Cost (₦/kg)	93.6	107.23	120.79	133.67	146.12

Table 2: Haematological indices of weaner rabbits fed diet containing different inclusion levels of *Ocimum gratissimum*

	Inclusion level of *Oscimum gratissimum* (%)					
Parameters	0	5	10	15	20	SEM
Pack cell volume (%)	31.00^{c}	38.33^{a}	35.00^{b}	32.00^{c}	27.67^{d}	1.42
Haemoglobin (g/dl)	10.30^{ab}	12.63^{a}	11.63^{a}	10.67^{ab}	9.20^{b}	1.24
Red blood cell ($\times 10^{12}$/L)	5.13^{ab}	6.53^{a}	5.90^{ab}	5.37^{ab}	4.60^{b}	0.59
White blood cell ($\times 10^{9}$/L)	7.03^{a}	4.47^{b}	6.47^{ab}	5.30^{b}	6.40^{ab}	0.85
Neutrophil (%)	27.67^{a}	23.00^{ab}	17.67^{b}	22.67^{ab}	18.33^{b}	3.25
Lymphocytes (%)	71.00^{c}	75.67^{ab}	78.00^{a}	76.00^{a}	75.33^{b}	3.63

^{abcd} Means within row with different superscript are significantly different at P<0.05; SEM= Standard error of [mean

CONCLUSION

From this study, it can be concluded that the inclusion of *Ocimum gratissimum* in the diet of rabbits had no negative effect on the haematological indices, as all parameters investigated were within the normal range.

REFERENCES

Charles, D.J. and Simon, J.E. (1992). A new geraniol chemotype of *Ocimum gratissimum* L. *Journal of Essential Oil Research*, 4: 231-234.

Gupta, A.R., Putra, R.C., Sani, M. and Swarup, D. (2007). Haematology and serum biochemistry of Chital (*Axis axis*) and barking deer (*Muntiacus muntijax*) reared in semi captivity. *Veterinary Research Communications*, 31: 801 – 808.

Hillyer,E.V. (1994). Pet rabbits. The Veterinary clinics of North America, *Small Animal Practice*, 24(1): 25-65.

Njidda, A.A., Shuai'bu, A.A. and Isidahomen, C.E. (2014). Haematological and serum biochemical indices of sheep in semi-arid environment of Northern Nigeria. *Global Journal of Science Frontier Research,* 14 (2):10-22.

Poole, T.B. (1987). UFAW Handbook of the care and management of Laboratory animals. 6th ed. Universities Foundation for Animal welfare, Longman Scientific and Technical, Harlow, UK

SAS. (2002). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.

Yashim, S.M., Achi, N.P., Aaron, E., Alphonsus, C., Abdu, S.B. and Abdulrashid, M. (2016). Hematological and serum biochemical indices of Yankasa rams fed diets supplemented with concentrate containing Ficus sycomorus leaf meal. *Lapai Journal of Science and Technology*, 3(1):102-110.

Yashim, S.M., Anene, D.O. and Gadzama, I.U. (2017). Effects of sampling time on haematological characteristics of weaner rabbits fed diets containing differently processed *Crotalaria retusa* leaves. *Nigerian Journal Animal Science,* 1:192-202.

GROWTH PERFORMANCE OF BROILER CHICKENS FED DIETS CONTAINING GRADED LEVELS OF BREWER'S DRIED GRAIN

*** Yisa, A. G. and Piental, S. A.**

Department of Animal Production,
Federal College of Animal Health and Production Technology, NVRI, Vom

*Correspondence: amosgyisa@gmail.com

ABSTRACT

This study investigated the growth performance of broiler chickens fed diets containing graded levels of Brewer's Dried Grain (BDG). One hundred and fifty 2 weeks old Arbor acre breeds of broiler chickens were divided into 5 groups (treatments) of 30 birds. Each group was further divided into 3 replicates of 10 birds in a completely Randomized Design. The 5 groups of birds after 2 weeks of brooding on commercial broiler starter diets were allotted to 5 different formulated diets containing 0 (control), 10, 20, 30 and 40% levels of inclusion of (BDG). The birds were fed the experimental diets for 6 weeks (42) days. Average total feed intake (5120.00, 5343.33, 5366.67, 5386.67, 5400.00) average total weight grain (2283.33, 2143.33, 2076.67, 1546.67, 1303.33), average final live weights 2546.67, 2430.00, 2386.67, 1850.00, 1603.33g) feed conversion ratio (2.25, 2.51, 2.67, 3.49, 4.14) and feed cost per kg gain (₦ 300.23, 288.70, 334.48, 427.13, 491.32) were significantly different (P<0.05) between treatment groups. Growth performance parameters decreased with increasing levels of BDG inclusion. It was concluded that inclusion of BDG should not exceed 30 % in broiler diets for cost effective feeding

Key words: Growth performance, broilers, brewer's dried grains

INTRODUCTION

Brewer's Dried Grain (BDG) is a solid waste from the Brewer's industries. It is available and cheap but difficult to dry to low moisture content for easy storage and use, especially during the wet seasons (Rijal, 2009). Jacquie (2015) stressed that agro-industrial by-products such as Brewer's Dried Grain (BDG) are primarily fed to dairy cattle but have some nutritional value for poultry as well. Rijal (2009) stated that with shortage and increasing prices of feed ingredients, continuous efforts are being made to make use of the cheaper and available agro industrial by-products in animal feeds in order to reduce cost without any deleterious effects on their performance. Some problems limiting the use of BDG in poultry rations are high fiber content (Jacuie, 2015), nucleic acid toxicity, poor palatability and limitation of sulphur amino acids in the product. Nucleic acid toxicity is said to be solved naturally due to the availability of the enzyme (uricase) in mammals which enables them overcome the problem (McDonald *et al*., 1998). Palatability is improved by blending it with other feedstuffs and sulphur amino acid limitation is overcome by supplementation with synthetic products. In Nigeria with several brewing industries, BDG is readily available. This study was aimed at determining the effects feeding diets containing graded levels of BDG on growth performance of broilers.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the poultry unit of the Livestock Investigation Department (L.I.D) of the National Veterinary Research Institute in Vom, a quiet rocky village in Jos South Local Government Area of Plateau State with an altitude of 1285 meters above sea level and a cool climate between December and January with temperatures as low as 8°C. The wet season extends from late April to middle October (NVRI, 2019).

Experimental Diets, Birds, Design and Management

Five (5) experimental diets were formulated such that Brewer's Dried Grain was included in the diets at 0 (control), 10, 20, 30 and 40 % levels at starter and finisher phases (Table 1) The diets were formulated to contain the same levels of dietary protein. After 2 weeks brooding on commercial broiler starter feeds, the birds were allotted to the five different diets, each having 30 birds. The five groups were further divided into 3 replicates of 10 birds in a Completely Randomized Design. The starter diet was fed to the birds for a period of 2 weeks while the finisher diet was fed for duration of 4 weeks. The parameters taken were the initial and final weights, feed intake, weights gained. Feed Conversion Ratio (FCR) and feed cost per kg weights gained were calculated from the values obtained from the aforementioned parameters.

Table 1: Ingredient Composition of Broiler Finisher Diets

Ingredients	Levels of BDG inclusion in diet (%)				
	0	10	20	30	40
Yellow Maize	49.23	44.21	38.24	34.25	29.25
Wheat offal	7.38	6.64	5.74	5.14	4.39
Rice bran	4.94	4.42	3.82	3.43	2.93
BDG	0.00	10.00	20.00	30.00	40.00
SBC	34.22	30.46	27.64	22.94	19.19
Fish Meal	1.00	1.00	1.00	1.00	1.00
Bone Meal	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15
Lysine	0.10	0.10	0.10	0.10	1.10
Total	100	100	100	100	100
Calculated Analysis					
Crude Protein %)	21.00	21.00	21.00	21.00	21.00
ME (Kcal/Kg)	2,920.41	2,803.97	2,682.31	2,581.16	2,468.16
Crude Fibre (%)	3.87	193.48	383.08	572.70	762.31
Ether extract (%)	3.50	193.15	382.75	572.45	762.10
Calcium (%)	0.66	190.65	380.44	570.62	760.61
Phosphorous (%)	0.76	190.71	380.66	570.61	760.56

M.E. = Metabolizable Energy

Water and feed were supplied *ad libitum* with other routine management, practices as outlined by Oluyemi and Roberts (2007). All growth performance data obtained were subjected to Analysis of Variance using SPSS (2017) package. Where applicable differences between the means were separated using the Duncan option in the same package

RESULTS AND DISCUSSIONS

Table 2. Proximate composition of Brewer' Dried Grain

Nutrients	Composition (%)
Moisture	6.19
Crude protein	17.79
Crude fibre	8.25
Lipids	6.41
Ash	5.53
NFE	55.83
Calcium	1.10

Table 3. Performance of broiler chickens fed diets with different levels of B D G

	Levels of inclusion of Brewer's Dried Grains (%)					
Parameter	0	10	20	30	40	SEM
Av. Initial weights (g)	263.33^{b}	286.67^{ab}	310.00^{a}	303.33^{a}	300.00^{a}	5.89
Av. Final weights (g)	2,546.67^{a}	2,430.00^{a}	2,386.67^{a}	1,850.00^{b}	1603.33^{b}	113.90
Av. Total weight gains (g)	2,283.33^{a}	2,143.33^{a}	2,076.67^{a}	1,546.67^{b}	1303.33^{b}	116.49
Av, Total feed intake (g)	5,120.00^{b}	5,343.33^{a}	5,366.67^{a}	5,386.67^{a}	5400.00^{a}	36.26
Feed Conversion Ratio	2.25^{c}	2.51^{c}	2.67^{c}	3.49^{b}	4.14^{a}	1983
Feed cost/kg gain (₦)	300.23^{b}	288.70 ^{b}	334.48^{b}	427.13^{a}	491.32^{a}	22.39

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
SEM = Standard Error of Mean

Proximate composition of Brewer's Dried Grain (BDG)

The proximate composition of BDG used in this study is presented in table 2. The values obtained for most of the nutrients are similar to 8.50 % Moisture, 17. 80 % Crude Fibre, 6.80 % Ether Extract, 50.80 % NFE, %.00 % Ash and 19.68 % Crude Protein reported by Imonikebe and Kperegbeyi (2014). However, the result is different from the composition obtained by Isikwenu (2011) who reported that BDG contained 24.21 % Crude protein, 11.20 % Crude fibre, 3.69 % lipids, 8.04 % Ash and 46.20 % NFE. The differences may be due to differences in geographical locations or soil compositions where the various grains were cultivated, the types of varieties or cultivars of crops used, stage of ripeness at which the grains were harvested (Bolton and Blair, 1986) or even differences in accuracy or precision of laboratory techniques used for the analyses. It may also be due to differences in processing methods of the grains in the different locations.

The Effect of Brewers Dried Grain on Feed Intake of Broiler Chickens

Based on the findings of this work presented in table 3, feed intake increased (P<0.05) with increasing levels of BDG inclusion across the treatments. A similar report was given by Swain *et al* (2012), who recorded significant (P<0.05) increases in feed intake as levels of brewer's dried grain incorporated in chick diets increased. However, the results of this work is not in agreement with what was obtained in the study undertaken by Denstadli *et al*. (2010), who reported that inclusion of brewer's dried grain had no effect on feed intake. The difference between this work and that of Denstadli *et al.* (2010) may be due to differences in compositions, methods of processing of BDG and differences in feed forms (mash and pellets respectively) fed to the birds in the different studies respectively. Weight gains decreased significantly (p<0.05) across the treatments. The birds fed diets containing 0 % BDG recorded the highest weight gain, followed by those fed diets containing 10, 20, 30 and 40 % in that order agreeing with reports of Denstadli *et al.* (2010) who stated that increasing levels of BDG reduced the rate of body weight gains of broilers. The feed conversion ratio (FCR)

values for birds in this study were 2.25, 2.51, 2.67, 3.49 and 4.14 respectively which increased (P<0.05) with increasing levels of BDG inclusion in the diets. Calculated Metabolizable Energy values decreased with increasing levels if BDG inclusion which could be why FCR values were increasing across treatments as birds are known to increase feed intake in order to meet their energy requirements (Davidson *et al*., 1961). The higher FCR values of birds fed diets containing BDG is as a result of the diets containing lower energy and higher fibre contents. Feed cost per kg weight gain of the birds in this study are ₦300.23, ₦ 288.70, ₦334.48, ₦427.13 and ₦ 491.36 were significantly different (P<0.05) across treatments with broilers fed diets containing 40 % level of BDG recording the highest cost per unit weight gain. Those fed 10 % BDG diet recorded the least cost per unit weight gain which was not significantly different from those fed 0 and 20 % BDG levels.

CONCLUSION AND RECOMMENDATIONS

Based on the results of this study, the growth rate of broiler chickens is influenced by levels of BDG in their diets. The rate of weight gain decreased with increasing levels of BDG in the diet and vice versa. Also, the higher the level of BDG in the diet, the higher the FCR and feed cost per kg gain values. It is therefore, recommended that broilers diets can contain up to 20 % level of BDG without any adverse effect on growth performance.

REFERENCES

Bolton, W. and Blair, R. (1986). **Poultry Nutrition.** Ministry of Agriculture, Fisheries and Food. Reference Book 147. London, UK.

Davidson, J., McDonald, I., Mathieson, J. and Willians, R. S. (1961). Protein intake in birds. *Journal of Food Science and Agriculture* **12**: 425 – 439.

Denstadli, V., Balance, S., Knutsen, S. H., Westereng, B and Svihus, B (2010). Influence of graded levels of brewer's dried grain on pellet quality and performance in broiler chickens. *Journal of Poultry Science,* **89** (12): 2640-2645.

Imonikebe, U. G. and Kperegbeyi, J. I. (2014). Effect of substitution of maize with Brewer's Dried Grain in pig starter diet on the performance of weaner pig. *Global Journal of Agricultural Research.* **2** (4):.42-48, (www.eajournals.org)

Isikwenu, J. O. (2012). Hematological, organs and performance response of cockerel chicks fed Urea-treated and fermented Brewer's Dried Grains diets as replacement for groundnut cake. *American Journal of Food and Nutrition* **2** (1): 1- 6

Jacquie, J. (2015). Feeding brewer's grain to poultry cooperative extension. *University of Kenturkey.* Pp 3-50

MacDonald P., Edwards, R. A., Greenhalg, J. F. D. and Morgan, C. A. (1998). Animal Nutrition (5th ed). *London Longman GRP. Ltd*.

Charbagh, Lucknow 226004 u.p. (INDIA).

National Veterinary Research Institute, Vom (2019). History of the National Veterinary Research Institute, Vom. www.nvri.gov.ng/history.html

Oluyemi, J. A. and Robert, F. A. (2007). Poultry production in the warm and wet climate. 2nd edition, spectrum books limited. Ibadan, Nigeria. Pp 101-105.

Rijal, T. B., Nepali, D. B., Sah, R. A and Sharma, M. B. (2009). Economic uses of brewer's dried grain in the diet of swine. *Nepal Journal of Science and Technology*, **10**: 29-35

SPSS (2017). Statistical Package for Social Sciences. PC Version 23. SPSS Inc. 444N. Michigan Avenue, Chicago, United States of America.

Swain , B. K.. Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2012). Effect of feeding brewers' dried grain on the performance and carcass characteristics of Vanaraja chicks. *Journal of Applied Animal Research* **40** (2): 163 - 166

EFFECTS OF REPLACING MILLET OFFAL WITH MAIZE MILLING RESIDUE ON THE PERFORMANCE OF BROILER STARTER CHICKS

*Yusuf S.Z.[1], Kawu Y.U.[2] Bah, U.J.[3] K. M. Bello[4] and Doma, U. D.[4]

[1] Department of Animal Science and Range Management, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, Yola, Nigeria

[2]Department of Agric. Technology Federal Polytechnic Damaturu Yobe State, Nigeria

[3] Department of Animal Science Faculty of Agriculture Ahmadu Bello University Zaria Nigeria

[4] Animal Production Programme, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Corresponding Author- Email dbanuzubair@gmail.com

ABSTRACT

The experiments was conducted to evaluate the performance of broiler starter fed different levels of maize milling residue (MMR) as replacement for millet offal (MO) at graded levels of 0, 25, 50, 75 and 100%. Two hundred broiler chicks were randomly assigned to five dietary treatments in a completely randomized design with forty birds per treatment (four replicates). Feed and water were offered ad-libitum. The feeding trials lasted for four weeks. The results of the daily feed intake (DFI) were similar across the dietary treatment. The DFI ranges from 69.26-73.10g. The highest value was obtained on diet 4 (75% MMR) and lowest on diet 1 (0% MMR). No significant dietary effect was observed in daily weight gain (DWG) across the treatment groups. Similarly no significant dietary effect observed among the treatments on feed conversion ratio (FCR). However, FCR was better in diet 1 (0% MMR). Based on the results obtained, MMR can completely (100%) replace millet offal (MO) as dietary fibre source for feeding broiler starter with no negative effects on performance.

Key words: Broilers Starter, Millet offal, Maize milling residue, Performance.

INTRODUCTION

Nowadays, one of the most important nutritional problems in most developing countries is that of inadequate protein intake, more especially that of animal origin (Fielding, 1991). Animal protein contains the essential amino acids which are more balanced and readily available to meet human nutritional needs than plant proteins. FAO (1986) asserted that out of 45.0 g total protein consumed by an average Nigerian, only 7.0 g comes from animal sources. This low protein intake has been attributed to low level of animal production and high cost of animal products. The consequences of this low protein intake are retarded growth, high incidence of kwashiorkor, high rate of child mortality, short life-span and wide-spread protein-energy malnutrition.

Therefore the need for increase in animal production is absolutely critical and this can be achieved by producing highly productive animals with short generation intervals like broilers, rabbits and pigs. These animals are known to have high fecundity, short generation interval and fast growing rate (Yusuf *et al* 2015). Despite their rapid rate of multiplication, one of most important constrain in producing monogastric animals is the high cost of production due to high cost of feed which discouraged many farmers from engaging in poultry business. The situation has drawn the attention of nutritionist, scientist and agriculturist to the need for research in to the use of simple agro-industrial by-product that are not staple food for man to meet the nutritional needs of the monogastric. If this is achieved, it would lower the cost of production and consequently lead to availability and affordability of animal protein for the increasing human population of Nigeria (Yusuf *et al*. 2019).

One of the agro-industrial by-products that are cheap and available all year round throughout the tropical region is maize milling residue (MMR). MMR is suitable in formulating broiler diets as a source of fibre and to some extend can provides a reasonable amount of energy in the diets. MMR is a by- product obtained during the processing of maize grain into flour mainly from small scale millers. It consists of the outer covering (coat) of the maize seed and few broken maize and relatively cheap and available in all communities in Nigeria. The amount of broken maize found in MMR is depended on the efficiency of the milling process and the variety of the maize. Generally, MMR is said to contain 89.41%Dry matter, 11.00% crude protein, 1.8% ether extract, 6.60% crude fibre, 68.07% nitrogen free extract, 62%Total digestible nutrient, 1.99% Ash, 0.30% Calcium and 0.16% phosphorus (Ogundipe, 2002).

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Poultry section of Department of Animal Production Program, Teaching and Research farm, Abubakar Tafawa Balewa University Bauchi, Bauchi State, Nigeria. Bauchi town is located within Southern Guinea Savannah on latitude 13°13'' N and longitude 11° 50'' E at an altitude of 690.20m above sea level. It is characterized by two distinct seasons, the dry season from November to May and wet season from June to October. Ambient temperatures range from 15-19°C in December to January (cool season) and 33-44°C in March to June (hot season) and low relative humidity ranging from 5-43.5% (Alaku, 1983).

Experimental Materials

The ingredients for formulating the experimental diets include maize, maize milling residue, ,millet offal, Soya bean, fish meal, common salt, bone meal, methionine, lysine and mineral-vitamin premix. All ingredients were purchased in the local market within Bauchi and Yobe State. Experimental starter and finisher diets were formulated to meet protein and energy requirement of the birds

Experimental stock and management

Two hundred unsexed day-old Anak 2000 broiler chicks were used for the experiment. The chicks were placed on commercial starter diet during brooding for a week, before they were randomly assigned to experimental starter diets for four weeks. The experiment consisted of five treatments (diets) replicated four times with ten birds per replicate making it forty birds in a completely randomized design (CRD). Experimental diets and clean drinking water were provided *ad-libitum* during the conduct of the experiment. The experiment was concluded when the birds were five weeks on the diets. All management practices such as routine vaccination, proper sanitation and treatment of sick birds were strictly adhered to. Initial live weights of the chicks were measured at the beginning of the experiment; daily feed intake and weekly live weight gain during the conduct of the experiment were measured. At the end of the experiment, feed conversion ratio was evaluated.

3.4.2 Experimental diets

Five starter diets were formulated in which maize milling residue replaces millet offal at 0, 25, 50, 75, and 100% and designated as diets 1, 2, 3, 4, and 5 respectively. The compositions of the experimental diets and calculated analysis are presented in Tables 1.

Table 1: Composition (%) and calculated analysis of dietary levels of maize milling residue as replacement for millet offal fed to broiler starter chicks

	Diets				
Ingredients	**1(0%)**	**2(25%)**	**3(50%)**	**4(75%)**	**5(100%)**
Maize	45.17	45.17	45.17	45.17	45.17
Soya bean	35.33	35.33	35.33	35.33	35.33
Millet offal	10.00	7.50	5.00	2.50	0.00
MMR	0.00	2.50	5.00	7.50	10.00
Fish Meal	5.00	5.00	5.00	5.00	5.00
Bone Meal	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Calculated Analysis					
CP)(%)	23.41	23.30	23.21	23.10	23.00
ME (Kcal/kg)	3012.90	3009.20	3005.50	3001.80	2998.10
CF (%)	3.85	3.99	4.14	4.28	4.43
EE(%)	8.78	8.73	8.68	8.63	8.58
Ca (%)	1.68	1.67	1.67	1.67	1.66
P (%)	0.93	0.94	0.95	0.95	0.96
Lysine (%)	1.45	1.45	1.45	1.45	1.45
Methionine(%)	0.70	0.70	0.70	0.69	0.69

Results

Productive performance

The productive performance of broiler chicks fed dietary levels of maize milling residue (MMR) as replacement for millet offal is presented in Table 2. The initial live weights of the birds ranged from 215.75-231.550g and were similar. The daily feed intake (DFI) of broiler chicks ranged from 69.26-71.68g for broiler chicks on diets 1 and 4 respectively and the values did not differ significantly across the treatments. The daily weight gain (DWG) of broiler chicks ranged from 34.61-38.49g for chicks fed diets 5 and 1respectively, however, all the values recorded were not significantly affected by dietary treatment. The final body weights of the birds varied between 949.80 and 1025.80g in broiler chickens on diets 5 and 1respectively, and were not significantly affected by MMR levels. Feed conversion ratio varied between 1.82 and 2.04 in broiler chickens on diets 1 and 3. However, all values obtained were not significantly affected by levels of MMR in the diets.

Mortality

No mortality was recorded at the starter phase of the experiment.

Discussion

Productive performance

The results of the daily feed intake (DFI) were similar across the dietary treatment which ranges from 69.26-73.10g. Though not significant, higher value was obtained on diet 4 (75% MMR) and lower on diet 1 (0% MMR). High feed intake in diet 4 may result from fibrous nature of the test materials as MMR is more fibrous than millet offal. The values obtained were similar to the findings of Ezieshi and Olomu (2008) in broiler chickens fed palm kernel cake and millet offal. No significant dietary effect was observed in daily weight gain (DWG). Though not significantly different, the higher DWG was also recorded on diet 4. This cannot be attributed to dietary effect as the values did not follow a definite trend. The values are similar to findings of Ezieshi and Olomu (2004) in broiler chickens fed palm kernel cake and millet offal. The replacement of millet offal with maize milling residue has no

significant dietary effect among the treatments on feed conversion ratio (FCR). However, FCR was better in diet 1 (0% MMR). The values were also similar to those reported by Diara *et al.* (2002) in broiler chickens fed millet offal as replacement for wheat offal.

Table 2: Productive Performance of Broiler Starter Chickens Fed Dietary Level of Maize Milling Residues as Replacement for Millet Offal

	Diets					
Parameter	**1(0%)**	**2(25%)**	**3(50%)**	**4(75%)**	**5(100%)**	**SEM**
Initial Weight (g)	231.50	225.00	215.75	224.00	222.75	4.458 ^{NS}
Daily Feed Intake(g)	69.26	71.29	71.68	73.10	71.55	1.001 ^{NS}
Daily weight gain (g)	38.49	36.01	35.22	37.05	34.61	1.157 ^{NS}
Final live weight (g)	1025.80	985.00	967.80	1001.80	949.50	18.682 ^{NS}
Feed conversion ratio	1.818	1.98	2.040	1.97	2.073	0.059 ^{NS}
Mortality (number)	0	0	0	0	0	-

CONCLUSIONS

MMR can completely (100%) replace millet offal (MO) as dietary fibre for feeding broiler starter with no negative effects on performance.

Recommendations

Based on the results obtained, the following recommendations were made:

i. Maize milling residue (MMR) is a suitable feedstuff and can be incorporated at 100% level in starter diets of broiler chickens as sole fibre source. It is a valuable substitute to most cereal fibres like millet offal particularly in the areas where it is cheap and readily available.
ii. Further research should be conducted to evaluate the suitability and its utilization in the diets of other monogastric animals such as layers, guinea fowl, turkey, ducks and rabbits.

References

Abakisi F., Atuahene C. C., Attoh-Kotoku V. & Adjei M. B .(2015) Response of Broilers to "Dusa", a millet residue meal: Effects on carcass traits and blood profile, *Journal of Animal Science Advances.* **5**(5): 1266-1272.

Alaku S. O., (1983) Body and carcass losses in goats during the advanced period o west African sahelian dry season World Review of Animal Production. 19: 49-54.

Atteh, J.O. (2002) **Principles and practice of Livestock feed manufacturing.** Adlek printers 64 Sabon- layi, Ilorin ,Kwara state, Nigeria p.217

Diara, S.S, Kwari I.D., & Ubosi, C.O, (2002) Potentials of millet bran as substitute for wheat bran in broiler chicken diets. *Journal of Sustainable Agriculture and Environment,* **4** (2): 165-169

Ezieshi, E.V. & Olomu, U. (2008) Biochemical Evaluation of millet offal as feeds for broiler chickens *Pakistan Journal of Nutrition.* **7**(3): 421-425.

Ezieshi, E.V. & Olomu, J.M. (2011) Comparative performance of broiler chickens fed varying levels of palm kernel cake and maize offal. *Pakistan Journal of Nutrition* **3**(4): 254-257.

Fielding, D. (1991). *Rabbits*. The Macmillan Press Ltd, London and Basingstoke, Pp 106.

FAO (1986). Food and Agriculture Organisation Production Year Book 36: 126 – 127. FAO Statistics Series No. 47, FAO, Rome, Italy.

Gwayo G. J., Doma U. D., Abubakar M. and Bello K. M. (2017) Response of broiler chickens fed graded levels of goat rumen digester in replacement for wheat offal as dietary fibre source. *Proceedings of the 6th ASAN-NIAS Joint annual meeting, septenber 10-14, 2017, Abuja . pp 527-530.*

Ogundipe, S.O. (2002) **Ration formulation** and least cost at the small ruminant training workshop held at NAPRJ ABU, Zaria, 13th-18th Jan 2002

Ojelade, A.Y.P., Lamid, A.W., Umaru, J.I. & Ogunmiluyi, O.A. (2015). Performance and organs weight of broiler chickens fed graded level of mixture of *Ocinum gratissmum* and *Vemonia amygdalina* leaf meal-based diet. ***Proc. 20th Ann. Conf. Animal Science Association of Nigeria***, Ibadan: PP 611-614.

Oluyemi, J.A and Roberts, F.A.(2000), **Poultry production in warm wet climate**.Rev. Ed. Spectrum Book, Ltd spectrum House Ring Road Ibadan, Nigeria.

Yusuf, S. Z., Igwebuike, J. U., Dunya, A. M. &s Husa, H. (2015) Effects of feeding graded levels of *Prosopis africana* pulp (Kirya) on growth and economic performance of finishing broiler chickens in tropical environment. *Pyrex journal of plant and Agriculture research, vol.* **2(**1) pp 26-30

Yusuf S.Z., Husa H., A. I. Abdullahi, M.A. Bose and U.D. Dass (2019) Utilization of Dietary Levels of Maize Milling Residue as Replacement for Sorghum Offal in the Diet of Broiler Chickens. *Nigerian journal of tropical agriculture, vol* 19.

GROWTH PERFORMANCE OF JAPANESE QUAILS (*Coturnix coturnixjaponica*) FED DIETS CONTAINING VARYING DIETARY LEVELS OF PROTEIN AND ENERGY

Zakari, A.* Alabi, O.J. and Aremu, A.

Department of Animal Production, Federal University of Technology, Minna.

***Corresponding author email: adamuzakari7790@gmail.com; +2349033998083**

Abstract

Present experiment was conducted to evaluate the effect of diets containing varying levels of crude protein (20, 22, 24 and 26%) and metabolizable energy (2600, 2800, 3000 and 3200 kcal/kg) on growth performance of growing Japanese quail. A total of 576 two-week old quail chicks were assigned into 16 treatments. Each treatment were replicated three times and each replicate had 12 birds using a 4 by 4 factorial arrangement in a completely randomized design. Data on performance and nutrient digestibility were recorded and analyzed using a completely randomized design with a 4×4 factorial arrangement during 6 weeks of age. Results of the study showed that both the main and interaction of varying dietary protein and energy levels had no effect on the growth performance of Japanese quails. It could, thus, be recommended that the lowest protein (20 %) and energy (2600 kcal ME/kg) levels be used in the diets of Japanese quails for optimal growth performance since their performance is similar even at the highest protein and energy levels.

Keywords: *Japanese quail, Crude protein, Metabolizable energy, Performance*

Introduction

The world population is growing at an alarming rate. According to PRB (Population Reference Bureau) Projects, Africa's population will more than double to 2.6 billion by 2050 and will account for about 58 percent of the global population increase by that date (Rosen *et al.*, 2016). With this population and the increased concern over low dietary animal protein supply. There is urgent need to increase the animal protein supply. This has led to search for animal that can supply the needed protein. If there is to be progress in this, effort must be placed on identification of alternative food resources that can meet to pace of the population growth (Rosen *et al*, 2016). The incorporation of game birds has been recommended, particularly for developing countries (Geldenhuys *et al.*, 2013) and one of the game birds that has identified is quail.

Quail has attained economic importance as an agricultural species producing eggs and meat that are enjoyed for their unique flavor. They have low maintenance cost because of their small body size (80-300 g), short generation interval having three to four generations in a year). Quail birds are more resistance to diseases and they have high egg production, thus they are an excellent laboratory animal because of their short generation interval. However, the nutritional requirement of this birds for the tropics have not been well established. Studies has shown that the nutrient of birds varies from species to species and from one location to another. Presently, in Nigeria, the diets fed to quail are mostly based on 24 and 20 % of crude protein for rearing and production, respectively, as recommended by NRC (1999) and there are also variations in the dietary crude protein and energy recommendations for quails.

Woodard *et al*., (1973) reported that quail can be raised on turkey starter diets containing 25 – 28 % crude protein while Lee *et al*. (1977) on the other hand indicated that dietary crude protein level of 24 % is needed in starter diet for quail and the protein content may be reduced to 20 % by 3rd week of age. Nwokedi *et al*. (2010) observed that when four crude protein levels of 20, 22, 24 and 26% were evaluated for Japanese quails, birds on 20 % crude protein level resulted in best performance from 1 to 42 days of age. Murakami *et al*. (1993) discovered that 18% crude protein was adequate at the laying phase this is, however, lower than the 20% recommended by NRC (1994) and 22.42% recommended by Pinto *et al*. (1998).Report of Reda *et al*. (2015) indicated that Japanese quail fed crude protein and energy levels of 22 % and 2900 kcal ME/kg, respectively, as adequate during the first few weeks of growth. While Jahanian and Edriss (2015) reported that Japanese quail fed CP and energy levels of 26 % and 3000 kcal ME/kg, respectively, for the same period.

For the review above, that there are variations in the Japanese quail requirements for energy and protein. The variation might be attributed to region (climatic), breed of quails, time of rearing among others. This study will therefore, determine the effect of four different energy (2600, 2800, 3000 and 3200 Kcal) and four dietary protein levels of 20, 22, 24 and 26 % on the growth performance of Japanese quail raised under intensive management system in Nigeria (a tropical country).

Materials and Methods

The study was conducted at the teaching and Research Farm of Animal Production Department Federal University of Technology Minna, Niger state. Minna lies between latitude $9^0 15^1$ and $9^0 45^1$ N and between longitude $6^0 15^1$ and $6^0 45^1$ of the equator. The mean annual rainfall is between 1200 and 1300 mm and mean temperature ranges from 38 – 42°C

A total of five hundred and seventy-six (576) two weeks old Japanese quails obtained from the National Veterinary Research Institute, VOM, Nigeria. The two-week old quail chicks were assigned into 16 treatments. Each treatment was replicated thrice and each replicate had 12 birds using a 4 by 4 factorial arrangement in a completely randomized design. The experimental diets were corn-soybean based with 4 levels of protein (20, 22, 24 and 26% CP) at either of 4 levels of energy (2600, 2800, 3000 and 3200 kcal ME/kg diet). The composition of the experimental diets is presented in Table 1. The birds in all the treatments were subjected to similar management practices throughout the six weeks experimental period.

Initial weights were determined at the start of the experiment with the aid of salter weighing scale (SGF 400) balance and thereafter at weekly intervals. The final weight was also taken by weighing the birds in each replicate on the last day of the experiment using the same weighing balance. The weight gain was calculated by subtracting the initial weight from the final weight. In addition, the feed intake was calculated by subtracting the feed remaining from the total feed supplied each day before serving fresh one. The feed conversion ratio was also calculated by dividing feed intake by weight gain.

Data Analysis. All data generated were analyzed using two-way analysis of variance (ANOVA) and where significant differences occurred, the means was separated using Duncan Multiple Range Test as contained in the SAS package (2015), version 15.0.

Table 1. Ingredients composition of the Experiment

Ingredient	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
Maize	40.00	40.00	45.00	50.00	40.00	42.00	46.00	45.00	40.00	44.00	44.00	40.00	40.00	40.00	40.00	40.00
G/Cake 44%	4.00	4.00	4.00	4.00	6.00	4.00	4.00	4.00	18.00	11.00	5.00	9.00	13.00	12.00	10.00	8.00
Full fat soya	30.00	30.00	31.00	30.00	31.00	36.00	34.00	34.00	24.00	31.00	36.00	36.00	22.00	32.00	31.00	30.00
Fish meal	3.00	3.00	3.00	3.00	4.00	3.00	4.00	4.00	4.00	4.00	5.00	4.00	10.00	6.00	8.00	10.00
Rice offal	18.00	16.00	8.00	2.00	14.00	10.00	4.00	2.00	9.00	5.00	3.00	0.00	10.00	4.00	2.00	0.00
Limestone	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Palm oil	0.00	2.00	4.00	6.00	0.00	0.00	3.00	6.00	0.00	0.00	2.00	6.00	0.00	1.00	4.00	7.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DI-Methione	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	100.0	100.00	100.00	100.00	100.0	100.0	100.0	100.0	100.00	100.0	100.00	100.0	100.00	100.0	100.00	100.0
Calculated analysis																
CP	20.00	20.00	20.00	20.00	22.00	22.00	22.00	22.00	24.00	24.00	24.00	24.00	26.00	26.00	26.00	26.00
ME	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.00	3200.0
% EE	8.37	10.06	11.78	13.26	8.52	9.00	11.31	13.86	7.70	8.47	10.77	14.22	7.52	9.54	11.97	14.40
% CF	9.82	9.04	6.08	3.80	8.44	7.07	4.72	3.92	6.83	5.32	4.46	3.44	6.87	4.98	4.04	3.11
Avail P %	0.47	0.46	0.46	0.45	0.50	0.47	0.49	0.48	0.50	0.50	0.52	0.49	0.65	0.55	0.60	0.65
% Lysine	1.29	1.28	1.31	1.29	1.39	1.42	1.43	1.42	1.41	1.47	1.54	1.54	1.60	1.60	1.65	1.69

Key: CP = Crude protein, **ME** = Metabolism energy, **EE** = Eater extract, **CF** = Crude fiber, **Avail P** = Available protein, **G/cake** = Groudnut cake, **T** =Treatment

Results and Discussion

The main effect of dietary protein and energy levels on the growth performance results of Japanese quails is presented in Table 2. All the growth performance parameters measured there were no significant differences observed between the treatment group on the performance value recorded.

The interaction results between protein and energy levels on performance were presented in Table 3. There were similar in the main performance of the Japanese quail in all the parameters. The interaction of protein and energy on all the performance parameters was not significant.

Table 2Main effect of dietary protein and energy on performance of Japanese Quails

Treatments	Initial weight	Final weight	Weight Gain	Daily weight Gain	Total feed intake	Daily feed Intake	FCR
Effect of crude protein							
20.00	20.23	84.16	63.94	1.52	892.89	21.26	2.00
22.00	20.27	84.83	64.56	1.53	893.01	21.26	1.98
24.00	20.25	84.63	64.38	1.53	915.44	21.80	2.02
26.00	20.24	84.06	64.82	1.54	903.16	21.50	2.04
SEM	0.02	0.66	0.65	0.02	20.92	0.50	0.06
p. value	NS	NS	NS	NS	NS	NS	NS
Effect of energy							
26.00	20.26	83.91	63.65	1.52	928.44	22.11	2.04
28.00	20.24	84.14	63.90	1.53	926.41	22.06	2.07
30.00	20.24	84.94	64.70	1.54	883.61	21.04	1.96
32.00	20.26	84.53	64.27	1.53	865.95	20.62	1.94
SEM	0.03	0.66	0.65	0.02	20.92	0.50	0.06
p. value	NS	NS	NS	NS	NS	NS	NS

Table 3Interaction effect of dietary protein and energy on performance of Japanese Quails

Protein	Energy	Initial weight	Final weight	Weight Gain	Daily weight Gain	Total feed Intake	Daily feed intake	FCR
20.00	26.00	20.21	84.35	64.14	1.54	875.90	20.85	1.92
	28.00	20.21	83.56	63.35	1.51	935.44	22.27	2.11
	30.00	20.25	84.71	64.50	1.54	880.58	20.97	1.95
	32.00	20.29	82.80	62.55	1.49	879.63	20.94	2.01
22.00	26.00	20.25	85.15	64.86	1.54	982.17	23.38	2.17
	28.00	20.21	85.29	65.04	1.55	910.70	21.68	2.00
	30.00	20.33	85.25	63.31	1.55	842.45	20.06	1.85
	32.00	20.25	83.64	63.31	1.51	836.71	19.92	1.89
24.00	26.00	20.25	83.62	63.37	1.51	954.00	22.71	2.08
	28.00	20.25	83.89	63.14	1.51	937.74	22.33	2.12
	30.00	20.25	85.89	65.64	1.56	883.80	21.04	1.82
	32.00	20.25	85.62	65.37	1.50	886.20	21.10	1.94
26.00	26.00	20.25	85.28	65.03	1.55	901.70	21.47	1.98
	28.00	20.25	84.33	64.04	1.53	921.75	21.95	2.06
	30.00	20.25	82.89	62.64	1.49	927.93	22.09	2.12
	32.00	20.21	83.74	63.53	1.50	861.25	20.51	1.94
SEM		0.06	1.31	1.30	0.03	41.85	1.00	0.11
p. value		NS	NS	NS	NS	NS	NS	NS

Conclusion

Results of the study showed that both the main and interaction of varying dietary protein and energy levels had no effect on the growth performance. It could be recommended that the lowest protein (20 %) and energy (2600 kcal ME/kg) levels be used in the diets of Japanese quails for optimal performance since their performance is similar even at the highest protein and energy levels. Further study on the digestibility and economic of production can be carried out to ascertain the effect on the quails.

REFEREES

Geldenhuys, G., Hoffman, L. C., & Muller, N. (2013). Gamebirds: A sustainable food source in Southern Africa? *Food Security,* 5(2), 235–249.

Jahanian R. & Edriss M.A (2015) Metabolizable energy and crude protein requirements of two Quail species (Coturnix japonica and Coturnix ypsilophorus).*The Journal of Animal and Plant Sciences,* 25(3): 603- 611.

Lee, T.K. Shim, K.F. and Tan, E.L. (1977a). Protein requirement of growing Japanese quails in the tropics. *Singapore. Journal Poultry Industry*., 5: 70-81.

Murakami, A. E. Moraes, V. M. B. Ariki, J. Junqeira, O. M. Kronka-S.da, N. Barbosa-da-Moraes V. M. and Do- Nascimento-Kronka (1993). Level of protein and energy diets for laying Japanese quail *(Coutrnix coutarnix Japonica). Revista - da- Sociedade-Brasileira -de-Zootecnia* 22(4): 541-551.

NRC (1999). *Quail. In: Micro-livestock's – Little known small animals with a promising economic future*. National Research Council, Academy Press, Washington D.C. pp. 147- 155.

NRC (1994). *Nutrient Requirements of Poultry*. National Research Council, National Academy Press, Washington, D. C., 9th Revised Edition. Pp. 234

Nwokedi, M.N. Sekoni. A.A. & Alphonsus, C. (2010). Evaluation of optimal energy and protein requirement of Japanes quails (Coturnix coturnix japonica) for growth and carcass characteristics. In: O.J Ifut., U.A. Inyang., I.P. Akpan and I.E Ebeso (Eds). Diversifying Nigerian Economy Animal production option. *Proceedings of the 15th Annual Conference of the Animal Science Association of Nigeria, 13-15th Sept, 2009,Uyo,* 503-507.

Pinto R, Ferreira A.S. Albino L.F.T. & Gomes, PC. (1998). Níveis de proteína e energia para codornas japonesas em postura. In: 35th Reunião Anual da Sociedade Brasileira de Zootecnia; FMVZ- UNESP – Botucatu – *São Paulo.* 5. (4): 147-149.

Reda F.M, Ashour E.A, Alagawany M & Abd El- Hack M.E (2015) Effects of Dietary Protein, Energy and Lysine Intake on Growth Performance and Carcass Characteristics of Growing Japanese Quails. *Asian Journal of Poultry Science,* 9: 155-164.

Rosen, S., Meade, B., Fuglie, K., & Rada, N. (2016). International food security assessment, 2014-2024. Economic Research, 2014, 2024.

SAS Institute Inc., Cary, NC. 2003 SAS. 2003. SAS Institute Inc., Cary, NC, USA.

Woodard, A.E. Abplanalp, H. Wilson, W.O. and Vohra, P. (1973). *Japanese quail husbandry in the laboratory (Coturnix coturnix japonica)*. Department of Avian Sciences, University of California, Davis, 22 pp.

RESPONSE OF GROWER PIGS FED DIETS CONTAINING HIGH FIBRE SUPPLEMENTED WITH COCKTAIL OF ENZYMES

Adesehinwa* A. O. K., Etop S. C.[1], Ajayi E.[1], Ogunyemi D. J.[2], Boladuro B. A., Sorunke A. O. and Abiola J. O.[3]

Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan
[1]Department of Animal Science, University of Ibadan, Ibadan. Nigeria
[2]Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife
[3]Department of Veterinary Medicine, University of Ibadan, Ibadan. Nigeria.
*Corresponding Author: aokadesehinwa@yahoo.com

Abstract

The study was conducted to evaluate the effect of cocktail of enzymes (Avemix XG 10) which comprised xylanase and glucanase on the performance of grower pigs fed a basal diet containing corn bran, wheat bran and palm kernel cake. A total of 48 grower pigs with an average initial body weight (BW) of 27.81±0.84 kg were randomly allocated to three treatments based on BW and sex (16 replicate pens with one pig) were used in this 56-day trial. Dietary treatments were: (T1) control: basal diet plus 0% Avemix XG 10; (T2) basal diet plus 0.01% Avemix XG 10 and (T3) basal diet plus 0.03% Avemix XG 10. The enzyme (Avemix XG 10) supplementation did not have significant (P>0.05) effect on final body weight, daily weight gain, average daily feed intake and feed conversion ratio. The pigs fed the control diet without Avemix XG 10 had the highest final body weight (43.882 Kg), daily weight gain (0.374 Kg) and average daily feed intake (1.544 Kg) while the lowest values for the aforementioned parameters were observed in the pigs fed diet supplemented with 0.01% Avemix XG 10. The pigs fed diet with 0.03% Avemix XG 10 (T3) had the best feed conversion ratio. The enzyme supplementation increased (P<0.05) the cost of feed/kg diet and also increased the feed cost/kg live weight by 2.64 and 7.92% at 0.01 and 0.03% respectively when compared to the control. In conclusion, dietary supplementation of Avemix XG 10 1in the diet containing high dietary fibre did not improve the performance of grower pigs.

INTRODUCTION

Animal nutritionists continuously search for a cost-effective optimum between ever changing dietary formula and increasing demands on performance. This has led to inclusion of Non-starch polysaccharides rich ingredients in the diets of animals, which often reduces feed cost. However, this hinders a proper digestion due to high fibre and presence of anti-nutritional factors (De Keyser *et al*., 2016). Non-ruminants are physiologically unable to hydrolyze NSP in their small intestine. Dietary fiber is one of the most significant factors that affect gut physiology and health in livestock (Viladomiu *et al.,* 2013; Lindberg, 2014). Non-starch polysaccharide (NSP)-degrading enzymes have been indicated to increase the utilization of fibre with a consequent increase in energy and other nutrients. Again, it has been reported that the addition of non-starch polysaccharides degrading enzymes improve animal growth performance, nutrient digestibility and responses to infectious diseases (Lan *et al*., 2017). Cocktail of enzymes (AveMix® XG 10) is a multi-enzyme concept with high glucanase and high xylanase activity, designed for monogastric feeds. The enzyme activities work synergistically to break down fibre structures. Through the capability of AveMix® XG 10 to break down also soluble fibres into smaller particles, intestinal viscosity will be reduced. This lower viscosity will enhance intake of nutrients in the small intestine, this effect is important in poultry (AVEVE Biochem, 2010). Therefore, the potency of cocktail of enzymes (Avemix XG 10) was assessed to upgrade dietary energy, total protein and amino acid digestibility as well as fibre utilization in growing pigs.

MATERIALS AND METHODS

Experimental location and duration

The feeding trial which lasted for a period of 56 days was carried out at AK farms located at Eleyele, Ibadan, Oyo state, Nigeria. A basal diet deficient in energy, crude protein and high in crude fibre was formulated using the nutrient requirement recommendations for growing pigs

by National Research Council (1998) as a guide (Table 1) for other nutrients. The basal diet was in pellet form, consisting of maize bran, wheat bran and palm kernel cake and other micronutrients. The basal diet served as control (T1) had no Avemix XG 10 while the enzyme (Avemix XG 10) was added to the basal diet at 0.01% (T2) and 0.03% (T3). The control diet (T1) contained 11.05 % crude protein (CP) and 2166 Kcal/ Kg metabolizable energy. All the treatments contained the same percentage of crude fibre (14.17%). Forty-eight growing pigs with average initial live weight of 27.81±0.84 kg were randomly allocated according to body weight and sex to the three experimental treatments with sixteen replicates and each animal represented a replicate in a completely randomized design. The pigs were kept in Pens with area (234 cm × 216 cm) which had concrete floors without litter. Each pen had a concrete feeder (97 cm × 33 cm) and a concrete drinker (97 cm × 33 cm). All the pigs were fed with the experimental diets throughout the experimental period**.** The experimental diets and water were given to the animals unrestrictedly for the period of the experiment. Standard management practices were duly observed. Data were collected on daily feed intake and body weight gain. Daily weight gain, feed conversion ratio and indices for economic analysis were evaluated. All the data were subjected to analysis of variance using General Linear Model of SAS (2002) and the means were separated using Duncan Multiple Range test.

Results and Discussion

The indices used to measure the performance of the growing pigs fed the experimental diets are shown in Table 2. These indices include the final body weight, body weight gain, daily weight gain, average daily feed intake and feed conversion ratio. The differences in all the parameters across the treatments were not significant (P>0.05). The pigs fed the control diet without Avemix XG 10 had the highest final body weight (43.882 Kg), body weight gain (15.721 Kg), daily weight gain (0.374 Kg) and average daily feed intake (1.544 Kg) while the lowest values for the aforementioned parameters were observed in the pigs fed diet supplemented with 0.01% Avemix XG 10. The pigs fed diet with 0.03% Avemix XG 10 (T3) had the best feed conversion ratio while the worst feed conversion ratio was observed in the pigs fed 0.01% Avemix XG 10 (T2), though, these variations were not significantly (P>0.05) different. The use of enzyme (Avemix XG 10) did not show any beneficial effect on the performance of the pigs. This may be as a result of high fibre content in the diets (14.17%) as revealed by the proximate analysis. The enzyme (Avemix XG 10) whose primary function is to break the non-starch polysaccharides in the diets could not make the nutrients encapsulates by the high fibre available to the animals. This has resulted in low bioavailable of several nutrients. The results of this study indicate that pigs fed diets supplemented with the Avemix XG 10 (xylanase and glucanase) had similar performance with those fed the control diet (T1). These results are in disagreement with earlier findings of Fang *et al*. (2007), who reported xylanase supplementation improved the average daily gain and feed efficiency in growing pigs fed corn, soybean and rapeseed based diets. The lack of significant effect of the cocktail of enzymes used in this study (Avemix XG 10) on average daily gain and feed conversion ratio is also in contrary to the report of Nortey *et al*. (2007) who indicated that xylanase supplementation to wheat-based diets improved the average daily gain and feed efficiency. However, the results are inconsistent. The results of this study corroborate the earlier findings of Passos *et al*. (2015) who reported that dietary supplementation of xylanase had no effect on average daily gain, average daily feed intake or feed efficiency in grower pigs fed a corn-soybean meal based diet**.** The seeming contradictions in the effectiveness of enzyme supplementation among studies may be due mainly to differences in pig age and the compositions of the experimental diets (Lan *et al*., 2017). There was a significant (P<0.05) difference in the costs of a kilogram of the diets across the treatments. The significant

difference that exists in the cost of feed per kilogram was ascribed to the inclusion of the enzyme (Avemix XG 10). At 0.01 and 0.03% inclusion levels, enzyme supplementation significantly ($P<0.05$) increased the cost of the feed per kilogram by 2.64 (T2) and 7.92 % (T3) respectively when compared with that of the control (T1).

Conclusion

It could be concluded that Avemix XG 10 (Xylanase and glucanase) supplementation did not improve the performance of grower pigs fed diets marginal in crude protein, metabolisable energy but high in crude fibre.

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References.

Aveve biochem (2010). Manual guide for Avemix XG 10

De Keyser, K., Kuterna L., S. Kaczmarek S., Rutkowski A and Vanderbeke E. (2018) High dosing NSP enzymes for total protein and digestible amino acid reformulation in a wheat/corn/soybean meal diet in broilers, *Journal of Applied Poultry Research* 25:239–246

Fang, Z. F., Peng J., Liu Z. L., Liu Y. G. (2007). Responses of non-starch polysaccharide-degrading enzymes on digestibility and performance of growing pigs fed a diet based on corn, soya bean meal and Chinese double-low rapeseed meal. *Journal of Animal Physiology and Animal Nutrition* 91: 361–368.

LAN, R., LI T. and Kim I. (2017). Effects of xylanase supplementation on growth performance, nutrient digestibility, blood parameters, fecal microbiota, fecal score and fecal noxious gas emission of weaning pigs fed corn-soybean meal-based diet, *Animal Science Journal* 88(9): 1398-1405

Lindberg J. (2014). Fiber effects in nutrition and gut health in pigs. *Journal of Animal Science Biotechnology* 5: 15–21.

Nortey, T. N., Patience J. F., Simmins P. H., Trottier N. L., Zijlstra R. T. (2007). Effects of individual or combined xylanase and phytase supplementation on energy, amino acid, and phosphorus digestibility and growth performance of grower pigs fed wheat-bases diets containing wheat millrun. *Journal of Animal Science* 85:1432–1443.

NRC. (1998). Nutrient Requirements of Swine, 11th edition. National Academic Press, Washington, DC.

Passos, A. A., Park I., Ferket P., Von Heimendahl E., Kim S. W. (2015). Effect of dietary supplementation of xylanase on apparent ileal digestibility of nutrients, viscosity of digesta, and intestinal morphology of growing pigs fed corn and soybean meal based diet. *Animal Nutrition* 1: 19–23.

SAS (2002). Statistical Analysis software, Version 9.0. SAS Institute Incorporation, Cary, NC, USA

Viladomiu, M., Hontecillas R., Yuan L., Lu P. and Bassaganya-Riera J. (2013). Nutritional protective mechanisms against gut inflammation. *Journal of Nutrition Biochemistry* 24: 929–939.

Table 1. Gross composition and calculated analysis of the experimental diets

Ingredients (%)	T1	T2	T3
Maize bran	45.50	45.50	45.50
Wheat bran	20.30	20.30	20.30
Palm kernel cake	30.00	30.00	30.00
Bone meal	2.00	2.00	2.00
Limestone	1.00	1.00	1.00
Salt	0.40	0.40	0.40
Premix Broiler	0.30	0.30	0.30
Lysine	0.10	0.10	0.10
BIOAD	0.30	0.30	0.30
NITROTRIM2	0.10	0.10	0.10
Larvacide	0.03	0.03	0.03
AVEMIX XG 10	-	0.01	0.03
Total	**100.03**	**100.04**	**100.06**
Calculated Analysis			
Crude protein (%)	11.05	11.28	11.74
Metabolisable energy (Kcal/Kg)	2166	2256	2435
Crude fibre (%)	14.17	14.17	14.17
Lysine (%)	0.53	0.54	0.57
Methionine (%)	0.23	0.23	0.23

Table 2. Growth performance and economic analysis of pigs fed diets containing high fibre supplemented with cocktail of enzymes

Parameters	T1	T2	T3	SEM	Pvalue
Initial body weight (Kg)	28.161	27.955	27.300	0.8441	0.9230
Final body weight (Kg)	43.882	41.564	42.070	1.0538	0.6511
Body weight gain (Kg)	15.721	13.610	14.770	0.7318	0.4894
Daily weight gain (Kg)	0.374	0.324	0.352	0.0174	0.4894
Average daily feed intake (Kg)	1.544	1.506	1.513	0.0369	0.9090
Feed conversion ratio	4.612	4.981	4.500	0.2458	0.7028
Economic analysis					
Feed cost/Kg diet (₦)	55.836^{c}	57.309^{b}	60.256^{a}	0.2961	<0.0001
Total cost of feeding (₦)	4827.9	4832.6	5106.4	120.650	0.6004
Feed cost /Kg live weight gain ((₦/Kg)	257.50	285.48	271.15	14.0238	0.7153

^{abc} Means within the same row with different superscripts are significantly different ($p<0.05$)
SEM; standard error of mean

PROXIMATE, MINERAL AND PHYTOCHEMICAL COMPOSITION OF SOME SELECTED FEED INGREDIENTS IN SEMI-ARID REGION OF NORTH EASTERN NIGERIA

Amaza, I. B., Boyi, B., Maidala, A., Adejumo I. O., Garba, A. M.
Department of Animal Science Federal University Gashua.
Corresponding Author; iliyaamaza20@gmail.com

ABSTRACT

Seeds of Cucumbar sativus L, Acacia nilotica, L, Glycine max L, Parkia globosa, Hibiscus subdariffa L, Mangifera indica, Moringa oleifera, Citrullus lanatus, Adonsonia digitata and Mesocarp of Hypalina theibecca indigenous to semi-arid zone of North Eastern Nigeria were analyzed for proximate composition, minerals and phytochemical properties to assess their potentials as alternative sources of protein, energy and other nutrients for non-ruminant animals. The Samples were purchased from Garin Alkali in Bursari local market in Yobe State. The samples were air dried and milled to pass through 1mm sieve screen and stored in a cleaned well labeled polythene bag prior to laboratory analyses. Triplicate of representative samples of the feed ingredients were used for analyses. The proximate compositions of the samples were determined using conventional standard analytical methods of Association of Analytical chemists. Mineral contents were determined using Flame Atomic absorption Spectrophotometer Photometer while the Iron contents were determined calorimetrically. All data collected were subjected to analyses of variance using statistical analytics software (SAS). The results of the proximate composition analysis showed considerable variations between samples in Crude Protein (CP), Crude Fiber (CF), Dry Matter (DM) and Ether Extract (EE), Nitrogen free extracts (NFE), Carbohydrates (CHO) and ash. The CP, DM, CF, EE, ash, NFE and CHO values of the samples under investigation ranged from 7.51 to 35.22, 77 to 94.00, 0.05 to 25.00, 2 to 26, 3.00 to 14.00, 10.27 to 70.46 and 30 to 74.48% respectively. The highest level of CP 35.22% was recorded in Glycine max seed while the lowest value of CP 7.51% was recorded in Mangifera indica seed. Minerals such as Sodium (Na), Potassium (K), Magnesium (Mg),Chromium (Cr), Zinc(zn), Copper(cu),Manganese(Mn) and Iron (Fe) ranged from 0.64 to 3.20, 0.06 to 0.77, 2.04 to 9.04, 0.29 to 0.89,0.88 to 2.72, 0.16 to 2.59, 0.83 to 4.96, 0.19 to 1.15 and 0.52 to 2.26 ppm respectively. Highest concentration of important minerals such as Calcium (2.72 ppm), Sodium (3.20 ppm), iron (2.26 ppm), Zinc (2.59 ppm) and Magnesium (9.06 ppm) were obtained in Acacia nilotica, Acacia nilotica and Moringa oleifera, Hibiscus subdariffa and Parkia globosa. Phytochemical screening revealed the presence of alkaloids, tannins, Phenols and Flavonoids. The highest values of total phenol 417 mg/GAE/100g, tannin 4.54 mg/GAE/100g, Flavonoid 2.21RE/100g and Alkaloid 11.00 % was recorded in Acacia nilotica, Glycine max, Citrullus lanatus and Hypalina theibecca. The study revealed that Acacia nilotica, Hibiscus subdariffa, Parkia globosa and Glycine max are rich in calcium and sodium, iron and Magnesium and zinc. Similarly the crude protein and carbohydrate values of Acacia nilotica, Hypalina theibecca, Citrullus lanatus and Adonsonia digitata are comparable to most cereal grains and can be used when processed.

Key Words: Proximate, Minerals, Phytochemicals and Feed ingredients.

Introduction

The production of conventional feed ingredients such maize and soya beans may no longer be able to keep pace with the demands (Diarra *et al*., 2011). Consequently, determination of other suitable alternative plants to serve as sources of protein, energy and other nutrients for non-ruminant animals are timely. The utilization of non-conventional feed resources is justified by serious feed deficits, rising cost of production, continuing low animal productivity, and inability of the components of the animal industries to meet national targets, especially of animal protein (Iyayi, 2017). Babiker *et al*. (2009) observed that tables of chemical composition of feed ingredients are in fixed figures without considering the variability in nutrients which may happen due to intrinsic (variety) and external factors such as soil type, climatic conditions, geographical locations, storage and season of growing. Several authors have also reported that energy value in feed ingredients is not constant and that may happens due to the conditions of harvesting (Zijlstra *et al*., 1999), post-harvest storage (Kim *et al*., 2003) or growing location (George and McCracken, 2003). Feed analyses are essential for ensuring accurate information on the composition of feed ingredients and determining the level of desirable and undesirable substances, enabling the production of safe, balanced diets for livestock. The study

was conducted to investigate the Proximate, Mineral and Phytochemical composition of some selected feed ingredients in semi-arid area of Yobe state, Nigeria.

Materials and Methods

Sample collection and preparation

The selected feed ingredients are *Cucumbar sativus L* seed, *Acacia nilotica*,L seed, *Glycine max L* seed, *Parkia globosa seed, Hypalina theibecca, (*mesocarp), *Hibiscus subdariffa L.*seed, *Mangifera indica* seed, *Moringa oleifera* seed, *Citrullus lanatus seed* and *Adonsonia digitata* seed. Samples were purchased from Garin Alkali in Bursari local market in Yobe State. The samples were identified and authenticated at the Agronomy and Forestry and Wildlife Departments, Federal University Gashua. The samples were air dried and milled to pass through 1mm sieve screen and stored in a cleaned well labeled polythene bag prior to laboratory analyses.

Sampling and Laboratory analysis

Triplicate of representative samples of the feed ingredients were obtained and placed in clean plastic containers properly labeled and tightly sealed. Samples were analyzed in the Department of Animal Science, Land Mark University Omu-Aran Kwara State, Nigeria.

Proximate analysis

Proximate chemical compositions for all samples were determined according to Official Methods of Analysis (A.O.A.C., 1990). Nitrogen free extract (NFE) was obtained by difference.

Mineral analysis

The Minerals were determined according to procedure described by (Martin Prevel, 1984) using flame atomic absorption spectrophotometer and photometer, Iron contents was determined calorimetrically.

Phytochemical

Total Flavonoid determination

The total flavonoid contents were determined using the Aluminum colorimetric methods (Chang *et al*., 2002, Stankovic, 2011) with some modification using Rutin as the standard.

Tannin determination

The tannin content was analyzed using the method reported by Ejikeme *et al*. (2014). One gram of the sample extracts was macerated with 50 ml of Methanol and filtered. 0.3ml of 0.1N Ferric Chloride, 0.1N HCl and 0.3ml of 0.0008m of Potassium Ferricyanide was added and the absorbance was read at 720nm.

Alkaloid determination

0.5g of the test samples was weighed and 20ml of 20% Acetic acid was added to it in 100ml beaker. The beakers were covered and allowed to stand for 4 hours. They were later filtered and placed in water bath to reduce the weight to one quarter. Concentrated Ammonium hydroxide was added drop-wisely until precipitation was complete. It was then collected by filtration and weighed. The total phenol content was analyzed using Folin-Ciocalteu method as reported by Agbenorhevi and Marshall (2012).Triplicate absorbance readings were taken for each sample. The results for the samples were expressed as concentration of gallic acid equivalent (mg GAE/100 g) using the equation obtained from the standard calibration curve.

Statistical analysis.

All measurements were replicated three times and expressed as mean ± SEM. Data collected were subjected to one way analysis of variance (ANOVA) and significant means were compared using Duncan multiple Range Test (DMRT).

Table1. Proximate composition of some selected feed ingredients

	Nutrients (%)						
Sample code	**DM**	**CP**	**CF**	**EE**	**Ash**	**NFE**	**CHO**
CS	86.00^{c}	9.02^{e}	7.14^{g}	21.00^{cd}	7.00^{c}	41.84^{e}	48.98^{f}
AN	85.00^{c}	13.21^{c}	4.34^{i}	20.00^{de}	4.00^{e}	61.45^{c}	65.78^{d}
GM	94.00^{a}	35.22^{a}	20.00^{b}	23.00^{bc}	5.00^{d}	10.27^{j}	30.27^{j}
PG	90.00^{b}	28.18^{b}	12.50^{d}	26.00^{a}	5.00^{d}	18.65^{h}	31.32^{i}
HT	92.00^{ab}	7.69^{f}	11.11^{e}	2.00^{h}	8.00^{b}	63.22^{b}	74.31^{a}
HS	91.00^{b}	11.38^{d}	17.94^{c}	19.00^{e}	14.00^{a}	15.27^{i}	33.22^{g}
ML	92.00^{ab}	7.51^{f}	0.05^{j}	10.00^{g}	4.00^{e}	70.46^{a}	70.48^{b}
MO	77.00^{d}	12.12^{cd}	10.00^{f}	25.00^{ab}	7.00^{d}	22.87^{g}	32.87^{h}
CL	87.00^{c}	8.83^{ef}	5.55^{h}	15.00^{f}	3.00^{f}	61.45^{c}	60.17^{d}
AD	87.00^{c}	11.38^{d}	25.00^{a}	9.00^{g}	7.00^{c}	34.63^{f}	59.62^{e}
SEM	1.33	0.66	0.48	0.80	0.33	0.002	0.002

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L.AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera* CL=*Citrullus lanatus*.L, AD= *Adonsonia digitata* DM= Dry matter, CP= Crude protein, CF= Crude fibre, EE= ether extract, NFE= Nitrogen free extract. All test performed are in triplicates and mean values were used.

Table 2: Mineral Composition of some selected feed ingredients.

	Minerals(ppm)								
Sample Code	**Na**	**K**	**Mg**	**Cr**	**Ca**	**Zn**	**Cu**	**Mn**	**Fe**
CS	0.64^{b}	0.12^{d}	8.00^{b}	0.88^{a}	1.52^{d}	0.35^{b}	3.31^{c}	0.76^{b}	1.22^{d}
AN	3.20^{a}	0.15^{c}	2.80^{e}	0.29^{c}	2.72^{a}	0.20^{e}	4.13^{b}	0.38^{c}	1.83^{b}
GM	0.64^{b}	0.15^{c}	4.72^{d}	0.29^{c}	1.68^{c}	0.20^{e}	4.96^{a}	0.38^{c}	1.23^{d}
PG	0.64$_{b}$	0.77^{a}	5.04^{c}	0.58^{b}	2.00^{b}	2.59^{a}	4.96^{a}	1.15^{a}	1.04^{e}
HT	0.64^{b}	0.18^{b}	2.72^{e}	0.29^{c}	0.88^{f}	0.22^{d}	3.31^{c}	ND	1.13^{de}
HS	0.64^{b}	0.13^{d}	9.04^{a}	0.89^{a}	0.88^{f}	0.23^{d}	4.13^{c}	ND	2.26^{a}
ML	0.64^{b}	0.06^{f}	2.04^{f}	0.58^{b}	1.04^{c}	0.16^{f}	ND	0.38^{c}	1.56^{c}
MO	3.20^{a}	0.09^{e}	4.96^{cd}	0.58^{b}	1.04^{c}	0.27^{c}	0.83^{e}	ND	ND
CL	0.64^{b}	0.07^{f}	3.12^{e}	0.58^{b}	1.04^{c}	0.22^{d}	1.65^{d}	0.19^{d}	1.83^{b}
AD	0.64^{b}	0.07^{f}	4.72^{cd}	0.58^{b}	0.88^{f}	0.17^{f}	1.65^{d}	ND	0.52^{f}
SEM	0.03	0.53	0.33	0.01	0.01	0.003	0.09	0.03	0.05

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L. AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera* CL= *Citrullus lanatus*.L, AD= *Adonsonia digitata* Na= Sodium, K=Potassium, Mg=Magnesium, Cr= Chromium, Ca= Calcium, Zn= Zinc, Cu= Copper, Mn= Manganese, Fe= Iron, All test performed are in triplicates and mean values were used"

Table 3: Phytochemical properties of some selected feed ingredients

Sample Code	Total Phenol (MgGAE/100g extract)	Tannin (Mg RE/100g extract)	TotalFlavonoid (MgRE/100g extract)	Alkaloid (%)
CS	150.97^{c}	4.23^{ab}	0.24^{fg}	1.09^{i}
AN	417.84^{a}	1.24^{e}	0.27^{e}	7.61^{c}
GN	69.04^{ef}	4.54^{a}	0.08^{h}	2.20^{h}
PG	59.28^{f}	4.34^{a}	0.08^{h}	4.35^{e}
HT	238.24^{b}	3.60^{bc}	1.02^{c}	11.00^{a}
HS	98.72^{d}	4.37^{a}	0.44^{d}	1.09^{i}
MI	387.92^{a}	1.48^{e}	1.10^{b}	3.30^{f}
MO	97.36^{de}	3.08^{c}	0.22^{g}	5.26^{d}
CL	104.52^{d}	3.37^{c}	2.21^{a}	10.87^{b}
AD	58.05^{c}	2.23^{d}	0.25^{ef}	3.19^{g}
SEM	17.35	0.33	0.01	0.003

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L. AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera,CL= Citrullus lanatus*.L, AD= *Adonsonia digitata* GAE= Gallic acid equivalent, RE=Rutin equivalent. All test performed are in triplicates and mean values were used"

Results and Discussion

Table 1 presents the result of the proximate chemical composition of some selected feed ingredients. The crude protein values of the samples under investigation ranged from 7.51 to 35.22 %. The highest level of CP was recorded in *Glycine max* seed while the lowest CP value of 7.51% was recorded in *Mangifera indica* seed. There were significant differences (P < 0.05) in CP, CF, EE, ash and NFE for the feed ingredients in this study. The DM, CP, EE, CF, ash and NFE values for *Mangifera indica* seed obtained in this study differed from the values earlier reported by other studies (Diarra *et al.*, 2011 and Fowonola, 2010).The highest value of NFE, EE, CF was recorded in *Mangifera indica*, *Parkia globosa* and *Glycine max* respectively. The DM, CP, CF, EE, ash and NFE values of 86, 9.02, 7.14, 21.00, 7.00 and 55.84 % obtained in this work for *Cucumis sativus* was not in agreement with values of 87.7, 24.5, 3.00, 0.07, 9.34 and 50.1% reported by Niyi *et al.* (2019). Similarly the values of 35.22, 20, 23 and 5% for CP, CF, EE and Ash for *Glycine max* was not in agreement with values of 39.08, 4.68, 21.08, and 3.40% reported by Diarra *et al.* (2011) and Fowonola (2010).The differences could be attributed to intrinsic (variety) and external factors such as soil type, climatic conditions, geographical locations, storage and season of growing. The mineral content of the various feed ingredients are presented in Table 2. The highest value of calcium, iron and magnesium was recorded in *Acacia nilotica* and *Hibiscus subdariffa.* The results showed significant difference (p<0.05) among the various feed ingredients investigated in this study. The present report showed that *Parkia globosa* had the highest concentration of Zinc. The highest values of total phenol 417mg/GAE/100g, tannin 4.54mg/GAE/100g, Flavonoid 2.21RE/100g and Alkaloid 11.00% was recorded in *Acacia nilotica, Glycine max, Citrullus lanatus* and *Hypalina theibecca* while the lowest values of 58.05 mg/GAE/100g, 1.24 mg/GAE/100g, 0.08 RE/100g and 1.09% were recorded in *Adonsonia digitata*, *Acacia nilotica, Parkia globosa and Glycine max,* and *Cucumis sativus* respectively as reflected in Table 3. The values of Flavonoid, Alkaloid, Tannin, and Phenol obtained in this study are at variance with values of 3.84 RE/100g, 1.64%, 0.46 mg/GAE/100g and 0.06 mg/GAE/100g reported by Okwu and Orji (2007).

Conclusion and recommendation

The study provided information on nutrient levels and phytochemical substances of some feed resources in semi-arid zone of Nigeria. This will serve as baseline upon which other studies can be done. It will also encourage the use of the less expensive and less competitive feed ingredients, thus, reducing the cost of feed, improve the profit margin of farmers. Further studies are recommended on processing of these feed ingredients to ensure effective utilization of these ingredients

REFERENCE

Agbenorhevi, J. K. and Marshall L. J.(2012). Investigation into the total phenols and activity during storage of fruit smoothies. *Journal of Food Science and Engineering* 2: 72-79

AOAC (1990). Official Methods of Analysis 15th Edition. Association of Official Analytical chemists, Washington D.C. Pp 71 – 73.

Babiker. M. S, Kijora , C. Abbas, S. A, and Danier, J. (2009). Nutrient Composition of Main Poultry Feed Ingredients Used in Sudan and their Variations from Local Standard Tables Values. *International Journal of Poultry Science,* 8 (4): 355-358.

Chang, C. C., Wen, H. M., Yang, M. H, Chern, J. C. (2002). Estimation of Total Flavonoid Content in Propolis by Two Complementary Colorimetric Methods. *Journal of food and drug analysis* 10(3) 178-182.

Diarra, S. S., Saleh, B. Kwari, I. D., and Igwebuike, J. U. (2011). Evaluation of boiled Mango kernel meal as energy source by broiler chickens in semi- arid zone of Nigeria. *International Journal of Science and nature*. Vol. 2 (2) pp270-274

Ejikeme, C. M. Ezeonu, C. S. and Eboatu, A. N. (2014)"Determination of physical and phytochemical constituents of some tropical timbers indigenous to Niger Delta Area of Nigeria," *European Scientific Journal*, vol. 10, no. 18, pp. 247–270.

Fowomola, M. A. (2010)**.** Some nutrients and anti-nutrients contents of Mango (*Magnifera indica* seed. *African Journal of Food Science*, 4(8): 472 – 476

George, J. and McCracken, K. J.(2003.). Effect of year and location of growth and year location interactions on physical and chemical characteristics of wheat grown in Northern Ireland. *Proceedings of the 14th European Symposium on Poultry Nutrition. Lillehammer, Norway*.

Iyayi, E A. (2017). Whatever goes on inside is revealed outside: the case of nutrient dynamics and sustainable animal productivity. An inaugural Lecture delivered at University of Ibadan on the 27 July 2017.

Kim, J. C., Mullan, B. P. Simmins, P. H. and Pluske, J. R. (2003). Variation in the chemical composition of wheats grown in Western Australia as influenced by variety, growing region, season and post-harvest storage. *Australian J. Agric. Res*., 54: 541-550.

Niyi, O. H., Jonathan, A. A. and Ibukun, A. O. (2019) Comparative Assessment of the Proximate, Mineral Composition and Mineral Safety Index of Peel, Pulp and Seeds of Cucumber (Cucumis sativus). *Open Journal of Applied Sciences,* 9: 691-701.

Martin-Prevel, P., J. Gagnard and P. Gautier, (1984). L'analyse Vegetale Dans le Controle de L'alimentation des Plantes Temperees et Tropicales [The Plant Analysis in the Power Control Temperate and Tropical Plants]. Technical and Documentation-Lavoisier, Paris, ISBN:9782852062283,Pp810.

Okwu D. E. and Orji, B. O. (2007). Phytochemical composition and nutritional quality of (*Glycine max* and *Vigna unguiculata* L) Walp. *American Journal of Food Technology* 2:512-520

.

Stanković, M. S. (2011).Total phenolic content, flavonoid concentration and antioxidant activity of Marrubium peregrinum L. Extracts, *Krag. Journal of Science.* 33, 63-72.

Zijlstra, R. T., De Lanfe C. F. M. and Patience, J. F. (1999.). Nutritional value of wheat for growing pigs: chemical composition and digestible energy content. *Canadian Journal of Animal Science*, 79: 187-194.

EVALUATION OF THE EFFICACY OF CHOLINE CHLORIDE AS A FEED ADDITIVE IN BROILERS

C.J. ARONU, C.N. UJU, P.C. UGWU, A. MORGAN, G. SUNDAY, C. AHAMEFULA, O.W. IDIGOH & C. EZEMA.
Department of Animal Health and Production, Faculty of Veterinary Medicine, University of Nigeria Nsukka.
***Corresponding author:** chinwe.aronu@unn.edu.ng

Abstract
The study evaluated the effect of choline chloride on growth, haematology, serum biochemistry, and relative organ weight of broilers. A total of 120-day-old chicks were randomly divided into four groups of 30 birds each, which was further sub-divided into 3 replicates of 10 birds each. Group A served as the un-supplemented control while the diets of groups B, C and D were supplemented with 0.5g/kg, 0.75g/kg and 1g/kg of choline Chloride (CC), respectively. The study lasted for six weeks. Result showed that dietary supplementation with CC did not enhance feed intake and weight gain. Group C had a significantly (P<0.05) higher feed efficiency (49.18%) than other choline-supplemented groups and control. There was no significant difference (P>0.05) in the mean values of AST, ALT, total protein and creatinine across all groups. However, the ALP and cholesterol values of group D were significantly (p<0.05) higher and its lymphocyte level significantly lower than all other groups. There was no significant (p>0.05) difference in the mean organ weights across all four groups, but the spleen weight (0.27g) of group D was significantly (p<0.05) higher than all other groups. Supplementation with CC at the level of 1g/ kg of feed seemingly had negative effect on serum cholesterol level and liver hepatocytes as evidenced in elevated values of these parameters in group D broilers.
Key words: Broiler, feed supplementation, choline, cholesterol, liver enzymes.

Introduction
The quest for cost-effective feeding and sustainable production of broilers have led farmers to compound feeds using relatively low-cost ingredients and supplemented with varied feed additives. Farmers have used antibiotics, hormones and many other feed additives to achieve this (Aidara-Kane, 2012). The potential threat to public health from inappropriate antibiotic use in food animals has led to a search for stable and healthier feed additives with positive effects.

Choline plays an essential role in several biological processes within the body such as building and maintaining cell structure as well as ensuring normal maturation of the cartilage matrix of bone, and the prevention of perosis in broilers (Workel, 2002). Very important to the poultry species, is the fact that choline provides the labile methyl groups necessary for the formation of methionine from homocysteine, by being oxidized to betaine (Zhang *et al*., 2013). However, Choline requirement of growing chicks decreases with age.

Conventional feed ingredients like maize and soybean contain choline chloride (CC) at levels lower than what is recommended for broilers (Fouladi *et al*., 2011). Broilers require about 1, 200 – 2,000 mg/kg choline in their feeds (depending on their growth rate). Yet, a typical diet based on corn and soybean (65% maize, 25% soybean, and 10% other) will contain about 1,040 choline from natural sources (Mavromichalis, 2015). Moreover, it is economical to add choline chloride directly to concentrate feed mixture (Erdman and Sharma, 1991).

This study was undertaken to evaluate the effect of CC on growth and health indices in broilers.

Experimental animals/design:

A total of 120 broilers (Ross breed) were procured from Agrited, Ibadan and randomly allocated into 4 groups (A – D) of 30 birds each. The groups were further divided into 3 replicates of 10 birds each. Experimental birds were acclimatized for one week before commencement of the study.

Composition of experimental diet

	Maize	Full-fat soya	Palm kernel meal	*Concentrate
Broiler starter:	60 %	30 %	0 %	10 %
Broiler Finisher:	50 %	30%	10 %	10 %

*Concentrate: Crude fibre 1.8%, Crude fat 4.13%, Sodium 1.41%, Lysine 2.45%, Methionine 32.53%, Methionine + cysteine 3.07%, calcium 5.80% and phosphorus 1.15%.
The compounded feed was divided into four parts; and CC was added at 0g, 0.5g, 0.75g and 1g/kg of feed, representing treatment groups A-D, respectively. Each group was fed their respective diet *ad lib* from day 1 of the experiment to day 42 (6 weeks)

Data collection
Feed intake was recorded daily and weight gain weekly using a sensitive weighing balance.
At the 6th week, 3 birds were randomly selected from each replicate and 5ml of blood collected from the jugular vein, 2 ml was discharged into prelabelled heparinized bottles and remaining 3 ml into clean sample bottles kept in slanted positions and allowed to clot. Serum was harvested after centrifuging the non heparinized blood samples at 3,000 revolution per minute for 3 – 5 minutes. Harvested sera were subjected to biochemical component assays while adhering to manufacturer's recommendations, and using commercial enzymatic kits. Alanine transaminase (ALT) and Aspartate transaminase (AST) activities were assayed by Reitman – Frankel colorimetric method and Alkaline phosphatase activities (ALP) by Phenolphthalein Monophosphate methods as described by Peters (1995). Serum cholesterol and triglyceride levels were assayed by enzymatic colorimetric method as described by Richmond (1973). Total protein and creatinine levels were assayed by Biuret method and modified Jaffe method respectively as described by Kohn and Allen (1995).
For relative organ weight, 12 birds were randomly selected (3 per group) and humanely sacrificed. The relative organ weights of the spleen, heart, liver, proventriculus, gizzard and abdominal fat were determined for each bird.

Statistical analysis
Data obtained were statistically analysed using Analysis of Variance (ANOVA). Significance was accepted at probability values ≤ 0.05. Means were compared using Duncan's new multiple Range Test (DVMRT) (Steel and Torre, 1960).

Results and Discussion
Results of the feed intake, weight gain and feed conversion ratio of broilers fed diets supplemented with varied level of choline chloride is presented in Table 1. The mean weight gain of group A was significantly ($p<0.05$) higher than group B and D but did not differ significantly from that of group C; of the supplemented groups, C and D had higher weight gain than group B. The mean feed intake of the birds across groups A, B and C did not vary significantly but were significantly higher than that of group D. Also, the mean feed efficiency of group C was significantly higher than that of groups A, D, and C.

The result of the serum biochemical parameters suggests that there was no significant difference ($P>0.05$) in the mean values among the four groups for AST, ALT activities and total protein and creatinine levels (Table 2). However, the mean value of ALP activities for group D was significantly ($P<0.05$) higher than group A, B and C. The mean cholesterol value of group D was significantly ($P<0.05$) higher than groups A and B and group C. While the mean triglyceride level of group A was significantly ($P<0.05$) lower than all other groups. Relative organ weight: There was no significant ($P>0.05$) difference in the mean of relative weights of the liver, heart, gizzard, abdominal fat and

proventriculus for the four groups (A, B C and D). However, the mean relative weight of the spleen in group D was significantly (P<0.05) higher than group A.

TABLE 1: Feed intake (kg/bird), weight gain (g/bird) and feed conversion ratio of broiler fed diets supplemented with choline chloride

Parameter	A (control)	B (choline 0.5mg/kg)	C (choline 0.75mg/kg)	D (choline 1mg/kg)
Initial weight(g)	44.03	43.50	44.00	43.60
Final weight(g)	2192.10±14.17^{c}	1668.47±13.17^{a}	2034.97±10.18^{bc}	1926.17±18.21^{b}
Mean weight gain(g)	2148.07±14.17^{c}	1624.97±13.04^{a}	1990.97±10.18^{bc}	1882.57±18.21^{b}
Mean feed intake(g)	4493.33±31.91^{a}	4790.00±41.63^{b}	4110.00±32.32^{a}	3876.67±83.33^{c}
Feed efficiency (%)	48.30±3.32^{b}	33.97±1.37^{c}	49.18± 5.81^{a}	48.61±1.41^{b}

Rows with different superscripts $^{a\ b\ c}$ indicates significant difference among groups (p<0.05). Values in the table represents means ± standard error of mean.

TABLE 2 Serum biochemical parameters of broilers fed diets supplemented with varied level of choline chloride at six weeks

Parameter	A (control)	B (0.5g choline)	C (0.75g choline)	D (1g choline)
Alkaline phosphatase (U/L)	11.5±16.59^{a}	21.2±36.80^{a}	18.4±18.40^{a}	44.2±1.24^{b}
Aspartate transaminase (U/L)	56.00±32.53^{a}	51.33±3.18^{a}	57.67±19.55^{a}	56.67±7.75^{a}
Alanine transaminase (U/L)	14.33±5.33^{a}	15.00±2.00^{a}	13.00±2.00^{a}	16.00±1.53^{a}
Total protein (g/dl)	2.43±0.16^{a}	2.57±0.13^{a}	2.29±0.25^{a}	2.86±0.24^{a}
Cholesterol (mg/dl)	106±10.02^{a}	101±9.72^{a}	104±7.35^{a}	168±13.25^{b}
Triglyceride (mg/dl)	40.28±5.01^{a}	51.39±9.12^{ab}	55.00±14.43^{ab}	51.04±27.74^{b}
Creatinine (mg/dl)	0.37±0.27^{a}	0.20±0.06^{a}	0.23±0.13^{a}	0.50±0.15^{a}

Rows with different superscripts $^{a\ b\ c}$ indicates significant difference among groups (p<0.05). Values in the table represents means ± standard error of mean.

TABLE 3 Relative organ weight of broilers fed diets supplemented with varied level of choline chloride at six weeks

Parameter	A (control)	B (o.5g choline)	C (0.75g choline)	D (1g choline)
Liver (g)	3.69±0.26^{a}	3.84±0.15^{a}	3.41±0.11^{a}	4.16±0.30^{a}
Spleen (g)	0.21±0.15^{a}	0.22±0.02^{ab}	0.23±0.01^{ab}	0.27±0.01^{b}
Heart (g)	0.67±0.05^{a}	0.60±0.05^{a}	0.71±0.07^{a}	0.68±0.02^{a}
Gizzard (g)	3.17±0.23^{a}	3.82±0.02a	3.41±0.28^{a}	3.43±0.40^{a}
Abdominal fat (g)	1.65±0.23^{a}	1.51±0.36^{a}	1.29±0.49^{a}	1.86±0.22^{a}
Proventriculus (g)	0.55±0.03^{a}	0.55±0.05^{a}	0.66±0.16^{a}	0.62±0.04^{a}

Rows with different superscripts $^{a\ b\ c}$ indicates significant difference among groups (p<0.05). Values in the table represents means ± standard error of mean.

Supplementation of broiler diets with the choline chloride used in this study did not improve production performance. However, at the inclusion level of 0.75g/kg feed, a slightly improved feed efficiency was observed but without a corresponding improvement in carcass yield. Elevated serum cholesterol levels are indicted with atherosclerosis (Glass and Witztum, 2001); elevated ALP levels are mostly seen in cases of liver damage (Senanayake *et al*., 2015). Dietary supplementation with CC

at the level of 1g/ kg of feed appears to be detrimental to liver hepatocytes and overall health of broilers and by extension could impact negatively on carcass quality of the meat.

Lack of significant difference between supplemented groups and the control was in contrast to McDevitt *et al*. (2000) report that CC could enhance production performance and overall carcass characteristics of broilers. Ratriyanto *et al*, (2009) reported lower activities of lipogenic enzymes and stabilization of protein and cell components against denaturing effect of high ionic strength; both, were not substantiated from our study.

It is recommended that Assay/analysis of 'industrial choline' should be carried out to estimate its actual choline content as well as its level of contamination before use.

Reference

Aidara-Kane A (2012) Containment of antimicrobial resistance due to use of antimicrobial agents in animals intended for food: WHO perspective. *Rev Sci Tech*, 31(1), 277-287.

Erdman RA & Sharma B K (1991) Effect of Dietary Rumen-Protected Choline in Lactating Dairy Cows1. *J. Dairy Sci*, 74(5), 1641-1647.

Fouladi P, Salamat DNR, Ahmadzade A, Aghdam SH, & Agajanzade A (2011) Effect of choline chloride supplement on liver's and blood's cholesterol and triglyceride contents in Japanese quail. *Ann. Biol. Res.*, 2(5):472-477.

Glass CK, & Witztum JL (2001) Atherosclerosis: The road ahead. Cell 2001; 104: 503-516.

Kohn RA, & Allen MS (1995) Enrichment of proteolytic activity relative to nitrogen in preparations from the rumen for in vitro studies. *Anim. Feed Sci. Tech.*, 52(1-2), 1-14.

Mavromichalis I (2015) doi: https://www.wattagnet.com/articles/23889-questions-regarding-choline-in-poultry-diets.

McDevitt, R. M., Mack, S., & Wallis, I. R. (2000). Can betaine partially replace or enhance the effect of methionine by improving broiler growth and carcase characteristics? *British Poult. Sci.*, 41(4), 473-480.

Peters Jr T (1995) All about albumin: biochemistry, genetics, and medical applications. Academic press.

Senanayake SSHMML, Ranasinghe JGS, Waduge R, Nizanantha K, & Alexander PABD (2015) Changes in the serum enzyme levels and liver lesions of broiler bird: reared under different management conditions. *Trop. Agric. Res.*, 26 (4): 584 – 595.

Steel RG & Torrie J (1960) Principles and Procedures of Statistics. Mcgraw-Hill Book Company, Inc, New York; Toronto; London.

Ratriyanto, A., Mosenthin, R., Bauer, E., & Eklund, M. (2009). Metabolic, osmoregulatory and nutritional functions of betaine in monogastric animals. *Asian-Austral J Animal Sci*, *22*, 1461-1476.

Richmond W (1973) Preparation and properties of a cholesterol oxidase from Nocardia sp. and its application to the enzymatic assay of total cholesterol in serum. *Clin. Chem.*, 19(12), 1350-1356.

Workel HA, Keller TH, Reeve A, & Lauwaerts (2002) Choline- The rediscovered vitamin for poultry. The Poultry Site; Available: http://www.poultrysite.com/articles/271/choline- the-rediscovered-vitamin for-poultry.

Zhang, C. X., Pan, M. X., Li, B., Wang, L., Mo, X. F., Chen, Y. M., & Ho, S. C. (2013). Choline and betaine intake is inversely associated with breast cancer risk: A two- stage case- control study in China. *Cancer Science*, *104*(2), 250-258.

CARCASS CHARACTERISTICS OF BROILER CHICKENS FED ACHA HUSK AS REPLACEMENT FOR WHEAT OFFAL

Chomo, F.K., Kalla, D. J. U., Igila, T. T. and Jatutu, S. S
Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi State, Nigeria

ABSTRACT
The study was conducted to evaluate the carcass traits of broiler chickens fed acha husk in place of wheat offal. Five different varying levels of acha husk were used in formulating the diets. The design used for the experiment was a completely randomized design. Birds were managed under the deep litter system for a period of 6 weeks. At the end of the experiment, four birds were randomly selected from each treatment for carcass evaluation. The values obtained were subjected to statistical analysis and the results showed that there were significant differences (p>0.05) in some of the parameters such as eviscerated weight, gizzard, liver, heart and spleen where birds on the acha husk base diets did better than the control diet. However, no significant differences were noted in the lungs, small intestine and large intestine of broiler birds under different treatments of acha husk. It was therefore concluded that using acha husk in place of wheat offal in broiler chickens' diets at 24.20% level produced broilers of better carcass traits compared to that fed wheat offal under conventional commercial feeds (p>0.05)

Keywords: Broiler chickens, acha husk, wheat offal, carcass

INTRODUCTION
Global consumption of poultry products (meat & eggs) has consistently increased over the years and this trend is expected to continue (Dale, 2009). The increase in the world population, high cost of conventional animal feed ingredients and low protein intake in most of the developing countries has necessitated animal scientists to search for alternative sources of feed ingredients (Medugu *et al*. 2011). The demand is higher in developing countries and such growth in poultry industry is having a profound effect on the demand for feed and raw materials. Corn and soybean meal are the major ingredients of poultry feed. The cost of virtually all feed ingredients like maize, soybean meal, Di-calcium phosphate, fat and even vitamins has gone beyond exception (Dale, 2009). Due to the ever increasing demand and less supply of raw feed ingredients, cost of feed production has increased. Alternatives for energy and protein sources in poultry diets will be an important means to meet future feed requirement and minimize the cost of feed production. Use of locally available raw feed ingredients like jowar, wheat, barley etc. is now getting importance. Thus, in order to reduce the cost of feed production without affecting the performance of poultry birds, the use of alternative feed sources is gaining importance. A wide range of alternative feedstuffs like jowar, wheat, barley etc. are available for feeding all three poultry production systems. Similarly, in most households and locations, several by-products from cereal milling are available for animal feeding, including bran, hulls and screenings. Despite their high fiber contents, these can be valuable source of energy. Economic quantities, price and nutritive value are the most important criteria to determine the use of a feedstuff in commercial poultry diets. Presently, various alternative protein sources are used like green materials, industrial by-products, animal and fish by-products, insects etc. Similarly, energy sources can be replaced by jowar, wheat, barley and rice. The energy sources are chiefly used at levels of about 50-70% and incidental to their inclusion at these levels, they contribute about 1/4 - 1/3 of the total protein requirement of poultry (Medugu *et al*. 2011).

MATERIAL AND METHODS
The study was conducted in Jos, Plateau Sate. Plateau State is located in Nigeria's middle belt. With an area of 26,899 square kilometers, the State has an estimated population of about three million people. It is located between latitude 08°24'N and longitude 008°32' and 010°38' east. Two hundred day old chicks of mixed sexes were used for the experiment. The chicks were raised/ brooded on deep litter management system for a period of one week. During the brooding, all the necessary management practices were strictly adhered to as appropriate. After the brooding, the chicks were then allocated to the various experimental treatments. The birds were provided with a known quantity of feed. Water was also provided *ad libitum*. The birds were vaccinated appropriately.

The design used for the experiment was a completely randomized design (CRD). The two hundred birds were randomly allocated to five different treatments (table 1) with forty (40) birds per treatment

and each treatment was replicated three times with thirteen birds per replicate. The experiment lasted for a period of eight (8) weeks.
The ingredients for diet formulation were maize, wheat offal, soya bean, cabbage leaves, bone meal, premix, lysine, calcium, methionine and salt with cabbage leaves serving as the test ingredient. Experimental diet was formulated to meet protein and energy requirement of broiler chickens table 1

RESULTS AND DISCUSSION

The result on dressed weight was not significantly different among the treatment mean values but numerically higher in birds fed diet 5. Birds fed Diet 5 had the highest live weight per bird. This observation therefore implied that the dressed weight of chicken may not necessarily be directly proportional to the performance traits. A high weight gain value does not imply a concomitant increase in dressed weight as a percent of live weight (Fasuyi, 2000). The percentages of the eviscerated weight were significantly higher ($p<0.05$) in birds fed diet 5 than those fed the control diet but similar to those fed diet 3 and 4. The result indicated that the diets promoted the development of identical eviscerated weight percent. The values for eviscerated weight in this study ranged from 73.77 – 77.07 % which surpassed the normal range of 65 – 70 % reported for broiler chicken (Oluyemi and Robberts, 1999). Organs are body parts, composed of several types of tissues, capable of carrying out specialized function. The weight of organs in broilers according to Atteh, 2004 reflects the anatomical response of birds to the type of diet consumed. The relative organs weight measured in this study were comparable in all the dietary treatments. Though there were significant differences ($P<0.05$) in the values obtained for heart, gizzard, liver and spleen. The chickens fed the control diet had similar values with acha husk base diet, suggesting that the diets were not detrimental even though the husks may have contained some anti-nutritional factors. The presences of anti-nutritional factors have been associated with abnormal enlargement of organs such as liver and pancreas due to detoxifying activities (Adeyemi, 2003). The significant variation among the treatment mean values of heart, liver, gizzard and spleen follow a particular pattern in relationship with the dietary treatments. It could generally be surmised that the control diet and the test diets enhanced identical organ development. The values obtained for organs weights were in agreement with the finding of Oforjindu, (2006).

Table 1: Ingredients and Composition (%) of the Experimental Diet

Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**
Maize	40	38.00	38.00	36.00	36.00
Soyabean cake	36.00	30.00	30.00	32.00	32.00
Acha husk	0.00	6.05	12.20	18.15	24.20
Wheat offal	18.20	18.15	12.20	6.05	0.00
Fish meal	2.00	4.00	4.00	4.00	4.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Lime stone	0.50	0.50	0.50	0.50	0.50
Lysine	0.15	0.10	0.10	0.10	0.10
Methionine	0.10	0.15	0.15	0.15	0.15
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**

Table 2: Carcass Characteristics of Broiler Chickens Fed Varying Levels of Acha Husk

Parameters	T1	T2	T3	T4	T5	SEM
Live weight (kg)	2.30	2.35	2.55	2.56	2.57	0.02^{NS}
Dress weight (%)	86.67	86.68	86.70	87.01	87.50	0.12^{NS}
Eviscerated weight (%)	73.77	74.78	75.88	76.57	77.07	0.96*
Gizzard (%)	12.52	12.49	13.66	14.44	14.48	0.65*
Liver (%)	14.01	14.57	14.83	15.29	15.35	0.79*
Heart (%)	3.08^{c}	3.63^{bc}	3.87^{b}	3.99^{b}	4.10^{a}	0.29*
Spleen (%)	0.87c	1.05b	1.14ab	1.11ab	1.25a	0.79*
Lungs (%)	3.63	3.65	3.62	3.64	3.59	0.20^{NS}
Small intestine (cm)	254.32	255.01	255.35	255.48	255.58	0.10^{NS}
Large intestine (cm)	28.98	28.99	29.05	29.11	29.25	1.27^{NS}

abc: means within the same row bearing different superscripts are significantly different (P<0.05)
*: level of significance
NS: Non significant difference

REFERENCES

Adeyemi, F. A. (2003). Effect of enzyme supplemented cassava root sievet (CRS) in cassava based diets on some visceral organs of pullet chicks. In: *Proceedings of the 8th Annual Conference of Animal Science Association of Nigeria*. September 16-18, 2003, Federal University of Technology, Minna. Pp. 25-27

Dale, A. M (2009). Use of Whole Pearl Millet in Broiler Diets. *Journal of Applied Poultry Research.* **13**:20-25.

Fasuyi, A. O. (2000). Biochemical, Nutrition and Socio-Economic Aspects of Cassava Leaf Utilization. PhD Thesis, The Federal University of Technology, Akure, Nigeria. Pp 56

Groen, A.F., Jiang, X., Emmerson, D.A and Vereijkan, A. (1998). A deterministic model for the economic evaluation of broiler production systems. *Poultry science* **77**(7): 925-933

Medugu, C. I., Kwari, I D., Igwebuike, J., Nkama, I., Mohammed, I.D and Hamaker, B (2011) Carcass and blood components of broiler chickens fed sorghum or millet as replacement for maize in the semi-arid zone of Nigeria Agricultural Biology. *Journal of Nutrition America* **1** (3): 326-329.

Oforjindu, O. (2006). The toxicity of graded levels of neem (Azadirachta indica) leaf meal. B. Agricultural Technology Project Report, Federal University of Technology, Owerri, Nigeria. Pp 36.

Oluyemi J. A. and F.A Roberts(1999).Poultry production in warm weather climate. Macmillart press, London. Pp. 31.

PERFORMANCE OF GROWING COTURNIX QUAILS (*COTURNIX COTURNIX JAPONICA*) FED DIFFERENT WATER SOURCES.

J.A. EDACHE[1], C.D. TULEUN[2], A.G. YISA[1], U.R. MUDUUDTAI[3], D.O. EDACHE[2], BONGTUR, G.E.[1].[1]

1. Federal College of Animal Health and Production Technmology, Vom, 2. University of Agriculture, Makurdi. 3 College of Education, Gindiri(amedzion@yahoo.com) 08037024295

Abstract

A study of 6 weeks was conducted to determine the effect of different water sources on the performance of growing Japanese quails. A total of two hundred 2-week old quail birds of mixed sexes were randomly allocated to four water treatments in a completely randomized design. The birds were allocated fifty per replicate. Every replicate has 15 birds with the extra birds distributed without bias at a bird per replicate. Feed given was an on-farm quail chick mash with feed and water supplied ad libitum for 6 weeks. The water sources were from borehole (control), well, stream and dam respectively. Birds on treatment A consumed the highest feed (17.42g), followed by those on treatment C (17.13), D (15.17) and B (15.16). However, the differences were not significant (p>0.05). Water intake of birds on treatment A was higher (39.97ml/bird) than those on treatment C (35.84), B (33.32) and D (32.86) respectively. However, differences were not significant (p >0.05). Birds on treatment D had a higher weight gain (3.88g/bird), followed by those on treatment C (3.67), B (3.62) and A (3.29) in that order. The differences were not also significant (p>0.05). Feed conversion ratio of birds seemed to follow a similar trend with water intake. It was better on treatment D (3.98) followed by those on B (4.14), C (4.76) and A (5.36) respectively. Result of this investigation showed that birds can be raised on any of the water sources. However, water from borehole and well have better control than those from other sources.

Key words: Water intake, feed intake, weight gain, Japanese quails.

Introduction

Japanese quails are little-known birds that are small-sized and early maturing (Robbins, 1981). This early maturing nature enables them to start laying as early as from the 5th week of life (Martins, 1987). It is recommended that persons prone to high blood pressure and related diseases could consume the meat and eggs with less risk. Recommended levels of some nutrients (CP, 25; ME, 2,600kcal/kg) when maintained in the feed is useful in achieving optimal performance in growing Japanese quails, (Edache *et al*., 2005). There is paucity of information regarding the use of water sources for growing quails hence the need for this study.

Water is the most important of all nutrients. Unfortunately, water is neglected in nutritional studies (Osuhor *et al*.2001) and survival time is limited with its absence (Atteh and Leeson, 1983). Water is needed in quantity and quality. In its pure form it is odourless, tasteless and transparent and it is essential to the developmental growth and survival all animals (Swick, 2003). According to Arujo (2010), water is available to animals through drinking water, water in the diet and metabolic water through catabolism of nutrients. Broilers are reported to have large appetite for water about twice or more than that of feed (Fairchild and Riz, 2012). It's usual for birds to consume more water when ambient temperature increases as a means of regulating body temperature (Fairchild and Riz, 2012). The possibility of water shortage affects livestock and therefore, all procedure involving water use must be reviewed (Gherman *et al*., 2012). Anaemia is indicated in the feeding of crude oil polluted water to cockerels (Eastham *et al*. 1993). An adequate knowledge and understanding of the behavior of an animal is inevitable in talking of the production, management and wellbeing and productivity of the animal (Kron *et al*. 2000). Wiseman (2010) opined that for efficient growth and production performance, rabbits need clean water at all times. Poultry house litter and fecal droppings became the major contaminants of water delivery systems, while algae, oil spills and gas flares became the most important contaminants as well as seepages and sewages disposed into water sources (Etuk *et al*., 2018). According to Enukwevwere *et al*. (2018), heavy metal concentrations in drinking water samples were high compared to WHO standards for drinking water. The objective of this study is to determine the effect of different sources of water on the performance of growing Japanese quails owing to the paucity of information regarding this.

Materials and Methods

Birds, housing and management: 200 two-week old Japanese quail birds of mixed sexes obtained from the National Veterinary Research Institute poultry farm were used in this study. They were uniform in size and housed in deep litter house partitioned into several pens with wire mesh to allow for adequate ventilation. The birds were offered one of four treatments involving borehole (control), well, stream and dam water respectively. The birds occupied 12 pens with 16 birds per pen. The experimental treatments were designated A, B, C and D respectively. The remaining birds were distributed without bias to treatments. All birds from each unit were weighed at the beginning and weighed weekly for six weeks. Feed and water were given *ad libitum*.

Water sources: borehole, well, stream and dam. The water was fetched fresh from the borehole, well, stream and dam and used for the experiment. A total of 200 birds were randomly assigned to the water sources in a completely randomized design at 48 birds per water source. This amounted to about 16 birds per replicate. The borehole was the control.

Diets: The diet used was the on –farm feed which was carefully prepared for the purpose..

Table 1. Composition of experimental diet (%)

	Diet
Ingredients	A
Maize	33.22
Rice offal	2.00
Ground nut cake	39.08
Calculated composition	
CP	25.00
ME (Kcal/kg)	2706.92
Ca	1.63
P	0.65
CF	5.25
Feedcost/kg(₦)	84.62

****Others:** palm kernel cake (20.00%), fish meal (1.50%), bone meal (2.00%), lime stone (1.50%), *premix (0.25%), salt (0.25%), methionine (0.10%), lysine (0.10%).

***** Hi Nutrient premix supplied the following per 100kg of diet: Vitamin A, 1,200,000 I.U; Vitamin D_3 250,000 I.U; Vitamin E, 3,000 I.U; Vitamin K, 200mg; Thiamin (B_1), 225mg; Riboflavin (B_2), 600mg; Pyridoxine (B_6), 450mg; Niacin, 4000mg; Vitamin B_{12}, 2mg; Pantothenic acid, 1,500mg; Folic acid, 150mg; Biotin, 8mg; Choline chloride, 30,000mg; Anti oxidant, 12,500mg; Manganese, 8,000mg; Zinc, 5,000mg; Iron, 2,000mg; Copper, 500mg; Iodine, 100mg; Selenium, 20mg; Cobalt, 50mg. Key: C.P, crude protein; M.E, metabolizable energy; Ca, calcium; P, phosphorus; C.F, crude fibre

Data Collection and analysis: The mean weekly body weights, water intake and feed intake were recorded throughout the experimental period. From the mean body weight and feed intake, feed conversion ratio was calculated. Feed cost/kg diet was calculated from prevailing local market price of feed materials. Data collection was subjected to analysis of variance; ANOVA (Steel and Torrie, 1980) and where significant differences occurred, means were separated by Duncan's new multiple range test (Obi, 1990). The analysis was carried out using Minitab version 14 (Minitab, 1991).

Results and Discussion

Data on feed intake, weight gain and feed conversion ratio are presented in Table 2. Data on feed intake was not significant throughout the period. The different water sources were significant for final body weight. This has been agreed to by Jegede *et al*. (2016) that different water levels affected final weight in their work with broilers. However, feed intake, weight gain and feed conversion ratio were not affected by the different water sources which is different from the findings of Jegede *et al*.(2016). Water intake for the different water sources were similar indicating tasteless and sweet water. This is

attested to by Folorunsho *et al*. (2016) and Czarick *et al*. (2001) that birds will consume more water with a sugar additive. Lower water intake is indicative of bitter water which was attested to by Watkins (2000) that it may be a natural response for birds to consume less of such water. Crina (1994) reported that chicks are sensitive to bitter –tasting substances and salt. Feed intake and weight gain were similar across the treatment even though the values were fluctuating but the levels of water intake are similar to that (39 – 44ml/bird/day) reported by Tuleun *et al*. (2009) for Japanese quails. However, quails have been reported to adjust feed intake across a wide range of energy levels (Weber and Reid, 1967) probably due to intrinsic habit developed in the wild. This adjustment may also include water intake.

Table 2. Effects of different rice offal levels on parameters measured

Parameters	A	B	C	D	SEM
Feed intake (g/b/d)	17.42	15.16	17.13	15.17	3.75NS
Water intake (ml/b/d)	39.97	33.32	35.84	32.86	7.70NS
Weight gain (g/b/d)	3.29	3.62	3.67	3.88	0.76NS
Feed/gain ratio	5.36	4.14	4.76	3.98	0.92NS
Initial weight (g/b)	78.27^{b}	52.05^{a}	78.27^{b}	52.53^{a}	1.36*
Final weight (g/b)	204.67^{b}	197.67^{c}	225.00^{a}	208.83^{b}	5.36*

a,b, means with different superscript letters within rows are significantly different ($p<0.05$)

Conclusion

Water is available all year round in many places in Nigeria. The choice of where to get water for birds is important consideration. Looking at the effects of the different water sources on feed intake, weight gain and feed conversion ratio, only the final body weight was significantly affected. Other values were not affected. Therefore, in order to obtain consistent water of high quality, water from borehole and well are recommended.

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References

Araujo, G.G.L., Voltulini, T.V., Chizzotti, M.L., Tureo, S.H.N.and De Caravalho, F.F.R. 2010. Water and small ruminant production. Revista Brasileira de Zootecnia 39: 326-336

Atteh, J.O. and S. Leeson, 1983. Poultry science. ncbi.nlm.nih.gov

Crina, J.B. 1994. Impact of citranaxanthin on broiler performance. Jour. Of Anim. Sci. 85:300-310

Czarick, M., Lacy, M.P. and Dozier, B. 2001. Water usage and broiler performance. Poultry housing tips. The University of Georgia Cooperative Extension Service vol. 13, no.5

Eastham, R.D and Slade, R.R. 1993. Clinical haematology, 7th ed. Butter-Heinemann ltd, 5-9, 83-105, 153-177.

Etuk, I.F., P.C. Aboh and T.C. Iwuji 2018. Assessment of contaminants of poultry drinking water in Eastern Nigeria. *Proc. 43rd Ann. Conf. Nig. Soc. Anim. Prod*.(NSAP). Federal University of Technology, Owerri, Nigeria, 18-22 March, p 82

Enunkwevwere, J.U., Anthony D. Ologhobo Timothy, T. Kuka and Oghenebrorhie Obakanurhe 2018. Effect of heavy metals in borehole water on broiler chickens in delta state. Proc. 43rd ann. Conf. Nig. Soc. Anim. Prod. Federal University of Technology, Owerri, 18-22 March, p236

Fairchild, B.D. and Ritz, C.W. 2012. Poultry drinking water. Primer Bulletin, 1301. Cooperative extension, University of Georgia, Anthens.

Folorunsho, R.O., Onibi, G.F. and Bakre, A.A.2016. Performance and water intake of broiler chickens on different water tastes. Proc. 44th ann. Conf. Nig. Soc. Anim. Prod. Federal University of Agriculture, Abeokuta, In: O.O. Oluwatosin, O.S. Sowande, O.Olowofeso, L.T. Egbeyale, O.O.Adeleye, C.P. Njoku, A.O. Osofowora, A.J. Sanda eds 20-24 March, 2016, 719-721

Gherman, G.A., Taden, V.V., Mario, L.C. and Silvia, H.N. 2012. Water and small ruminant production. *R. Brasil. Zootecn, Vol. 39 supl. Spe vicosa*

Jegede, O.O., Adeyeye, S.A. and J.O.Agbede 2016. Influence of varying levels of water supply and dietary protein on performance and carcass characteristics of broiler chickens. Proc. 41st Ann. Conf. Nig. Soc. Anim. Prod. Federal University of Agriculture, Abeokuta, Nigeria pp 311-313

Kron, T.C. Ritskes-Hoitinga, J. and Svenden, P. 2000. The effect of feeding and housing on the behavior of the laboratory rabbits. J.Royal Society of Medicine laboratory animals, Vol, 33, 101-107

Minitab Statistical Software 1991. Minitab statistical software, Rehearse 15.0. Minitab Inc., State College, P.A. USA.

Obi, U.I. 1990. Statistical methods of detecting differences between treatment means. Snnap press 2ndEdition, Enugu, Nigeria, pp24-35

Osuhor, C.U., Tanko, R.J., Dung, D.O., Mohammed, I.R. and A.C. Odunze 1998. Water consumption of yankassa rams fed maize stover and Lablab. Proc. 26th Ann. Conf. Nig. Soc. Anim. Prod., University of Ilorin, 21-25 March, 1998.

Swick, R.A. 2003. Water quality and management for poultry. Technical Bulletin. American Soyabean Association, Singapore.

Steel, R. G. D and J. A. Torrie 1980. Principle and procedure of Statistics. A biometrical approach. 2nd ed. McGraw Hill Book Co. New York, USA.

Watkins, S. 2000. Water quality can influence poultry performance. *Avian Advice*. Winter 2000, vol. 2 no. 2.

Weber, C.W. and Reid, B.L. 1967. Protein requirements of Coturnix quail chicks at 5 weeks of age. *Poultry Science*, 46: 1190-1194

Wiseman, A.M.(2010). Fresh water, an essential part of rabbit's daily diet. Ferret Magazine, Oct, 2010 www.petwebsite.com (2010). Rabbits care,2-7.

EFFECT OF PROCESSING OF LABLAB BEANS AT VARRYING DURATION OF TIMES ON THEIR PROXIMATE COMPOSITION AND ANTI-NUTRITIONAL FACTORS CONTENT

[1]Igila, T. T[*]., [4]Yaakugh, I.D.I [2]Olusiyi, J. A., [3]Yusuf, H. B., [1]Ebule K

[1]*Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi State, Nigeria*
[2]*Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria*
[3]*Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa State, Nigeria*
[4]University of Agriculture, Makurdi.
Author for correspondence: igilatimothy17@gmail.com; 08063128409

ABSTRACT
The study was designed to evaluate the effects of processing on the proximate composition and anti nutritional factors in Lablab purpureus seeds. The raw seeds were processed by directly cooking the seed at various duration of time (30, 45 and 60 mins) and by soaking the seed in excess water overnight for about 14hours before cooking at various duration of time (30, 40 and 50 mins). Samples of the raw and processed seeds were analysed for proximate and anti nutritional factors. Result for proximate analysis showed that, the raw lablab seeds contained 93.88%DM, 4.73%Ash, 37.01%CP, 9.67%EE, 6.76%CF and 41.79%NFE. The result for anti nutritional factors revealed that, the raw lablab contained 8.39% Alkaloids, 0.01mg/l00g terpenoids, 0.32mg/l00g, trypsin inhibitor, 8.91mg/l00g cyanide, 1.45% tannin, 18.90mg/l00g oxalate and 0.30% phytate. Generally, both the proximate components and anti nutritional factors analysed were reduced with processing. Directly cooking the lablab seedsfor 30, 45 and 60 minutes yield reduction in both the proximate and anti nutritional factor content. Soaking the seeds before cooking also yields significant reduction in the proximate and anti nutritional factors contents of lablab seeds.

Keywords: Lablab beans, Anti nutritional factors, Proximate compositions.

INTRODUCTION

One of the major problems facing the livestock industry in Nigeria is the increasing unavailability and high cost of conventional feedstuffs like maize, groundnut, soya beans, etc (Bawal *et al*, 2007). This has been attributed to the high level of competition between livestock and man for the same ingredients. The overall effect of this competition is shortage of animal protein production and hence, shortage of animal protein intake due to scarcity and high cost of animal products (Akinmutimi *et al*, 2007).The need therefore, to source for alternative feedstuffs cannot be over emphasized. Such alternative should be cost efficient, available and less competed for by man and industry. Lablab bean can be one of such alternative feedstuff. Lablab bean *(Lablab purpureus)* is an annual leguminous crop that is grown in many tropical and sub tropical areas, particularly in Asia and Africa. It is grown as seed, fodder and vegetable crop. Lablab bean seed is very nutritious and generally estimated to contain 20%-23% protein, 48%-53% carbohydrate and 1.3% fat (Elsiddig *et al.,* 2002). Other nutrient composition of lab lab seed includes; 0.48% calcium and 0.4% phosphorus.The nutritive value of the seed protein is determined by its amino acid content and the magnitude of susceptibility to hydrolysis by the digestive enzymes. However, the nutritional value of *lablab purpureus* beans is shrouded by the presence of anti nutritional factors such as tannin, phytate, trypsin inhibitors, etc which would limit its u se in monogastric nutrition (Shaahu *et al.*,2014*).*Tannin is considered the major anti nutritional factor in lablab bean. Tannin is known to interact with proteins to form Tannin-Protein complexes, which lead to either inactivation of the enzymes or make the protein insoluble (Salunkhe *et al.*,1989). Tannins cause growth depression in animals due to reduction in feed intake of animals. The coat colour of the seed has been associated with tannin content with

the brown seeded cultivar being more tannin containing . Deka and Sarkar (1990) reported that tannin content of five cultivars of lablab bean ranged from 2000-2005 mg/100g, while Elsiddig et *al* (2002) reported a range of 201- 353. Phytate or phytic acid chelates minerals like Calcium, Iron, Magnesium and Zinc. Such chelates make the elements nutritionally unavailable thereby inducing dietary deficiency (Nelson *et al.,* 1999*).* All these anti nutritional factors limit the use of lablab bean in monogastric nutrition.

MATERIALS AND METHODS

This study was conducted at the Livestock Teaching and Research Farm of the university of Agriculture Makurdi, Benue State, Nigeria. Makurdi lies between latitude 7.41° North and longitude 8.3^0 East with ambient temperature range of 17.3^0C to 35.6^0C and a relative humidity of 47-85% and 95 metres above sea level. The area has an annual rainfall of 1200-1500mm.

Cooking

The 25kg of the beans was added in 50 litres of water and then placed on a well stoked fire. Timing commenced immediately the pot was placed on the fire. The beans were cooked at varying duration of times (30,45 and 60 minutes).

Soaking

25kg of the beans were soaked in 50 litres of water overnight for a period of about 14 hours. The beans were then drained and placed in 50 litres of fresh water. The beans were then cooked for varying duration of times (30, 40 and 50 minutes).

Chemical Analysis

Samples of the processed *Lablab purpureus* were oven-dried, weighed and sent for laboratory analysis.

RESULTS AND DISCUSSION

The results of the effect of processing of lablab beans at various duration of time on their proximate composition and anti nutritional factors content are presented in table 1, 2, 3 and 4

Table 1: The proximate and Mineral Composition of Directly Cooked Lablab Seeds (%DM).

Parameter	RS	DC30	DC45	DC60	SEM
DM (%)	93.88	93.60	93.41	92.26	3.48NS
CP(%)	37.01	36.58	36.55	35.76	4.58NS
EE(%)	9.67^{bc}	9.78^{b}	10.78^{b}	11.59^{a}	1.25*
CF(%)	6.76	6.46	5.85	5.65	1.78NS
NFE(%)	41.79	41.84	43.25	44.52	2.87NS
Energy (mj/kg)	17.19	17.41	17.92	18.42	1.98NS
Ca (mg/100g)	22.38	22.22	22.95	21.13	3.11NS
P (mg/l00g)	81.93^{c}	85.43^{b}	86.88^{b}	87.82^{a}	1.88*
Ash (%)	4.73	4.25	4.06	3.75	2.75NS

^{abc}: means with different superscripts within a row are significantly different; SEM: Standard error of mean; RS: Raw seed; DC30: Directly cooked beans for 30 minutes; DC45: Directly cooked beans for 45 minutes; DC60: Directly cooked beans for 60 minutes; DM: Dry matter; CP: Crude protein; EE: Ether extract; CF: Crude fibre; NFE: Nitrogen free extract; Ca: Calcium; P: Phosphorus

Table 2: The Proximate and Mineral Composition of Soaked and Cooked Lablab Seeds (%DM).

Parameter	RS	SC30	SC40	SC50	SEM
DM (%)	93.88	93.55	93.40	92.25	5.17NS
CP(%)	37.01[a]	35.79[b]	34.58[b]	32.19[c]	2.74*
EE(%)	9.67	10.94	10.99	11.61	3.88NS
CF(%)	6.76	6.52	5.77	5.60	2.97NS
NFE(%)	41.79[b]	41.86[b]	43.56[ab]	44.72[a]	1.65*
Energy (mj/kg)	17.19	17.43	17.49	17.59	2.12NS
Ca (mh/100g)	22.38	21.43	21.96	22.22	2.49NS
P (mg/100g)	81.93	81.56	81.77	82.25	3.90NS
Ash (%)	4.73	4.20	4.04	3.63	1.98NS

[abc]: means with different superscripts within a row are significantly different; SEM: Standard error of mean; RS: Raw seed; SC30: Soaked and cooked beans for 30 minutes; SC40: Soaked and cooked beans for 40 minutes; SC50: Soaked and cooked beans for 60 minutes; DM: Dry matter; CP: Crude protein; EE: Ether extract; CF: Crude fibre; NFE: Nitrogen free extract; Ca: Calcium; P: Phosphorus

Table 3: The Anti- nutritional Factor Composition of Directly Cooked Lablab Beans at Various Duration of Time.

Parameters	RS	DC30	DC45	DC60	SEM
Alkaloids (%)	8.39[a]	7.00[b]	6.75[bc]	4.05[c]	1.09*
Terpenoids (mg/100g)	0.01	0.01	ND	ND	0.00NS
Trypsin inhibitor (mg/100g)	0.32	0.28	0.22	0.15	0.02NS
Cyanide (mg/kg)	8.91	8.62	8.44	7.59	2.85NS
Tanin (%)	1.45	1.34	1.33	1.08	0.57NS
Oxalate (100mg/100g)	18.90[a]	18.90[a]	18.90[a]	16.88[b]	1.99*
Phytate (%)	0.42	0.35	0.34	0.30	0.98NS

[abc]: means with different superscripts within a row are significantly different; SEM: Standard error of mean; RS: Raw seed; DC30: Directly cooked beans for 30 minutes; DC45: Directly cooked beans for 45 minutes; DC60: Directly cooked beans for 60 minutes

ND: Not detected

Table 4: The anti- nutritional Factor Composition of Soaked and Cooked Lablab Beans at Various Duration of Time.

Parameter	RS	SC30	SC40	SC50	SEM
Trepenoids (mg/100g)	0.01	0.01	ND	ND	0.00NS
Trypsin Inhibitor (mg/l00g)	0.32	0.25	0.18	0.12	0.05NS
Cyanide (mg/kg)	8.91[a]	8.45[a]	8.04[ab]	5.74[c]	0.97*
Tanin (%)	1.45	1.33	0.85	0.69	0.56NS
Oxalate (100mg/100g)	18.90[a]	18.10[a]	16.85[b]	14.20[c]	1.04*
Phytate (%)	0.42	0.30	0.30	0.30	0.27NS
Alkaloids (%	8.39[a]	5.42[b]	4.41[c]	4.11[c]	1.03*

[abc]: means with different superscripts within a row are significantly different; SEM: Standard error of mean; RS: Raw seed; SC30: Soaked and cooked beans for 30 minutes; SC40: Soaked and cooked beans for 40 minutes; SC50: Soaked and cooked beans for 60 minutes

Proximate Analysis

The proximate analysis showed that, the raw lablab seeds contained 93.8%DM, 4.73%Ash, 37.01%CP, 9.67%EE, 6.76CF and 41.79% NFE.

Dry matter: The dry matter content of the lablab seeds ranged from 93.88% in the raw seeds to 92.26% when directly cooked for 60min and 92.25% in soaked and cooked seeds (SC50). The variations in DM content may mean that the seeds were not equally dried as it is the level of dryness that can affect the dry matter of seeds.

Crude protein: Directly cooking the beans for 30, 45 and 60 min effected a 36.58, 36.55 and 35.76% reduction respectively in the crude protein content of the seeds, while soaking and cooking the seeds for 30, 40 and 50 mins effected 35.79, 34.58 and 32.19 reduction respectively in the crude protein content of the lablab seeds. These decreases in crude protein content of the seeds with boiling could be as a result of leaching of soluble or proteineous part of the seeds into the boiling water. Singh (1990) reported similar reduction when pigeon pea seeds were cooked for at different temperatures.

Anti Nutritional Factors

The level of anti nutritional factors (ANFs) as influenced by boiling periods is in table 5 and 6. Results of anti nutritional determination have revealed that, lablab bean seeds contained alkaloids, terpenoids, trypsin inhibitor, cyanide, tannin oxalate and phytate. This finding confirm the reports of D'Mello (1995) Udeibie and Carlini (2002).Cooking resulted in reduction of all the anti nutritional factors analysed in this study in agreement with Bawa *et al,* (2003) who reported that cooking of lablab beans significantly decreasedthe level of trypsin inhibitor activity, phytic acid, tannin and cyanide.The reduction increased as cooking periods increased.

CONCLUSION

Directly cooking of the lablab seeds and soaking of the seeds in excess water for about 14 hours before cooking had reducing effects on the level of anti nutritional factors measured therby enhancing its utilization.

RECOMMENDATION

Processing of lablab seeds is beneficial and should be done for 60 minutes when the seeds are to be cooked directly in water without soaking and 50 minutes when the seeds are to be soaked in water before cooking.

REFERENCES

Akinmutimi, A.H, Abasiekong, S.F and Osuagwu, C.C. (2007). Growth performance of weaner rabbits fed sweet potato peels in place of maize based diet. *Proceedings of the 32nd Annual Conference of the Society for Animal Production* (NSAP) at the University of Calabar-Calabar, Cross river State. March 18th-21st .Pp. 347-349.

Akinmutimi, A.H. (2004). Effects of cooking periods on the nutrient composition of *Mucuna utilis* seeds. *Nigerian Poultry Science Journal* 3:45-51.

Bawal, O.S, Abu, E.A and Adegbulu, M.T (2007). Effect of duration of cooking whole or crushed African locust bean seeds on the levels of some anti- factors and growth performance of young rabbit. *Nigeria Journal of Animal Production,* 34(2): 208-219.

Bawa, G.S., Tegbe, T.S.B. and Ogundipe, S.O. (2003). Effect of feeding graded dietary levels of lablab seeds as replacement for soybean on performance characteristics of young pigs. *Proceedings of the Nigerian Society of Animal Production conference*. Ibadan, Nigeria, 28:230-232.

Deka, R.K. and Sarkar, C.R. (1990). Nutrient composition and anti- nutritional factors of dolichos lablab seeds. *Journal of Food Chemistry* 38 (4): 239-246.

D'Mello, I.P.F. (1995). Antinutritional substances in legumes seeds. Tropical legumes in Animal nutrition. *CAB International Walhing ford, UK.*

EISiddig, O.A.; EI Tinay, A.H.; Abdalla, A.H and EIKhalifa, A.O. (2002). Proximate composition, minerals, tannins, *in vitro* protein digestibility and effect of cooking on protein fractions of hyacinth bean (Dolichos lablab). *Journal of Food Science and Technolology* 39(2):111-115

Nelson, T.S.,Ferrata, L.W. and Stover, N.L.(1999): Phytate phosphorus content of feed ingredients derived from plants. *Poultry Sci*.47:1372-1378.

Shaahu, D.T., Carew, S.N and Dzungwe, N.E. (2014). Effect of using raw or processed lablab seed as major protein source in diets on the economic of feeding and growth performance of rabbits. *Journal of Agriculture and Veterinary Science*. 7:22-26.

Singh, U. (1990). Functional properties of grain legume flours. *Journal of Food Science and Technology* 38:191-199.

COMPARATIVE EVALUATION OF SELF-FORMULATED AND THREE COMMERCIAL DIETS ON THE GROWTH PERFORMANCE OF BROILER STARTER

[1]Adamu, M. O., [1]Bello, K. M., and [2]Muazu, M. S.
[1] Department of Animal Production, Abubakar Tafawa Balewa University Bauchi State, Nigeria
[2] Department of Animal Production Technology, Bauchi State college of Agriculture, Bauchi

Corresponding author email: shiramusa1@gmail.com
+ 2348065166682

ABSTRACT
An experiment was conducted to evaluate the performance of broiler chickens fed self-formulated and three different commercial diets. A total of 240-day old cobb broiler chickens from a reputable hatchery were fed a self-formulated diet and 3 different commercial feeds for duration of 21 days to compare their growth performance. Daily feed intake of the dietary groups differed significantly (P<0.05). T2 dietary group showed high trend of feed consumption (99.27g) while the lowest feed intake was recorded on diet 3 (91.41g).The daily body weight gain was highest (58.60g) on diet 5 (P<0.05) which was statistically different (P<0.05) with value obtained on diets 2 (54.50). Lowest body weight gain was observed on diet 3 (35.91g) which was statistically similar with the value obtained on diet 1 (38.29). Higher FCR level (P<0.05) was observed on T3 dietary group which indicated low feed conversion efficiency. The result of the experiment from biological responses of birds gave an impression that commercial feeds of the feed mills T2 and T4 were found to be better than that of T3 and the self-formulated diet. The study recommended diet 4 for broiler starter production.

Keywords: Self-formulated, Performance, Commercial diets, Broiler starter

INTRODUCTION
The production of poultry meat safe for human consumption is dependent on many factors which include suitable environment, breeds, nutrient requirement and health status of the birds. Among these factors, meeting the nutritional requirement of the animals with the objective to optimize digestibility and absorption of nutrients is certainly one of the most important elements. Onabanjo *et al* (2018).
Efficiency of production of any animal depends on the provision of adequate protein, energy, vitamins and minerals in the right proportion in their diet. In broiler nutrition, energy and protein level are of great importance. Presently, poultry occupies a unique position in the livestock sector of Nigeria Kareem *et al* (2015).
Expansion of the industry depends to a large extent on the availability of good quality feed at affordable price. An overview of the poultry industry in Nigeria shows that majority of the producers are small scale holder farmers that rely on commercial feed millers for the supply of feed. Olarinmoye *et al* (2009).
Poultry feeds are made up of many ingredients which are broadly grouped into providers of energy (fat and carbohydrates), protein (amino acids), vitamins, minerals and feed additives. Cereal grains such as maize, sorghum, wheat and millet provide energy while soya beans and groundnut provide protein. These ingredients are combined in such a way as to provide energy, protein, vitamins and minerals for poultry through the process of feed formulation. However, several factors may affect both feed quality and feed manufacturing parameters. (Loar and Corzo, 2011).
The nutritional value of grains used in poultry feed varies with the grain cultivars, its chemical characteristics and non-starch polysaccharide content, diet physical form, availability of energy and bird category (Gutierrez-Alamo *et al.,* 2008). These factors in addition to the choice of feedstuffs and quantity incorporated in the finished feed by different feed manufacturers has given to variation in the nutritive value of manufactured feeds and performance of birds fed different brands of feeds.

Materials and Methods
The experiment was conducted at the Poultry Unit of Bauchi State Agricultural development programme (BSADP). Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East (BSD, 2009).
A total of two hundred and forty (240) broiler chicks were used for the experiment. They were randomly divided into five treatment groups of 60 chicks per group in a completely randomized

design (CRD) consisting of four replicates of 20 birds each. Birds were reared on a deep litter, with feed and water provided *ad libitum*. Left over feed and body weight of birds were monitored on a weekly basis for the starter phase of the experiment and routine vaccines were given as recommended. All feed not consumed were removed, weighed and deducted from feed given daily to get the daily feed intake.

A self- formulated and three (3) broiler starter diets of different selected commercial brand were purchased and label as diet 1, 2, 3 and 4 which were given to treatment groups 1, 2, 3 and 4 respectively. All these feeds differ in composition of energy, crude protein, crude fibre, ether extract among others.

Results and Discussions

The daily feed intake values ranged between 99.42g on diet 2 and 91.41g on diet 2 which is similar with the result of Kareem *et al* (2015) who reported a range of between 80.36 and 62.20g in his work titled studies on performance, haematology and serum biochemistry of broilers fed three types of commercial feed.. The daily weight gain value of 58.60g on diet 4 was observed to be highest followed by 54.50 on diet 3 while the lowest daily weight gain was 35,41g on diet 3 which was statistically ($P<0.05$) with 38.29g on diet 1. These levels are in conformity with levels of Opoola et al (2015) who reported daily weight gain values of between 36.48 and 41.56g in performance of broiler chicks fed dietary levels of tryptophan and commercial diet. Feed conversion ratio was significantly affected by the dietary treatment. The result is similar to what was obtained by Sanusi *et al* (2015). Birds on diet 4 were having better feed conversion ratio of 1.65 which differed significantly ($P<0.05$) with 1.82, 2.43 and 2.55 levels of dietary treatment groups 2, 1 and 3 respectively.

The highest feed cost/kg is recorded on diet 4 and 2 (164 and N160/kg) while diet 3 had relatively low feed cost of N148/kg and the lowest feed cost was recorded on the self-formulated diet (N128//kg}. The feed cost/gain ranged between 200.70 and N409.49 on diet 1 and 4.. This result differs with the values of between N124.67 and N190.29 reported by Sanusi et al (2015).

Conclusion and Recommendation

Birds on diets 4 and 2 performed better than those on diets 1 and 3. And low feed cost/gain was recorded to be lowest on the self-formulated diet (diet 1) while broiler chickens on diet 4 had the highest feed cost/gain of N409.49 during the experiment. Diets 2 and 4 were therefore recommended for production broiler starter.

Table 1: Composition of control diet fed to Broiler Chickens at starter phase

Feed ingredients	**Percentage**
Maize	47.98
Soya beans	33.82
Fish meal	4
Wheat offal	10
Limestone	1.5
Bone meal	2
Salt	0.25
Premix	0.25
Mrthionine	0.1
Lysine	0.1
Total	**100**
Calculated analysis	
Crude protein	23
Crude fiber	5.0
Ether extract	4.0
Metabolizable energy (MJ/kg)	11.88

Table 2: Nutrient composition of three different commercial diets fed to broiler chickens at the starter phase

	Commercial diets		
Composition (%)	**T2**	**T3**	**T4**
Crude protein	20.00	22.00	22.00
Crude fibre	3.00	4.30	5.00
Ether extract	6.00	5.10	4.50
Calcium	1.00	1.20	1.10
Phosphorus	0.45	0.45	0.50
Methionine	0.45	0.56	
Lysine	1.10	1.30	1.33
Metabolizable energy (MJ/kg)	12.08	12.50	12.50

Table 3: Growth performance of broiler chickens fed self formulated and three different commercial diets at starter phase

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Initial body weight	277.78	288.89	286.11	280.55	7.86 NS
Final body weight	1081.96^{c}	1433.33^{b}	1040.28^{c}	1511.11^{a}	29.12*
Body weight gain	804.17^{c}	1144.44^{b}	754.17^{c}	1230.57^{a}	26.98*
Daily body weight gain	38.29^{c}	54.50^{b}	35.91^{c}	58.60^{a}	1.29*
Total feed intake	1955.11^{ab}	$20.84.61^{b}$	1919.64^{b}	2032.47^{ab}	55.04*
Daily feed intake	$93,10^{ab}$	99.27^{a}	$91.41.^{b}$	96.79^{ab}	2.62*
Feed conversion	2.43^{a}	1.82^{b}	2.55^{a}	1.65^{c}	0.53*

^{abc} means on the row with the same superscript are not significantly different (P>0.05)
NS = Not Significant Difference
SEM = Standard Error of Mean

Table 4: Economic analysis of broiler chickens fed self-formulated and three different commercial diets at starter phase

Parameters	**T1**	**T2**	**T3**	**T4**
Total FI (kg)	1.96	2.08	1.92	2.03
Feed cost (N/kg)	128	160	148	164
Total feed cost (N)	250.88	332.80	284.16	332.92
Total weght gain (kg)	0.80	1.14	0.75	1.23
Feed cost gain (N)	200.70	379.39	213.12	409.49

TI = Self formulated diet
T2 – T4 = Commercial diets

References

Bauchi State Diary (BSD), (2009). ABU/ICT-Centre database, http//:www.nigeriagalleria.com/Nigeria/statenigeria/bauchistate.

Gutiérrez-Alamo, A, P., Pérez, D. A., Verstegen, M. W. A., Den Hartog, L. A., and Villamide, M. J. (2008). Variability in wheat: factors affecting its nutritional value. *World's Poultry Science Journal*. 64(**1**):20-39

Kareem, A. O., Rotimi, R. A., and Adeoye, A. A. Studies on performance, haematology and serum biochemistry of broilers fed three types of commercial feed. (2015) 20th Annual conference of of Animal Science Association of Nigeria 511-513

Loar, R. E, and Corzo, A. (2011). Effects of feed formulation on feed manufacturing and pellet quality characteristics of poultry diets. *World's Poultry Science Journal,* **67**: 19-28.

Onabanjo, R. S., Amaduruonye, W.N. and Amaefule, K. U. (2018) Microbial population and blood profile of finisher broiler chickens fed diets supplemented with Crina poultry plus. *Nigerian Journal of Animal Science* **20** (4): 609-618

Opoola. E., Ogundipe.. S. O., Onimisi. P.A. and Bawa, G.S. (2015) Growth response of broiler chicks fed diets fortified with varying levels of tryptophan versus commercial diet under tropical environment. 20th annual conference of Animal Science Association of Nigeria 603-606

Sanusi, M., Rabi, A., Doma, U.D. and Haruna, J. (2015). Comparative effect of self-formulated and four commercial diets on the growth performance, carcass and haematological parameters of broiler finishers in the tropics. *Sokoto Journal of Veterinary Sciences* **13(**2):14-19

RESPONSE OF STARTER BROILER BIRDS FED DIFFERENT COMMERCIAL FEED

Ohagenyi, I.J., Onah, C.S. and Udeh, V. C.
Department of Animal Science, University of Nigeria, Nsukka, Nigeria.
Correspondence email: ifemma.ohagenyi@unn.edu.ng**; Tel: +2348160516532**

ABSTRACT
This study was conducted to compare the performance of broilers fed with different commercial feeds at the starter phase. A total of 200 birds were used for the experiment which lasted for 8 weeks. The birds were randomly divided into 5 treatment groups which were assigned to the 5 experimental diets. The experimental design used was completely Randomized Design (CRD). Growth performance parameters were measured weekly and feed intake measured daily. Feed conversion ratio and cost per kilogram weight gain were also determined. Data collected were subjected to analysis of variance (ANOVA) and separated using DMRT. The result indicated that the final body weight of broiler chicks fed the various commercial starter diets range from 683g in treatment D to 876g in Trt E. The daily weight gain of broiler starter ranges from 21.36 in birds fed with Trt D to 28.25 for bird fed with Trt E. The feed intake (FI) of commercial broiler fed with Trt A, B, C, D and E were 94.7g, 91.3g, 81.0g and 99.0 respectively. The feed conversion ratio (FCR) of birds in the five treatments were similar (p>0.05). This implies that commercial feeds are better utilized. The result showed that diet B has the lowest cost (N124/kg), while E had the highest cost (N156/kg) at the start phase. From the economic point of view, it seems that diet E would increase production cost for the poultry meat producer considering that feeding is known to take up to 70% production cost in livestock production.

Keywords: Starter, broiler, Commercial feed, response, cost

INTRODUCTION
The poultry industry has been the most dynamic sector within the global meat business since the last decade, with an increased production driven by global population growth especially in developing countries (Delgado 2005). The high demand for animal products in Nigeria coupled with her teeming population, an increasing number of people are venturing into the poultry business. Consequently, this has led to high demand for commercial feed. There is now the tendency for feed manufacturers to produce substandard feeds, especially as the quality control agencies in Nigeria are non-existent or non-functional (Okoli *et al*., 2007: Omede, 2008., Okoli, *et al*., 2009), hence, leaving farmers and consumers at the mercy of commercial feed millers.

Poultry feeds are expected to contain a certain level of protein and energy for proper growth and development in birds. However, the feeds offered to birds constitute varied mixtures of ingredient. Moreso, the tendency of feed producer to maximize profit, might contribute to differences in the quality of the manufactured feeds sold in the market. It is important, therefore, to ensure that quality commercial feeds with proven nutritional value capable of achieving efficient production performance are patronized by the farmers. Hence, this study was conducted to compare the performance of the broilers fed different commercial feeds and to evaluate the economic implication of using these feeds.

MATERIALS AND METHODS
Location and duration of study
This study was conducted at the poultry unit of the Department of Animal Science Teaching and research farm, University of Nigeria, Nsukka in Enugu state. Nsukka is located on latitude 05˚ 22’ north and longitude 07˚ 24’ east with annual rainfall ranging from 986-2098mm (Asadu, 2002). The climate of the study area is typically tropical, with relative humidity ranging from 65 – 80% and mean daily temperature of 26.8˚C (Agbagha *et al.,* 2000). The rainy season is between April and October while dry season is between November and March with annual rainfall range of 1680 – 1700mm (Breinholt *et al.,* 1981). The study lasted for 8 weeks.
Experimental birds and management
A total of 200 broiler day-old chicks from a commercial farm at Ibadan were procured for the experiment. The birds were randomly divided into 5 treatment groups. Each bird in the group served

as replicate. The five groups were assigned to different experimental diets TA, TB, TC, TD, and TE. There was no control diet. The birds were housed in a deep litter system and subjected to the same experimental and management conditions. Water and feed were given ad-libitum. Feed and water intake were recorded daily while body weight (BW) measurement was also taken on a weekly basis.

Experimental materials and diets

The experimental diets were different commercial broiler feeds produced by different feed manufacturing companies in Nigeria. These feed were bought from their various distributors in Nsukka in Enugu State, Nigeria. The study involved the use of five commercial feeds TA, TB, TC, TD and TE of the starter diet. The composition of diets is given in the table below.

Data collection

Data were collected on daily feed intake, weekly body weight, weekly body length and shank length, daily water intake, feed conversion ratio and rearing phase mortality of the birds.

FCR (feed: gain) = $\frac{\text{feed consumed}}{\text{Weight gain}}$

Experimental Design

The feed trial experiment was carried out in a completely randomized design (CRD) with five treatments. The statistical model was as follows:

$X_{ijk} = \mu_1 + T_j + E_{ijk}$

Where X_{ijk}= the record of body weight, body length and shank length of individual broiler

μ_1 = overall mean

T_1 = the random effect of various feeds

E_{ijk} = the error

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) in completely randomized design using a statistical package to social science (SPSS 2007). Significant difference among mean was separated using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (2000).

RESULTS AND DISCUSSION

Table 1: Proximate composition of experimental diets.

Treatment	Moisture	Ash	Fat	Crude protein	Crude fibre	M.E (Kal/kg)
A	8.150	3.100	6.00	18.00	5.00	3200.00
B	12.000	7.000	8.00	15.00	15.00	2600.00
C	10.000	5.100	3.80	19.60	5.00	3100.00
D	7.130	3.100	3.00	18.50	4.00	3100.00
E	8.150	3.247	3.247	19.264	2.986	3100.00

ME = Metabolizable energy

Table 2: Performance of Starter Broiler Fed with Different Commercial Diet

Parameter\ Treatments	A	B	C	D	E	SEM
Initial body weight (g)	85.00	85.00	85.00	85.00	85.00	3.46
Final body weight (g)	747.0	710.0	700.0	683.0	876.0	124.5
Daily weight (g/day)	23.64^{b}	22.32^{b}	21.96^{b}	21.36^{b}	28.25^{a}	2.30
Daily feed intake (g/day)	94.7^{NS}	90.7^{NS}	91.3^{NS}	81.0^{NS}	99.0^{NS}	5.73
Feed conversion ratio (g/feed, g/gain)	2.661^{NS}	2.682^{NS}	2.740^{NS}	2.490^{NS}	2.373^{NS}	0.15
Mortality (Number of deaths)	3.0	3.0	2.0	3.0	1.0	0.00
Feed cost (₦/kg)	136	124	128	136	156	2.20
Feed cost /kg weight gain (₦)	544.81	503.89	532.17	515.73	546.69	6.48

[ab]Means within a row with different superscript are significantly (p<0.05) different.

The performance of starter broilers fed with different commercial feed is presented in Table 2.

This result indicated that the final body weight of commercial birds fed with treatment A, B, C, D, and E was 747g, 710g, 700g, 683g and 876 respectively. The final body weight gain for commercial

starter broiler ranges from 683g among birds in Trt D to 876g among birds in Trt E which was not in agreement with Uchegbu *et al*. (2009). It may be due to the problem of disease that affected my birds during the course of the study.

Daily Weight Gain: The daily weight gain of broiler starter was 23.64, 22.32, 21.96, 21.36 and 28.25 respectively. It ranges from 21.36 among birds fed with Trt D to 28.25 for bird fed with Trt E. The commercial broilers fed with Trt E at the starter phase recorded significantly ($p<0.05$) higher daily weight than birds in Trt A, B, C and D. This result is in agreement with report of Uchegbu *et al*. (2009).

Feed Intake: The result of this study shows that the feed intake of commercial broilers fed with Trt A, Trt B, Trt C, Trt D and Trt E at 8 weeks of age were 1.32, 1.31, 0.97, 1.23 and 1.36 respectively. The result further revealed that the feed intake (F.1) of broiler birds fed with different commercial feed is not significant ($p>0.05$). At the starter phase, the feed intake (F.1) of commercial broiler fed with Trt A, B, C D and E were 94.7g, 91.3g, 81.0g and 99.0 respectively. The feed intake was similar in Trt A, B, C and E ($p>0.05$) but significantly ($p<0.05$) higher than those on treatment D. The low feed intake of birds on treatment D relative to those on treatment A, B, C and E might have resulted from metabolizable energy requirement (Leason and Caston, 1993). It has also been reported that birds overeat under moderate protein insufficiency which is not necessary a craving for protein insufficiency but a compensatory increase in feed intake in response to the deficient essential nutrients (Lipstein and Bronstein, 1975).

Feed conversion ratio: The result of this study revealed that the feed conversion ratio (F.C.R) of commercial broilers fed with Trt A, Trt B, Trt C, Trt D and Trt E was 5.19, 5.31, 3.61, 5.47 and 4.93 respectively. It also revealed that the FCR of commercial broiler fed with Trt A, Trt B, Trt C, Trt D and Trt E is not significant ($p>0.05$). At the starter phase, the FCR of commercial broiler fed with Trt A, B, C, D and E were 2.661, 2.682, 2.740, 2.940 and 2.373 respectively. F.C.R ranges from 2.373 (Trt E) to 2.740 (Trt C). The FCR ranges from 2.373 (Trt E to 2.740 (Trt C). The FCR of birds in these five treatment are similar ($p>0.05$). It was in agreement with the report of Martin *et al*. (2009). This implies that commercial feeds are better utilized. This may have resulted from the likelihood that the manufacturers used better and utilizable feed raw materials for compounding their feeds.

Feed Cost: The study pointed out that in the starter phase the feed cost per diet A, B, C, D and E were N136/kg, N124/kg, N128/kg, ₦136/kg and N156/kg respectively. The result shows that diet B has the lowest cost, while E had the highest cost at the start phase. From the economic point of view, it seems that diet E would increase production cost for the poultry meat producer considering that feeding is known to take up to 70% production cost in livestock production.

Mortality: Mortality records in treatment A, B, C, D and E were 6, 3, 3, 2 and 1 respectively. The study showed that Trt A had the highest mortality, while Trt E had the least. High mortality in Trt A could be due to infected feedstuff or poor quality of feedstuff.

CONCLUSION AND RECOMMENDATION

The response of birds to body weight and daily weight gain were highest in Trt E while Trt B was poorest from the result in terms of feed utilization. Trt B was the cheapest of the five commercial feed while treatment E was the costliest in terms of the cost of feed used to produce 1kg of broiler meat. Variability in the nutrient contents of commercial feeds appeared to be an important factor that resulted in the performance differences in this study.

The farmer who depends on commercial feeds and who want his birds to reach market weight at the shortest possible time and at a lower cost of production should consider treatment B, C, and D feed.

REFERENCES

Agbagha, F.M., Ezema F.U. and Omeke, B.C.O. (2000) Studies of management effects on fertility of purbred and crossbred exotic gilts in two breeding farms at Nsukka. *Nigeria Journal of Animal Production*. 28(1)Pg 20.

Asadu, C.L.A. (2002). Fluctuations in the characteristics of an important short tropical season, august break in eastern Nigeria, discovery and innovation 14(1/2).IITA England.

Breinholt, K.A., Gowen, F.A. and Nwosu, C.C. (1981). Influence of Environmental and Animal Factors on Day and Night Grazing Activity of Imported Holstein Freisian Cows in the Humid Lowland Tropics of Nigeria. *Trop. Animal Produc*.6:4.

Delgado, C. (2005). Rising demand for meat and milk in developing countries: implication of grassland-based livestock production in Grassland: a global resources (ed.MC Gilloway D.A. editor), pp. 29-39 the nature lands: wagen-ingen Academic publishers.

Kumar, P., Ali, N., Rajkumar, Kumar, J., Bansala, M. K. and Kumar, P.1 (2015).Effect of different dietary protein level on the growth performance of broiler chickens. *Progressive Research - An International Journal* 10 (2): 157-15.

Leson, S. and Caston. L. J. (1993). Production and carcass yield of broiler using free-choice cereal feeding *Journal of applied poultry research* 2:253-258.

Lipstein, B. and Bronstein, S. (1975) The replacement of soybeen meal by the limiting amino acid in practical broiler diet 2 special additions of methionine and lysine as partial substitute for protein in finder diet. *Brit. Poult. Sci*.,16: 189-00.

Obi, I.U. (2000). Statistical methods of detecting differences between treatment means. SNAAP Press Ltd. Enugu Nigeria pp.45.

Okoli IC, Omede AA, Ogbuewu IP, Ekwuagana IC, Ndujihe GE and Emeka J (2007). Prevalence of Salmonella in commercial poultry feeds and feed raw materials sold in Imo State, Nigeria. In: S.O. Oseni., O.Makinde., A. Fafiolu., and O. Betiku (eds). Book of Abstracts, 12th Annual Conference of Animal Science Association of Nigeria, 10th - 13th Sept., 2007 Obafemi Awolowo University, Ile-ife, Osun State, Nigeria. Pp: 114.

Okoli, I.C. Owede, A.A., Ogbuewu, J.P. and Uchegbu, M.C. (2009). Physical characteristics as indicator of poultry feed quality. A Review proceeding of the 3rd Nigerian International Poultry summit, S.I. Ola., A.D Fafiohu and AA Fatufe (editors) (A Review. Publication). February 22-26 Abeokuta, Ogun state, Nigeria pp. 124-128.

Omede AA (2008). Critical Issues in Poultry Feed Quality Evaluation in Nigeria. Book of Abstracts and Congress Proceedings, XXIII World's Poultry Congress, Volume 64, supplement 2, pp455. 29th June-4th July, 2008, Brisbane, Australia.

SPSS. (2007). SPSS 16.0.1 for Windows. SPSS Inc., Chicago, IL, USA.

Uchegbu, M. C., Irechukwu, N. M., Omede, A. A., Nwaodu, C. H., Anyanwu, G. A., Okoli, I. C. and Udedibie, A. B. I. (2009) Comparative Evaluation of Three Commercial feeds on the performance of Broilers. *Report and Opinion* 1(4)

NUTRIENTS AND PHYTOCHEMICAL COMPOSITION OF SOME NON-CONVENTIONAL FEED SUPPLEMENTS

Haladu S[1]., Akande T.O. [2], Nasir M[3]. and Oguntade M.O.[1]

[1]Department of Agric. and Bio-Environmental Engineering Technology, Federal Polytechnic, Ede, P.M.B. 231 Osun state, Nigeria. [2]Department of Animal Sciences, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Osun state, Nigeria, [3]Department of Animal Science, Kano State University of Science and Technology, P.M.B. 3045, Wudil, Nigeria
Corresponding author: Haladu S.; sadiqhaladu3@gmail.com; +2348060311855

Abstract
Phytochemicals are organic substances in plants that play various roles in maintaining healthy living of an organism; they achieve that in conjunction with the roles played by other nutrients such as vitamins and minerals. Fresh fluted pumpkin leaf, Moringa leaf, tomato, and garlic bulb were obtained, dried and milled. They were later analysed to quantify phytochemicals such as phenolics using the folinciocalteu's as oxidizing reagent, alkaloids, flavonoids and β-carotene using emulsion preparation method. Minerals such as calcium, magnesium, sodium, iron, phosphorous, copper and zinc were determined. The result showed significantly (P<0.05) higher flavonoid and alkaloid in fluted pumpkin, phenol and β-carotene were significantly (P<0.05) higher in moringa. Calcium, phosphorus and iron were significantly (P<0.05) higher in moringa, fluted pumpkin had significantly (P<0.05) higher magnesium and iron. The test supplements contain appreciable crude protein to be used in dietary formulation. It is concluded that leaf meals contain more phytochemicals and mineral than tomato and garlic.
Key words: fluted pumpkin, moringa, tomato, garlic, phytochemical

Introduction
Phytochemicals such as alkaloids, carotenoids, phenolics, and flavonoids reduce the deposition of fat in the arteries (Anderson, 2004). Sulphur compounds such as allixin and S-allyl-cysteine, as examples of phytochemicals, are known to decrease the cholesterol synthesis in the body and consequently keep the blood pressure low (Anderson, 2004).
Telfairia occidentalis has antioxidant, antidiabetic, haematological, anticancer, anti-Inflamatory, male fertility, hepatoprotective, antimicrobial, antimalaria, toxicity and biochemical activities. These activities may be due to the phytochemicals, vitamins and minerals present in the plant (Imosemi 2018). Umaya (2014) reported the health benefits of *Moringa Oleifera* include regulation of hyperthyroidism, radio-protective effect, vitamin A supplement, antihypertensive effect, hypoglycemic effect, antioxidant and enhanced milk yield. Garlic contains a compound, allicin (organosuphur compound), which is an oily liquid that contain more than 60% thiosulfinates, (Harunobu *et al.,* 2001). Allicin has odour and it is highly unstable compound that decomposes to sulfides, including ajoene and dithiins, (Freeman and Kodera, 1995). It has been tested to have antimicrobial effect, (Harunobu *et al.,* 2001). Tomato is a good source of vitamin, mineral, flavonoid and carotenoid (Campbell, *et al*., 2004). Because of their nutrients composition, they can serve the poultry sector as non-conventional feeding materials.
This study intends to screen four selected non-conventional feed supplements; fluted pumpkin leaf meal (*Telfairia occidentalis*), moringa leaf meal (*Moringa oleifera*) tomato powder (*Lycopersicom esculentus*), and garlic bulb powder (*Allium sativum*) for their chemical constituents

Materials and Methods
Fresh fluted pumpkin leaf (*Telfeiria occidentalis*), Moringa leaf (*Moringa oleifera*), tomato (*Lycopersicom esculentus*), and garlic bulb (*Allium sativum*) were obtained from local market in Ile-Ife and were dried, milled and stored in freezer for subsequent chemical analyses. They were later analysed to quantify phytochemicals such as phenolics as described by Othman *et al* (2007) using the folinciocalteu's as oxidizing reagent, alkaloids, flavonoids as described by Zhilen *et al.* (1999) and β-carotene using emulsion preparation method of Sarker *et al*. (1993). Minerals such as calcium, magnesium, sodium, iron, phosphorous, copper and zinc were determined using the method described by Sharma and Sangha (2009). Data collected were subjected to Analysis of Variance (ANOVA) of SAS (2002) and means were separated using Duncan's Multiple Range Test.

Results and Discussion

The result of phytochemicals analysed (Table 1) showed the flavonoid composition of the test supplements was higher significantly (P≤0.05) in fluted pumpkin leaves meal followed by moringa leaf meal. Flavonoids (myrecytin, quercetin and kaempferol) have high antioxidant ability as cited in the report Vergara-Jimenez *et al*. (2017). The alkaloid composition of fluted pumpkin (226.67 mgAAE/g) and moringa (215.88 mgAAE/g) were higher than those found in dried tomato fruit (199.61 mgAAE/g) and dried garlic bulb (94.44 mgAAE/g). This may be responsible for their medicinal properties. Vergara-Jimenez *et al*. (2017) reported that alkaloid contain several nitrogen compounds which include N,α-L-rhamnopyranosyl vincosamide, phenylacetonitrile pyrrolemarumine which have an anti-inflamatory effect on patients with ailments such as hypertension and heart related diseases. The result of phenol in moringa and fluted pumpkin were higher significantly (P≤0.05) than that of tomato and garlic. Phenolic acids such as gallic acid and chlorogenicacid have free radical scarvenging activities which have health promoting effects (Nour *et al.,* 2018). The β-carotene was however, significantly (P≤0.05) higher in dried tomato powder than other test supplements. Tomato contained high lycopene (a form of carotenoid) which was reportedly essential for the alleviation of oxidative stress in chicken (Sahin *et al.* 2016), meaning that tomato could be used to address challenges of oxidative stress.

Table 1: The phytochemical composition of test supplements

Parameters	Fluted pumpkin leaf meal	Dried tomato fruit meal	Moringa leaf meal	Dried garlic bulb meal	SEM
Phenol (mg GAE/g)	57.48[b]	43.28[c]	60.21[a]	11.20[d]	0.55
Flavonoid (mgQUE/g)	29.81[a]	23.44[c]	26.34[b]	24.24[c]	2.14
Alkaloid (mgAAE/g)	226.67[a]	199.61[c]	215.88[b]	94.44[d]	6.23
β-Carotene (mg/kg)	138.48[b]	174.81[a]	179.64[a]	66.50[c]	6.50

[abcd]Means in the same row having different superscripts differ significantly at P≤0.05

The result of mineral content of the test supplements (Table 2) showed that calcium was higher significantly (P≤0.05) in moringa leaf meal compared to other test supplements. Sebola *et al.* (2017) reported significantly higher calcium content (19.15g/kg) in moringa. The magnesium content was significantly (P≤0.05) higher in fluted pumpkin leaf meal compared to other test supplement followed by moringa leaf meal. This was in line with the result reported by Nworgu *et al. (*2007). The phosphorus content of the test supplements was significantly (P≤0.05) higher in moringa leaf meal followed by dried garlic bulbs. This shows the potentiality of moringa in improving egg shell thickness. The iron in fluted pumpkin and moringa were higher significantly (P≤0.05) than the content of other test supplements. This may be responsible for their effectiveness in the treatment of anaemia. Ustundag and Ozdogan (2016) reported significantly (P≤0.05) higher iron in fluted pumpkin and moringa, respectively. The zinc content of the test supplement was however significantly (P≤0.05) higher in dried garlic bulb than other test supplement. Ustundag and Ozdogan (2016) reported higher content of zinc in moringa than copper. Revell *et al*. (2009) reported an increased in the total iron content by over 15% compared to the control when an iron rich diet was fed to laying hens.

Table 2: The mineral composition of test supplements

Parameters	FPLM	DTFM	MOLM	DGBM	SEM
alcium (g/kg)	10.10[b]	1.5[d]	13.13[a]	1.76[c]	0.004
Magnesium (g/kg)	4.32[a]	2.00[c]	2.58[b]	1.06[d]	0.003
Sodium (g/kg)	1.80[d]	3.02[a]	2.92[b]	2.01[c]	0.009
Phosphorus(g/kg)	0.27[d]	0.28[c]	0.66[a]	0.46[b]	0.004
Iron (mg/kg)	155.00[a]	76.00[c]	154.00[a]	94.00[b]	0.763
Copper (mg/kg)	8.00[c]	12.33[a]	4.00[d]	11.00[b]	0.004
Zinc (mg/kg)	49.00[d]	62.33[c]	73.00[b]	76.00[a]	0.287

[abcd]Means in the same row having different superscripts differ significantly at P≤0.05

Table 3 shows the results of the proximate composition of test supplements. The crude proteins (18.07-27.96%) in the test supplements were moderately higher to furnish requirement for farm animals except in garlic which had 8.93%. This tallied with result sited by Karangiya *et al.* (2016) who cited low crude protein in garlic when fed to broiler chicken. The fibre content of the test supplements were significantly low in dried tomato fruit and dried garlic bulb, this showed their potentiality for inclusion into the poultry diet as they cannot withstand high fibre diet. Ether extract was higher in fluted pumpkin (9.06%) than dried garlic (1.13%). The nitrogen free extract was significantly high in dried garlic than other test supplements. This was the same with 85.83% nitrogen free extract reported by Karangiya *et al.* (2016).

Table 3: The proximate composition of test supplements and experimental diets

	Supplements			
Parameters (%)	**FPLM**	**DTFM**	**MOLM**	**DGBM**
Dry matter	90.81	92.79	90.13	87.39
Crude protein	25.27	27.96	18.07	8.93
Crude fibre	10.91	3.37	10.63	3.5
Ether Extract	9.06	3.97	5.10	1.13
Ash	5.15	4.29	4.59	2.44
Nitrogen Free Extract	49.61	60.41	61.60	84.00

FPLM=fluted pumpkinleaf meal, DTFM=dried tomato fruit meal, MOLM=moringa leaf meal, DGBM=dried garlic bulb meal, Mix=mixture of FPLM and MOLM in a ratio of 1:1.

Conclusion

It is concluded that fluted pumpkin and moringa leaf meals contain more phytochemical and mineral than tomato and garlic. The crude protein in tomato is higher than other test supplements

References

Anderson, G.D. (2004). Phytochemicals 2004. Dynamic Chiropractic *Trends Food Science Technology*, 2(1):168-175.

Campbell, J. K., Canene-Adams, K., Lindshield, B. L., Boileau, T. W. M., Clinton, S. K., and Erdman, J. W., Jr. (2004). Tomato phytochemicals and prostate cancer risk. *The Journal of Nutrition*, 134 (12): 3486S-3492S, http://doi.org/10.1093/jn/134.12.3486S. Retrieved on 30th September, 2018.

Harunobu A., Brenda L. P., Hiromichi M., Shigeo K. and Yoichi I. (2001). Intake of Garlic and Its Bioactive Components. *American Society for Nutritional Sciences*, 995S-1002S. Downloaded from https://academic.oup.com/jn/article-abstract/131/3/955S/4687054 by guest on 20 October 2018.

Imosemi, I.O. (2018). Review of the Toxicity, Medicinal Benefits, Pharmacological Actions and Morphological Effects of *Fluted pumpkin* Hook. F. *European Journal of Phamaceutical and Medical Research*, 5(7): 22-32.

Nour, V., Panaite, T. D., Ropota, M., Turcu, R., Trandafir, I. and Curbu, A. R. (2018). Nutritional and bioactive compounds in dried tomato processing waste, CyTA - *Journal of Food*, 16:1, 222-229: https://doi.org/10.1080/19476337.2017.1383514

Nworgu, F.C., Ogungbenro S.A. and Solesi, K.S. (2007). Performance and Some Blood Chemistry Indices of Broiler Chicken Served Fluted pumpkin (*Telfairia occidentalis*) Leaves Extract Supplement. *American-Eurasian Journal of Agric and Environmental Science*, 2(1): 90-98.

Othman, A., Ismail, A., Abdul Ghani, N. and Adenan, I. (2007). Antioxidant capacity and phenolic content of cocoa beans. *Food chemistry*, 100(4): 1523-1530. Retrieved 18/10/2018 from https://doi.org/10.1016/j.foodchem.2005.12.021

Revell, D.K., Zarrinkalam, M.R. and Hughes, R.J. (2009). Iron content of eggs from hens given diets containing organic forms of iron, serine and methyl group donors, or phytoestogens. *Poultry sciences*, 30(4): 536-46.

Sahin, K., Orhan, C., Tuzcu, M., Sahin, N., Hayirli, A., Bilgili, S., and Kucuk, O. (2016). Lycopene activates antioxidant enzymes and nuclear transcription factor systems in heat-stressed broilers. *Poultry Science*, 95:1088–1095 http://dx.doi.org/10.3382/ps/pew012

Sarker, H., Mahtab, R. and Ahmed, M. (1993). Investigation on the chemical components of jute (*Corchorus capsularis* L.) leaf. Dhaka University Studies, Part-B Science 41, 13-18.

SAS (2002). Statistical Analysis System Institute. Users Guide Version 9 for Windows. Cary North Carolina USA.

Sebola, N.A., Mlambo, V., and Mokoboki, H.K. (2017) Chemical characterisation of *Moringa oleifera* Leaves and the apparent digestibility of *Moringa oleifera* leaf meal-based diets offered to three chicken strains. *Agroforestry Systems*, 93(1): 149-160. DOI: 10.1007/s10457-017-0074-9.

Umaya, S.R. (2014). Application of Moringa Oleifera in Poultry: A review. *World Journal of Pharmaceutical Research*, 3(2): 1955-1960.

Ustundag, A.O. and Ozdogan, M. (2016). Using *Moringa oleifera* in poultry Nutrition. *Journal of Agricultural Faculty of Uludag University*; 30: 195-201.

Vergara-Jimenez, M. Almatrafi, M. M. and Fernandez, M. L. (2017). Review: Bioactive Components in Moringa Oleifera Leaves Protect against Chronic Disease. *Antioxidants 6, 91: 1-12; doi:10.3390/antiox6040091*

Zhilen J, Mengeheng T, Jianming W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chemistry*, 64:555-559.

Karangiya, V. K., Savsani, H. H., Patil, S. S., Garg, D. D., Murthy, K. S., Ribadiya, N. K., Vekariya, S. J. (2016) Effect of dietary supplementation of garlic, ginger and their combination on feed intake, growth performance and economics in commercial broilers, *Veterinary World*, 9(3): 245-250.

Sharma, R.K. and Sangha, S.P.S. (2009). Basic in Biochemistry and Molecular Biology. I.K. International publishing house, New Delhi

Freeman, F. and Kodera, Y. (1995). Garlic chemistry: stability of S-(2-propenyl)2-propene-1-sulfinothioate (allicin) in blood, solvents, and simulated physiological fluids. *Journal of Agriculture and Food Chemistry*, 43: 2332–2338.

GROWTH PERFORMANCE, DIETARY SELECTIVITY AND NUTRIENTS PROFILE OF BROILER CHICKENS ON A CAFETERIA FEEDING REGIME

***AJETUNMOBI, A.W.; + OLOGHOBO, A.D. AND ++EGUAOJE, S.A.**
***Agric., Edu Dept. Adeniran Ogunsanya Coll. of Edu., Lagos.**
+ Dept. of Animal Science, University of Ibadan, Ibadan.
++ Dept. of Animal Science, University of Benin, Benin City.

Abstract

The study was conducted to determine growth performance, dietary selectivity of feed ingredients and nutrient profile of broiler chickens at 42 days of rearing. Two hundred and eighty-eight (288) unsexed day-old FUNAAB ALPHA Strain broiler chicks raised in battery cages were randomly distributed in a completely randomized design into 5 cafeteria dietary treatments and a basal dietary treatment groups of 6 replicate each containing 20% crude protein and 300kcal MC/kg. The results showed significant differences (P<0.01) among the treatment for all production variables except for feed: water radio. Weight gains were better (P>0.01) in broiler fed Red sorghum-soyabean meal-concentrate and Red sorghum-millet-soyabean meal-groundnut cake-concentrate. The feed conversion ratio showed similar trends with the weight gains and final body weights. The co-efficient of preference (%) indicated higher values (74g 5%) for millet in millet-soyabean concentrate diet compared to 67.43% for red sorghum in Red sorghum-soyabean meal- concentrate diet. Nutrient profile of the cafeteria dietary treatments showed similar trends with other measured variables. It was shown that Red sorghum and millet can nutritionally and suitably be used with soyabean meal for cafeteria-fed broilers that can select and consumed feedstuffs to meet energy, protein and mineral needs for growth and production.

Keywords: Cafeteria, coefficient of preference, dietary selectivity, nutrient profile, growth indices.

Introduction

Birds' performance and their products are affected by nutrition and feeding systems. Poultry can be managed under different feeding systems.Feed intake is influenced by the interface between nutrition, management and animal responses (Church and Pond, 1988; Leeson and Summer, 2005). About 86.2 percent of the poultry are managed under traditional husbandry systems (Tewe, 1998). Cafeteria system could be an option to *ad libitum* complete diet feeding. It allows the animals to select their own diet (Forbes and Shariatmadari, 1994; Forbes and Covasa, 1995). Cafeteria feeding has recently not received considerable research attention to meet the current needs of the poultry industry. Cafeteria study will serve as a basis for establishing semi intensive system for rural small-scale poultry production. The objective of the study was to evaluate the production response, dietary selectivity and nutrient profile of broiler chickens on a cafeteria feeding system.

Materials and Methods

The experiment was conducted at the poultry unit, Teaching and Research Farm, Agricultural Education Department, Adeniran Ogunsanya College of Education, Otto/Ijanikin, Lagos. Two Hundred and Eighty-eight unsexed day-old broiler chicks obtained from the hatchery of the Federal University of Agriculture, Abeokuta were randomly allotted to six experimental diets with six replicates of 48 broiler chicks each in a completely randomized design and raised in constructed cage system. The dietary treatments are presented in Table 1.

Table 1: Gross and Nutrient Composition of Test Finisher Diets

	COMPOSITION, %					
Ingredients	***Ma-SBM-C***	***S-SBM-C***	***S-GNC-C***	***Mi-SBM-C***	***Mi-GNC-C***	***S-Mi-SBM-GNC-C***
Maize	58.60	-	-	-	-	-
Sorghum	-	62.00	52.00	-	-	31.00
Millet	-	-	-	61.20	50.50	25.25
Soyabean meal	19.40	16.00	-	16.80	-	8.40
Groundnut cake	-	-	26.00	-	27.50	13.;75
Brewer's Dried Grain	5.00	5.00	5.00	5.00	5.00	5.00
Palm kernel cake	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	6.00	6.00	6.00	6.00	6.00	6.00
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00
Dicalcium phosphate	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.25	0.25	0.25	0.25	0.25	0.25
*Vitamin/Mineral premix	0.25.	0.25	0.25	0.25	0.25	0.25
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis	20.00	20.00	20.01	19.97	19.56	20.02
Crude Protein, %	4.34	4.19	4.25	7.90	7.33	5.78
Crude Fibre, %	3.95	3.35	4.05	3.97	4.60	3.99
Fat, %	157.56	150.01	152.49	150.79	153.63	154.92
Calorie:Protein ratio	3151.28	3001.10	3051.38	3011.20	3005.10	3101.50
ME,Kcal/kg						

**Contain per kg of diet: 10,000 iuVit. A, 2000 iuVit. D_3 51 iuVit. E, 2.24mg Vit. K, 5.5mg riboflavin, 10mg Vit. B_{12}, 25mg Niacin, 1mg Folic Acid, 250mg Choline, 8mg pantothenate, 54mg, Mn, 48mg Zn, 10mg Cu, 20mg Fe, 2.25mg Cobalt and BHT antioxidant*.

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The feeds were presented in a mash form with 3 - compartment feeding troughs to separate the sources of energy, protein and concentrate with the exception of 5 - compartment feeder for treatment containing all the energies and protein sources.

The following parameters were measured; weight gain, feed intake, feed conversion ratio, feed/gain ratio, water consumption, feed to water ration co-efficient of preference and nutrient profile. The data obtained were subjected to analysis of variance using the General Linear model procedure (SAS Institute, 2012).

Result and Discussion

The results of the growth performance, co-efficient of preference and the nutrient profile of the broiler chicken at the finisher stage (22-42 days) are presented in Tables 2, 3 and 4 respectively.

Table 2: Growth Performance of Broiler Chickens at the Finisher Phase (22-42days)

PARAMETERS	Ma-SBM-C	S-SBM-C	S-GNC-C	Mi-SBM-C	Mi-GNC-C	S-Mi-SBM-GNC-C	P-Value
MBW, g/bird	183.8±10.5^{a}	181.8±17.8^{ab}	98.1±9.3^{c}	163.8±14.6^{c}	118.5±14.6^{c}	171.5±15.1^{ab}	<0.001
MBW @ day 42, g/bird	1158.7±20.6^{a}	1020±95.41^{b}	311.6±122.5^{c}	858.5±55.1^{b}	428.2±139.2^{c}	1001±99.9^{b}	<0.001
Total Feed intake, g	2256.6±120.5^{bc}	2436.4±343.7^{ab}	895.8±211.2^{d}	1941.9±245.9^{c}	1185.4±186.2^{d}	2162.5±110.7^{bc}	<0.001
Feed Intake , g/b/d	376.1±15.5^{bc}	406.1±57.2^{ab}	149.3±35.2^{d}	323.6±40.9^{c}	197.5±31.03^{d}	360.4±18.4^{bc}	<0.001
Weight gain, g	974.8±61.8^{b}	838.2±81.8^{b}	213.5±113.2^{c}	694.7±59.4^{b}	309.8±130.9^{c}	829.5±109.5^{b}	<0.001
Weight gain, g/bird	162.4±13.5^{a}	139.7±13.8^{b}	35.5±4.3^{d}	115.7±12.3^{c}	51.6±9.57^{d}	138.2±11.3^{b}	<0.001
Feed Conversion Ratio	2.31±0.03^{a}	2.89±0.19^{b}	5.05±2.43^{a}	2.80±0.32^{b}	4.09±0.96^{ab}	2.64±0.37^{b}	0.089
Feed Efficiency	0.43±0.16^{a}	0.35±0.02^{ab}	0.22±0.10^{c}	0.36±0.04^{ab}	0.25±0.06^{bc}	0.38±0.05^{a}	0.029
Mean total water intake (ml)	4563.8±360.4^{a}	4747±1502.9^{a}	1736.3±625.7^{b}	3975.1±204.1^{a}	2111.4±776.8^{b}	4511.7±435.3^{a}	0.001
Mean water intake (ml/b/d)	126.7±4.8^{a}	138.2±43.6^{a}	48.7±18.5^{b}	113.4±5.7^{a}	60.2±21.8^{b}	128.7±12.5^{a}	0.009
Feed: Water ratio	0.49±0.06	0.53±0.11	0.53±0.06	0.49±0.06	0.61±0.22	0.48±0.03	0.709

MBW=Mean Body weight
a, b, c, d Means with different superscripts in the same row are significantly different

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

There were significant differences (P<0.01) among the treatments for all variables except for feed to water ratio. Feed intake was greater in broilers on cafeteria feeding of red sorghum - soya bean meal - concentrate differing significantly (P<0.01) from birds on free-choice feeding of sorghum-GNC-concentrate and millet-GNC concentrate. Feed intake was not statistically different (P>0.01) among the treatments of red sorghum-soyabean meal concentrate, millet-soyabean meal- concentrate and millet- red sorghum-soyabean-GNC-concentrate.

Table 3: Co-efficient of Preference and Proportion (%) of each Ingredient consumed by Broiler chicken at Finisher Phase (22-42 days)

INGREDIENTS	TREATMENTS					
	Ma-SBM-C	**S-SBM-C**	**S-GNC-C**	**Mi-SBM-C**	**Mi-GNC-C**	**Mi-S-SBM-GNC-C**
Maize (Ma)	74.20±3.49	-	-	-	-	-
Sorghum (S)	-	67.43±2.45	60.59±9.81	-	-	7.47±2.89
SBM	22.85±1.52	30.69±2.14	-	23.14±4.31	-	19.90±2.61
Millet (Mi)	-	-	-	74.95±4.49	66.22±5.59	53.26±7.13
GNC	-	-	37.17±9.89	-	32.28±6.07	16.28±6.06
*Conc (C)	2.95±0.68	1.87±0.68	2.24±0.27	1.91±0.77	1.50±0.25	2.55±0.65

SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The result indicated higher preferences for millet, red sorghum and soyabean meal as good sources of energy and protein for better performance. Birds consumed less groundnut cake probably due to its low protein quality, poor palatability and unattractiveness compared to soyabean meal.

Table 4: Nutrient Profile of Broiler Chickens at Finisher Phase (22-42 days)

Parameters	TREATMENTS							
	Ma-Soy-C	**S-Soy-C**	**S-GNC-C**	**Mi-Soy-C**	**Mi-GNC-C**	**S-Mi-SBM-GNC-C**	**SEM**	**P – Value**
Feed Intake, g/b/d	376.1±15.5^{bc}	406.1±57.2^{ab}	149.3±35.2^{d}	323.6±40.9^{c}	197.6±31.1^{d}	360.4±18.4^{bc}	-	<0.001
Weight gain, g/bird	162.4±13.6^{a}	139.7±13.8^{b}	35.5±4.35^{d}	115.7±12.3^{c}	51.6±9.5^{d}	138.2±11.3^{b}	-	<0.001
ME intake, Kcal/Kg	1135.2^{c}	8032.1^{a}	2334.3^{bc}	6471.4^{a}	3749.6^{b}	7272.7^{a}	292.94	<0.0001
Energy conversion	7.3^{c}	13.3^{b}	15.56^{a}	13.24^{b}	19.41^{a}	11.99^{b}	3.40	<0.0001
CP intake, g/bird	75.2^{d}	643.5^{a}	168.8^{cd}	447.7^{b}	248.9^{c}	577.1^{ab}	29.1	<0.0001
Protein conversion	0.46^{b}	1.07^{a}	1.13^{a}	0.92^{a}	1.26^{a}	0.96^{a}	0.24	0.0001
Calorie: Protein ratio	15.7^{ab}	12.6^{c}	14.1^{bc}	14.4^{bc}	15.4^{ab}	12.7^{c}	0.6	0.005

ME - Metabolisable Energy CP - Crude Protein
a, b, c, d, Means with different superscripts in the same row are significantly different.
SBM – Soya bean meal, GNC – Groundnut cake, Ma – Maize, S – Sorghum, Mi – Millet, C – Concentrate Supplement

The birds utilized the nutrient in feedstuffs according to their choice to meet their nutritional needs. Poultry has been reported to adjust voluntary intake of feeds with different energy and protein densities (*Cruz et al, 2005; Rose, 1997).*

Conclusion and Recommendations

Red sorghum and millet as energy sources can adequately be utilized in combination with soya bean meal as the broilers on the diets containing these ingredients presented better growth performance, dietary selectivity and nutrient profile than when groundnut cake was used. This therefore will provide a guide for the improvement of feeding and nutrition of the rural poultry system, which will ultimately improve smallholder poultry production in a sustainable and economic manner for higher animal protein intake.

References

Church, D.C and Pond W.G. (1988). **Basic Animal Nutrition and Feeding**. Third Edition. U.S.A; John Wiley & Sons, Inc.

Cruz, V.C., Pezzato, A.C., Pinheiro, D.F., Goncalves and Sartori, J.R., (2005). Effect of Free-choice feeding on the performance and Ileal Digestibility of Nutrients in Broilers. *Brazilian Journal of Poultry Science* 7**(3)**:143-150.

Forbes, J.M. and Shariatmadari, F., (1994). Diet Selection for Protein by Poultry. *World's Poultry Science Journal* **50**: 7-24

Forbes, J.M and Covasa, M., (1995). Application of diet selection by poultry with particular reference to whole cereals. *World's Poultry Science Journal **51**: 149-165*

Leeson, S and Summers, J.D. (2005). **Commercial Poultry Nutrition.** 3rd Edition. England: Nottingham University Press.

SAS Institute. (2012). SAS/STAT® User's Guide. SAS Institute Inc. Cary, NC

Tewe. O.O., (1998). Sustainability and Development: Paradigms from Nigeria's livestock industry, Ibadan. Inaugural Lecture, 1996 – 1997. University of Ibadan, 42pp

Effects of Varying Levels of Sun Dried Yam Peel Meal on the Growth Performance, Carcass Characteristics and Economic Efficiency of Weaner Rabbits

Nuhu, T[1]., Bello, K. M[1]., I. M. Hassan[2], Husa, H[3].

1. **Department of Animal Production, Abubakar Tafawa Balewa University Bauchi P.M.B 0248, Bauchi State, Nigeria**
2. **Department of Animal Production Technology, Federal College of Animal Health and Production Tech. NVRI, VOM Jos, Plateau State.**
3. **Department of Animal Production Technology, Ramat Polytechnic Maiduguri, Borno State.**

Abstract:
Twenty weaner rabbits of mixed sexes with an average initial weight of 0.62kg were used to determine the effect of varying level of sun-dried yam peel meal (YPM) as a source of fibre on their growth performance, carcass characteristics and economics of production. The rabbits were randomly allotted to five diets formulated with sun dried yam peel meal (YPM) replacing wheat offal (WO) at 0, 25, 50, 75 and 100% level of inclusion. The final live weight of rabbits were significantly higher ($p<0.01$) in diet 2 (25% YPM), the feed conversion ratio and feed efficiency compare favourably among the dietary treatments. There was significant difference ($p<0.05$) with higher daily feed intake on diets 1 and 2 value compared to others. Weight of organ expressed as a percentage of live weight did not show any significant difference between the treatment means accepts in the carcass weight which shows a highly significant difference ($p<0.01$). The cost in Naira per kilogram gain was highest on diet 1 (0% YPM) and lowest on diet 5 (100% YPM). The result indicates that yam peel meal can be used to replace wheat offal at up to 75% in the diet of weaner rabbits with good performance and tremendous reduction in feed cost.

E-mail: tukurnuhuatbubn2012@gmail.com GSM: +2347036713835

Key Words; Varying, Wheat offal, Yam Peel Meal, Rabbits Diet, Economic Analysis.

INTRODUCTION

Animal protein consumption in Nigeria and other developing countries has been reported to be comparatively low (Ayorinde and Aromolaran 1998). (Food and Agricultural organization FAO (1996) recommended a protein consumption level of 65g per day of which 35g should be from animal source. However, the consumption of protein especially animal protein is about 6.8g (OYenuga, 1995).This problem has generally been attributed to shortage of animal protein products. This has led to current high cost of animal products making them out of reach of an average Nigerian. This problems can bridged by directing efforts at the production of animals that are highly prolific, with short generation interval (Akinmutimi and Onwukwe, 2002). One of such is the rabbit. It has high fecundity with short gestation period (Fielding and Metheron 1991). They are fast growing and can obviously convert forage and kitchen wastes into meat with high efficiency (Nworgu and Ogbosuka, 2003). Rabbit supply animal protein to Nigeria especially in rural and peri-urban areas (Egbo *et al*., 2001). Rabbit production has the potential to improve on the diet and income of many poor households due to its growth and fecundity rate, low investment and labour cost (Spore. 2007: Soyebo. 2006).

According to Oseni *et al*. (2008) a major limitation to the development of small holder rabbit production in Nigeria is the absence of reliable sources of quality genetic stocks of rabbits suitable for such units. Rabbit meat is delicious, tasty, well accepted and contains low fat and cholesterol levels. The nature of rabbit in terms of size, short generation interval, rapid growth rate (Ensminger, 1991), easy conversion of available proteins in cellulose-rich plants to meat (Nowak, 1991) and good source of high quality animals protein (Fielding and Metheron 1991) make rabbit production attractive. According to (Omole *et al*, 2005), the white meat of rabbit is very nutritious, easily digestible and extremely low in cholesterol and sodium levels. However, the major constrains in animals production has being compounded with the present economic depression and the fact that most of the feed ingredients such as maize, sorghum and soya beans used in preparing rabbit diets face serious competition from man as food (Ijaiya and Awonusi, 2002). Consequently, there was a need to search for alternative sources of feed ingredients that will be cheap, locally available and nutritionally adequate. One of such feed ingredient is the yam peels which are usually regarded as waste products.

This work therefore attempts to study the performance and cost effectiveness of varying levels of yam peel and meal and wheat offal as a fibre source in the diets of weaner rabbits. This forms the basis of this study.

MATERIALS AND METHODS

Experimental site and housing: The experiment was conducted at Abubakar Tafawa Balewa university teaching and research farm. Located in southern part of Bauchi town about six kilometers along Dass road in Bauchi state. Bauchi state occupied a land area of about 60,000sq km approximately 7% of Nigeria total land area. The state lies between latitude $90^0$30'n and $120^0$30'N and longitude $80^0$42'E and $11^0$8'.The average rainfall ranges from 130mm to 600mm. The vegetation is guinea savanna (B.S.A.D.P. 1999).
The experimental weaner rabbits were housed in hutches located inside the rabbitry building. Each hutch had a feeder and waterer attached.

Experimental Diets: The test feedstuff (fresh yam peel) were collected as kitchen waste from Muda Lawan market in Bauchi metropolis and sun-dried on clean floor until it is crispy to touch it was then milled using the hammer mill at the feed milling unit of the Abubakar Tafawa Balewa University to produce yam peel meal.

Five experimental diets were formulated. In the diets sundried yam peel were used to replace varying levels of wheat offal in the weaners diets. Sundried yam peel meals replaced 0, 25, 50, 75, and 100% dietary inclusion levels of wheat offal. The table were designed as T1, T2, T3, T4, and T5 respectively.

Experimental animals and their management: Twenty weaner rabbits of mixed breeds (mongrels) and sexes with an initial weight of 435-600g were used for the investigation. They were randomly assigned to five dietary treatments in four (4) rabbits per treatment in a complete randomized design (CRD) arrangement. The experiment lasted for six weeks (42 days). Experimental diets and water were made available *ad-libitum* throughout the study period.

Prior to arrival of the weaner rabbits, the house and the cage were cleaned and disinfected, the feeder and waterer were equally cleaned before the beginning of the experiment, also the feeders and drinkers were cleaned before the next feeding and watering. The surrounding was kept clean by sweeping and cleaning on daily basis.

Data collection: Initial average weight of the rabbits was taken on the first of the experiment. They were subsequently weighed on weekly basis. Feed conversion ratio (FCR) was calculated by dividing the average feed intake by the average weight gain. Percentage mortality was calculated using number of dead rabbits divide by number of rabbits X100.
Gross margin/profitability test of the diets were calculated according to Saniya(2007). Evaluations of carcass quality and organ weight were carried out as described by Ojewola and Longe (1999).
Statistical analysis: data collected were analyzed using SPSS (1996) statistical package 7.5.

RESULT AND DISCUSSION

The growth performance and cost analysis of weaner rabbits fed experimental diets as is shown in table 2. There was no significant difference ($p>0.05$) in the parameters measured except in the daily feed intake and daily weight gain ($p<0.05$.) T4 and T4 has the lowest and highest daily feed intake respectively i.e. 59.08g and 79.50g and the values are lower than 80.08g and 89.13g as reported by Akinmutimi (2008) who fed weaner rabbits with similar diet. The difference may be due to ambient temperature and fibre content (Preston, 1987). Diets 5 and 3 has the lowest and highest daily weight gain (13.22g and 19.49g) respectively. These values were higher than 9.23g and 11.3g reported by Akinmutimi (2008).

The mean total weight gain obtain in this result shows that Diet 3 has the highest (818.75g) value and Diet 5 has the lowest value (635.25g) this shows that the higher the inclusion level of yam peel the lower the total weight gain. The value obtained are to those reported by Akinmutimi *et al*, (2006) who fed weaner rabbits with ripe plantain and yam peels base diet. The result for final body weight shows that animal fed Diet 3 and diet 2 have the highest final body weight of 1505.5g and 1458.80g respectively. The values obtained are higher than 1375.00g and 1308.33g reported by Akinmutimi(2006).The fed conversion ratio ranged from 3.92-4.28g were lower than 6.56-7.99g reported by Akinmutimi and Anakebe (2008) who fed rabbits with yam peels, sweet potato peels meal in place of maize and also lower than (4.39-6.64g) as reported by Osakwe and Nwose (2008) for rabbits fed graded levels of cassava meal. The fed efficiency was similar for all the treatment (0.24-0.26g).

The economic analyses of the experimental diets were presented in table 2. The cost (per kg) of feed ingredient favoured diets 4 and 5, this may be due to the cheaper price of the test ingredients. This may be due to effect of the cost of kg of feed reported by Akinmutimi (2004). Thus increase in the levels of yam peel meal may result in considerable reduction in the cost of rabbits production which in extension makes the product affordable to consumers thereby achieving the major objective of this trial.

Table 3: shows carcass characteristic of weaner rabbits fed experimental diets. There was no significant ($P>0.05$) treatment effect on the carcass parameters measured except live and carcass weight ($P<0.01$) this result is higher than the reported by Ijaya and Awonusi (2002) when they replace maize with yam peel meal. Dressing percentage of 47.8-55.7% recorded were not significantly different this result agrees with value of 47.42 –

54.08% for rabbits (Akinmatimi (2004) the differences could be attributed to breed, age and feed to the animals. The percentage weight of liver, kidney, heart and spleen were similar to those reported by (Akinmuti, 2004) for rabbits fed yam peel meal in place of maize based diets. The percentage small intestine (5.89-8.84%) and large intestine (0.64-081) were statistically similar. The values are higher when compared to those reported by Ironke (2004) for rabbits fed agricultural by-products based diets.

Table 1: Percentage composition of experimental diet

Ingredient	**T_1 0%**	**T_2 25%**	**T_3 50%**	**T_4 75%**	**T_5 100%**
Wheat offal	40	30	20	10	0
Yam peel	0	10	20	30	40
Maize	25.25	25.25	25.25	25.25	25.25
Soya beans meal	19.05	19.05	19.05	19.05	19.05
Groundnut hay	10	10	10	10	10
Fish meal	2	2	2	2	2
Bone meal	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100
Calculated Analysis					
Crude protein (%)	18.00	17.84	17.68	17.49	17.28
ME (kcal/kg)	2253.05	2345.05	2447.05	2538.05	2633.05

Table 2: Growth performance and cost analysis for weaner rabbits fed experimental diets.

	Replacement levels of yam peel meal						
Parameter	**0%**	**25%**	**50%**	**75%**	**100%**	**SEM**	**LS**
Initial weight (g)	578.25	665.75	686.75	601.25	564.75	54.55	NS
Final weight (g)	1360.50	1458.80	1505.50	1239.60	1200.00	121.75	NS
Total weight gain (g)	782.25	802.50	818.75	638.35	635.25	123.57	NS
Daily feed intake (g)	78.77^{a}	79.50^{a}	73.90^{b}	59.08^{c}	60.44^{c}	5.69	13.13*
Daily weight gain (g)	18.63^{a}	19.11^{a}	19.49^{a}	15.19^{b}	13.22^{c}	1.35	2.88*
Feed conversion ratio	4.28	3.80	3.92	3.91	4.02	0.36	NS
Feed efficiency	0.24	0.26	0.26	0.26	0.25	0.02	NS
Total feed intake (kg)	3.31	3.05	3.10	2.48	2.54		
Feed cost (₦/kg)	44.89	42.69	40.24	38.48	30.07		
Total feed cost (N)	148.59	130.20	125.49	90.93	91.62		
Feed cost (₦/kg gain)	190.50	162.75	176.75	148.33	143.16		
Mortality	0.00	0.00	0.00	0.00	0.00	0.00	-

Superscripts a,b,c =means in the same raw with different superscripts differed significantly *($p<0.05$)
SEM= Standard Error of Mean, LSD= Least Significant Different,

Table 3: Carcass characteristic as percentage live weight of weaner rabbits fed experimental diets

	Replacement levels of yam peel meal						
Organs	**0%**	**25%**	**50%**	**75%**	**100%**	**SEM**	**LSD**
Live weight (g)	1401.7^{a}	1494.1^{a}	1341.0^{b}	1191.4^{d}	1204.3^{c}	53.22	168.65**
Carcass weight (g)	785.00^{a}	689.67^{b}	723.67^{a}	630.67^{b}	602.33^{bc}	29.66	93.99**
Dressing	55.70	47.36	54.22	52.92	50.12	2.83	NS
Spleen	0.07	0.07	0.07	0.08	0.10	0.01	NS
Hard	0.26	0.28	0.27	0.22	0.28	0.05	Ns
Kidney	0.46	0.64	0.74	0.64	0.67	0.10	NS
Liver	4.17	2.77	3.49	2.99	2.95	0.40	NS
Lungs	0.67	0.59	0.50	0.65	0.55	0.07	Ns
Large intestine	0.69	0.64	0.67	0.81	0.78	0.07	NS
Small intestine	8.84	5.89	6.43	7.33	7.53	1.09	NS
Large intestine length (CM)	48.67	55.67	59.33	59.00	80.33	28.17	NS
Small intestine length (CM)	252.67	334.67	338.93	332.32	275.67	27.54	NS

Superscripts a,b,c,d= means with different superscript in the same raw differ highly significantly**($p<0.01$)

CONCLUSION

Judging from the performance, carcass characteristics and economic analysis yam peel meal, which is economically cheaper than wheat offal can replace up to 75% of wheat offal in weaner rabbits diets without adverse effects on performance. This would go a long way especially during periods of feed scarcity to increase animal protein availability and reduce accumulation of waste (SDYPM) in the environment.

REFERENCES

Akinmutimi, A.H. (2006). Nutritive value of raw and processed Jack fruit seed *(Artocarpus heterophyllus)*: Chemical analysis. *Agricultural Journal.* 1: 266-271

Akinmutimi, A.H. and Anakebe, O.C. (2008). Performance of weaner rabbits fed graded levels of yam and sweet potato peel meal in place of maize base diet. *Pakistan Journal of Nutrition*. 7(**5**):700-704

Akinmutimi, A.H. and Onwukwue, C.C.,(2002). An Agricultural Biotechnology Environ. 1: 1959-0468.

Akinmutimi, A.H., Ewa, E.U., Ojewola, G.S., Okoye, F.C. and Abasiekong, S.F. (2004). Effect of Replacing Soyabean Meal with Lima Bean Meal on Finishing Broiler Chicken. Global Journal Agricultural Science, 3**(1)**:1-4

Ayorinde, I.A. and Aromolaran, A.B. (1998). Economics of Rabbits production in Abeokuta South L. G.A of Ogun State, Nigeria. *Nig. J. Anim. Prod.*, 25:100-105.

BSADP (1999). Bauchi state Agricultural Development Programme.

Egbo, M.L., Doma, U.D. and Laedaks, A.B. (2001). Characteristics of Small Scale Rabbit Production and management in Bauchi Metropolis. *Proceeding of the 26th Annual Conference of Nigeria Society of Animal Production* (NSAP). 18-21 ABU-Zaria Pp. 160-162.

Esminger, G.O. (1991). Ripe plantain (*Musa Paradica*) Peel Meal as an Alternative Energy Source for Weaned Rabbits. *Proceeding of the 28th Annual Conference of the Nigeria society for animal production*. Federal college of animal health and production technology, Ibadan, Nigeria. 28:348-351.

FAO (1996). Food and agricultural organization on Rural Poultry production: Rome, Italy Pp 32-36.

Fielding, D. and Metheron, G. (1991). **The tropical agriculture.** Macmillan Education Limited London, Pp 12-26.

Ijaiya, A.T. and Awonnusi, E.A. (2002). Effects of replacing maize with yam peel meal on the growth performance of weaner rabbits. *Proceeding 7th Annual Conference. Animal science Association of Nigeria* (ASAN). Abeakuta, Nigeria. Pp 91-93.

Ironke, M.O.(2004). Comparative Performance of Weaner Rabbits Fed Concentrate, Forage and Concentrate Plus Forage. *Proceedings of the 19th Annual Conference of Annual Science Association of Association of Nigeria*. On September, 13-16 Pp 14-16.

Nowak, L. (1991). Antibodies to the alhpha q subfamily of guanine nucleotide binding regulatory protein alpha subunits attenuate activation. Pp 122-124.

Nworgu, F.C. and Ogbosuka G.E. (2003).Ripe Plantain (*Musa Paradica*) Peels Meals as an Alternative Energy Source for Weaned rabbits Nigerian Soc. Anim. Prod., PP: 348.phosphatidylinositol 4, 5 bisphophate hydrolysi. Journal of Biological Chemistry 266**(30)**.20519-20524.

Ojewola, G.S. and Long, O.G. (1999). Protein and Energy in Broiler Diet. Effect on Growth Performance and Nutrient Utilization. *Nigeria Journal of Animal Production*.28: Pp 23-28.

Omole, T.A., Ajasin, F.O. and Tiamiyu, A.K. (2007). Back to Agriculture, rabbit farming without tears. Green choice agricultural publications Nigeria Pp 78-90.

Osakwe, I. and Nwose, R. (2008). Feed intake and nutrient digestibility of weaner rabbits fed cassava peel as replacement of maize. African Journal 5 (**1**): 770-773

Oseni, A.M., Alaku, S.O. and Atseomajumi, E.D. (2008). Effects of varying Level of Crude Protein on Short Term Egg Production of Japanese Quail in a Humid Tropical Environment. *Proceeding of 13thAnnual Conference Animal Science Association of Nigeria*. September 15-19. Pp 410-412.

Oyenuga, V.A. (1995). Nigerian feeds and feeding stuffs. Their chemistry and nutritive value 93th edition. Ibadan, Nigeria. Pp432-452.

Preston, T. R. (1987).Pig and Poultry in the tropics. Wageningen, Netherland, Technical Center for Agriculture Co-operation (CTA). Pp. 25

Sonaiya, E.B. (2007). Family Poultry, Food Security and the Impact of HPAI. *World Poultry Science Journal* 639**(1)**:132-138.

Soyebo, O..Ortserga, D.D. and Okoh, J.J. (2006). Response of broiler chickens to palms kernel cake and maize offal mixed in different ratio. Pakistan *Journal of Nutrition* 9 (6): 516-519.

Spore, O.(2007). Performance and nutrient digestibility of rabbits fed fermented and unfermented cocoa pod husk. *Proceeding of the 28th Annual Conference of the Nigeria Society for Animal Production.* Federal college of animal health and production technology, moor plantation, Ibadan, Nigeria. Pp 243-246.

SPSS (statistical package for social science, 1996). Release 7.5

NUTRIENT DIGESTIBILITY AND CARCASS CHARACTERISTICS OF WEANER RABBITS FED DRIED CABBAGE LEAF MEAL

Igila, T. T., Bello, K.M., and Kalla, D. J. U

Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi

Correspondence authors email: igilatimothy17@gmail.com; 08063128409

The study was conducted to determine the nutrient digestibilty and carcass characteristics of weaner rabbits fed dried cabbage leaf meal. A total of sixty (60) mongrel rabbits (12 rabbits per treatment, 4 per replicate) were fed five (5) experimental diets containing graded levels of cabbage leaf meal at 0, 5, 10, 15 and 20% designated as diets T1, T2, T3, T4 and T5 respectively. The experiment lasted for eight (8) weeks. The result showed that, most of the carcass traits showed significant differences (P<0.05) among the treatments except for organs such as heart, kidney, head, feet, tail, shoulder and thigh. The digestibility result also showed significant treatment (P<0.05) effect except for nitrogen free extract. Diet 4 also gave the highest digestibility values. Diet 1 gave the least value for dry matter, crude protein and crude fibre, while diet 5 (20% cabbage leaves inclusion) gave the least values for ether extract, ash, nitrogen free extract and total digestible nutrients. It was therefore concluded that cabbage leaf meal can be used in the diet of weaner rabbits at 20% level of inclusion for efficient nutirents digestibilty and optimum carcass yiels. Cabbage leaf meal was therefore recommended to farmers as a feed material so as to improve digestibilty and carcass yield of their weaner rabbits.

Keywords: Cabbage leaves, Nutrients, Digestibilty, Carcass, Rabbits,

INTRODUCTION

The increasing demand for dietary protein in Nigeria due to population increase has aroused the interests of Nigerians in the production of animals with short production cycles, which are prolific, good converters of feed to flesh, relatively easy to care for and require low capital investment in raising such as rabbits, poultry and swine. Poultry and pigs on the other hand require more of commercial feeds which often incorporate ingredients in direct competition with humans and are usually too expensive for most small scale farmers. Therefore, in order to maximize food production in developing countries like Nigeria all viable options including the use of non-conventional livestock must be explored and evaluated (Owen *et al* 2008). Rabbits *(Oryctolagus cuniculus*),which can be considered as non conventional livestock specie appear to be a cheap and sustainable means of producing high quality animal protein for the expanding populations of the developing countries. This is due to the rabbit's established prolificacy, early maturity, fast growth rate, high genetic selection potential, high feed conversion efficiency and economic utilization of space (Hassan *et al* 2012). Also Rabbit meat is low in fat, caloric value, sodium and cholesterol, but high in protein, thereby making it the meat of choice for coronary heart patients and people on low cholesterol and sodium diets. Generally, it is agreed that feed cost accounts for between 60-85% of the total cost of livestock production. Livestock feeds particularly for non- ruminants are becoming prohibitively costly in the developing countries because of the increasing competition between man and livestock for food. One way of reducing cost and increasing animal protein production in the developing countries such as Nigeria is through use of the cheap and readily available feed ingredient in the diets of livestock. Cabbage leaves, one of such cheap ingredients having potential values as a feeding resource is a by-product of the local processing of cabbage and is a rich source of crude protein and energy (Choi and Park, 2003). As cabbage production increases, there is a concomitant increase in the quantity of residues produced. These residues are often discarded into the environment where they pose major environmental concerns (e.g., landfill and nitrate leaching to water sources). Consequently, there is growing interest in alternative and non-polluting methods of management such as composting and recycling through livestock feeds. Cabbage leaves are characterized by high crude protein (CP) and mineral concentrations (Choi and Park, 2003).

MATERIALS AND METHODS

The experiment was conducted at the Abubakar Tafawa Balewa University Research Unit Bauchi, Bauchi State. The feeding trial was conducted with sixty (60) mongrel weaner rabbits obtain from different rabbit farmers and open markets. The rabbits were randomly allotted to the experimental diets. The weaner rabbits were managed intensively. Water and feeds were given *ad libutum*. Drugs were also administered and deworming done appropriately. The experiment lasted for a period of eight weeks. The cabbage leaves were collected from different markets across Bauchi metropolis. They were then sundried for duration of 6-7 days until completely dried. The cabbage leaves were then milled and mixed with other ingredients to formulate a balanced diet for the weaner rabbits. There were five treatments and each treatment was replicated three times with four rabbits per replicate in a completely randomized design. Cabbage leaf meal was included at 0, 5, 10, 15 and 20% designated as diets T1, T2, T3, T4 and T5 respectively.

Table 1: Ingredients and Composition (%) of the Experimental Diet

Ingredients	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
	0%	**5%**	**10%**	**15%**	**20%**
Maize	55.20	54.75	51.35	50.30	49.05
Soyabean meal	24.65	23.15	21.55	20.20	18.75
Cabbage leaves	0.00	5.00	10.00	15.00	20.00
Wheat offal	16.70	13.65	13.65	11.05	8.75
Bone meal	2.80	2.80	2.80	2.80	2.80
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.20	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude protein	18.07	18.02	18.12	18.18	18.21
Me/kcal/kg energy	2700.74	2700.02	2634.67	2623.01	2605.09
Crude fibre	4.24	4.71	5.38	5.89	6.38
Calcium	1.12	1.12	1.11	1.11	1.10
Phosphorus	0.93	0.88	0.86	0.82	0.78
Lysine	0.93	0.89	0.84	0.77	0.69
Methionine	0.32	0.29	0.29	0.28	0.24

Table 2: Digestibility of Nutrients by Rabbits Fed Graded Levels of Cabbage Leaf Meal

Parameters	Dietary Treatments						
	T1	T2	T3	T4	T5	SEM	LOS
Dry matter	78.81^{ab}	79.84^{a}	78.26^{b}	83.51^{a}	79.85^{a}	1.53	*
Crude protein	74.19^{b}	75.01^{b}	76.17^{b}	80.81^{a}	76.42^{b}	1.83	*
Crude fibre	18.46^{b}	20.04^{b}	24.49^{b}	32.37^{a}	25.62^{b}	2.24	*
Ether extract	90.76^{ab}	89.36^{b}	90.18^{ab}	92.37^{a}	88.74^{b}	0.76	*
Ash	75.11^{bc}	79.74^{b}	73.80^{c}	86.43^{a}	74.85^{bc}	1.82	*
Nitrogen free extract	90.62	88.31	89.76	91.21	88.51	0.93	NS
Total digestible nutrients	79.82^{a}	53.15^{b}	78.19^{a}	82.41^{a}	77.88^{ab}	1.40	*

^{abc}: Means within the same row bearing different superscripts are significantly different (P<0.05); LOS: Level of significance; NS: Non significant difference; SEM: Standard error of mean,

Table 3: Carcass Traits of Weaner Rabbits Fed Graded Levels of Cabbage Leaf Meal

Parameters	Dietary Treatments						
	T1	T2	T3	T4	T5	SEM	LOS
Pre-slaughter weight	1350.00^{b}	1435.00^{a}	1453.33^{a}	1485.33^{a}	1386.67^{b}	12.95	*
Carcass weight	775.98^{c}	959.10^{a}	963.07^{a}	989.63^{a}	899.54^{b}	10.15	*
Dressing percentage	57.68^{b}	65.85^{a}	65.95^{a}	66.70^{a}	64.77^{a}	0.43	*
Heart	0.28	0.27	0.27	0.31	0.29	0.01	NS
Lung	0.66^{b}	0.77^{ab}	0.82^{ab}	0.89^{a}	0.67^{b}	0.02	*
Liver	3.26^{c}	3.81^{ab}	3.22^{c}	4.37^{a}	3.62^{b}	0.07	*
Kidney	0.96	1.02	1.14	1.18	1.17	0.03	NS
Stomach	1.99^{a}	1.72^{a}	1.40^{b}	1.78^{a}	1.22^{b}	0.03	*
Intestine	15.29^{c}	19.56^{b}	20.00^{ab}	21.90^{a}	19.50^{b}	0.40	*
Head	12.13	11.77	11.08	12.33	11.56	0.25	NS
Skin	10.96^{ab}	12.59^{a}	10.73^{ab}	12.74^{a}	11.55^{ab}	0.25	*
Feet	2.62	2.65	2.62	3.13	2.59	0.10	NS
Tail	1.I6	1.26	1.08	1.06	1.25	0.03	NS
Shoulder	25.66	23.90	26.99	27.42	25.66	0.31	NS
Loin	21.45^{a}	17.37^{b}	20.41^{ab}	27.78^{a}	19.86^{ab}	0.34	*
Thigh	26.02	24.91	23.44	29.65	26.01	0.64	NS

^{abc}: means within the same row bearing different superscripts are significantly different (P<0.05); LOS: level of significance; SEM: Standard error of mean, NS: No significant difference (P>0.05)

These results showed marked improvement in the digestibility of nutrients up to 20% cabbage leaf meal inclusion level reflecting efficient utilization of nutrients with increasing level of cabbage leaf meal inclusion. These results corroborate the findings of Obeh and Tewe (1992) who reported that feeding of cassava leaf meal to pigs resulted in better utilization of nutrients from leaves, improved digestibility of nutrients as well as better growth and higher feed intake. However the result observed in this study did not agree with the findings of Iyayi (2001) who reported that digestibility values of dry matter, crude

protein, crude fibre, ether extract, ash and nitrogen free extract were not significantly ($P<0.05$) different when growing rabbits were fed diets containing graded levels of moringa leaves.

The result of carcass yields obtained in this study is similar to the report of Jamroz *et al*. (1996) who observed increased dressing percentage when broiler chickens were fed vegetable based diets. The decline in dressing percentage (20% inclusion of cabbage leaf meal) may have resulted from the rapid impact of the cabbage leaves on caecal fermentation thus resulting in higher microbial activities.

CONCLUSION AND RECOMMENDATIONS

Cabbage leaf meal can be included in the diet of weaner rabbits at up to 20% without compromising carcass yields and nutrients digestibility of the rabbits. It is therefore recommended for use in weaner rabbits diets. Farmers are therefore encouraged to make use of this cheap and easily available feed material especially during the dry season when it is readily available and concides with period of rabbit feed scarcity.

REFERENCES

Choi, H. J and Park, T.Y. (2003). Taxonomy of the Allium sect. Sacculiferum in Korea: with special reference to the morphology. *Korean. Journal of plant taxonomy*. **33**: 71-78.

Hassan, H.E., Elamin,K.M.,Yousif,I.A., Musa,A.M.and Elkhairey,M.A. (2012). Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. *Journal of Animal Science Advances*, **2(4)**: 407-415.

Iyayi, E.A., (2001). Cassava leaves as supplement for feeding weaner swine, *Tropical Animal Production*. Invest., **4**: 141-150.

Jamroz, D., Skorupinska, J., Orda, J., Williczkie-wicz, A. and Volker,L. (1996). The effects of increased Roxazyme-G supplementation in the broiler fed with triticale mixture rich mixture. *Journal of Animal Science* **60**: 165-173.

Owens, P. Daniel K., Anne B. Alerding, Kevin C. Crosby, Aloka B. Bandara, James H. Westwood, Brenda S.J. Winkel (2008). Functional Analysis of a Predicted Flavonol Synthase Gene Family in *Arabidopsis*. *Journal of applied science.* Pp. 108-117.

UTILIZATION OF GRADED LEVELS OF DRIED CABBAGE LEAVES BY WEANER RABBITS

Igila, T. T., Bello, K.M., Kalla, D. J. U.

Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi

Correspondence authors email: igilatimothy17@gmail.com

ABSTRACT

The study was conducted to determine the utilization of sun dried cabbage leaf meal by weaner rabbits. A total of sixty (60) mongrel rabbits (12 rabbits per treatment, 4 per replicate) were fed five (5) experimental diets containing graded levels of cabbage leaf meal at 0, 5, 10, 15 and 20% designated as diets T1, T2, T3, T4 and T5 respectively. The experiment lasted for eight (8) weeks. The performance variables recorded in this study were significantly affected by the graded levels of inclusion of cabbage leaf meal. In all the parameters, diet 4 (15% inclusion of dried cabbage leaves) gave the best performance, while diet 1 (0% cabbage leaves) gave the least performance. The haematological parameters also showed significant differences (P<0.05) across dietary treatments except for mean corpuscular haemoglobin. Diet 4 recorded higher values in all the parameters analysed while diet 1 and 3 recorded least values. All the parameters analysed for biochemical indices showed significant (P<0.05) differences across the dietary treatments. Diet 4 recorded higher values in all the parameters considered except for cholesterol, where diet 3 recorded higher values, while diet 1 recorded least values. The highest feed cost savings was recorded in diet 5 (20% inclusion of cabbage leaf meal) while the highest cost was recorded in diet 1. It was therefore concluded that cabbage leaf meal can be used in the diet of weaner rabbits for up to 20% level of inclusion for optimum performance. Cabbage leaf meal was therefore recommended to farmers as a feed material so as to reduce cost and increase productivity.

Keywords: Cabbage leaves, Utilization, Rabbits,

INTRODUCTION

The increasing demand for dietary protein in Nigeria due to population increase has aroused the interests of Nigerians in the production of animals with short production cycles, which are prolific, good converters of feed to flesh, relatively easy to care for and require low capital investment in raising such as rabbits, poultry and swine. Poultry and pigs on the other hand require more of commercial feeds which often incorporate ingredients in direct competition with humans and are usually too expensive for most small scale farmers. Therefore, in order to maximize food production in developing countries like Nigeria all viable options including the use of non-conventional livestock must be explored and evaluated (Owen *et al* 2008). Rabbits *(Oryctolagus cuniculus*),which can be considered as non conventional livestock specie appear to be a cheap and sustainable means of producing high quality animal protein for the expanding populations of the developing countries. This is due to the rabbit's established prolificacy, early maturity, fast growth rate, high genetic selection potential, high feed conversion efficiency and economic utilization of space (Hassan *et al* 2012). Also Rabbit meat is low in fat, caloric value, sodium and cholesterol, but high in protein, thereby making it the meat of choice for coronary heart patients and people on low cholesterol and sodium diets. Generally, it is agreed that feed cost accounts for between 60-85% of the total cost of livestock production. Livestock feeds particularly for non- ruminants are becoming prohibitively costly in the developing countries because of the increasing competition between man and livestock for food. One way of reducing cost and increasing animal protein production in the developing countries such as Nigeria is through use of the cheap and readily available feed ingredient in the diets of livestock. Cabbage leaves, one of such cheap ingredients having potential values as a feeding resource is a by-product of the local processing of cabbage and is a rich source of crude protein and energy (Choi and Park, 2003). As cabbage production increases, there is a concomitant increase in the quantity of residues produced. These residues are often discarded into the environment where they pose major environmental concerns (e.g., landfill and nitrate leaching to water sources). Consequently,

there is growing interest in alternative and non-polluting methods of management such as composting and recycling through livestock feeds. Cabbage leaves are characterized by high crude protein (CP) and mineral concentrations (Choi and Park, 2003).

MATERIALS AND METHODS

The experiment was conducted at the Abubakar Tafawa Balewa University Research Unit Bauchi, Bauchi State. The feeding trial was conducted with sixty (60) mongrel weaner rabbits obtain from different rabbit farmers and open markets. The rabbits were randomly allotted to the experimental diets. The weaner rabbits were managed intensively. Water and feeds were given *ad libutum*. Drugs were also administered and deworming done appropriately. The experiment lasted for a period of eight weeks. The cabbage leaves were collected from different markets across Bauchi metropolis. They were then sundried for duration of 6-7 days until completely dried. The cabbage leaves were then milled and mixed with other ingredients to formulate a balanced diet for the weaner rabbits. There were five treatments and each treatment was replicated three times with four rabbits per replicate in a completely randomized design. Cabbage leaf meal was included at 0, 5, 10, 15 and 20% designated as diets T1, T2, T3, T4 and T5 respectively.

Table 1: Ingredients and Composition (%) of the Experimental Diet

Ingredients	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
	0%	**5%**	**10%**	**15%**	**20%**
Maize	55.20	54.75	51.35	50.30	49.05
Soyabean meal	24.65	23.15	21.55	20.20	18.75
Cabbage leaves	0.00	5.00	10.00	15.00	20.00
Wheat offal	16.70	13.65	13.65	11.05	8.75
Bone meal	2.80	2.80	2.80	2.80	2.80
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.20	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude protein	18.07	18.02	18.12	18.18	18.21
Me/kcal/kg energy	2700.74	2700.02	2634.67	2623.01	2605.09
Crude fibre	4.24	4.71	5.38	5.89	6.38
Calcium	1.12	1.12	1.11	1.11	1.10
Phosphorus	0.93	0.88	0.86	0.82	0.78
Lysine	0.93	0.89	0.84	0.77	0.69
Methionine	0.32	0.29	0.29	0.28	0.24

RESULTS AND DISCUSSION

Table 2: Performance of Weaner Rabbits Fed Graded Levels of Cabbage Leaf Meal

Parameters	Dietary Treatments						
	T1 0%	T2 5%	T3 10%	T4 15%	T5 20%	SEM	LOS
Average initial weight (g)	277.89	278.67	278.83	278.83	277.89	14.99	NS
Average final live weight (g)	1249.17^{b}	1390.00^{a}	1395.00^{a}	1398.00^{a}	1326.00^{ab}	22.27	*
Average daily feed intake(g)	38.53^{b}	46.41^{a}	46.68^{a}	46.74^{a}	46.47^{a}	0.82	*
Average daily weight gain (g)	17.41^{b}	20.11^{a}	20.15^{a}	21.54^{a}	19.28^{ab}	0.32	*
Feed conversion ratio	2.84^{a}	2.79^{a}	2.50^{ab}	2.11^{c}	2.41^{c}	0.06	*
Feed cost/kg of feed (₦)	76.85	67.70	67.02	66.25	60.51	1.95	NS
Feed cost/kg gain (₦)	218.25	188.88	167.55	127.68	159.66	2.81	NS
Mortality (No.)	5.00	3.00	5.00	2.00	2.00	-	-

^{abc}: Means within the same row bearing different superscripts are significantly different (P<0.05); LOS: Level of significance; NS: Non significant difference

Table 3: Heamatological Indices of Rabbits Fed Graded Levels of Cabbage Leaf Meal

Parameters	T1	T2	T3	T4	T5	SEM	LOS
Packed cell volume (%)	38.20^{c}	43.80^{b}	41.70^{b}	47.40^{a}	37.90^{c}	2.68	*
Haemoglobin (g/100ml)	11.70^{b}	10.00^{b}	10.40^{b}	15.50^{a}	10.20^{b}	2.11	*
Red blood cell ($\times10^{6}$/mm^{3})	5.55^{b}	4.84^{b}	4.68^{b}	7.04^{a}	4.55^{b}	2.02	*
White blood cell ($\times10^{3}$/mm^{3})	12.90^{a}	6.40^{b}	6.41^{b}	12.90^{a}	6.50^{b}	1.39	*
Mean corpuscular volume (μm^{3})	68.80^{b}	82.20^{a}	89.00^{a}	90.00^{a}	67.90^{b}	3.12	*
Mean corpuscular haemoglobin concentration (%)	30.6^{b}	22.9^{c}	24.9^{c}	32.5^{a}	27.4^{bc}	1.14	*
Mean corpuscular haemoglobin (pg)	21.0	20.7	22.1	22.5	22.0	2.32	NS

^{abc}: Means within the same row bearing different superscripts are significantly different (P<0.05); LOS: Level of significance; NS: Non significant difference

Table 4: Biochemical Indices of Rabbits Fed Graded Levels of Cabbage Leaf Meal

Parameters	T1	T2	T3	T4	T5	SEM	LOS
Blood urea (mol/l)	4.0[b]	3.1[c]	3.3[c]	4.2[a]	2.5[c]	0.46	*
Total protein (g/dl)	6.3[b]	5.3[c]	4.9[c]	7.2[a]	4.0[c]	0.27	*
Cholesterol (mol/l)	162[b]	155[c]	199[a]	100[c]	87[c]	2.06	*
Albumin (g/dl)	3.4[c]	3.1[c]	4.4[b]	5.1[a]	3.2[c]	0.33	*
Calcium (mol/l)	7.3[bc]	9.1[a]	8.8[b]	10.0[a]	5.3[c]	0.76	*
Phosphorus (mol/l)	4.0[a]	3.1[b]	2.9[c]	4.3[a]	3.8[a]	0.89	*
Magnessium (mol/l)	5.0[a]	4.7[b]	3.8[c]	5.3[a]	4.8[b]	0.34	*
Potassium (mol/l)	4.8[a]	4.0[a]	3.3[b]	5.5[a]	3.6[b]	0.94	*

[abc]: Means within the same row bearing different superscripts are significantly different ($P<0.05$); LOS: Level of significance

The average daily weight gain was significantly affected by the dietary treatments. The average daily weight gain ranged from 17.41g in treatment 1 to 21.54 in treatment 4 which follow the same trend as daily feed intake and final live weight. The result for average daily weight gain recorded in this study were similar to the values reported by Agunbiade *et al*. (2003) on weaner rabbits fed cabbage waste base diets. There was significant difference in the feed cost across the treatments. The least feed cost was recorded in diet 4 while the highest cost was observed in diet 1. The result of this study showed that, using cabbage leaf meal in the diet of weaner rabbits is cheaper than using conventional feed ingredients.

The packed cell volume values (37.40 to 47.90%) were within the range of 33 to 50% reported by Hillyer (1994) for growing rabbits. The values obtained for all the treatment groups indicate nutritional adequacy of all diets since values did not indicate mal-or-under nutrition (Church *et al*. 1984). The values for white blood cells which ranges from 6.40 to 12.90 $x10^3mm^3$ reported were within the range reported by Hillyer, (1994) for healthy young rabbits. This shows that the animals were healthy because decrease in number of white blood cells below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism, while elevated values (leucocytosis) indicate the existence of a recent infection, usually with bacteria (Ahamefule *et al*.,2008).

CONCLUSION AND RECOMMENDATIONS

Cabbage leaf meal can be included in the diet of weaner rabbits at up to 20% without compromising growth performance and haematological indices of the rabbits. There was reduction in cost in the use of cabbage leaves based diets. There was also increased productivity in the use of cabbage leaf meal.

Diet 5 (20% inclusion of cabbage leaf meal) gave the least feed cost and is therefore recommended for use in weaner rabbits diets. Farmers are therefore encouraged to make use of this cheap and easily available feed material especially during the dry season when it is readily available and concides with period of rabbit feed scarcity.

REFERENCES

Ahamefule FO, BE Obua, I A, Ukweni, MA Oguike and RA Amaka, (2008). Haematological and biochemical profile of weaner rabbits fed raw or processed pigeon pea seed meal based diets. *African Journal of Agricultural Research*, **3**: 315-319.

Choi, H. J and Park, T.Y. (2003). Taxonomy of the Allium sect. Sacculiferum in Korea: with special reference to the morphology. *Korean. Journal of plant taxonomy*. **33**: 71-78.

Church, J. P., Judd, J. T., Yong, C. W., Kebay, T. L. and Kim, W. W. (1984). Relationship among dietary constituents and specific serum clinical components of subjects eating self- selected diets. *American Journal of Clinical Nutrition*. **40**: 1338 – 1344.

Hassan, H.E., Elamin,K.M.,Yousif,I.A., Musa,A.M.and Elkhairey,M.A. (2012). Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. *Journal of Animal Science Advances*, **2(4)**: 407-415.

Hillyer EV, (1994). Pet Rabbits. The Veterinary Clinics of North America, Small Animal Practice, **24**(1):25-65.

Owens, P. Daniel K., Anne B. Alerding, Kevin C. Crosby, Aloka B. Bandara, James H. Westwood, Brenda S.J. Winkel (2008). Functional Analysis of a Predicted Flavonol Synthase Gene Family in *Arabidopsis*. *Journal of applied science.* Pp. 108-117.

EFFECTS OF VARYING LEVELS OF MORINGA (*Moringa oleifera*) LEAF MEAL ON THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF WEANER RABBITS

D.U. Mmadu*, M.M. Abubakar, D,J,U Kalla** U.D. Doma** and Agishi S.T*****
*Department of Agricultural Technology, Federal College of Forestry, P.M.B. 2019, Jos Plateau State, Nigeria
**Department of Animal Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa University Bauchi, Nigeria
*** College of Agriculture, Yandev Benue State
Corresponding email: undavis@yahoo.com /mmadudave@gmail.com

ABSTRACT
Performance of weaner rabbits fed varying levels of Moringa oleifera meal (MOLM) was investigated using sixteen mixed breed weaner rabbits of average weight of 400-600 grams (5-7 weeks) old. The rabbits were randomly allotted to four dietary treatment groups in a completely randomized design (CRD) and each treatment was further sub-divided into four replicates, each having one rabbit per replicate. They were fed growers ration supplemented with Moringa oleifera leaf meal at varying levels of 0%, 5%, 10% and 15%. Results obtained showed that rabbits on 10% Moringa Oleifera Leaf Meal diet achieved the highest weight gain (1575g) while T_2, T_1 and T_4 recorded weight gains of 1500, 1400 and 1066.67g respectively. The result of the mean effects of the treatment on the feed intake revealed that treatment 1, 2 and 4 has significant effect on the feed intake but there was no significant difference between 2 and 3 as well as treatment 3 and 1. The carcass evaluation revealed a very strong, positive and highly significant relationship between dressed weight and carcass length (0.98, $P \leq 0.01$). The result of this experiment revealed that MOLM at 10% level of inclusion can support the growth of rabbit without any deleterious effect on growth performance and health status of weaner rabbits.

Keywords: *Moringa, Performance, Carcass, Weaner.*

INTRODUCTION
The rapid growth of human and livestock population create increasing demands for food and nutrition security in the least developed countries that alternative feed resources must be identified and evaluated (Olugbemi *et al*., 2010). The inadequate supply and intake of animal protein in developing countries is high due to high cost of feeding with the accompanying high cost of production. One of the ways of reducing the cost of production and making protein available to people at cheaper prices is by the use of agricultural by-products and tropical plants which are not directly used by humans as food to feed livestock (Asar, 2010).

Rabbit plays a vital role in the utilization of fibrous by-products which can be converted into animal protein for the Nigerian populace. They are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species (Egbo *et al*., 2001). Rabbits can utilize unconventional feedstuffs such as blood meal and diverse forage materials such as wild sunflower. This is why attention is now being shifted to rabbit production in order to solve the problem of shortage of protein. Therefore, alternative feed sources need to be investigated such as, *Moringa oleifera*, the leaves of which have been used as animal feed in many places.

For the past two decades the interest of animal producers has been centred mostly on search for cheaper feed ingredients that are always available and have no competition with man's dietary demand. Feed alone accounts for up to 70% of the total cost of production and there can be no success in raising rabbits if proper attention is not given to diet and if wholesome feed in adequate quantity are not provided (Compaoré *et al*., 2011). *Moringa oleifera* leaves, fruits, immature pods and flowers are integrated into the traditional food of humans in several tropical and subtropical countries (Siddhuraju & Becker 2003, Anhwange *et al.,* 2004).

This study is designed to investigate the feeding varying levels of moringa leaf meal on the performance and carcass characteristics of weaner rabbits.

MATERIALS AND METHODS

Experimental Procedure

The research was conducted at the Piggery and Rabbitry unit of Federal College of Forestry Jos, Plateau State, Nigeria. Twelve (12) cross bred rabbits of both sexes made up of four males and eight females were used for the experimental study. Three (3) rabbits were randomly assigned to each treatment in the ratio of one (1) male and two (2) females per treatment. The experiment lasted for six (6) weeks after a one week of pre-feeding trial. *Moringa oleifera* leaves were harvested from mother tree, air dried and ground into powder before incorporating into the rabbit's diets. Four experimental diets were formulated containing 0%, 5%, 10% and 15% *Moringa oleifera* leaf meal (MOLM). Known quantities of feed were fed daily to each group. Water was given ad libitum. Prior to the commencement of the experiment, the rabbits were prophylactically treated against parasites (internal and external).

Data Collection, Experimental Design and Statistical Analysis

At the end of the experiment, the parameters assessed include; average daily feed intake; average body weight; average weight gain; carcass characteristics (live weight (kg), dressed weight (kg),dressed percentage (%), carcass length (cm), head weight (g), thorax width (g), loin weight (g), fore limb weight (g), hind limb weight (g), liver weight (g), heart weight (g), kidney weight (g), lungs weight (g) and spleen weight (g)).

A completely randomised design was adopted for the study. All data collected at the end of the six weeks were subjected to analysis of variance (ANOVA) using SAS (2001), and differences between the treatment means were separated using Duncan's New Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Performance of Rabbit Fed Graded Level of *Moringa oleifera* Leaf Meal

The performance of rabbit fed graded levels of *Moringa oleifera* leaf mean on the growth performance of weaner rabbits (1-6 weeks) revealed that that there was significant in Daily Feed Intake (DFI) among the treatments. Rabbits fed diet at 15% level of inclusion had the lowest numerical value of 1.60g followed by diets 10%, 0% and 5% respectively. As the quantity of the *Moringa oleifera* increases the intake decreases, although these was no significant difference (P> 0.05) in feed intake among the treatment. This collaborate that of Shaalu *et al.*, (2008) and Kakengi *et al.,* (2007). Daily Weight Gain (DWG) of the rabbits shows that there was significant difference among the diets. The highest value was obtained on rabbit fed at 15% level of inclusion of the experimental diets with a value of 4.61 (15%) followed by 4.06 (10%), 4.05 (5%) and 3.96g (0%) respectively. This shows that diets containing 15% MOLM produced rabbits with higher body weights and higher weight gain than rabbit in the other diets (Table 1). The higher body weight gain might be an indication that the diets were more palatable and easily assimilated by the rabbits. This is in agreement with (Kakengi *et al.*, 2007), who reported that MOLM diets were highly preferred by chickens because of its palatability. Similar result was reported by Onimisi *et al;* (2007), when they fed MOLM to rabbits.

A very strong, positive and highly significant relationship was observed between dressing weight and carcass length (0.976 at 0.01 level). This implies that an increase in the dressing weight will lead to an increase in the carcass length and vice versa. There was a strong, negative and insignificant relationship between carcass length and spleen weight (-0.762). The implication of this is that, an increase in the carcass length will result in a decrease in the spleen weight and vice versa (Table 2).

Table 1: The performance of rabbit fed graded levels of M*oringa oleifera meal* (1-6 week)

Parameters	**T_1% (0)**	**T_2(5%)**	**T_3(10%)**	**T_4(15%)**	**SE±**
Initial average body weight (g)	800	820	810	800	3.03
Final average body weight (g)	1066.67	1500	1400	1575	70.92
Daily average feed intake (g)	1.64[c]	1.65[a]	1.63[b]	1.60[ab]	0.01
Daily average weight gain	3.96[c]	4.05[b]	4.06[b]	4.61[a]	0.36
FCR (g)	0.40[a]	0.41[ab]	0.40[a]	0.36[c]	0.07
Mortality	1	0	0	1	0.18

a,b,c,d: means within the same row bearing different superscripts are significantly different

(P<0.05), SEM = Standard Error Means, FCR = Feed Conversion Ratio

Table 2: Effect of the treatment on the carcass characteristics of rabbits after six weeks

Parameters	**LW (g)**	**DW (g)**	**DP (%)**	**CL (cm)**	**HW (g)**	**TW (cm)**	**LoW (g)**	**FLW (g)**	**HLW (g)**	**LiW (g)**	**HeW (g)**	**KW (g)**	**LuW (g)**	**SW g)**
Live weight (g)	1													
Dressed weight(g)	0.752	1												
Dress percentage (%)	0.438	0.922	1											
Carcass length(cm)	0.268	0.829	.976*	1										
Head weight(g)	0.688	.993**	0.949	0.860	1									
Thorax weight(cm)	0.665	.992**	.963*	0.890	.996**	1								
Loin weight(g)	0.790	.997**	0.894	0.786	.988*	.981*	1							
Fore limb weight(g)	0.872	.978*	0.822	0.701	.952*	0.945	.988*	1						
Hind limb weigh(g)	0.673	.994**	.960*	0.886	.996**	1.000**	.983*	0.949	1					
Liver weight(g)	0.444	0.322	0.159	0.034	0.360	0.273	0.383	0.369	0.273	1				
Heart weight(g)	0.205	0.669	0.777	0.707	0.749	0.713	0.667	0.554	0.706	0.608	1			
Kidney weight(g)	0.905	0.948	0.758	0.608	0.925	0.903	.969*	.986*	0.907	0.509	0.577	1		
Lungs' weight(g)	0.496	0.615	0.530	0.362	0.665	0.596	0.654	0.604	0.594	0.919	0.853	0.698	1	
Spleen weight(g)	-0.345	-0.286	-0.601	-0.762	-0.326	-0.393	-0.211	-0.109	-0.385	-0.565	-0.311	-0.034	-0.217	1

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

LW: Live weight, DW: Dressed weight, DP: Dress percentage, CL: Carcass length, HW: Head weight, TW: Thorax weight, LoW: Loin weight, FLW: Fore limb weight, HLW: Hind limb weight, LiW: Liver weight, HeW: Heart weight, KW: Kidney weight, LuW: Lungs weight, SW: Spleen weight

CONCLUSION AND RECOMMENDATION

It can be concluded that MOLM can be incorporated up to 15% level in the diets of weaner rabbits, since it met the growth performance without any deleterious effects. In this study, the best performance was observed by rabbits at T3 (15%) level of MOLM inclusion. This indicates that rabbits tolerate MOLM up to 15% level of incorporation for optimal performance. However, more research may be required on the use of *Moringa oleifera* leaf meal, as a protein supplement on the diets of other livestock species.

REFERENCES

Anhwange, B.A., Ajibola, V.O. & Oniye, S.J. (2004). Chemical studies of the seeds of *Moringa oleifera (Lam.)* and *Detoriummicro carpum (*Guill and Sperr), *Journal of Biological Sciences.* **4**: 711-715.

Asar V.I. (2010). Utilization of corn-cob meal and faba bean straw in growing rabbits diets and their performance, digestibility and economic efficiency. *Egypt Poultry Science*. **30**:415-442.

Compaore, W.R, Nikiema, P.A, Bassole, H.I.N., Savadogo, A., Mouecoucou., Hounhouigan, DJ. & Traore, S.A. (2011). Chemical composition and antioxidative properties of seeds *of Moringa oleifera* and pulps of *Parkiabi globosa* and *Adansonia digitata* commonly used in food fortification in Burkina Faso. *Current Research Journal of Biological Sciences.* **3** (1): 64-72.

Egbo, M.L., Doma, U.D. & Lackaks, A.B. (2001). Characteristics of small rabbit productions and management in Bauchi metropolis. *In the book of proceedings* of the 26th Annual conference of Nigerian society for animal production (NSAP), 18th -21 March, 2001, ABU, Zaria, Nigeria. pp. 160-162

Kakengi, A.M.V., Kaijage, J.T., Sarwatt, S.V., Mutayoba, S.K., Shem M.N. & Fujihara, T. (2007). Effect of *Moringa oleifera* leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. *International Journal of Poultry Science*, **9**: 363-367.

Olugbemi, T.S, Mutayoba, S.K. & Lekule, P.P. (2010). Evaluation *of Moringa oleifera* leaf meal inclusion in cassava chip based diets fed to laying birds. *Livestock Research for Rural Development*, **22** (118): pp.127-132

Onimisi, P.A., Omage, J.J. & Maiguizo, K. (2007). Evaluation of Moringa (*Moringa oleifera*) Leaf Meal as Protein Source in Rabbit Diets. *In the book of proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production (NSAP)* Calabar March 18-21. pp. 293-294.

Siddhuraju, P. & Becker, K. (2003). Antioxidant properties of various solvents extracts of total phenolic constituents from three different agro climatic origins of drumsticks tree *(Moringa oleifera* Lam.) leaves. *Journal of agriculture and food chemistry*, **51**:2144- 2155.

Shaalu, D.T Carew, S.N & Ayoade, J.A. (2008). Growth performance, meat yield and organ weights of rabbits fed cassava leaf meal. *In the book of proceedings* of the 13th *Annual conference of Animal Science Association of Nigeria (ASAN)* Sept.15-19 ABU Zaria. pp.256-266

PROXIMATE COMPOSITION OF RED FINGER MILLET VARIETY

[*]Bot, M.H., [**]Bawa, G.S., [**]Omage, J.J. and [**]Onimisi, P.A.
*Federal College of Animal Health and Production Technology, NVRI, Vom, Plateau State.
**Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State.

[*]**Correspondent Author:** maryambot@yahoo.co.uk

Abstract
The aim of determining the proximate analysis of red finger millet/*Tamba* (*Eleusine coracana*) was to ascertain its nutritional composition and its ability to be used as feed ingredient. Proximate analysis of red finger millet was carried out at the biochemistry laboratory of the department of Animal Science, Ahmadu Bello University, Zaria. The result of the analysis revealed that it contained Dry Matter-88.48; Crude Protein (CP)-13.98; Ether Extract (EE)-3.70; Crude Fiber (CF)-6.67; Ash-4.90; Nitrogen Free Extract (NFE)-59.22. Therefore, it can be concluded that finger millet is a nutritious feed resource and can be incorporated into animal feed. It is recommended for farmers to use it by incorporating it into livestock feed because of the prospects it has shown in the proximate analysis result.

Key words: Finger millet, Proximate, Feed resource, Analysis, Nutrients

Introduction

The term millet is derived from the French word "mille'' which means thousand, with a handful of millet containing up to 1000 grains (Shahidi and Chandrasekara, 2013). *Eleusine coracana* is called *kpana* by the Beroms, *tamba* in Hausa (Fernandez *et al.*, 2003). Millet belongs to the group of small seeded species of cereal crops or grains which are annual plants (Shiihii *et al*., 2011). The grain belongs to the family Poaceae which originated in Ethiopia and the sub-family *Chloridodeae* (Pradeep&Sreerama, 2015; Sood *et al*., 2016; Ramashia *et al*., 2018). The brown cultivar is utilized for brewing traditional opaque beer in Southern Africa (Sood *et al*., 2017). The grain is a semi-arid region crop cultivated in dry areas with limited rainfall and can adapt to various agro-climatic conditions (Gull *et al*., 2014). Hence, it is important to look at ways of how to economically and effectively substitute some of the conventional feed resources since they are becoming scarce and beyond the reach of the small and medium entrepreneur farmers. Hence, the proximate analysis to find out the nutritional contents of red/brown finger millet so that farmers can be encouraged to adopt its usage.

Materials and method

Source of finger millet

The grain which is popularly called finger millet or *tamba* locally was purchased from Ganawuri local market located in Riyom local Government Area of Plateau State and Manchok in Kaduna State.

Determination of finger millet proximate composition

The proximate composition of finger millet was carried out at the biochemistry laboratory of the department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. The analysis was carried out according to the standard method of (AOAC, 2005).

Results and Discussion

The proximate analysis results obtained for red finger millet revealed that it had a crude protein of 13.98%, The value obtained here is higher than 9.1g/100g recorded byRavishankar *et al*., (2003); D'Andrea *et al.* (1999) who reported 7.3%; Chethan and Malleshi, (2007) 5-8%, Gull *et al.,* (2015), Gupta *et al.*, (2011) 7.5 – 9.56, brown/red 8.7 g /100 g (Rao, 1994) for other members of the millet family, such as foxtail millet (10.29%), burnyard millet 6.93% (Verma *et al*., 2014), These differences could be due to the variations experienced in geographical locations and soils where the finger millet was planted or the amount of rainfall in those areas. Therefore, this high CP of red finger millet makes it a very nutritionally important ingredient for animal feed, since protein is very vital for normal functioning of the entire body system. Proteins are essential components of the diet needed for survival of animals and humans; their basic function in nutrition is to supply adequate amount of required amino acids (Pugalenthi *et al*., 2004).

The ether extract or crude fat obtained from the analysis of red finger millet revealed that it had 3.70%. This is higher than what was reported by Ravishankar *et al*., (2003) 1.2g/100g, David *et al*., (2014) 0.83%, 1-2% (Chethan and Malleshi, 2007), 1.3-1.8% (Bhatt *et al*., 2003; Lupien, 1990). However, it is comparable to what was obtained 2.1% (Anthony *et al*., 1996).The differences and variations seen may be as a result of different methods of laboratory analysis by different laboratory personnel that carried out the analysis. High fat ingredients are suggested for inclusion in weight gaining diets because of the energy embedded in them. Leeson, (1997) reported that fats are widely used energy sources in addition to improving the consistency and palatability of mash feed.

The result of the proximate analysis revealed Ash content of 4.90% for red finger millet, this is higher than what was reported by David *et al*., (2014) 2.37%; 1.7% (Rao, 1994). The differences recorded may be due to the different types of fertilizer used and the methods of application found in those areas. This suggests that red finger millet has more content of inorganic or mineral in it. This result agrees with what was reported by Singh and Raghuvanshi, (2012) that the Ash content in finger millet is higher than what was obtained in the commonly used cereal grains.

The result of crude fiber showed that Red finger millet had 6.67%, This is higher than what was reported in foxtail millet 4.25% and burnyard millet 2.98% (Verma *et al*., 2014); 72% obtained by D'Andrea *et al* (1999). These wide variations could be as a result of using different cultivars on different soils with various rainfalls ranges, probably the stage of maturity at which the crop was harvested. Crude fiber is nutritionally important as it aids the absorption of trace elements in the gut and elimination of undigested waste through the bowel (Abolaji *et al*., 2007).

The nitrogen free extract (NFE) obtained from the result revealed that red finger millet had 59.22% which is lower than 72% obtained by D'Andrea *et al* (1999); 77.9g/100g (Ravishankar *et al*., 2003). These wide variations could be as a result of using different cultivars on different soils with various rainfalls.

Table 1: Proximate composition Finger millet (*Eleusinecoracana)*(%)

Parameter	**Composition**	
	Red colour	**Black colour**
Dry matter	88.48	87.55
Crude protein	13.98	13.14
`Ether extract	3.70	3.10
Crude fiber	6.67	7.02
Ash	4.90	4.36
Nitrogen Free Extract	59.22	59.84

References

Abolaji, O.A., Adebayo,A.H. and Odesanmi, O.S. (2007). Nutritional qualities of three medi plants parts in (*Xylopiaaethiopica, Bligiasapida and Parinaripolyandra*) commonly used by pregnant women in the western part of Nigeria. *Pakistani Journal of Nutrtion,* 6(6): 665-668.

Association of Official Analytical Chemists (AOAC) (2006).*Official method of analysis*. (15th edition). Washington D.C. USA.

Bhatt, A., Singh, V., Shrotria, P.K., Baskheti, D.C. (2003). Coarse grains of Uttaranchal: Ensuring sustainable food and nutritional security. *Indian Farmers Digest.* Pp. 34-38.

Anthony, U. Sripriya, G. Chandra, T.S. (1996). Effect of fermentation on the primary nutrients in finger millet (*Eleusine coracana*) *J. Agric. Food Chem.,* 44 (9), pp. 2616-2618

Chethan S., Malleshi N.G. (2007). Finger millet polyphenols optimization of extraction and the effect of pH on their stability.*Food Chem.*105 862–870. 10.1016/j.foodchem.2007.02.012 [Cross Ref]

David, B.M., Michael, A., Doyinsola, O., Patrick, I. and Abayomi, O., (2014). Proximate composition, mineral and phytochemical constituents of finger millet (*Eleusine coracana*).*International Journal of Advanced Chemistry.*,**2**(2):171-174.

D'Andrea, A.C., Lyons, D.E., Mitiku Haile, and Butler, E.A. (1999).Ethnoarchaeological Approaches to the study of prehistoric Agriculture in the Ethiopian highlands of Van der Veen. Ed., *The exploitatinof plant resources in ancient Africa.Kluwer Academic*: Plenum publishers, New York.

Fernandez, D.R, Vanderjagt, D.J., Millson, M., Huang Y-S., Chuang, L-T., Pastuszyn, A. and Glew, R.H. (2003). Fatty acid, amino acid and trace mineral composition of *Eleusine coracana* (Pwana) seeds from northern Nigeria. *Plant foods Human Nutritio*. Volume 58:1. pp 1-10. http://doi.org/10.1023/B:QUAL. 0000040323.67330.cb Kluwer Academic Publishers, Printed in the Netherlands.

Gull, A., Jan, R., Nayik, G. A., Prasad, K., & Kumar, P. (2014). Significance of finger millet in nutrition, health and value added products: a review. *Journal of Environmental Science, Computer Science and Engineering and Technology*, 3(3): 1601-1608.

Gull, A. Nayik, G.A., Prasad, K. and Kumar P. (2015).Nutritional, Technological and medical approach of Finger millet (E*leusine coracana*).*Journal of cogent food and Agriculture*, Vol. 1, issue 1.http://doi.org 10.1080/23311932.2015.1090897

Gupta, N., Gupta, A.K., Sing, N. K. and Kumar, A. (2011). Differential expression of PBF D of transcription factor in different tissues of three finger millet genotypes differing in seed protein content and colour. *Plant MolBiol Rep.* 29:69–76.

Leeson, J.D. (1997). *Commercial Poutry Nutrition*.2nd Edition. Summer Published University books, Canada.

Lupien, J.R. (1990). *Sorghum and millets in human nutrition.* FAO, ICRISAT. At: ao.org. p. 86.

Pradeep, P. M., & Sreerama, Y. N. (2015). Impact of processing on the phenolic profiles of small millets: Evaluation of their antioxidant and enzyme inhibitory properties associated with hyperglycemia. *Journal of Food Chemistry*, 9: 455-463.

Pugalenthi, M. Vadivel, U. Gurumoorthi, P. Jonardhanan, (2004). Comparative Nutriritional evaluation of little known legumes, *Tamarindus indica, Erythrina indica* and *Sesbaniabispinosa. Tropical. Subtropical Agroecosystem*. 4: 107-123.

Rao, P.U. (1994). Evaluation of protein quality of brown and white ragi (*Eleusine coracana*) before and after malting.*Journal of Food Chem*. 51: pp. 433-435.

Ravishankar, C. R., Prakash, P. and Ramappa, H. K., (2003).Grain yield and nutritional composition in promising finger millet (Eleusine coracana Gaertn.) varieties. Recent Trends in Millet Processing and Utilisation., 1: 121-122.

Shahidi, F., & Chandrasekara, A. (2013). Millet grain phenolics and their role in diseases risk reduction and health promotion – review. *Journal of Functional Foods*, 5(2), 570-581.

Shiihii, S. U., Musa, H., Bhati, P. G., & Martins, E. (2011).Evaluation of physicochemical properties of *Eleusine coracana* starch.*Nigerian Journal of Pharmaceutical Sciences*, 10(1): 91-102.

Singh, P. and Raghuvanshi, S. (2012). Finger millet for food and nutritional security.*African Journal of food Science.* 6(4): 77-84.

Sood, S., Komar, A., Babu, B. K., Gaur, V. S., Pandey, D., Kant, L., &Pattnayak, A. (2016).Gene, discovery and advances in Finger millet [*Eleusine coracana* (L.)Gaertn.].Genomics-An important nutri- cereal of future. Frontiers in Plant Science, 7:1-17.

Sood, S., Kant, L., & Pattnayak, A. (2017).Finger millet [*Eleusine coracana* (L.)Gaertn.]: a minor crop for sustainable food and nutrition. Mini Review.*Asian Journal of Chemistry*, 29(4): 707-710.

Verma, S., Srivastava, S. and Tiwari, N. (2014) Comparative study on nutritional and sensory quality of barnyard and foxtail millet food products with traditional rice products.*J Food Sci. Technol:*doi 10.1007/s13197-014- 1617-y.

REPLACEMENT VALUE OF AFRICAN LOCUST BEAN (*Parkia biglobosa*) FRUIT PULP FOR MAIZE IN WEANER RABBITS DIET

Mohammed S[1*], Ijaiya A.T[2], Ayanwale B.A[2], and Kudu Y.S[2]

[1]Niger State Agricultural and Mechanization Development Authority Zone II, Kuta Niger State
[2]Department of Animal Production Federal University of Technology, Minna Niger State, Nigeria.
*Corresponding author: mohammedsani90042@gmail.com
Phone number – 08036389573, 08070426419

Sub theme –Monogastric Nutrition. Oral Presentation

Abstract
A feeding trial of 84 days was conducted to assess the replacement value of African Locust bean fruit pulp for maize in weaner rabbits diet. Five diets were formulated, such that 100% maize and 0.00% fruit pulp of African fruit pulp at (T1), 75% maize and 25% inclusion of African locust bean at (T2), 50% maize and 50% African locust bean pulp as (T3), 25% maize and 75% African fruit pulp at (T4) while (T5) contain 100% fruit pulp of African locust bean and 0.00% maize respectively. Seventy five (75) weaner rabbits (5-6wks old) with average initial weight between 610.67g -622.60g were randomly allocated in a complete randomized design (CRD) experiment to the five diets with fifteen (15) weaner rabbits in each treatment which were subdivided into three (3) replicates having five (5) weaner rabbits in each replicate. The weaner rabbits were housed in individual cage compartment. Proximate composition of the experimental diets fed to weaner rabbits carried out indicated that T1 had dry matter content of 93.28 %, crude protein of 19.80 % and also 12.41 % of crude fiber. Ether extract was higher in T5 with 8.48 %, while nitrogen free extract contained in T3 had the highest value of 51.17 %. However ash content in T5 has the highest value of 7.83 %. The metabolizable energy in all the dietary treatment shows that T5had the highest value of 3013.21 ME/Kcal/Kg. Data were collected on daily feed intake and weekly weight. Feed conversion ratio, protein efficiency ratio, energy efficiency ratio, nutrient digestibility and feed cost benefit ₦ (kg) were calculated. Weaner rabbits fed 75% maize and 25% African fruit pulp (T2) consumed more feed and significantly gained more weight P<0.05 than those fed the other diets. Feed conversion ratio, protein efficiency ratio and energy efficiency ratio were not significantly (P>.0.05) influence by the treatment diets. Average feed cost of production with inclusion of maize was estimated at ₦311.25 in T1 while the African locust bean fruit pulp inclusion was ₦161.81in T5, a cost difference of ₦149.44, this resulted to a progressive reduction in the cost treatment of feed with increase in the level of fruit pulp of African locust bean meal. The results of this study indicated that when 25% fruit pulp of African locust replaced maize, the rabbits performed better than the control diet and also of more economical option.
Keywords: Fruit pulp, weaner rabbits, diet, proximate, metabolizable.

INTRODUCTION

There is an estimate of an annual five to seven percent growth rates for meat consumption, such increase cannot be met easily by large animals like sheep and cattle because of their slow production cycle, they may however be met by short cycle animals such as rabbits, poultry and pigs. The growing demand for maize in the last few years for both human and livestock consumption has pushed its market price to an alarming rate and that has directly affected the production cost of farm animals particularly the non –ruminants.(Igwebuike *et al*., 2003). The fruit pulp is obtained from the locust bean tree. The African Locust bean, (*Parkia biglobosa*) is a perennial tree. It grows in the savanna region of West African up to the edge of the Sahel zone. The fruit of the plant is straight or sickle shaped 15.6cm -31.20cm long and 2.6cm broad with thick waxy margin. When dried it is light brown with black seed embedded in yellowish mealy tasting pulp (Edigwe *et al*., 2012). The study herein conducted is to evaluate the replacement value of African locust bean fruit pulp for maize in weaner rabbits diet.

MATERIALS AND METHOD.

Experimental site – The experiment was carried out at the Rabbit unit of Animal Teaching and Research Farm, located at Gidan Kwano, Federal University of Technology Minna, Niger State.

SOURCE OF EXPERIMENTAL INCREDIENTS – Pulp of locust bean was purchased at Dandaudu village 56km away from Minna. Five dietary treatment were formulated at 16% crude protein requirement
with energy level of 2884.16(Kca/kg) for the rabbits using Pearson square method of feed formulation. Scwartz and Allen (2012).

EXPERIMENTAL DESIGN

A total of seventy five (75) rabbits of mixed sexes and breeds (New Zealand and chinchilla) were randomly allotted to five treatment groups as T1, T2, T3, T4, and T5 with three (3) replicate each, containing (5) rabbits in each replicate.

MANAGEMENT OF EXPERIMENTAL RABBITS.

Rabbits were kept in hutches made up of wood and mesh wire, with height of 60cm, and width 40cm. Hutches were enclosed in a house under intensive system were the floor of the house is cemented on the. All hutches and house were disinfected before commencement of the experiment work. (Olomu, (2008)

DATA COLLECTION AND ANALYSIS

Initial weight of weaner rabbits were taken at the first day on commencement of the experiment. Formulated feed were weighed each morning on daily basis and fed to rabbits in each treatment. Left over feed were weighed the following morning and feed intake obtained. by difference. Initial body weights of all the weaner rabbits were obtained on the first day of commencement of the experimental work, while the weekly body weight were obtained by weighing the weaner rabbits at the end of each week

Table 1 Feed composition and calculated nutrients of experimental diets fed to rabbits at weaner stage

	T1	T2	T3	T4	T5
INGREDIENT (%)	100:00	75:25	50:50	25: 75	100:00
Maize	60.74	45.56	30.37	15.18	00.00
Locust bean fruit pulp	00.00	15.18	30.37	45.56	60.74
Soyabean meal	24.61	24.61	24.61	24.61	24.61
Rice husk	10.00	10.00	10.00	10.00	10.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.30	0.30	0.30	0.30	0.30
Methionine	0.80	0.80	0.80	0.80	0.80
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.25	0.25	0.25	0.25	0.25
Total (kg)	100.00	100.00	100.00	100.00	100.00
Calculated nutrients					
Crude Protein	17.01	17.25	17.49	17.72	17.012
Crude Fibre	10.36	11.09	11.82	12.55	13.28
ME (Kcal/Kg)	2884.16	2788.22	2792.22	2796.22	2648.87
Protein: calorie Ratio	1:149	1:146	1:143	1:139	1:137
Calcium	1.40	1.45	1.47	1.49	1.51
Phosphorous	1.03	1.03	0.99	0.99	0.79
Methionine	1.01	1.00	0.98	0.97	0.96
Lysine	0.87	0.88	.088	0.88	0.89
Ether Extract	0.23	0.21	0.31	0.28	0.22

* = The premix provides nutrients kg^{-1}: Vit. A, 500 IU; Vit. D_2,1500 IU; Vit. E 3, IU; Vit. K,2 mg; Niacin, 15 mg; Vitamin B_{12},0.8 mg;Riboflavin, 3 mg; Pantothenic, acid 6 mg; Chlorine, 3 mg; Folic acid, 4 mg; Manganese, Iodine, 1.0 mg; Cobalt, 1.2 mg; 8 mg; Zinc, 0.5 mg.
Kg = kilogram
ME = Metabolizable energy
Kcal = Kilo calorie

Table 2 Proximate Composition and Calculated Energy Values of Experimental Diets Fed to Weaner Rabbits

Nutrient	T1	T2	T3	T4	T5
Dry matter (%)	93.28	92.22	91.58	92.42	92.10
Crude protein (%)	17.41	16.68	16.01	16.44	15.85
Crude fibre (%)	12.71	10.44	11.26	10.74	10.47
Ether extract %	5.19	7.21	7.97	8.26	8.48
Nitrogen free extract (%)	51.14	50.30	51.17	49.79	49.47
Ash (%)	6.83	7.59	7.17	7.19	7.83
Metabolizable Energy (ME/Kcal/Kg)	2947.58	2915.82	2953.02	2963.02	3013.21

% - Percent, T1- 100 % Maize and 0.00 % Fruit pulp of African locust bean.
T2 = 75 % Maize and 25 %, Fruit pulp of Africa locust bean,
T3 = 50 % Maize and 50 % Fruit pulp of Africa locust bean,
T4 = 25 %, Maize and 75 % Fruit pulp of Africa locust bean,
T5 = 100 % Fruit pulp of Africa locust bean and 0.00 % Maize,
ME = Metabolizable energy,
Kcal = Kilo calorie,
Kg = Kilogram

Table 3 Performance characteristics of weaner rabbits fed inclusion levels of dried fruit pulp of African locust bean

Treatment	T1	T2	T3	T4	T5	±SEM	LS
Average initial weight (g)	610.67^{a}	616.67^{a}	622.00^{a}	622.00^{a}	618.67^{a}	25.9	NS
Average final body weight (g)	1508.33^{ab}	1561.67^{a}	1413.33^{c}	1396.67^{c}	1455.67^{bc}	20.06	**
Average Weight gain (g)	897.67^{a}	944.00^{a}	791.33^{a}	774.67^{a}	839.00^{a}	38.86	NS
Average daily weight gain (g)	10.69^{a}	11.23^{a}	9.43^{a}	9.22^{a}	9.96^{a}	0.46	NS
Total Feed intake (g)	3603.33^{a}	3631.66^{a}	3609.83^{a}	3377.00^{a}	3375.10^{a}	165.27	NS
Average Daily Intake (g)	42.90^{a}	43.23^{a}	40.59^{a}	40.20^{a}	40.17^{a}	2.18	NS
Feed Conversion Ratio	4.06^{a}	3.75^{a}	4.56^{a}	4.40^{a}	4.03^{a}	0.3	NS
Protein Efficiency Ratio	2.22^{a}	2.36^{a}	2.45^{a}	2.22^{a}	2.31^{a}	0.11	NS
Energy efficiency Ratio	1.31^{a}	1.35^{a}	1.33^{a}	1.24^{a}	1.21^{a}	0.06	NS
Cost/Weight Gain (₦ /Kg)	311.25^{a}	253.25^{ab}	206.21^{ab}	192.8^{bc}	161.81^{c}	21.04	**
Mortality %	0.00^{a}	0.00^{a}	0.00^{a}	0.20^{a}	0.20^{a}	0.13	NS

^{abc} Means in the same row with different superscript are significantly different
T1 = 100 % Maize and 0.00 % Fruit pulp of African locust bean,
T2 =75 % Maize and 25 %, Fruit pulp of Africa locust bean,
T3 = 50 % Maize and 50 % Fruit pulp of Africa locust bean,
T4 -=25 %, Maize and 75 % Fruit pulp of Africa locust bean,
T5 =100 % Fruit pulp of Africa locust bean and 0.00% Maize.
SEM = Standard error of mean, LS – Level of significance,
** = Significant at ($P < 0.05$),
NS = Not Significant ($P > 0.05$),
g = gram

RESULTS AND DISCUSSION

Rabbits fed 25% replacement level of fruit pulp of African locust bean diet had a higher feed intake and with a significant ($P<0.05$) weight gain than diet containing 75% and 50% levels respectively. This result agrees with Gernah *et al*., (2007) that low level of sweetness in the pulp yield a higher intake at

25% inclusion compared to the increased level of 50% and 75%. The high average weight recorded in 25% replacement level could be as a result of high level of feed intake by the rabbits in the treatment, this result agrees with Osagie (2011) that weight gain is directly related to feed intake, while low growth rate in diet 4 could be as a result of low intake of feed. The feed conversion ratio did not show a significant different (P>0.05) in all the dietary levels. Diet 2 shows lowest value, this is in agreement with the work of Okah (2004) who reported that the higher the weight gain per unit feed consumed, the lower the value of feed efficiency obtained. Protein and energy efficiency ratio did not show a significant difference (P>0.05) in all the diet. The ₦311.25 cost of fruit pulp of African locust bean, and maize ₦161.81gave rise to a cost differential of ₦149.44, this resulted to reduction in the cost of feed as level of fruit pulp of African locust bean meal is increased ((Kwari and Igwebuike 2010)

CONCLUSION AND RECOMMENDATION

The result of this study reveal that fruit pulp of African locust bean could replace maize at 25% level for weaner rabbits diet without adverse effect on their performance. This level of replacement had less cost than maize based diet. However the effect of dietary fruit pulp of African locust bean on the performance of rabbits depends on the nutrient profile. The levels of maize in the reference diets might also influence performance of the rabbits.

REFERENCES

Gernah, D.I Atolagbe, M.O & Echegwo C.C (2007). Nutrient composition of the African locust bean (*Parkia biglobosa)* Fruit pulp. Nigeria food journal vol. 25 no. 1 pp190-196

Igwebuike, J.U, Kwari, I.D and Usman Y. (2003) The replacement of maize grain with grain residue in concentrate diets in growing rabbits proceedings of 8 annual conference of the Animal science Association of Nigeria (As An) Sp+-g16-18th 2003. FUT Minna N/state

Kwari I.D and Igwebulke J.U (2010) performance of brother chickens fed graded levels of African locust bean *(Parkia Biglobosa)* pulp. Proceeding of the Nigeria sovety for animal production (NSAP) Sept. 17th -19th University of Maiduguri, Nigeria.

Okah Y (2004) Effects of dietary replacement of maize with maize processing waste on the performance of boiler starter. Proceedings of the 29th Annual conference of Annual science Association of Nigeria pp.2-4

Olomu, J.M. (2008). *Monogastric Animal Nutrition. Principles and Practice.* Second Edition, St. Jackson publishing, Benin City, Nigeria.

Osagie, J.A (2011). Some chemical constituent of the fruits pulp of *Parkia elappertoniana* as potential industrial raw material. Savanna 9 (2): 24-27

Scwartz, B.S. and Allen B.A (2012). Plants allmantarieset vie AgricoladeL`Afque Noire Larose

Paris. Vol 3: 110-115.

HAEMATOLOGICAL PROFILE AND BIOCHEMICAL RESPONSE OF WEANER RABBITS FED GRADED LEVELS OF AFRICAN STAR APPLE *CHRYSOPHYLLUM ALBIDUM* SEED MEAL

AMAO, E. A., ADEOTI, T. M., OLAOGUN, Y. A. and OLADOKUN, A. A.
Department of Animal Production technology, The Oke Ogun Polytechnic, Saki
Corresponding author E-mail: amaoemmanuelayodeleamao@gmail.com

Abstract
This study was carried out to determine the haematological profile and serum biochemical indices of rabbits fed graded level of African star apple (Chrysophyllum albidum) seed meal. The study involved forty eight (48) mixed breed weaned rabbits of seven - eight weeks old, with average weight of 186.87±0.03g.The rabbits were allotted into four dietary treatments comprising twelve (12) rabbits per treatment. The dietary treatments were 0%, 5%, 10% and 15% ASASM inclusion levels. The experimental diet contained 15% crude protein and 2488.68 Kcal/Kg metabolizable energy. The feeding trial lasted eight weeks, during which period feed and water were provided ad – libitum. Data generated were subjected to analysis of variance. Results obtained from this study revealed that the haematological profile and serum biochemical indices of rabbits recorded no significant (P > 0.05) differences among dietary treatments except cholesterol, AST and ALT (P <0.05) . The study concludes that inclusion of graded levels of C albidum seed meal up to 15% will not pose any adverse effects on the blood characteristics of rabbits.

KEYWORDS: Weaner rabbits, *C albidum*, haematology, serum biochemistry

Introduction
Feed scarcity has remained a major limitation to livestock production and productivity (Agbede and Aletor, 2003). The high cost of animal feeds precipitated by the ever increasing cost of feed ingredients has resulted in poor nutrition leading to declining productivity of animals in developing nations like Nigeria (Nodu *et al*., 2014). According to Fetuga (1997) there is a disappointing rate and low level of performance in the Nigerian livestock industry, due to high cost of feeds, poor quality feeds and inefficiency in production and distribution in the feed industry. The low level of livestock production has affected adequate protein intake. However, intensive rabbit production and domestication can help bridge the meat supply gap in Nigeria and ensure animal protein adequacy. Increase in meat production can be achieved through proper nutrition, inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010).

The domestic rabbit (*Oryctolagus cunniculus*) is an important non-ruminant herbivore for meat production. Rabbit meat is a source of healthful food as it is low in cholesterol, but high in protein, 22g/100g (Aduku, and Olukosi 1990). Rabbits can also utilize the available proteins in cellulose rich plants, whereas it is not economical to feed these to chicken and turkeys. Since there is high demand for additional source of food worldwide the exploitation of plants of low economic importance would be a step towards better resource utilization (Telek, and Martin 1983) which is in line with the strategy to achieve sustainable animal production systems by matching them with locally available feed resources (Preston and Sansoucy 1987).

African star apple (*Chrysophyllum albidum)* is a dominant canopy tree of lowland and mixed rainforests, sometimes, riverine (Madubuike and Ogbonnaya, 2003). The plant is propagated by seedlings, wildings and direct sowing. It is a seasonal fruits-bearing tree. The fruit is fleshy and juicy, producing whitish gummy exudates (Adewusi, 1997). It is widely eaten in South Western Nigeria, popular among women and children (Amusa *et al.*, 2003).

The seeds of *C. albidum* are about 1-1.5 x 2 cm, beanlike, shiny when ripe, compressed, with one sharp edge and a star-shaped arrangement in the fruits (Orwa *et al.*, 2009). The seed coat is hard, bony, shiny, and dark brown, and when broken reveal white-colored cotyledons (Amusa *et al.*, 2003).

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajao *et al.*, 2013). Nutritional status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These can be determined by either or combinations of chemical, anthropometric, biochemical or dietary methods (Bamishaiye *et al.,* 2009). Haematology refers to the study of the numbers and morphology of the cellular elements of the blood – erythrocytes, leucocytes, and thrombocytes and the use of these results in the diagnosis and monitoring of disease (Merck Manual, 2012). Haemtological studies are useful in the diagnosis of many diseases as well as investigation of the extent of damage to blood (Onyeyili, *et al.,* 1992; Togun *et al.,* 2007). Haematological parameters are good indicators of the physiological status of animals (Khan and Zafar, 2005). Haematological parameters are those parameters that are related to the blood and blood forming organs (Waugh *et al*., 2001; Bamishaiye *et al*., 2009). Blood act as a pathological reflector of the status of exposed animals to toxicant and other conditions (Olafedehan *et al.,* 2010). As reported by Isaac *et al.* (2013) animals with good blood composition are likely to show good performance.
However, there is no information on the effect of seeds of *C. albidum* on haematology and serum biochemical parameters of rabbits. Therefore, this study was carried out to investigate the effect of feeding graded levels of seeds of *C. albidum* on the haematological and serum biochemical parameters of rabbits.

Materials and Methods
The study was carried out at the rabbitary unit of the Oke-Ogun Polytechnic, Saki. Oyo State, Nigeria.

African Star Apple seeds were collected from primary and secondary schools in Saki, Oyo State, Nigeria. The seeds were sun dried and further broken to obtain the cotyledons. The cotyledons were sun dried and milled for inclusion in diet mixture of growing rabbits.

Experimental Animals and Management
A total of Forty-eight (48) growing rabbits (7 – 8 weeks of age with average weight 186.87 ±0.03g) of mixed sexes were obtained from a reputable farm in Oyo State, Nigeria for the purpose this study. The animals were housed in wooden cages raised from the ground level. Before the animals were brought into the rabbitary, the cages were thoroughly washed and disinfected and allowed to dry. The floor of each cage was covered with wire mesh to allow for the passage of waste materials. Feed and water troughs were provided in each cage, while feed and water were provided *ad – libitum.* The rabbits were caged individually in clearly marked cells. The feeding trial lasted eight weeks.

3.3 EXPERIMENTAL DIET

Four experimental diets were formulated with the inclusion of 0%, 5%, 10% and 15% African Star Apple seed meal (ASASM) as substitute for maize in rabbit diet.

Parameters	0% (ASASM)	5% (ASASM)	10% (ASASM)	15% (ASASM)
Maize	40.00	38.00	36.00	34.00
ASAS	0.00	2.00	4.00	6.00
Maize offal	25.00	25.00	25.00	25.00
Rice offal	18.00	18.00	18.00	18.00
Soybean meal	2.00	2.00	2.00	2.00
Fish meal	1.20	1.20	1.20	1.20
Groundnut cake	10.00	10.00	10.00	10.00
Limestone	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Total	100kg	100kg	100kg	100kg

Blood collection:

Blood collection was done at end of the 8th week of feeding trial from six rabbits per treatment. Blood samples were obtained from the prominent ear vein with the aid of a hypodermic needle and syringe. Two blood samples each were collected per rabbit; one set of the blood samples was collected into plastic bottles containing Ethylene Diamine Tetra acetic acid (EDTA) for haematological studies while the other sample was collected into plain sterile bottles for the serum biochemical indices determination. All haematological parameters were determined by conventional laboratory methods of Baker and Silverton (1982); Bitto and Gemade (2001), while serum biochemical indices were determined by methods described by Ochei and Kolhathar (2007).

STATISTICAL ANALYSIS

All data collected were subjected to analysis of variance (ANOVA) technique using statistical analysis software.

Results and Discussion

Table 2: Haematological indices of rabbit fed African Star Apple seed meal.

Parameters	0%ASASM	5%ASASM	10%ASASM	15%ASASM	SEM
PCV (%)	39.00	40.33	40.66	39.33	3.16
Haemoglobin(g/dl)	12.96	13.60	13.60	12.76	1.08
RBC($x10^{12}$/l)	6.33	6.60	6.64	6.44	0.53
WBC($x10^{9}$/l)	5.93	5.86	5.96	5.77	3.25
Platelet ($x10^{9}$/l)	128.33	146.00	125.66	115.00	0.83
Lymphocyte (%)	68.33	67.66	69.33	69.33	0.83
Neutrophils (%)	28.66	28.33	28.33	28.00	2.62
Monocyte (%)	2.00	2.00	1.00	2.00	0.43
Eosinphils (%)	1.00	2.00	1.33	0.66	0.41

KEY: Packed cell volume (PCV), White blood cell (WBC), Red blood cell (RBC), African Star Apple Seed Meal (ASASM).

Table 3: Biochemical indices of rabbit fed African Star Apple Seed Meal.

Parameters	0%ASASM	5%ASASM	10%ASASM	15%ASASM	SEM
Glucose(mg/dl)	78.39	65.33	66.66	64.18	3.87
Cholesterol(mg/dl)	75.23[b]	113.33[a]	70.83[b]	87.59[b]	6.57
AST (IU/L)	51.66[b]	97.90[a]	55.69[b]	43.40[b]	4.47
ALT (IU/L)	41.59[a]	38.23[a]	28.07[b]	30.08[a]	1.58
Total protein (g/l)	7.14	5.93	5.97	5.28	0.5
Albumin (g/l)	3.14	3.42	3.89	3.49	0.6

Key: Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline Phosphatase (ALP),

Results and discussion

It is well established that changes in haematological and biochemical parameters reflect the physiological status of animal. Packed cell volume (PCV) values obtained in this study were not significantly ($p>0.05$) influenced by dietary treatments. The values (39 – 40.66%) were within the reference range of 33 to 50% reported by MediRabbit (2007). The red blood cell (RBC) range of 6.33 – 6.64x106/mm3 and haemoglobin (Hb) range of 12.76 to 13.60 were within standard range of 4 – 8.6 to 7.9 x 106/mm3 for RBC and 10 - 15g/dl for Hb respectively (RAR, 2009). This result indicates that *C. albidum* seed support red blood cell synthesis. The platelet counts recorded in this study ranged from115 to 146 $x10^9$/L for rabbits fed graded levels of *C. albidum* seed. The values were however lower than the normal range (250.00 – 600.00 $x10^9$/L) for rabbits reported by Medirabbit (2011). The white blood cell (WBC) values obtained in this study which were not significant among treatments were within the normal range of 4.5x 10^9 /l to 11 x 10^9 /l reported (RAR, 2009). The white blood cell differentials namely lymphocytes, neutrophils, monocytes and esonophils were not significantly influenced by dietary treatments.

Biochemical response of rabbits fed *C. albidum* seed was presented in table 3. No significant difference ($p>0.05$) was observed in the values of glucose, total protein and albumin. Values for glucose range from 64.18 to 78.39mg/dl, only animals on control diet falls within the standard range of 75 – 140mg/dl (Medirabbit, 2011) animals placed 5%, 10% and 15% had values below the standard range and this implies hypoglycemia in the rabbits. Values of total protein (5.28 – 7.14g/l) and values of albumin (3.14 – 3.89g/l) were within the standard reference of 5.0 – 7.5g/l and 2.7 – 5.0 g/l respectively (Medirabbit, 2011). This suggests that normal protein metabolism occurred in rabbits, since protein synthesis is related to the amount of protein available in the diet (Iyayi and Tewe, 1998). Cholesterol and Aspartate aminotransferase (AST) followed the same trend with animals placed on 5% having highest values, cholesterol ranged from 70.83 – 113.33 while AST value ranged from 43.40 – 97.90 values for the two parameters falls within the standard range of 10 to 80mg/dl and 10 to 98mg/dl respectively (Medirabbit, 2011). This implies no deleterious influence of ASASM on rabbit biochemical response.

Conclusion and Recommendation

Results obtained in this study have shown that *C. albidum* seed can be included in weaner rabbits' feed without adverse effects on their haematological profile and serum biochemical indices.

References

Adewusi H. A. 1997. The African Star Apple *Chrysophyllum albidum* Indigenous Knowledge from Ibadan, Southwestern Nigeria. *In: Proceedings of a National Workshop on the Potentials of the Satr Apple in Nigeria. (Eds.) Denton OA, Ladipo DO, Adetoro MA, Sarumi MB* pp. 25-33.

Aduku, A. O and Olukosi J. O. 1990. Rabbits Management in the Tropics, *Books Gospel Publication*, Abuja, pp 40.

Agbede, J. O and Aletor, V. A., 2003. Comparative evaluation of weaning food from glycerides and leucaena leaf protein concentrates and some commercial brands in Nigeria. *Journal of Science of Food and Agriculture*, 84: 21 – 34.

Ajao, B. H., Ola, S. I., Adameji, O. V. and Kolawole, R. F. 2013. The relationship of ambient temperature and relative humidity of thermo respiratory function of greater grasscutter. Proc. of the 18th *Annual Conf. of Anim. Sci. Assoc. of Nig*., 92.

Amusa N. A, Ashaye O. A and Oladapo M. O. 2003. Biodeterioration of the African star apple *(Chrysophyllum albidum)* in storage and the effect on its food value. *African Journal of Biotechnology*, 2: 56-59.

Baker, F S and Silverton, R. E., 1982. Introduction to Medical Laboratory Technology, 5th edition, *Butterworth S. C., London*, Pp. 481 – 494.

Bamishaije, E., Muhammad, N. and Bamishaiye, O. 2009. Haematological parameters of albino rats fed on tiger nuts (*Cyperuss esculentus*) tuber oil meat based diet. *The Internet Journal of Nutrition and Wellness*, 10(1): 23-45

Bitto, I. I and Gemade, M., 2001. Preliminary investigations on the effect of pawpaw peel meal on growth, visceral organ and endocrine gland weights, testicular morphometry and haematology of male rabbits. *Global Journal of Pure and Applied Sciences*, 7 (4): 62 – 65.

Etim, N. N. and Oguike, M. A. 2010. Egg production of the domestic fowl (*Gallus gallus*): Implications for food security. *Proc. of the 35th Annual Conf. of the Nig. Soc. for Anim. Prod. (NSAP)*, 660.

Fetuga, B. L., 1997. Animal production in Nigeria and feed supplies. *Nigerian Journal of Animal Production*, 4 (1): 19 – 41.

Isaac, L. J., Abah, G., Akpan, B., & Ekaette, I. U. 2013. *Haematological properties of different breeds and sexes of rabbits* (p.24-27). *Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria.*

Iyayi, E. A and Tewe, O. O., 1998. Serum total protein, urea, creatinine levels as indices in cassava diets for pigs.*Tropical Veterinary*, 8: 11 – 15.

Khan, T. A. and Zafar, F. 2005. Haematological study in response to various doses of estrogen in broiler production. *Int. J. Poult. Sci*., 40(10):748-751.

Madubuike FN, Ogbonnaya O (2003). The Potential Use of White Star Apple seed (*Chrysophyllum albidum*) and Physic Nut (*Jatropha Curcas*) as Feed Ingredients for Rats. *J. Fac. Agric. Vet. Med.* 1: 97-105.

Medirabbit , 2007. www.medirabbit.com/EN/Hematology/blood_chemistry.htm

Medirabbit., 2011. Complete blood count and biochemical reference values in rabbits. Retrieved from www.medirabbit.com

Merck Manual 2012. *Haematologic reference ranges*. Mareck Veterinary Manual. Retrieved from http://www.merckmanuals.com/.

Nodu, M. B., Okpeku, M. and Abezi, A. E., 2014. Haematological characteristics of rabbits fed a mixture of *Alchornea cordifolia*/ Pawpaw leaf meal. *Journal of Agricultural and Veterinary Sciences*, 7 (1): 92 – 96.

Ochei, J and Kolhatkar, A., 2007. Medical Laboratory Science Theory and Practice, 6th edition, *McGraw – Hill Publishing Company Limited, New York, USA*, 1338pp.

Olafedehan, C. O., Obun, A. M., Yusuf, M. K., Adewumi, O. O. Olafedehan, A. O., Awofolaji, A. O. and Adeniji, A. A. 2010. Effects of residual cyanide in processed cassava peel meals on haematological and biochemical indices of growing rabbits. *Proc. of the 35th Annual Conf. of the Nig. Soc. for Anim. Prod., 212.*

Onyeyili, P. A., Egwu, G. O., Jibike, G. I., Pepple, D. J., & Ohaegbulam, J. O. 1992. Seasonal variation in haematological indices in the grey-breasted guinea fowl (*Numida mealagris Gallata pallas*). *Nigerian Journal of Animal Production, 18*(2), 108-110.

Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. 2009. Agroforestree Database: A tree reference and selection guide version 4.0. *World Agroforestry Centre, Kenya*.

Preston, T. R and Sansoucy R. 1987. FAO Animal Production and Health Paper , **1987**, 63: 32-41.

Research Animal Resource [RAR]. 2009. Reference values for laboratory animals: Normal haematological values. RAR Websites, RAR, University of Minnesota. Retrieved from http://www.ahc.umn.edu/rar/refvalues.html.

Telek, L and Martin F. W. 1983. Tropical Plants for leaf protein concentrate *Av 1 Pub. U.S.A.* PP 81-116.

Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., Mustapha, F. 2007. Effects of chronic lead administration on the haematological parameters of rabbits – a preliminary study. *Proceedings of the 41st Conferences of the Agricultural Society of Nigeria.* (p. 341)

Waugh, A., Grant, A. W., & Ross, J. S. 2001. Ross and Wilson Anatomy and Physiology in Health and Illness *Churchill Livingston, an imprint of Elsevier Science Limited*. (9th ed., p. 59-71).

EFFECT OF SUPPLEMENTAL LEVELS OF LEMON GRASS LEAF MEAL ON THE GROWTH PERFORMANCE AND HAEMATOLOGICAL CHARACTERISTICS OF STARTER BROILER BIRDS (A CASE STUDY IN ISHIAGU, IVO, L.G.A OF EBONYI STATE)

[1]Olabode, A.D. and [2]Okelola, O.E.

[1]Federal College of Agriculture, Ishiagu, Ebonyi State.

[2]Federal College of Fisheries and Marine Technology, Victoria Island, Lagos State.

E-mail:- *Adeoladavid2005@yahoo.com*: 08063379970

Abstract

The effect of supplementing lemon grass (Cymbopogon citrates) leaf meal on the growth performance and haematological profile of starter broiler birds formed the basis of this study. A total number of one hundred and twenty (120), one week old "Agric-tech" broiler chicks were randomly allocated to four dietary treatments, each replicated three times with ten birds per replicate in a completely randomized design (CRD). Four different diets were formulated such that the lemon grass leaf meal was incorporated into the diets at the rate of 0.75%, 1.50% and 2.25% respectively, while treatment 1 served as the control with 0% level of lemon grass leaf meal. Feed and water were given ad-libitum throughout the experimental period of twenty one day. Results obtained from the growth performance in terms of initial body weight, final body weight, average daily body weight gain, average daily feed intake and feed conversion ratio showed significant ($p<0.05$) difference across the treatment group. Haematological profile results showed that there was significant ($p<0.05$) effect of lemon grass leaf meal across the treatment groups. From the present results, it can be concluded that lemon grass leaf meal can be added up to the levels of 2.25% in the diet of starter broiler birds without any negative impact in terms of growth performance and no detrimental effect to the health of the birds at this phase of growth.

Keywords: Growth performance, starter broiler birds, lemon grass leaf meal, haematological indices

Introduction

High quality feed together with clean environment, clean water and subsequently good managerial qualities can ensure the production of nutritious animal products with desirable traits for man consumption. Thus the use of additives of natural origin as alternatives to antibiotics in animal and human nutrition has been encouraged recently. Feed additives like probiotics, prebiotics, organic acids and plant derivatives with their biochemical structures and physiological functions of various degrees have been reported. The subsequent consumption of medicinal herbs, aromatic plants and spices in man's nutrition for improvement of taste, aroma and colour of feed as additive have been carefully substituted into animal nutrition for growth and health of the animals. With the recent ban of antibiotics use in animal nutrition due to the emergence of microbes' resistance alternative growth promoters must be evaluated. Thus the removal of antibiotics as growth promoters has been reported (Ceylon and Fung, 2004). A wide range of herbs, spices and their extracts exerts beneficial effects within the digestive tract, such as laxative acid, spasmolytic effects and reduction of flatulence (Onyimonyi *et al*., 2009). These active components effects largely depends on its dosage administered. Increased in quantity of doses can even be detrimental to animals and subsequent doses reduction in quantity poses no effect to the animal.

Lemon grass (*Cymbopogon citratus*) is an aromatic plant belonging to the gramineae family (Akhila, 2010). The compounds identified in *Cymbopogon citrates*are mainly terpenes, alcohols, ketones, aldehyes and esters.Studies indicate that *Cymbopogon citrates* possess various pharmacological activities such as anti-amoebic, antibacterial, antidiarrheal, antifilarial, antifungal and anti-inflammatory properties. Other effects such as antimalarial, antimutagenicity, antimycobacterial, antioxidant and hypoglycemic have also been studied (Mirghani *et al*., 2010)

Materials and Method

The experiment was conducted at the poultry unit of the Animal Production Department, Federal College of Agriculture, Ishiagu, Ebonyi State. The lemon grass leaf that was use for the experiment was sourced from Afikpo and Ishiagu, both in Ebonyi state. The lemon grass leaves was obtained fresh and wash, then air-dried for a week at room temperature after which it was sun-dried for about 2 hours to get a cripsy-like leafy material. The cripsy leaves was then turned to leaf meal by means of grinding. One hundred and twenty (120) day old broiler chicks were used for the research work. The birds were brooded for one week after which they were randomly distributed into four treatments. Each treatment was replicated three times in a completely randomized design (CRD) with ten (10) birds per replicate. The birds were purchased from a reputable farm in Enugu, Enugu state.

Prior to the arrival of the birds, the pens were washed and cleaned so as to avoid pathogenic and disease infection. A good source of light was provided, which served as insulator to keep the chicks warm. Feeders and drinkers were thoroughly washed and cleaned. The birds were raised on a deep litter system with wood shavings which served as a source of litter. The chicks were brooded for one week after which they were randomly distributed to their various pens. The initial weight of the birds was obtained after distribution to their various pens. Feed and water were given *ad-libitum*. All the routine vaccination and medication necessary for the birds' good health during the entire growth cycle from day old to the end of the experiment were strictly adhered to according to specification.

Experimental diets

Four experimental diets were formulated with diet 1 containing 0% lemon grass leaf meal which served as the control. Diets 2, 3 and 4 contain the lemon grass leaf meal at the levels of 0.75%, 1.50% and 2.25% respectively..

Table 1. Composition of starter broiler diet fed supplemental levels of lemon grass leaf meal

	Treatments			
Ingredients	T1	T2	T3	T4
Maize	54.00	53.25	53.25	52.50
Wheat offal	7.25	7.25	6.50	6.50
Lemon grass leaf meal	0	0.75	1.50	2.25
TOTAL	**100**	**100**	**100**	**100**

Other feed ingredient had same value across treatment group: Soybean meal-7.00; Groundnut cake-22.15; Fishmeal- 3.00; Blood meal-2.50; Bonemeal-2.00; Limestone-1.00; Salt-0.25; Starter premix-0.30; Lysine-0.25; Methionine-0.30.

Feed intake was recorded as the difference between the quantity of feed given the previous day and the quantity that was left the next day. Feed conversion ratio was obtained as the ratio of feed intake divided by the body weight gain. Data collected were subjected to analysis of variance (ANOVA) and significant difference mean were separated according to the method of Duncan multiple range test as outlined by Obi (2002).

Results and discussion

Table 2 showed the results of starter broiler birds fed diet supplemented with graded levels of lemon grass leaf meal. The result of final body weight showed that birds in treatment 4 had the highest value of 1193.33g which was similar ($p>0.05$) to those of birds in treatment 3 (1173.33g g), but differ ($p<0.05$) from those in treatment 2 (1150.00g) and 1 (1113.33g) respectively. The significant increase in value of final body weight across the treatment group may be due to the ability of the birds' enzymatic system to stimulate protein synthesis and also optimized the antioxidant activities of lemon grass leaf meal. This present research work is similar with the work of Mmereole (2010) who observed significant ($p<0.05$) higher body weight and body weight gain when compared with the control in starter broiler birds fed diet supplemented with lemon grass leaf meal.

Table 2. Growth Performance Characteristics of Starter Broiler Birds fed Supplemental levels of Lemon Grass Leaf Meal (lglm)

	Treatments				
Parameters	T1	T2	T3	T4	SEM
*Initial Body Weight (g)	115.00	115.00	113.33	113.33	-
*Final Body Weight (g)	1113.33	1150.00	1173.33	1193.33	23.78
*Av. Daily Body Wt. gain (g)	47.5	49.29	50.48	51.4	1.11
*Av. Daily Feed Intake (g)	93.12	94.99	96.21	92.49	0.79
*Feed conversion ratio	1.96	1.93	1.91	1.80	0.04
*Packed Cell Volume (%)	30.09^{bc}	32.91^{b}	31.31^{b}	35.07^{a}	0.89
*Haemoglobin (g/l)	8.95^{a}	8.60^{ab}	8.99^{a}	9.13^{a}	0.09
*Red Blood Cell ($x10^{12}$/l)	3.00^{ab}	3.70^{a}	3.40^{a}	3.72^{a}	0.11
*White Blood Cell ($x10^{9}$/l)	7.94^{c}	8.21^{b}	8.56^{a}	8.56^{a}	0.09

^{abc} Means on the same row with different superscripts are significantly ($p<0.05$) different.
SEM = Standard error of mean

Average daily feed intake showed significant ($p<0.05$) effect among treatment group. Values for birds in treatment 3 (96.21g) was significantly ($p<0.05$) different from those obtained for birds on treatment 2 (94.99 g), 1 (93.12g) and 4 (92.49g) respectively. The result was in variance with the observation made by Mehala and Moorthy (2008) where they claimed that there were no significant ($p>0.05$) difference between the control and the treatments groups, probably due to the iso-caloric and iso-nitrogeneus nature of the experimental diets. The blood parameters for hematology were significantly ($p<0.05$) affected by lemon grass leaf meal across the treatment group, even though they did not follow a particular pattern. All values obtained for packed cell volume (PCV), hemoglobin (Hb), red blood cell (RBC) and white blood cell (WBC) studied falls within the normal ranges for broiler as reported by The Merck Veterinary Manual (2015). The improvement in the haematological constituents observed in the present study is an indication that the inclusion of lemon grass leaf meal did not show any pathological effect on the bird thus did not cause or create any haematological disorder.

Conclusion

Thus it can be concluded from the results obtained that the inclusion of lemon grass leaf meal in the diet of starter broiler birds up to 2.25% is acceptable by the birds without any decrease in growth performance and no negative effect in terms of their health status as reflected in the percentage mortality value and haematological profile results.

References

Akhila, A. (2010). Essential oil bearing grasses: The genus *Cymbopogon.* Medical and aromatic plants-industrial profile. Taylor and Francis Group. L.L.C.

Ceylon, E. and Fung, O.Y.C. (2004). Antimicrobial activity of species. *J. Rapid Methods. Autom. Microbiol.,* 12(1): 1-55.

Mehala, M. and Moorthy, M. (2008). Production performance of broilers fed with Aloe vera and Curcuma longa (Turmeric). Int. J. Poult. Sci., 7: 862-871.

Mirghani, M.E., Parveen, J. and Liyana, Y. (2010). Comparison studies of chemical composition analysis from different parts of lemon grass (*Cymbopogoncitratus*) essential oil.*In:Proceedings of the 9th International annual symposium on Sustainability Science and Management*. Pp. 232-237.

Mmereole, F.U.C. (2010). Effect of lemon grass leaf meal feed supplement on growth performance of broiler chicks. Int. J. of Poult. Sci. 9(120: 1107-1111.

Obi, I.U. (2002). Statistical methods of detection differences between treatments mean and research methodology issue in laboratory and field experimentation. A.P. Company Ltd. Enugu State, Nigeria.

Onyimonyi, A.E., Olabode, A.D and Okeke, G.C (2009). Performance and economic characteristics of broilers fed varying levels of neem leaf meal. *International Journal of Poultry Science*, 8(3): 256-259.

PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF LAYING HENS FED DIETS SUPPLEMENTED WITH SELENIUM AND VITAMIN E

Jemiseye, F. O., Ogunwole, O. A., Adedeji, B. S. and Mosuro, A. O.
Agricultural Biochemistry & Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria

Abstract
An experiment was conducted to assess the effect of supplemental selenium and vitamin E on performance and blood profile of laying hens. In a completely randomised design, ISA brown hens (n=192) at week 20 of age were assigned to six experimental diets: T1 (Basal diet), T2 (Basal diet + 0.5 mg selenium), T3 (Basal diet + 1.0 mg selenium), T4 (Basal diet + 1.5 mg selenium), T5 (Basal diet + 20 mg vitamin E), T6 (Basal diet + 40 mg vitamin E*). Each treatment was replicated four times with eight birds per replicate. Data were recorded daily for performance characteristics.* At week 26, blood was sampled from hens and analysed using standard procedures. Supplemental selenium and vitamin E had no significant effect (p>0.05) on hens' performance. However, dietary supplemental selenium and vitamin E had significant influence on eosinophils and monocytes. Eosinophils of hens on T1 (4.25) was similar to 4.00, 3.50, 4.33 and 3.75 recorded for hens on T2, T3, T4 and T5, respectively but higher than 1.33 obtained for hens on T6. Similarly, monocyte value in T1 (2.0) was similar (p>0.05) to T2 (3.25) and T3 (3.25) but lower than 4.00, 3.75 and 4.00 obtained in hens on T4, T5 and T6, respectively. It was therefore concluded that supplementation of vitamin E and selenium up to 40 mg/kg and 1.5 mg/kg, respectively had no significant effects on hen's performance.
Keywords: Performance, Haematology, Selenium, Vitamin E, Stress.
Corresponding author: jemiseyefo@gmail.com**, 08037064917**

Introduction

Stress exerts negative effects on the body such as disturbance of acid-base balance of the blood, various changes in metabolism and oxidative damage to the cells (Ertas and Sahik 2002). This often has resultant effect on egg production and quality, feed consumption, live weight and overall productivity in chickens.

When formulating feed for animals, nutritionists take into account several factors including stress management and immunity enhancement as very critical (Linge, 2005). The use of antioxidant nutrients in this respect cannot be overemphasized. Antioxidants are substances that can scavenge, suppress or reduce the formation of reactive oxygen species (Khan *et al*., 2011; Lu *et al*., 2010) that are constantly produced *in vivo* in the course of the physiological metabolism in tissues (Surai, 2015). Reactive oxygen species are detrimental to productive performance in laying birds (Assar *et al*., 2016). Antioxidants nutrients such as vitamin E and selenium *have been implicated in immune functions of domestic animals (Finch and Turner, 1996) and* with important roles in maintaining chicken health, productive and reproductive performance (Surai, 2002). However, there have been conflicting reports (Scheideler, 2010: Adebiyi *et al*., 2004) on the benefits of Selenium and vitamin E in poultry. *Therefore, t*he objective of this study was to evaluate the effect of dietary selenium and α-tocopherol supplementation on performance and haematological status of laying hens.

Materials and methods

Experimental Site and Animal Allotment

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. *A total of 192, ISA brown hens at the point of lay (20 weeks of age) were assigned to six experimental diets in an experiment that lasted twenty weeks. The experiment was a completely randomized design with each treatment replicated four times and with eight birds per replicate.*

Experimental Diets

Basal diet was supplemented with selenium and vitamin E as follows: T1=Basal diet, T2=Basal diet + 0.5mg selenium/kg, T3= Basal diet + 1.0mg selenium/kg, T4= Basal diet + 1.5mg selenium/kg,

T5=Basal diet + 20mg vitamin E/kg, T6=Basal diet + 40mg vitamin E/kg*)* Feed and water were supplied *ad libitum*. (Jemiseye and Ogunwole 2019).

Data collection and analysis

During the period of the trial, pen temperature-humidity index was monitored three times daily, between the hours of 7:00-8:00, 12:00-13:00 and 17:00-18:00 using digital thermo-hygrotherms placed strategically at different locations within the pen house. Temperature Humidity Index (THI) was calculated from the average ambient temperature and relative humidity obtained using the formula: THI = 0.6 T_{db} + 0.4 T_{wb}, where, T_{db} = dry bulb temperature and T_{wb} = wet bulb temperature.
Eggs were collected daily and recorded, hen day egg production was calculated by number of eggs laid divided by number of chicken at the period of data collection, feed intake was calculated by subtracting left over from feed offered to the chickens, egg were weighed with sensitive scale to obtain egg weight and egg mass was calculated from the percent hen day egg production and average egg weight. At week 26 of laying, blood was collected from two birds per replicate via the jugular vein into heparinized test tubes for haematology. Packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC) and differential counts were determined using standard procedures (Schalm *et al.*, 1975).

Statistical analysis

Data were subjected to analysis of variance using the SAS (1999) package. Means were separated using Duncan's multiple range test of the same package.

Results and Discussion

Temperature-humidity index of the experimental pen: Temperature-Humidity index of the experimental pen is shown in Figure 1. The maximum and minimum values were 30.40 and 25.10, respectively. The reported temperature and relative humidity were higher than thermoneutral temperature range (18-22 ^{o}C) of laying chicken reported by Charles (2002). Pen house temperatures beyond thermoneutrality have been reported to aggravate stress in chickens (Adedeji and Ogunwole, 2018) as higher ambient temperature and relative humidity have direct implications on feed consumption.

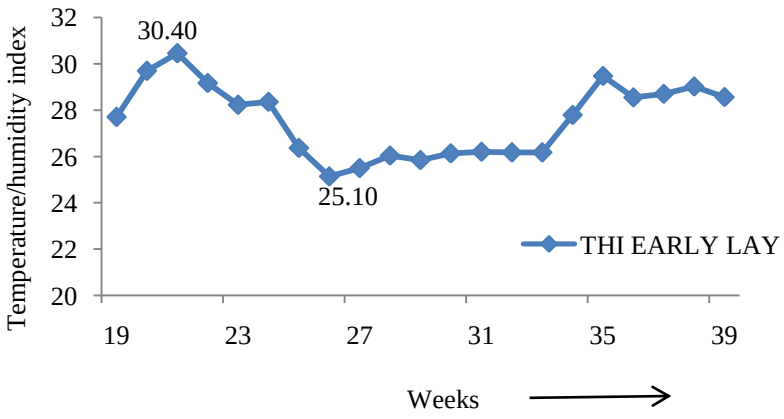


Figure 1: Temperature-humidity index of the experimental pen

Performance of laying chickens: Performance of laying chicken fed diet supplemented with selenium and vitamin E is shown in Table 1. **S**upplementation of layers' diet with selenium and vitamin E at the early laying phase did not have any significant effects ($p>0.05$) on the performance parameters measured. This observation corroborated earlier findings of Adebiyi *et al.* (2014) that neither vitamin E nor selenium and their combination increased hen day percentage and weight in turkeys. Also, Scheideler (2010) reported that there were no overall effect of vitamin E on egg production. Although, high temperatures have been reported to reduce production performance in

laying hens (Deng *et al.*, 2012), this was not so as observed in this study. This may further emphasise the alleviating effect of antioxidants (Se and vitamin E) in stress management *(*Khan *et al*., 2011*)*.

Table 1. Performance of laying chicken fed diet supplemented with selenium and vitamin E

Parameters	T1	T2	T3	T4	T5	T6	SEM
Hen day egg production (%)	40.80	36.98	43.88	35.60	46.34	42.99	1.79
Feed intake (g)	90.46	96.88	92.63	94.04	94.38	98.67	1.38
Egg weight (g)	53.28	57.77	51.95	50.93	53.69	58.72	1.56
Egg mass (g)	21.79	21.46	22.88	17.90	24.94	25.63	1.25

T1-Basal diet, T2-Basal diet+0.5mg selenium/kg, T3-Basal diet+1.0mg selenium/kg, T4-Basal diet+1.5mg selenium/kg, T5-Basal diet+20mg vitamin E/kg, T6-Basal diet+40mg vitamin E/kg. Means in the same row with different superscripts are significantly different (P<0.05). SEM-standard error of mean

Haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation. Table 2 shows the haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation. There were no significant differences (p> 0.05) across treatments for all haematological parameters measured except for monocytes and eosinophils. Eosinophils of hens on T1 (4.25) was similar to 4.00, 3.50, 4.33 and 3.75 recorded for hens on T2, T3, T4 and T5, respectively but higher than 1.33 obtained for hens on T6. Similarly, monocyte value in T1 (2.0) was similar (p>0.05) to T2 (3.25) and T3 (3.25) but lower than 4.00, 3.75 and 4.00 obtained in hens on T4, T5 and T6, respectively. Blood is significant in measuring the physiological, nutritional and pathological status of animals (Olorode *et al*., 2007). Elevated monocyte and eosinophil levels observed in this study was an indication that inclusion of the supplements improved the responsiveness of the immune cells to invading germs. This observation supports earlier position of *Finch and Turner (1996)* on the relevance of Se and vitamin E in immune function. Bush (1991) had earlier pointed out that low levels of WBC especially eosinophil and basophil in chickens could lead to poor immunity against diseases and may be an indication of poor health conditions due to parasitic disturbances. A slight deviation from this was observed in T6 for eosinophils. This however could imply that supplemental vitamin E beyond 20mg/kg of diet may lower eosinophil count in chicken.

Table 2: Haematological parameters of laying chickens fed levels of dietary selenium and vitamin E supplementation

Parameters	T1	T2	T3	T4	T5	T6	SEM
PCV (%)	28.50	28.75	30.75	30.66	31.25	29.33	0.73
RBC (x100^{6}IU/L)	2.91	3.09	3.30	2.87	2.87	3.37	0.10
Hb (g/100mL)	9.30	9.45	10.22	10.03	10.40	9.03	0.28
PLAT (x100^{5})	1.62	1.72	2.41	2.31	2.28	2.06	1.34
WBC (×10^{10}IU)	1.77	1.81	1.98	1.89	1.98	1.85	3.37
LYMP (%)	64.00	64.25	58.50	65.66	63.25	57.00	1.47
HET (%)	29.75	30.25	35.75	25.33	31.50	35.66	1.56
HET:LYMP	0.48	0.48	0.63	0.40	0.50	0.63	0.03
MON (%)	2.00^{b}	3.25^{ab}	3.25^{ab}	4.00^{a}	3.75^{a}	4.00^{a}	0.22
EOS (%)	4.25^{a}	4.00^{a}	3.50^{a}	4.33^{a}	3.75^{a}	1.33^{b}	0.32

T1-Basal diet, T2-Basal diet+0.5mg selenium/kg, T3-Basal diet+1.0mg selenium/kg, T4-Basal diet+1.5mg selenium/kg, T5-Basal diet+20mg vitamin E/kg, T6-Basal diet+40mg vitamin E/kg. PCV-Packed cell volume, RBC_ Red blood cell, WBC_ white blood cell, Hb- Haemoglobin, LYMP-Lymphocytes, HET-Heterophyl, PLAT-platelets, MON- Monocytes, EOS-Eosinophils. ^{ab}Means in the same row with different superscript are significantly different (P<0.05).

Conclusion

Supplemental selenium and vitamin E in the diets of laying hens had no effects on performance and haematological parameters except for monocytes and eosinophils.

References

Adebiyi, O. A. Oludare, O. F. Majekodunmi, B and Adeniyi, O. A. (2014). Effect of Vitamin E or Selenium on Blood Profile and oxidative Stability of Turkey meat. *Journal of Animal Production Advances,* **4**(7). 469-475.

Adedeji, B. S. and Ogunwole, O. A. (2018). Performance and physiological response of heat stressed growing pullets fed diets supplemented with ascorbic acid. *Nigerian Journal of Animal Production* **44**(5): 167-176.

Assar, A. S., Muhammad S. K., Saleem, K., Nazir, A., Ibrahim, A. A., Rifat, U. K. and Tao, S. (2016). Effect of different levels of alpha tocopherol on performance traits, serum antioxidants enzymes, and trace elements in Japanese quail (Coturnix coturnix japonica) under low ambient temperature. *Revista Brasileira de Zootecnia*, **45**(10): 622-626.

Bush, B. M. (1991). **Interpretation of Laboratory Results for Small Animal Clinicians**. Backwell Scientific Publications, London, ISBN: 9780408108492, Pages: 515.

Charles, D. R. (2002). **Responses to the thermal environment.** In: Poultry Environment Problems, A guide to solutions (Charles, D.A. and Walker, A.W. Eds.), Nottingham University Press, Nottingham, United Kingdom, pp.1-16.

Deng, W., Dong, X. F., Tong, J. M. and Zhang, Q. (2012). The probiotic Bacillus licheniformis ameliorates heat stress-induced impairment of egg production, gut morphology, and intestinal mucosal immunity in laying hens. *Poultry Science*, **91**(3) :575-82.

Ertas, N. O. and Sahik, K. 2002 preventing heat stress with different feeding methods in laying hens. *Turkish Journal of Veterinary and Animal Science*, **26**: 453-462

Finch, J. M., Turner, R. J. (1996). Effects of selenium and vitamin Enon immune responses of domestic animals. *Research in Veterinary Science* **60**: 97-106.

Jemiseye, F. O. and Ogunwole, O. A. (2019). Effects of serial dietary supplement of selenium and vitamin E on laying hens performance, egg quality attributes and deposition of vitamin E in eggs. *Journal of Animal Production Research,* **31** (1): 101-110.

Khan, R., Naz, S., Nikousefat, Z., Tufarelli, V., Javdani, M., Rana, N. and Laudadio, V. (2011). Effect of vitamin E in heat-stressed poultry. *World's Poultry Science Journal*, **67**: 469-478.

Linge P. (2005). The use of probiotic and yeast derivatives in India. *World Poultry* 21: 12-15

Lu, T., Piao, X. L., Zhang, Q., Wang, D., Piao, X. S. and Kim, S. W. (2010). Protective effects of *Forsythia suspensa* extract against oxidative stress induced by diquat in rats. *Food Chemical Toxicology*, **48**: 764-770

Olorode, B. R., Adeniran, R. A. and Abiola, J. O. (2007). Effect of graded levels of *Moringa oleifera* seed meal on haematological values and organs weight of broiler chicken. *Tropical Journal of Animal Science,* **10**: 63-67.

Packer, L. (1991). Protective role of vitamin E in biological system. *American Journal of Clinical Nutrition,* **53**:1050-1055.

SAS (1999). SAS/STAT User's guide Version 8 for windows SAS Institute Inc. cary NC.

Schalm, O. W., Jain, N. C. and Carroll, E. J. (1975). Veterinity haematology (3rd ed., p.15- 218). USA: Lea & Fabiger, Philadelphia.

Scheideler, S. E. (2010). Supplemental vitamin E and selenium effects on egg production, egg quality, and egg deposition of α-tocopherol and selenium. *The Journal of Applied Poultry Research*, Volume **19** (4): 354–360.

Surai, P. F. (2015). Antioxidant Systems in Poultry Biology: Superoxide Dismutase. *Journal of Animal Research and Nutrition*, 1:8.

Surai, P. F. (2002). **Selenium: Natural Antioxidants in Avian Nutrition and Reproduction**. Nottingham, Nottingham University Press, UK.

GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEANER PIGS FED CEREAL OFFALS IN DIETS

***Wafar, R.J., Tarimbuka, L.I and Sini, T.**

[1]Department of Animal Production and Health, Federal University Wukari, PMB 1020 Wukari Taraba State

[2]Department of Animal Health and Production Technology, Adamawa State College of Agriculture, Ganye, Nigeria.

[3]Department of Agriculture Education, Adamawa State College of Education, Hong Adamawa State

*Corresponding Author: rjwafari@gmail.com Phone No.: Tel: +2348066320686

Abstract

Twenty (20) weaned crossbred (Landrace × large white) pigs with an average body weight of 8.5±0.4 kg were used to evaluate performance and nutrient digestibility of weaned pigs fed five experimental diets containing cereal milling by-products. Diet 1 contained maize offal, while diets' 2, 3, 4 and 5 contained wheat offal, sorghum offal, millet offal and rice offal respectively. The animals were balanced for sex and weight and allotted to five dietary treatments and replicated four times in a completely randomized design. Data were collected on feed intake and weight gain for a period of eight weeks. A digestibility trial was carried at the end of the feeding trial using four pigs per treatment. Average daily weight gain ranged from 0.21kg/ day (T5) to 0.44kg/day in (T1). The result of growth performance and nutrient digestibility showed that average feed intake, final body weight as well as digestibility of dry matter, crude fibre, ether extracts, crude protein and ash were higher ($P<0.05$) for pigs fed T1, T2, T3 and T4, while those on T5 had the lowest growth and nutrient digestibility. It was concluded that maize offal, wheat offal, sorghum offal, millet offal can be used in weaner pigs' diet.

Keywords: Digestibility, Growth performance, offal, Pigs

Introduction

High cost of feeding has been identified as one the major impeding factors affecting the pig industry in developing countries (Uddin and Osasogie, 2016). This is as a result of continued increase in prices of conventional feedstuffs which are mostly used as sources of dietary energy and protein. However, for the pig industry to remain profitable, development of low- cost feeding strategies which are locally available to pig farmers has been the major challenge of animal nutritionist (Nelson *et al.* 2007). The use of agro-based by-products in pigs has been evaluated by various researchers indicating improved growth performance (De Lange *et al*. 2010; Kim *et al.* 2011) while others reported depressed performances (De la Llata *et al*. 2001) as a result of high dietary fibre depending on the cereal type (Freira *et al*. 2000; Galassi *et al.* 2004), type and extent of milling (Amaefule *et al.* 2009) as well as climate and soil conditions where the grain is produced (Wenk 2001). The comparative evaluation of feeding the cereal milling by products on pig performance and nutrient digestibility is scanty. This study therefore assessed the performance of weaned pigs fed diets containing cereal milling by-products.

Materials and methods

Experimental animals and their management

Twenty (Landrace × Large white) pigs with an average initial body weight of 8.00±0.56 kg were used. Each pen had solid concrete floor and were fitted with water and feed troughs. The pigs were treated against parasites using Ivomectin®. The pigs were offered experimental diets and water *ad libitum*.

Experimental diets

Five experimental diets (Table 1) were formulated based on the five cereal milling by-products i.e. maize offal, wheat offal, sorghum offal, and millet offal and rice bran. They were purchased at the agro-by product market in Yola. Diet 1 contained maize offal, while diets' 2, 3, 4 and 5 contained wheat offal, sorghum offal, and millet offal and rice bran.

Experimental design and data collection

Twenty weaner pigs were randomly allotted to five dietary treatment groups replicated 4 times in a Completely Randomized Design. Data were collected for eight weeks. Pigs were weighed at the beginning of the experiment and weekly, subsequently. Weight gain was calculated as final live weight minus initial live weight. Feed intake was obtained as the difference between the quantity offered and quantity not consumed. Feed conversion ratio (FCR) was calculated as feed intake divided by weight gain

Statistical analysis

Data collected were subjected to one way analysis of variance means were separated using Duncan's Multiple Range Test using SAS (2003).

Table 1 Ingredient and Percentage Composition of Experimental Diets

	Dietary treatments				
Ingredient	T1	T2	T3	T4	T5
Maize offal	56.00	0.00	0.00	0.00	0.00
Millet offal	0.00	56.00	0.00	0.00	0.00
Sorghum offal	0.00	0.00	56.00	0.00	0.00
Wheat offal	0.00	0.00	0.00	56.00	0.00
Rice offal	0.00	0.00	0.00	0.00	56.00
Soybean cake	20.00	20.00	20.00	20.00	20.00
Kapok seed cake	10.00	10.00	10.00	10.00	10.00
Fishmeal	10.00	10.00	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
Determined analysis					
ME/Kcal/kg	2727.91	2701.56	2768.89	2834.56	2714.56
Crude protein	20.79	20.12	20.89	20.89	20.10
Crude fibre	16.45	17.34	17.12	18.05	20.56

Vitamin/Mineral premix from Bio-organics supplied per kg: Vit. A, 10,000 iu; Vit. B, 2,000 iu; Vit. E, 13,000 iu; Vit. K, 1,500mg; Vit. B12, 10mg; Riboflavin, 5,000mg; Pyridoxine,1,300mg; Thiamine, 1,300mg; Panthothenic Acid; 8,000mg; Nicotinic Acid, 28,000mg; Folic Acid, 500mg; Biotin, 40mg; Copper,7,000mg; Manganese, 48,000mg, Iron, 58,000mg; Zinc, 58,000mg; Selenium, 120mg; Iodine, 60mg; Cobalt, 300mg; Choline,275,000mg**.**

Results and discussion

The crude protein and fibre of the cereal offal are represented in Table 2. The values recorded were similar to that of Aduku, (1993).

Crude protein and fibre composition of cereal offals

Parameter	Crude protein	Crude fibre
Maize offal	11.8	10.52
Wheat offal	12.00	10.56
Sorghum offal	12.56	9.23
Millet offal	11.1	7.50
Rice bran	13.20	11.50

Growth performance of weaner pigs fed cereal offal in diets

Table 3 shows the effect of the cereal offal on the growth performance weaner pigs. Final body weight, average daily feed intake (ADFI), average daily gain (ADG) and feed conversion ratio (FCR) were significantly (P<0.05) influenced by experimental diets. ADWG, ADFI and final weight were significantly higher (P<0.05) for pigs fed T1, T2, T3 and T4 diets than those fed T5 diet. This could be due to the palatability and acceptability of this diets as demonstrated by high intake of the diet and high ADG. The result agreed with the findings of García-Valverde *et al.* (2008) and Mwesigwa *et al.* (2012) who fed by-products of maize and that of wheat. The dietary fibre in T1, T2, T3 and T4 diets could have improved pig gut morphology, hence stimulating mucosa enzyme activity which eventually improves nutrient digestibility and growth olist *et al.* 2009). Pigs fed T5 diet had significantly (P<0.05) lower feed intake. Low protein intake has been reported to result in slow growth rate of pigs (Nyachoti *et al.* 2006)

Table 3 Growth Performance of weaner pigs fed offals

	Dietary treatments					
Parameter	T1	T2	T3	T4	T5	SEM
Initial body weight (kg)	8.56	8.77	8.69	8.69	8.76	0.23
Final body weight (kg)	38.25^{a}	31.75^{a}	30.00^{ab}	32.75^{a}	21.00^{c}	1.70
Average daily weight gain (kg)	0.44^{a}	0.41^{a}	0.37^{a}	0.42^{a}	0.21^{b}	0.03
Average daily feed intake (kg)	1.42^{a}	1.47^{a}	1.42^{ab}	1.47^{a}	0.90^{c}	0.04
Feed conversion ratio	3.24^{b}	3.60^{b}	3.84^{b}	3.59^{b}	4.32^{a}	0.38

Mean on same row bearing different superscript differ significantly (P<0.05)
SEM = Standard error mean

Nutrient digestibility of weaner pigs fed offals in diets

Nutrient digestibility of the diets is presented in Table 4. DM, CF, CF, EE and ash digestibility were significantly higher (P<0.05) for pigs fed T1, T2, T3 and T4 diets than those fed T5 diet. Nutrients digestibility of pigs fed T5 diet was significantly lower (p<0.05). Lower values of nutrient digestibility observed in T5 diet could be attributed to the decrease in the mean retention time of this diet in the gastro-intestinal tract (Bindelle *et al.* 2008) brought about by higher levels of fibre, compared with those in T1, T2, T3 and T4 diets. High dietary fibre depresses apparent digestibility of dry matter and nitrogen, decreases daily body weight and increase feed to gain ratio The higher fibre digestibility observed for pigs fed T1, T2, T3 and T4 diet could have resulted from fermentation of CF in the hind gut with the volatile fatty acids produced contributing to the net energy requirement of the pigs. Birkett, (2005) reported VFAs contribute about 5–28 % of the energy required for maintenance in the growing pig resulting from fermentation of fibre in the gastro-intestinal. Utilisation of CF by non-ruminants has been shown to vary considerably according to the fibre source (Freira *et al*. 2000; Galassi *et al*. 2004), degree of lignification, level of inclusion and the extent of processing (Amaefule *et al.* 2009).

Table 4 Nutrient digestibility of weaner pigs fed cereal milling by –products In Diets

	Dietary treatments					
Parameter (%)	T1	T2	T3	T4	T5	SEM
Dry matter digestibility	86.42^{a}	82.57^{a}	81.50^{a}	80.94^{ab}	74.13^{c}	1.34
Crude protein digestibility	66.15^{a}	69.06^{a}	69.80^{a}	68.62^{a}	50.67^{b}	1.55
Crude fibre digestibility	72.94^{a}	73.42^{a}	69.38^{ab}	72.38^{a}	49.19^{a}	1.97
Ether extracts digestibility	73.93^{a}	72.17^{a}	70.73^{a}	70.81^{a}	52.13^{b}	2.64
Ash digestibility	60.56^{a}	62.53^{a}	69.39^{a}	59.67^{ab}	50.53^{c}	1.09

Mean on same row bearing different superscript differ significantly (P<0.05)*
SEM = Standard error mean

Conclusion

The study reveals that using maize offal, sorghum offal, wheat offal and millet offal in the diet of weaned pigs improves their growth and nutrient digestibility, compared to rice bran. It is therefore recommended that pig farmers, animal nutritionist and feed milling industries should include maize offal, sorghum offal, wheat offal and millet offal in the diet of weaner pigs.

References

Amaefule, K.U., Abasiekong, S.F., Ibe, S.N. and Onwudike, O.C. (2009). Digestibility and nutrient utilization of some agro-industrial by-products fed to growing pigs in the humid tropics. *Pakistan Journal of Nutrition 8, 355–360*

Bindelle, J., Leterme, P. and Buldgen, A. (2008). Nutritional and environmental consequences of dietary fibre in pig nutrition: a review. Biotechnology Agronomy Social Environment12, 69–80

De Lange, C.F.M., Pluske, J.R., Gong, J. and Nyachoti, C.M.. (2010). Strategic use of feed ingredients and feed additives to stimulate gut health and development in young pigs. Livestock Science 134, 124–134

De la Llata, M., Dritz, S.S., Tokach, M.D., Goddband, R.D., Nelssen, J.L. and Loughin, T.M. (2001). Effect of dietary fat on growth performance and carcass characteristics of growing-finishing pigsreared in a commercial environment. *Journal of Animal Science79, 2643–2650*

Freira, J.P.B., Guerreiro, A.J.G., Cunha, L.F. and Aumaitre, A. (2000). Effect of dietary fibre source on total tract digestibility, caecum volatile fatty acids and digestive transit time in the weaned piglet. *Animal Feed Science and Technology 87, 71–83*

Galassi, G., Crovetto, G.M., Rapetti, L. and Tamburini, A. (2004). Energy and nitrogen balance in heavy pigs fed different fibre sources. *Livestock Production Science 85, 253–262*

García-Valverde, R., Barea, R., Lara, L., Nieto, R. And Aguilera, J.F. (2008). The effects of feeding level upon protein and fat deposition in Iberian heavy pigs. *Livestock Science114, 263–273*

Kim, J.C., Mullan, B.P., Nicholls, R.R. and Pluske, J.R.. (2011). Effect of Australian sweet lupin (Lupinus angustifolius L.) inclusion levels and enzyme supplementation on the performance and meat quality of grower/finisher pigs. *Animal Production Science 51, 37–43*

Molist, F., Gomez de Segura, A., Gasa,J., Hermes, R.G., Manzanilla, E.G., Anguita, M. and Perez, J.F. (2009). Effects of the insoluble and soluble dietary fibre on the physiochemical properties of digesta and microbial activity in early weaned piglets. *Animal Feed Science and Technology 149, 346–353*

Mwesigwa, R.,Mutetikk, D and Kugonza, D.R. (2012). Performance of growing pigs fed diets based on by-products of maize and wheat processing. *Tropical Animal Health and Production 43(3) 1-10*

Nelson, F.S., Ameleke, G.Y., Donkoh, A. and Lamptey, V. (2007). Use of locally available agro-industrial by-products (AIBPs) for egg production in the Western Region of Ghana. The results of an on farm trial. Proceedings Ghana Society Animal Production Symposium, 15, 103–107

Nyachoti, C.M., Omogbenigun, F.O., Rademacher, M. And Blank, G., (2006). Performance responses and indicators of gastrointestinal health in early-weaned pigs fed low-protein amino acid supplemented diets. *Journal of Animal Science 84, 125–134*

SAS, (2003). SAS User's Guide: Statistics. SAS Inst., Inc., Cary, NC, USA

Uddin, O and Osasogie, D.I (2016) Constraints of Pig Production in Nigeria: A Case Study of Edo Central Agricultural Zone of Edo State. *Asian Research Journal of Agriculture 2(4): 1-7*

Wenk, C. (2001). The role of dietary fibre in the digestive physiology of the pig. *Animal Feed Science and Technology 90, 21–33*

NUTRIENT DIGESTIBILITY OF CROSSBRED WEANED PIGS FED SUNDRIED CASSAVA STARCH EXTRACT PULP

Ogunbode, A.A., Adams, T.O and Oyeboade, A.A

Department of Animal Production Technology

Faculty of Animal and Fisheries Technology

Oyo State College of Agriculture and Technology, Igboora

+2348062455318 aaogunbode@gmail.com

Abstract

As the search for alternative sources of energy for monogastrics animals to reduce competitions between humans and industries for available conventional feedstuffs continues, this study was undertaken to investigate the effect of sundried cassava starch extract pulp on nutrient digestibility of crossbred weaned pigs. Cassava starch extract pulp from cassava processing factory in Ado-Awaye near Iseyin in Oyo State were processed into meal by sundrying for three weeks and included in diets at graded levels of 0%, 25%, 50% and 75% in a complete randomized design experiment using eight weeks old crossbred (largewhite x landrace) weaned pigs. Crude protein, ash, crude fibre, ether extract, dry matter, nitrogen free extract similarly gave values on the processed sundried cassava starch extract pulp diets that were comparable or even superior to values on the control diet ($p<0.05$). Based on the findings of this study, it is concluded that inclusion of sundried cassava starch extract pulp meal in diet at 75% has no deleterious effects on nutrient digestibility of crossbred weaned pigs.

Keywords: nutrients, digestibility, weaned pigs, sundried, cassava starch extract, pulps

Introduction

The high nutritive value, relative cheap cost of production and short gestation period of pig enable pig product (pork) to be the ideal animal protein source for feeding the world human population. Despite this, high feed cost remains a major bottleneck to efficient and improve pig farming. Cribb, (2010) opined that orthodox feed ingredients used in formulating pig diets are in short supply mainly as a result of the increase in human population and unfavorable climatic conditions. The high demand for conventional energy and protein feed ingredients as food by the ever growing world human population and other industrial uses has increased research interest in alternative cheaper ingredients for pig feeding. Cassava pulp is a solid by product of starch production from cassava root. During starch production, cassava pulp yields from 10 – 15% of the root which is a readily available material in major starch producing countries (Khempaka *et al*., 2009).Cassava pulp is rich in starch ranging from about 54 -70% (Khempaka *et al*., 2014) and the pulp is reported to contain between 4.40%, 1.30%, 3.15%, and 0.71% of ash, crude protein, crude fibre and ether extract respectively (Ogunbode, *et al*., 2019). Suksombat *et al*., (2007) opined that cassava pulp contains 36.7% neutral detergent fibre, 9.8% acid detergent fibre and 3.9% acid detergent lignin. The by- products of cassava processing stand out as cheaper energy substitutes for feed formulation for animals and this would probably enhance the reduction of agribusiness waste which are often discarded indiscriminately in the environment. All these by- products are generally found in the vicinity of factories where cassava tubers are processed into starch. As cassava starch production increases, so does the large volume of waste by – product generated. This study was therefore conducted to investigate the nutrient digestibility of crossbred weaned pigs fed sundried cassava starch extract pulp.

Materials and Methods

The experiment was carried out at the piggery unit of the Teaching and Research Farm, of the Oyo State College of Agriculture and Technology Igboora, Nigeria. The experimental areas lie in savannah forest zone on latitude 7^0.43N and latitude 3^0.28E in an elevation of 140m, above the sea level. The average minimum temperature is above 21.5^0C and maximum average temperature is about 32.5^0C. The cassava starch extract pulp was collected from Psaltery Farm International along Ado- Awaye Maya Road. The fresh cassava starch pulp collected was sundried for three weeks based on intensity of the sun and environmental temperature after which it was milled using hammer mill and stored for proximate analysis. Sixteen (16) crossbred large white X landrace weaned pigs in their 8th weeks of age was obtained from the piggery unit of the College. The pigs were dewormed to eliminate both endo and ectoparasite using ivomec at1ml per body weight and offered feed at 4% of their body weight at the beginning of the experiment and with subsequent increase as the animals' age while water was supplied *ad libitum*. The pigs were allowed three (3) days of acclimatization and were fed twice daily in the morning (7:30am) and evening (4:00pm). The experiment lasted 56 days. Proximate analysis of sundried cassava starch extract pulp was carried out according to the procedure of AOAC (2010). Two pigs per treatment was randomly selected and housed separately in individual pens and were acclimatized for two days prior to the commencement of a five - days metabolic trial. A known weight of feed was fed to the pigs housed in individual pen. Total daily faecal sample was collected once in a day, sundried and later stored for analysis according to the procedure (Mc Donald *et al.,* 2002) as shown below:

Nutrient in feed = Amount of feed consumed x Nutrient of diet analyzed.

Nutrient in faeces = Amount excretal x % of excretal analyzed

$$\text{Nutrient Digestibility} = \frac{\text{Nutrient in feed} - \text{Nutrient in faecal}}{\text{Nutrient in feed}} \times \frac{100}{1}$$

The experimental design used was completely randomized design and data collected was subjected to one way analysis of variance and where significant differences exist between the means Duncan Multiple Range Test (Duncan, 1955) was used to separate the means.

Table 1. Nutrient digestibility of weaned pigs fed sundried cassava starch extract pulp

Parameters (%)	1	2	3	4	SEM
Crude Protein	14.55^{c}	15.40^{ab}	14.96^{bc}	16.01^{a}	0.23
Ash	10.50^{c}	13.10^{a}	11.04^{b}	11.10^{b}	0.30
Crude Fibre	7.50^{b}	9.80^{ab}	8.40^{ab}	9.10^{a}	0.29
Ether Extract	3.10	3.30	2.29	3.10	0.80
Dry Matter	90.50	89.77	90.10	90.36	0.10
NFE	64.35	64.17	62.70	60.60	1.09
Digestible Energy (Kcal/g)	1.10	1.12	1.11	1.13	0.00

a, b, c, d means on the same row with different superscript differ significantly ($p<0.05$)

NFE: Nitrogen Free Extract

Results and Discussion

The results of nutrient digestibility of crossbred weaned pigs fed sundried cassava starch extract pulp meal are presented in Table 1.There were significant ($p>0.05$) difference in crude protein, ash and crude fibre digestibility. Their improvements observed was as a result of processing techniques employed in reducing the toxins in cassava. Pigs in T4 reported the highest crude protein digestibility value of (16.01%) followed by those in T2 with a value of (15.40%), while the least values from pigs in T3 and T1. Ash digestibility were highest (13.10%) in pigs fed T2 while the least value (10.50%) was recorded for pigs in the control diets. Crude fibre digestibility was highest (9.30%) in pigs maintained on T2 and the pigs on the control recorded the lowest value (7.50%). Ether extract, dry matter and nitrogen free extract digestibility were not significantly ($p<0.05$) different across the treatment group as the values obtained on test ingredient compared favourably with those on the control. Higher crude protein, ash and crude fibre digestibility observed might be an indication of the better palatability of the diets contrary to the energy-diluting effects of higher dietary fibre in the diets. There was no significant ($p<0.05$) difference in the ether extract digestibility as the pigs on the test ingredient compared favourably with the pigs on the control diet. Dry matter and digestible energy digestibility follow the same pattern. This indicated that the appetite of pigs was not affected when sundried cassava starch extract pulp was incorporated in the diet up to 75%. Lizardo and Aumaitre (2001) stated that six to twelve percent of beet pulp in piglet diets did not affect total tract digestibility of energy and nitrogen. The values obtained for crude fibre digestibility increased with increased level of inclusion of sundried cassava starch extract pulp. The result implied that the inclusion of sundried cassava starch extract pulp had a positive effect on the digestion of dietary fibre. This result was in line with the findings of Zhang *et al.*, 2013 who opined that fibre digestibility was improved when total dietary fibre increased. The better digestibility of crude protein, ash and crude fibre could be attributed to increased short-chain fatty acid production and absorption in pigs fed with the high fibre diet (Ziemer *et al*., 2012).

Conclusion and Recommendation

It can be concluded that the inclusion of sundried cassava starch extract pulp up to 75% level has no adverse effect on nutrient digestibility.

References

AOAC, (2010). Association of Official Analytical Chemists. Official methods of Analysis 16th Ed. Washington DC. Arlinton.

Cribb, J. (2010). The coming famine (The global food crisis and what we can do to avoid it). CSIRO Publishing.

Duncan, O.B. (1955). Multiple Range and Multiple F Test. Biometrics, 11, Page 1- 42.

Khempaka, S.K., Thongkratok, S., Okrathok, and Molee, W. (2014). An evaluation of cassava pulp feedstuff fermented with *A. oryzae* on growth performance, nutrient digestibility and carcass quality of broilers. *J. Poult. Sci*., 51: 71 -79.

Khempaka, S., Molee, W. and Guillame, M. (2009). Dried cassava pulp as an alternative feedstuff for broiler: Effect on growth performance, carcass traits, digestive organs and nutrients digestibility. *Journal of Applied Poultry Research*. 18: 487 – 493

Lizardo, R and Aumaitre, A. (2001). Non – starch polysaccharides of sugar – beet pulp improve the adaptation to the starter diet, growth and digestive process of the weaned pig. In: J. Brufau (ed). Feed manufacturing in the Mediterranean region. Improving safety from

feed to food. Cahiers Options Mediterraneennes No. 54. P.185 – 189. Zaragoza: CIHEAM.

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D and Morgan, C.A. (2002). Animal Nutrition, 6th edition. Pearson, Prentice Hall, UK

Ogunbode, A.A., Akinosun, A.A and Olajide, T.M. (2019). Nutrient and anti- nutrient content of sundried cassava starch extract pulp. *J. Appl. Sci. Environ. Manage*. Vol. 23 (6).1133-1135

Suksombat, W., Lounglawan, P and Noosen, P. (2007). Energy and protein evaluation of five feedstuffs used in diet in which cassava pulp as main energy source for lactating dairy cows. *Suranaree J. Sci. Technol*. 14: 99 – 107.

Zhang, W., Li, D., Liu, L., Zang, J., Duan, Q., Yang, W and Zhang, L. (2013). The effects of dietary fiber level on nutrient digestibility in growing pigs. *Journal of Animal Science and Biotechnology*. 4: 17

Ziemer, C.J., Kerr, B.J., Weber, T.E., Arcidiacono, S., Morrison, M and Ragauskas, A. (2012). Effects of feeding fiber-fermenting bacteria to pigs on nutrient digestion, fecal output and plasma energy metabolites. *Journal of Animal Science*. 90: 4020 – 4027.

EVALUATION OF SUBSTITUTION LEVELS OF UNRIPE PLANTAIN PEEL (*MUSA PARADISCA*) MEAL ON THE PERFORMANCE OF GROWING JAPANESE QUAILS (*COTURNIX*).

*E.O. Ahaotu[1], and C.N. Nze

[1] Department of Animal Production Technology, Imo State Polytechnic Umuagwo, Nigeria.

*Corresponding author: emmaocy@yahoo.com 08038520777

Abstract

A total of fifty growing quail birds of two weeks of age were randomly assigned to five dietary treatments at 0, 7.91, 15.81, 23.73 and 30.51% in a completely randomized design experiment to evaluate the effect of unripe plantain peel meals on the growth performance of growing quails. A feeding trails lasting for 42 days was carried out. Results on performance showed that the dietary treatments influenced ($P<0.05$) final weight, total weight gain, total feed intake , average feed intake and feed conversion ration of the quail birds with the highest total weight gain (10.11) recorded for T_1 in the control diet . For total feed intake the values were 21.57, 22.60, 14.50, 4.07 and 6.00g. This study showed that incorporation of unripe plantain peel could economically replace maize at level of 30.51%; but for optimal growth performance of unripe plantain growing quail birds, feeding of UPPM at the level of 23.73% is advised.

Key words: Japanese Quails, Unripe Plantain Peel Meal, Maize, Performance, Feed efficiency.

Introduction

Quails (*Coturnix coturnix japonica*) are popularly known as a game bird since its domestication in the world. Presently, quail rearing has been popularized because of rapid economic return from commercial quail production. Meat and eggs of quail are highly accepted by people in many countries.

The high cost of feed ingredients in most tropical countries clearly indicates that the production of cereal grains for livestock business in these countries is grossly inadequate (Ahaotu et *al.*, 2010a). Feed cost alone accounts for 75-80% of the total costs of raising livestock (Ahaotu *et al.*, 2010b). This is due to ever increasing competition between man, and livestock for available feedstuffs.

Thus, there is an urgent need to divert our attention toward exploitation of other tropical sources. One such potential source that is not realized to its fullest extent is unripe plantain peels which are generally not used for human consumption. Therefore, any attempt to substitute maize in poultry feed will significantly reduce cost of production. As quail production attention is needed in the country, more effort should be geared towards increased research into possible use of alternative feed resource to improve cost effectiveness or gains in the production of quail meat and eggs. Quail birds are highly prolific and hardy. The meat is lean, both eggs and meat are low in cholesterol (Robbins, 1981). The effort at multiplying these birds, the more readily available will be the meat and eggs for human consumption with less risk of public health implications.

Plantain peels, a waste from plantain is observed to have some nutritional values as it contains about 12% crude protein, 16% crude fibre and 1300KCal/Kg energy on dry matter basis (Uwalaka *et al.*, 2013). The plantain peel waste is known to constitute menace to the society thereby adding to the worse problem of environmental pollution particularly in places where ruminants (sheep and goat) are not allowed to roam about (Ahaotu *et al.*, 2013). The authors further reported no significant difference in the weight gain of weaned rabbit fed 15% plantain peels in place of maize. Von Loesecke (1990) revealed that fresh plantain peels are good sources of energy for broilers.

The use of plantain peels in poultry has been limited because of possible deleterious effects arising from the presence of tannins. Tannins exist in plantain in two different forms (a) free or active tannins which are insoluble, supposedly inert and which have little or no effect on the palatability (Ukachukwu, 2000). The objectives of the study were to determine the performance of quail birds

feed graded levels of unripe plantain peels meal, determine the optimum level of inclusion of unripe plantain peels meal and to evaluate the proximate chemical composition of the test ingredient.

Materials and Methods

This experiment was carried out at the poultry unit of Teaching and Research Farm, Imo State Polytechnic Umuagwo – Ohaji, Nigeria..

Management of the birds

A total of fifty growing quail birds of two weeks of age were randomly assigned to five dietary treatments at 0, 7.91, 15.81, 23.73 and 30.51% in a completely randomized design experiment to evaluate the effect of unripe plantain peel meals on the growth performance of growing quails. A feeding trails lasting for 42 days was carried out. The birds were stabilized with commercial broiler starter diets for seven days after which their initial weight were measured and consequently weekly thereafter to determine their weight gain. Adequate medication was done using broad spectrum antibiotics and vitamins via drinking water.

Experimental diets

Five experimental broiler starter diets represented by T_1, T_2, T_3, T_4 and T_5 were formulated. Treatment (T_1) was the control and contained 0% unripe plantain peel meal. Feed and clean drinking water were supplied *ad libitum*.

Table 1: Proximate Analysis of Unripe Plantain Peel Meal.

Chemical	**Unripe plantain peel meal (%)**
Component	
Crude protein	10.64
Crude fibre	5.82
Ether extract	9.57
Ash	12.82
ME (Kcal/kg)	3918.90

Table 2. Nutrient composition of Experimental Diets

	%T_1 (Control)	**T_2 %**	**T_3%**	**T_4%**	**T_5%**
Maize	31.62	23.43	15.26	7.06	0.00
UPPM	0.00	7.91	15.81	23.73	30.51
GNC	38.68	39.23	39.23	39.52	39.79
PKC	14.00	14.00	14.00	14.00	14.00
Fish meal	1.50	1.50	1.50	1.50	1.50
Soya bean meal	10.00	9.73	9.71	9.99	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Calculated Crude Protein	20.59	20.10	20.89	20.63	20.92
ME/KCal/kg	2782.3	2799.8	2788.4	2783.7	2785.6

Key: UPPM= Unripe Plantain Peel Meal, GNC= Groundnut cake, PKC= Palm kernel cake

Experimental Procedure

At the end of the seventh day of the stabilization period with commercial feed, the birds were allocated to their various treatment diets. Their initial weights were determined using a weighing balance. Their feed intakes were calculated by subtracting the weight of left over feed from the weight of quantity of feed offered each day.

Data Analysis

Data generated was subjected to Analysis of variance (ANOVA). Means were separated using Duncan multiple range test (DMRT) (Gordon and Gordon, 2004).

Results and Discussion

The result of the nutrient composition of UPPM agrees with the report of Uwalaka *et al.,* (2013) who reported that UPPM contains 10.64% Crude protein, 5.82% Crude fibre, 9.57% Ether extract, 12.82% Ash and 71.2% Nitrogen free extract. Also, the values obtained on the nutrient composition of UPPM agrees with the values of 10-12% Crude protein, 8-11% Crude fibre, 11-16% Ash, 8-12% Ether extract reported by Nwifa and Hedo (2010).

Table 4: Growth Performance of Growing Japanese Quail Birds Fed Graded Levels of Unripe Plantain Meal (Uppm) from 2-6 Weeks

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial weight (g)	27.10	26.20	26.60	25.90	26.36	0.45^{ns}
Final weight (g)	37.44^{a}	34.00^{b}	31.86^{b}	28.33^{c}	26.40^{c}	0.69*
Total weight gain (g)	10.11^{a}	8.26^{ab}	5.57^{b}	2.00^{c}	0.80^{c}	0.05*
Daily weight gain (g)	1.44^{a}	1.18^{ab}	0.80^{b}	0.29^{c}	0.11^{c}	0.11*
Total feed intake (g)	21.57^{a}	22.60^{a}	14.50^{b}	6.00^{d}	4.07^{c}	0.43*
Av. Daily feed intake (g)	0.05^{b}	0.06^{a}	0.04^{c}	0.02^{d}	0.02^{d}	0.02*
Feed Conversion Ratio	2.04^{a}	2.13^{b}	2.60^{c}	2.74^{d}	3.50^{e}	0.03*
Age at First egg (day)	39.33^{a}	40.90^{a}	42.22^{a}	44.22^{b}	46.77^{c}	3.58*
First Egg Weight (g)	10.10	10.18	10.13	10.15	10.17	0.03^{ns}

abcde: Means with different superscripts within the same row are significantly($P<0.05$) different.
SEM= Standard error of the means.

The general increase in feed intake of birds in treatment 2 groups with increase in the dietary levels of UPPM could be attributed to the increased crude fibre content of the diet. As the inclusion levels of UPPM increased, there was a reduction in the feed intake of the diets. Thus, quails had to increase their feed intake to satisfy their energy needs. In addition, the higher the UPPM level, the higher the expected concentration of tannins which was reported to cause growth depression and increased feed conversion ratio (Calles *et al.*, 2010). Tannins also interferes with the digestive action of trypsin and α-amylose by forming an indigestible complex with the substrates (Ferket *et al.,* 1999) leading to poor digestibility.

Decrease in daily feed intake at higher levels of UPPM in this study did not agree with the findings of Uwalaka *et al.*, (2013) who observed a linear increase in feed intake as the level of maize replaced by UPPM increased. Also, Ahaotu *et al.,* (2013) observed that feed consumption and body weight gains especially in meat type birds decreased when birds were fed high fibre diets. There was a reduction in daily weight gain of birds with increased UPPM and with reduced maize levels of inclusion in the tested diets. This revealed the superiority of the quality of the control diet which contained higher levels of maize than other diets containing UPPM and maize.

Conclusion

UPPM was beneficial for inclusion in the diets of quails but separate use of either 7.91% or 15.81% UPPM (T_1 and T_2) gave good results during the grower phase. Also, utilization of UPPM at 30.51% inclusion levels during egg laying phase gave the best performance and did not affect egg production and egg quality. There is an economic advantage of using UPPM in quail diets with lower feed cost per kg weight gain and therefore, their usage should be encouraged.

References

Ahaotu E.O, B.U Ekenyem, E.A Agiang, V. Balakrishan and F.N Madubuike (2010a). Effects of dietary
substitution of rubber seed cake for groundnut cake on the body Conformation of Finisher Broiler. Anim.
Prod Adv 6: 49-52.

Ahaotu EO, Q Guang-Hai, BU Ekenyem , AU Korie and FN Madubuike (2010b). Replacement Value of
Feather Meal for Fish Meal on the Performance of starter Cockerels. *Anim Prod. Adv*,6:53-57.

Ahaotu, E.O; A. Akinfemi and T.K.O Obih (2013). Effects of processed ripe banana peel meal (*Musa sapentum*) as energy source for growing rabbits. Proc. 38th Conf., Nig . Soc. Anim. Prod 17-20 March, 2013. Pp 275-277.

Calles A, H Clavijo Hervas, E. and IH Maner (2000). *Ripe Plantain (Musa paradisca) as energy source*
for growing pigs. J Anim Sci. Prod. 61:197.

Ferket, P.R. and Middleton, T. (1999): *Anti-nutrients in feedstuffs.* Poultry International, March 1999 Vol. 38 No. 3 pp 46-55.

Gordon S.P and F.S Gordon (2004). Contemporary Statistics: a computer Approach. Mc Graw Hill Publisher, USA, 295 pp.

Nwifa M and B Hedo (2010). Effects of different inclusion levels of unripe plantain peel meal (*Musa paradisca*) on the performance of broiler finisher birds. Student Project; Department of Animal Production and Health Technology, Imo State Polytechnic Umuagwo , Nigeria.54pp.

Robbins, G.E.S. (1981). Quail, their breeding and management. Publisher- World Pheasant Association (WPA) 1,9,10.

Ukachukwu, S.N. (2000). *Chemical and Nutritional Evaluation of Mucuna chochinchinensis As An Alternative Protein Ingredient In Broiler Diets.*

Uwalaka,R.E, Ihezuo, J.P and E.O.Ahaotu (2013). Effects of lnclusion of Unripe Plantain Peel Meal (*Musa paradisca*) on Carcass Quality, Performance and lnternal Organ Weights in Finisher Broiler Birds. ISSN 2305-6622, Inter J Agri Biosci, 2(4): 136-140.

Von Loesecke, H.W. (1990). *Bananas*: Chemistry, Physiology and Technology. ALPA Press, Norway.

EFFECT OF FEEDING GRADED LEVELS OF ENZYME (NATUZYME®) TREATED AND UNTREATED BAMBARA GROUNDNUT OFFALS ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHER BROILER CHICKENS

Tarhemba,F., Ogwiji,O., Famave,M.T., Agishi,S.T.&, Wayo,N.S.

School of Animal Technology, Department of Animal Husbandry,Akperan Orshi College of Agriculture Yandev, Gboko, Benue State, Nigeria.

Abstract

Effect of enzyme (Natuzyme) fortification of Bambara groundnut (*Voandzeia subterranea* L) offal diet on growth performance and carcass characteristic of finisher broiler chickens was investigated. One hundred and eighty nine (189) day old commercial broiler chicks were randomly divided into 7 groups of 27 birds each. The groups were randomly assigned to diets in a 3 × 2 factorial arrangement involving four levels (0, 10, 20 and 30%) of treated and untreated Bambara nut offal with control diet (0) in a complete randomized design. Each treatment was replicated three times with nine birds per replicate. Results showed that increasing levels of treated and untreated Bambara nut offal in the diets increased ($P < 0.05$) average daily feed intake and feed cost per kg weight gain, but decreased ($P < 0.05$) final body weight, average daily weight gain, feed conversion efficiency and protein efficiency ratio. Final body weight and average daily weight gain of control diet, feed conversion ratio at the 10, 20 and 30% treated and untreated Bambara groundnut offal levels, and reduced average daily feed intake and feed cost per kg weight gain at all the Bambara groundnut offal (BGO) inclusion levels. The results of the study indicate that 20% Bambara groundnut offal treated and untreated can be included in broiler diet without adverse effects on broiler chickens and also to reduce cost of production.

Key words: Bambara groundnut offal, dietary enzyme, broiler chickens, performance, carcass

Introduction

High cost of feed is a limitation to monogastric animal production in Nigeria which has been rated at 70 - 80 percent of total cost of production (Madubuike and Ekenyem, 2001). Consequently, the fight to reduce the cost of poultry production becomes critically urgent in order to salvage Nigerians from the scourge of sub-optimal animal protein intake and malnutrition. With the food situation rapidly worsening, the poultry industry has a key role to play in many parts of the world as a most economical source of protein (Augusto *et al.,* 1999). The poultry industry is one of the fastest growing segments of the livestock industry. Poultry are highly prolific and very efficient in converting feed nutrients into high quality animal protein (Smith, 2001). It is therefore very important to use unconventional materials such as cowpea waste, soybean waste, bambara nut offal, etc., that are locally available and can be obtained at lower prices. The inclusion of graded levels of raw bambara nut (*Voandzeia subterranea L*) offal in the diets of broiler chickens will help to enhance production by reducing the cost of production. Bambara nut is widely cultivated in the Northern and Southern States of Nigeria where the seeds are processed into flour and consumed as moi moi (Enwere, 1998). The processing of the seeds into flour results in the production of the waste that contains 16.40% crude protein (Okeke, 2000). Bambara nut waste has been used in the feeding of poultry and rabbits (Okeke, 2000; Ani and Okafor, 2004; Ani, 2007). However, its use in the feeding of monogastric animals is limited by the presence of high fibre and antinutritional factors such as protease inhibitors, haemaglutinins, tannins, cyanogenic glycosides and flatulence factors in the raw bean (Ensminger *et al*, 1996; Enwere, 1998). Poultry cannot fully utilize high fibre diets because they lack the digestive framework that can elaborately digest large amount of fibre. It becomes imperative, therefore, to incorporate exogenous enzymes into their diets in order to enhance the breakdown of the non-starch polysaccharides (NSPs) present in fibre (Doku and Karikari, 1981; Ensminger *et al.,* 1996; Enwere, 1998). Besides antinutritional factors, another limitation is its high fibre content. The enzyme being considered in this study is Natuzyme which has been shown to increase digestibility of fibrous feed ingredients by

disrupting the plant cell walls, and by reducing the viscosity of the gut contents, thereby enhancing nutrient absorption (Choct and Annison, 1992; Bedford *et al.,* 1992; Acromovic, 2001). The present study was therefore conducted to determine the effects of graded levels of raw bambara nut waste and supplementary enzyme (Natuzyme) on the growth performance and carcass characteristics of finisher broiler chickens.

Results and Discussion

The effect of feeding different levels of enzyme treated and untreated BGO in finisher diet of broiler chicken is as shown in TTable 1

Table 1: Effect of feeding diet containing enzyme treated or untreated BGO on finisher growth characteristics of broiler chicken (Treatment effect)

	Treatment						
Parameter	T_1	T_2	T_3	T_4	T_5	T_6	T_7
AIW	41.90±0.10	41.90±0.15	42.00±0.00	41.87±0.13	42.00±0.00	41.90±0.10	42.00±0.00
AFW	2605.09±61.38^{bcd}	2865.74±31.68^{a}	2772.22±58.35^{ab}	2526.30±65.86^{de}	2720.37±41.86^{abc}	2388.89±60.94^{e}	2587.73±44.18^{cd}
AWG	2563.19±61.29^{bcd}	2823.78±31.75^{a}	2730.22±58.35^{ab}	2484.43±65.91^{de}	2678.37±41.86^{abc}	2346.99±60.86^{e}	2545.73±44.18^{cd}
ADWG	40.68±0.97^{bcd}	44.82±0.51^{a}	43.34±0.93^{ab}	39.44±1.05^{de}	42.51±0.66^{abc}	37.25±0.97^{e}	40.41±0.70^{cd}
ATFI	5806.70±24.74^{d}	6442.62±112.12^{a}	6023.61±18.05^{c}	6109.85±60.12^{bc}	6104.39±39.31^{bc}	6248.11±26.12^{bc}	6136.20±74.43^{b}
ADFI	92.17±0.39^{d}	102.26±1.78^{a}	95.61±0.29^{c}	96.98±0.96^{bc}	96.90±0.62^{bc}	99.18±0.41^{b}	97.4±1.18^{bc}
FCR	2.27±0.05^{ab}	2.28±0.02^{ab}	2.21±0.06^{a}	2.46±0.09^{ab}	2.28±0.02^{ab}	2.66±0.07^{c}	2.41±0.07^{b}
PI	18.44±0.08^{d}	20.45±0.36^{a}	19.12±0.05^{c}	19.40±0.19^{bc}	19.38±0.12^{bc}	19.84±0.08^{b}	19.48±0.24^{bc}
PCR	0.45±0.01^{ab}	0.46±0.00^{abc}	0.44±0.01^{a}	0.49±0.02^{c}	0.46±0.00^{abc}	0.56±0.01^{d}	0.48±0.01^{bc}
PER	2.21±0.05^{ab}	2.19±0.02^{abc}	2.27±0.05^{a}	2.03±0.07^{cd}	2.22±0.04^{ab}	1.88±0.05^{d}	2.07±0.06^{bc}
F. cost/Kg	332.94±8.08	326.52±2.48	327.54±8.16	338.81±13.85	323.37±3.27	323.37±3.27	326.84±9.55

^{abcde}--- Means with different superscript along the same row are significantly ($p<0.05$) different

T_1-Control T_2-0BGO+250mg enzyme T_3-10%BGO+mg enzyme T_3-10%BGO + 250mg Enzyme T_4-20%BGO + 0mg Enzyme T_5-20%BGO +250mg Enzyme T_6-30%BGO +0mg Enzyme T_7-30%BGO +250mg Enzyme AIW-Average initial weight AFW -Average final weight AWG-Average weight gain ADWG-Average daily weight gain ATFI-Average total feed intake ADFI-Average daily feed intake FCR-Feed conversion ratio PCR Protein conversion ratio PI-Protein intake PER-Protein efficiency ratio Fcost/kg -feed cost per kilogram.

The average daily weight gain was significantly ($p<0.05$) different across the various treatment groups as treatment 2 had the highest value (44.82g) while treatment 6 had the least value (37.25 g). Average daily feed intake was highest in treatment 2 (102.26 g) and differed significantly ($p<0.05$) from the other treatment groups with the least value (92.17 g) found in treatment 1(Control group). Feed conversion ratio was also significantly ($p<0.05$) different across the treatment groups. Treatment 3 had the best feed conversion (2.21) while Treatment 6 had the least feed conversion ratio (2.66). Feed cost per kilogram feed produced was not significantly ($p<0.05$) affected by different levels of enzyme treated and untreated BGO.

The effect of feeding different levels of enzyme treated and untreated BGO in diet of broiler chicken on carcass and organ characteristics is shown in Table 2. Treatment 5 had the best dressed weight and dressing percentage (2203.00 g and 81.65 % respectively) while the least values were observed in treatment 1 (1849.67 g and 72.07 % respectively). Breast weight was higher in treatment 5 (809.67 g) and least in treatment 1 (641.00 g).Back weight highest in treatment 3 (351.67 g) while the least value is in treatment 1 (289.67 g). Thigh weight was highest in treatment 3 (322.67 g) and least in treatment 6 (245.67 g). Drum stick weight was best in treatment 5 (335.67g) while treatment 6 had the least value (265.00 g). The Wing weight was highest in treatment 2 (240.00 g) and least in treatment 7 (203.00 g). Neck weight was highest in treatment 3 (181.67 g) and least in treatment 6 (147.67 g). Head weight was highest in treatment 3 (57.67 g) while the least and similar values were observed in treatment 4 and 7. Shank weight was highest in treatment 5 (118.00 g) and least in treatment 7 (84.67 g). Liver weight was highest in treatment 5 (49.67 g) and least in treatment 3 (38.67 g). Gizzard weight was highest in treatment 4 (69.67 g) and least in treatment 7 (53.00 g).

Table 2: Effect of feeding diet containing graded levels of enzyme treated or untreated BGO on carcass/organ characteristics of broiler chicken (Treatment effect).

	Treatment						
Parameter	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Live wt.	2566.67±33.33^{ab}	2733.33±66.67^{a}	2733.33±66.67^{a}	2566.67±88.19^{ab}	2700.00±57.74^{a}	2400.00±57.74^{b}	2600.00±0.00^{a}
Evis. wt.	1974.33±4.67^{c}	2275.67±18.76^{ab}	2313.00±2.31^{a}	2195.00±42.72^{ab}	2382.67±1.47^{a}	1997.67±103.05^{c}	2091.67±109.99^{bc}
D. wt.	1849.67±22.81^{c}	2108.00±14.43^{ab}	2140.67±0.88^{ab}	2052.00±38.68^{b}	2203.00±27.14^{a}	1852.00±86.60^{c}	2022.67±55.56^{b}
Dressing %	72.07±0.46^{b}	77.22±1.20^{ab}	78.41±1.97^{a}	80.07±2.06^{a}	81.65±1.48^{a}	77.08±1.76^{ab}	77.80±2.14^{ab}
Back wt.	289.67±2.03^{d}	335.67±11.26^{ab}	351.67±2.03^{a}	320.00±19.63^{bc}	321.67±4.33^{bc}	292.67±3.76^{cd}	301.67±0.88^{cd}
Thigh wt.	274.33±6.36^{b}	318.00±6.35^{a}	322.67±4.91^{a}	278.00±0.58^{b}	302.67±8.95^{ab}	245.67±12.99^{c}	279.67±14.15^{b}
Drum stick	267.33±3.53^{c}	307.00±10.39^{ab}	318.00±2.89^{ab}	283.67±6.64^{bc}	335.67±3.18^{a}	265.00±21.94^{c}	269.67±12.99^{c}
Wing wt.	204.00±4.51^{b}	240.00±4.62^{a}	237.67±2.60^{a}	216.00±1.15^{ab}	229.67±0.88^{ab}	204.00±12.12^{b}	203.00±17.90^{b}
Neck wt.	155.33±0.33^{de}	166.00±5.77^{c}	181.67±0.33^{a}	162.00±0.57^{cd}	174.00±1.15^{b}	147.67±2.60^{e}	152.00±1.15^{e}
Head wt.	51.00±2.08^{b}	57.33±0.33^{a}	57.67±0.33^{a}	50.67±1.45^{b}	58.33±0.33^{a}	56.00±1.15^{a}	50.67±3.18^{b}
Shank wt.	79.33±3.28^{bcd}	109.00±4.04^{abc}	114.33±0.88^{ab}	19.67±2.60^{cd}	118.00±5.20^{a}	95.67±11.84^{cd}	84.67±4.33^{d}
Liver wt.	47.00±0.58^{ab}	43.67±1.45^{b}	38.67±3.18^{c}	48.00±1.15^{ab}	49.67±0.33^{a}	45.67±0.33^{ab}	46.67±0.88^{ab}
Gizzard wt.	56.33±1.45^{cd}	66.00±3.46^{ab}	57.67±2.03^{cd}	69.67±2.03^{a}	58.67±2.03^{bcd}	62.67±2.03^{abc}	53.00±2.89^{d}
Pancreas wt.	3.33±0.33^{b}	5.67±0.33^{ab}	3.67±0.33^{b}	6.67±0.33^{a}	4.67±0.33^{ab}	7.00±73^{a}	4.67±0.33^{ab}
Spleen wt.	1.67±0.33^{b}	1.67±0.33^{b}	3.00±0.58^{ab}	3.00±0.58^{ab}	5.00±0.00^{a}	4.67±1.76^{a}	3.00±0.58^{ab}
Heart wt.	9.00±0.58^{de}	10.00±1.15^{cd}	11.67±0.33^{bc}	13.00±0.58^{ab}	13.67±0.33^{a}	12.00±0.58^{ab}	8.00±0.00^{e}
S. intestine	208.00±8.72	209.00±4.62	221.67±3.18	211.00±4.04	200.67±15.30	207.67±1.45	209.67±0.33
L. intestine	13.00±0.58	13.67±0.33	13.00±0.58	13.67±0.33	13.00±0.58	13.00±0.58	13.00±0.00
Caecum int.	38.67±1.76^{ab}	42.00±1.15^{ab}	37.67±0.33^{ab}	37.33±0.33^{b}	43.67±3.76^{a}	43.67±2.00^{a}	39.00±1.73^{ab}

^{abcde}--- Means with different superscript along the same row are significantly ($p<0.05$) different

T_1-Control T_2-0BGO+250mg enzyme T_3-10%BGO+mg enzyme T_3-10%BGO + 250mg Enzyme T_4-20%BGO + 0mg Enzyme T_5-20%BGO +250mg Enzyme T_6-30%BGO +0mg Enzyme T_7-30%BGO +250mg Enzyme Wt.-Weight Evis.-Evisceration S-Small L-Large int.-Intestine

Pancreas was highest in treatment 6 (7.00 g) and least in treatment 1 (3.33 g). The spleen weighed highest in treatment 5 (5.00 g) while the list and similar value was found in treatment 1 and 2 (1.67 g). Heart weight was found to be highest in treatment 5 (13.67 g) and the least value was found in treatment 7 (8.00 g). The caecum was similar and highest in treatment 5 and 6 (43.67 g) and least in treatment 4 (37.33 g). Feed intake decreased significantly as BGO inclusion level increased beyond 10%. This result agrees with earlier report of Onyimonyi and Onukwufor (2003), who replaced soybean meal and maize with bambara groundnut offal in broiler diets. They further reported that bambara groundnut offal could replace the 2 feedstuffs up to 10% in the diets without adverse effect on feed intake of broiler chickens. The control treatment group, treated and untreated diets had lower fibre content and therefore birds on the control diets had the highest feed intake values when compared with the other diets. According to Ani (2007) poultry cannot utilize high fibre diets fully because they lack the digestive framework that can elaborately digest large amount of fibre. In the finisher phase, the birds fed diets containing treated BGO consumed more feeds than those fed with untreated BGO. This was attributed to improved energy availability and utilization for the growth of poultry (Odetallah *et al.*, 2005 and Wang *et al.*, 2005). Results of the carcass parameters showed significant differences ($P < 0.05$) between treatments for the live weight, carcass weight and dressed weight, head and shank weight, wings, thigh and breast had significant differences ($P < 0.05$). There was a consistent reduction in the values of parameters as the inclusion level of BGO increased beyond 20%. As shown in Table 2, the marked effect of dietary levels of BGO had significant ($p<0.05$) effect on live body weight, dressed carcass weight and carcass dressing %, especially as the level of BGO in the diets increased beyond 20 %. Perhaps the increased anti-nutritional factors (ANFs) in the Bambara groundnut offal could have been responsible for the observed reduction (Huisman and Tolman, 1990). The slaughter weights of birds, plucked weight (dressed weight), eviscerated-carcass percentage, dressing percentage and internal organs were significantly different ($P<0.05$). Birds fed on diets containing BGO dressed better than those fed control diet.

Conclusion and Recommendation

The result of this study showed that raw Bambaranut offal can be incorporated in broiler chicken diet at 20% inclusion level, without any deleterious effect on the performance of the birds. The study also showed that raw bambara groundnut offal can be used to supplement soya bean meal and maize in broiler chicken diets .Further investigation should be done in determining the proper inclusion rate of BGO as a feed resource.

Reference

Acromovic, T. (2001). Commercial application of enzyme technology for poultry production. World Poult. Sc. J. 57:225-242.

Ani, A.O. 2007. Effect of raw bambara groundnut (voandzeia subterranean L) waste on performance of growing rabbits. Agroscience J. Tropical Agric, Food Environ and Extension, 6 (1): 89 - 97

Ani, A.O. and Okafor, I.C.(2004).Nutritional evaluation of raw Bambara groundnut waste (Voandzeia subterranean L) waste for weaner rabbits. Proc. 29th Ann. Conf. Nig. Soc. for Anim. Production (NSAP), March 21st – 25th 2004, Usman Danfodiyo Univ. Sokoto, Nigeria pp 183 – 186.

Augusto, A.A., Cuca, C.M. and Pino J.A. (1999) Poultry Nutrition in Latin America with Special Reference to Scientific Poultry Raising In: Animal production in the Tropics. (eds) Loosli, J.K.., Oyenuga, V.A., and Babatunde, G. M. Trade Island Nigeria, Ltd, Lagos. Pp 213-226.

Bedford,M.R. Smith,C.H. M.Veldman A,Versteng and Beynene, A.C (1992).Dietary carboxymethylcellulose with high instead of low viscocity reduces macronutrient digestion in broiler chicken. J. Nutr. 127: 483-487. Carsten, P. 2013. Reduction of anti-nutritional factors in (pre) starter feed. All About Feed (international magazine on Animal Nutrition, Processing and Feed Management). Volume 21 – No 2 – 2013. Pp 25-27.

Choct, M. and Annison, G. (1992). Anti-nutritive effect of wheat pentosans in broiler chickens. Role of Viscosity and gut microflora. Brit. Poul. Sc.33: 821-834.

Doku, J.A. and Karikari, O.O. (1981).Tropical Grasses. Legume Bull.31:20-27.

Ensminger, M.E, Oldfied, J.E. and Heinemann, W.N. 1996) Feeds and Nutrition. The Ensminger publishing Coy; Clovis Califomia, USA PP. 324-366.

Enwere, N.J. 1998. Foods of Plant Origin. 301 pp (Afro-orbispub. Ltd. Nsukka Nigeria).

Huisman, J. and G. H. Tolman (1990). Anti-nutritional factors in the plant protein diets for non-ruminants, Eds. P. C. Garnsworthy, W. Haresign and D. J. A. Cole. In: Recent Advances in Animal Nutrition. Butterworths/Heinemann. London.

Madubuike, F. N. and Ekenyem, B. U. (2001) Non-Ru- minant livestock production in the tropics Gust-Chuks Graphic Centre, Owerri, Nigeria, 196.

Odetallah, N. H., J. J. Wang.,. J. D. Garlich and J. C. H. Shih. (2005). Versazyme Supplementation of Broiler Diets Improves Market Growth Performance. Poultry Science 84: 858–864.

Okeke, D.P. (2000). Replacement of soybean meal with bambara waste (*Voandezia subterranea*) in broiler diets. M.Sc. Thesis Dept. of Anim. Sci. University of Nigeria, Nsukka.

Onyimonyi, A.E. and J.O. Onukwufor, 2003. Effects of toasted Bambara groundnut *(Voandzia subterranean (L.) thouras)* waste (TBW) on performance of growing pullets. Proceedings of the 28th Annual Conference of the Nigerian Society for Animal Production (NSAP), 28: 237-239.

Smith, A.J. (2001) Poultry. The Tropical Agriculturalist. Revised Macmillan Education Ltd. London. Pp 1-11.

Wang, Z. R., S. Y. Qiao., W. Q. Lu and D. F. Li. (2005). Effects of Enzyme Supplementation on Performance, Nutrient Digestibility, Gastrointestinal Morphology, and Volatatile Fatty Acid Profiles in the Hindgut of Broilers Fed Wheat-based Diets. Poultry Science 84: 875–881.

Assessing the changes in lipid profile of broiler finisher chicken fed diets containing processed *Balanite aegyptiaca* Fruit Meal

***Abdulahi I., [+]Omage J. J., *Abeke F. O., [+]Onimisi, P. A. [+]Idachaba, C.U., [+ +]Anoh K. U., *Ahmad, S.A.,**

[*]National Animal Production Research Institute (NAPRI), Shika
[+]Department of Animal Production, University of Jos, Plateau State
[+ +]Department of Animal Science, Ahmadu Bello University Zaria
idrisabdullahi170@gmail.com Tel: 08053230010

Abstract

The aim of this study was to evaluate the changes in lipid profile of broiler finisher fed diets containing processed *Balanite aegyptiaca* Fruit Meal. A total of 315-day old broiler finisher chickens of Ross breed were used. The birds were assigned to five dietary treatments with three replicate consisting of twenty one (21) chickens per replicate in a completely randomized design and lipid profile of the birds were evaluated. It was found that *Balanite aegyptiaca* Fruit Meal did not reduce lipid parameters in the chicken as significantly ($P<0.05$) high values of lipids profile were recorded but were within the normal range for broilers. It was concluded that the use of *Balanite aegyptiaca* Fruit Meal had no effect on lipid profile of broilers and cannot be used as a fat reducing agent.

Key Words: Lipid Profile, *Balanite aegyptiaca*, Broiler finisher

Introduction

In recent time, a lot of people are paying attention to the type of diet they consume in order to maintain a healthy life style. Some of the diets that pose potential health threat are fatty and oily food, red meat (because of their high cholesterol) amongst others. Lyon, (2000) observed a gradual shift from the consumption of conventional animal protein sources (cattle, sheep, swine, goat and poultry) to a class of livestock referred to as non-conventional livestock. It now becomes pertinent for animal scientist to produce lean meat to meet with these recent demands of the populace.

Broiler industry is a source of nutrition, provides rural employment and fulfils all nutritional standards. Broilers as a meat source also have fast growth rate and the meat is generally accepted by all categories of people. In addition, depressed hepatic cholesterol levels in chicken were observed by Sklan *et al*. (1992).

The different parts of *Balanite aegyptiaca* plant (leaves, bark, fruit or root) can serve multipurpose medicinal application as antidiabetic, hypocholesterolemic, hepatopro-tective, cardioprotective**,** antioxidant, antiviral, antibacterial, anti-inflammatory, anti-nociceptive, analgesic and anthelmintic (3).

The aim of this study is to evaluate the changes in lipid profile of broiler finisher fed diets containing processed *Balanite aegyptiaca* Fruit Meal.

Materials and Methods

Experimental Site

The experiments were carried out at the teaching and research farm, of the Department of Animal Science Ahmadu Bello University, Zaria. The Departmental farm is located on latitude 11^0 $9^{'}$ $45^{''}$ N and longitude 7^0 $38^{'}$ $8^{''}$ E, at an altitude of 610m above sea level. The temperature of the area ranges between 26-40°C depending on the season while the relative humidity during the dry and wet seasons

are 21 and 72% respectively. The wet periods in Zaria are between May and October with annual rainfall of about 1500mm (IAR, 2012).

Collection of *Balanites aegyptiaca* fruits

Raw samples of *Balanites aegyptiaca* fruits were collected from various locations in Mai-Adua Local Government Area of Katsina State.

Processing of *Balanites aegyptiaca*fruit

Balanites aegyptiaca fruit meal was processed by soaking, boiling, roasting and fermentation.

Experimental design and management of experimental chickens

Three hundred and fifteen (315) day old broiler chicks of Ross breed were used in this experiment. The chicks were weighed and allotted to five dietary treatments each replicated thrice with twenty-one (21) chickens per replicate in a completely randomized design. The chickens were raised on deep litter with feed and water provided *ad libitum*. Management practices ideal for broiler chickens was strictly adhered to.

Experimental diets

Five broiler starter and finisher diets were formulated to meet the nutrient requirement of the chickens according to recommendations by NRC (1994). Treatment 1 is the control (T_1) and treatments 2 – 5 contained 20% each of the differently processed seeds. The composition of the experimental diet is presented in Tables 1.

Lipid profile evaluation

Blood samples (5ml) were collected by severing the jugular vein at 10.00h from four birds chosen randomly from each treatment of birds respectively into sample bottles without anticoagulant. Serum harvested was used to evaluate for lipid profile. They were determined by using chemical commercial kits with the help of auto analyzer.

Statistical Analysis

All the data collected from the experiment were subjected to analysis of variance (ANOVA) using general linear model of Statistical Analysis System (SAS, 2003) Software package. Significant differences between means were compared using Dunnetts Test in the SAS package.

Results and Discussion

Table 2 shows the lipid profile of broiler chickens fed diets containing differently processed *Balanite aegyptiaca* fruit meal. Triglycerides, low and high density lipoprotein differ significantly ($P<0.05$) across the dietary treatments with the exception of total protein and cholesterol which were similar ($P>0.05$) across the dietary groups. The normal ranges observed in cholesterol and total protein across the treatment groups imply adequate protein and energy metabolism. This showed that the diets had adequate nutritional quality and good amino acid balance as was reported by Eggum (1989).

Although there was no significant difference in cholesterol levels across the treatments, however the rising numerical trend observed showed that *Balanite aegyptiaca* may have limited capacity to lower cholesterol level at higher inclusion levels. This could be attributed to the higher crude fiber of *Balanite aegyptiaca* which may have affected carbohydrate metabolism (Abdullahi, 2018). The same phenomenon could possibly explain the low level of triglyceride in the serum of chickens fed the control diet, which in turn resulted in less fatty adipose tissues recovered from the treatment group.

Chickens fed *Balanite aegyptiaca* based diets showed increased high density lipoprotein (HDL) levels compared to those on the control diet. This shows that *Balanite aegyptiaca* improves animal health as it encourages the build-up of high density lipoprotein (good cholesterol). This may also play a significant role on the consumers' viewpoint of chickens raised on *Balanite aegyptiaca* based diets, as medical studies have shown that HDL can reduce the risk of developing atherosclerotic plaques around the soft organs in the body.

Conclusion and Recommendation

It was concluded that the use of *Balanite aegyptiaca* Fruit Meal had no effect on lipid profile of broilers and cannot be used as a fat reducing agent. *Balanite aegyptiaca* can be used to improve the nutrient quality of the diet, body metabolism and nutritional status of the birds. It was recommended that 20% *Balanite aegyptiaca* can be used in broiler finisher's diet for nutritional adequacy of the birds without adverse effect.

References

Abdullahi, I., Omage, J. J., Abeke, F. O., Onimisi, P. A. and Idachaba, C. U. (2018). Performance of broiler chickens fed diets containing differently processed Desert date (*Balanite aegyptiaca)* fruit meal. *Journal of Animal Production Research,*(2018) 30(2):10-21.

Eggum, B.O. (1989). Influence of diet and microbial activity in the digestive tract on digestibility and nitrogen and energy metabolism in rats and pigs. *Poland Journal of Nutrition*, 48: 161-165.

Institute of Agricultural Research (IAR) (2012). Meteorological Station Data, IAR Zaria.

Lyon W. F. (2000). Insects as human food (Micro livestock); (Accessed 15 March 2015) Available:rollinghillszoo.org/forourvolunteers/training/Dec06-Insects as HumanFood.pdf

NRC, (1994). Nutrient Requirements of Poultry (9th Ed.).National Academy Press, Washington, DC.

SAS Institute (2003). SAS-STAT User's Guide Statistic. 4th Edition, SAS Inst. Incc, Cary. NC

Sklan, D., Y.N. Berner and H.D. Rabinowitch, (1992). The effect of dietary onion and garlic on hepatic lipid concentrations and activity of antioxidative enzymes in chicks. J. Nutr. Biochem., 3: 322-325.

Table 1: Composition of broiler finisher diets containing differently processed fruit meal (5-8 weeks)

Ingredients (%)	T_1 Control	T_2 Soaked BAFM	T_3 Cooked BAFM	T_4T_5 Roasted BAFM	Fermented BAFM
Maize	61.50	61.50	61.50	61.50	61.50
Groundnut cake	20.00	0.00	0.00	0.00	0.00
Soya cake	12.20	12.20	12.20	12.20	12.20
BAFM	0.00	20.00	20.00	20.00	20.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Maize offal	1.50	1.50	1.50	1.50	1.50
Limestone	0.80	0.80	0.80	0.80	0.80
Common Salt	0.30	0.30	0.30	0.30	0.30
*Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00

Calculated analysis

ME (Kcal/Kg)	2932	2938	2938	2938	2938
Crude Protein (%)	20.01	19.74	19.74	19.74	19.74
Crude fibre (%)	4.96	4.95	4.95	4.95	4.95
Ether Extract (%)	4.91	4.91	4.91	4.91	4.91
Calcium (%)	1.14	1.14	1.14	1.14	1.14
Phosphorus (%)	0.61	0.62	0.62	0.62	0.62
Lysine (%)	1.20	1.17	1.17	1.17	1.17
Methionine (%)	0.68	0.65	0.65	0.65	0.65
Feed cost/kg diet (₦)	148.00	132.92	131.80	129.80	129.20

*Biomix chick premix provide per kg of diet vit A, 10,000 I.U; vit D3, 2000 I.U; vit. E 23mg; vit K, 2.mg; calcium pantothenate, 7.5mg; B12, 0.015mg; folic acid, 0.75mg; choline chloride, 300mg; vit B1, 1.8mg; vit B2, 5mg; vit B6, 3mg; manganese, 40mg; iron, 20mg; zinc, 53.34mg; copper, 3mg; iodine, 1mg; cobalt, 0.2mg; selenium, 0.2mg

Table 2: Lipid Profile of Broiler Chickens Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal

Parameters	Control	Soaked BAFM	Boiled BAFM	Roasted BAFM	Fermented BAFM	SEM
Triglycerides	48.66^{c}	79.67^{a}	77.33^{a}	62.33^{b}	63.00^{b}	3.51
Total Protein (g/dl)	5.67	5.33	5.00	4.90	5.00	2.28
LDL (g/dl)	87.33^{b}	100.66^{a}	83.67^{b}	72.00^{b}	71.33^{b}	7.68
HDL (g/dl)	123.30^{b}	138.60^{a}	149.00^{a}	128.00^{b}	178.67^{a}	25.46
Cholesterol	2.50	2.30	2.53	2.37	2.77	0.99

a, b= Means with different superscript on the same row differ significantly ($P<0.05$), SEM= Standard error of mean, BAFM=*Balanite aegyptiaca* fruit meal, LDL=low density lipoprotein, HDL=high density lipoprotein.

HAEMATOLOGICAL AND CARCASS CHARACTERISTICS OF BROILER CHICKENS FED DIFFERENTLY PROCESSED MANGO SEED KERNEL MEAL

Jatutu, S. S., Bello, K. M., and Kalla, D. J. U
Department of Animal Production, Abubakar Tafawa Balewa University Bauchi State, Nigeria
Corresponding author email: samsonshalom@gmail.com

+ 2347035421636

ABSTRACT

An experiment was conducted to evaluate the haematological and carcass of differently processed mango seed kernel meal (MSKM) on broiler chickens for eight weeks. The processing includes: soaking for 24 and 72hours, boiling and soaking and boiling. Two hundred and twenty-five (225) day old broiler chicks were randomly allotted to five dietary treatments with three replicates of 15 birds each in completely randomized design. The experimental diets consisted of raw, soaked for 24hours, soaked for 72hours, boiled and soaked and boiled mango seed kernel meal included at 10% in both broiler starter and finisher diets designated as T1, T2, T3, T4 and T5. The proximate composition, carcass and haematology of broiler chickens were obtained. T3 has the highest crude protein (8.37%) compared to T1 (6.03%) and the crude fibre ranges from 1.99-2.82% for T4 and T2 respectively. The carcass analysis shows that there was significant difference in dressing %, liver and abdominal fat across the treatments. Haematological evaluation shows that all the parameters were significant. From the experiment conducted, it is therefore concluded that mango seed kernel based diets does not affect the carcass characteristics of broiler chickens

Keywords: Mango seed kernel meal, Soaking, Carcass, Haematology, broiler chickens

Introduction

Poultry production is gaining popularity in the developing countries due to its role in bridging the protein malnutrition, economic empowerment of the resource poor segment of the society and its ability to fit well in the farming systems commonly practiced (Gebremedhn and Alemu, 2015). Such growth in the poultry industry is having a profound effect on the demand for feed and raw materials. However, it is also becoming clear that the requirements for the four traditional feed ingredients (maize, soybean meal, fish meal and meat meal) cannot be met (Adewale *et al.,* 2016). The gap between local supply and demand for these traditional ingredients are expected to be widening over the coming decades thus, providing a compelling reason for exploring the usefulness of locally available alternative feedstuffs in feed formulation (Adewale *et al.,* 2016). Substituting maize with another non-conventional energy sources such as cassava peels (Ojebiyi *et al*., 2014), mango seed kernel meal (Diarra, 2014) etc, had been discovered to be of great importance. This research is aimed at evaluating the effect of feeding diets containing differently processed mango seed kernel on the carcass and haematology of broiler chickens

Materials and Methods

Experimental Site:

The experiment was conducted at the Poultry Unit of Bauchi State College of Agriculture Bauchi Teaching and Research farm. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' North and longitudes 8° 50' and 11° East (BSD, 2009).

Experimental Design and Management of Birds

A total of two hundred and twenty-five (225) broiler chicks were used for the experiment. They were randomly divided into five treatment groups of 45 chicks per group in a completely randomized design (CRD) consisting of three replicates of 15 birds each. Birds were reared on a deep litter, with feed and water provided *ad libitum*. Routine vaccines were given as recommended.

Collection and Processing of Mango seed into Mango Seed Kernel Meal

Mango Seed Kernel were collected from various locations in Sibire, Ardo kola LGA of Taraba State. The kernels were obtained by cutting the seed coat using a knife or crushed with a

hammer. The Mango Seed Kernel (MSK) obtained were divided into five parts. The parts processed either by soaking for 24 and 72 hours, boiling and soaking for 24 hours and boiled.

Soaking of mango seed kernel for 24 hours

The Mango Seed Kernel were soaked in water for 24 hours at the rate of 100g per 1.5 litre of water in containers. The water was changed at regular intervals of 8 hours. The Mango Seed Kernels were then removed and sundried. The dried MSK were then milled before incorporation into the diets.

Soaking of mango seed kernel for 72 hours

The Mango Seed Kernel were soaked in water for 72 hours at the rate of 100g per 1.5 litre half of water in containers. There was change of water at regular intervals of 8 hours for 3 days. The Mango Seed Kernels were then removed and sundried. The dried MSK were then milled before incorporation into the diets.

Boiling of mango seeds kernel

The Mango Seeds Kernel were put in boiling water at the rate of 100g per 1.5 litre of water at 100°C temperature for 30 minutes. The sample were removed, drained, sun dried, and milled before incorporation into the diets.

Soaking for 24 hours and boiling of mango seeds kernel

The Mango Seed Kernel were soaked in water for 24 hours at the rate of 100g per 1.5 litre of water in containers. The Mango Seeds Kernel was put in boiling water at the rate of 100g per litre and half of water at 100°C temperature for 30 minutes. The sample was removed, drained, sun dried, and milled before incorporation into the diets.

Experimental Diets

Five broiler starter and finisher diets were formulated. Diet 1 was the control 10% raw MSKM, diet 2, 3,4 and 5 contained soaked for 24 hours, soaked for 72 hours, soaked for 24 hours and boiled and boiled MSKM respectively all at 10% level of inclusion as replacement for maize.

Determination of the proximate composition of mango seed kernel

The proximate composition (Table 3) was obtained by analyzing the different samples of mango seeds kernel according to the methods described by AOAC(1990).

Results and Discussions

Proximate composition of mango seed kernel Meal

The Mango seed kernel meal with a protein content of 6.03-8.37% is higher than 4.7% CP of mango fruit reported by Palma Castillo and Hurtado (2009) and similar than 6-10% reported by Diarra (2014). The raw mango seed kernel content 6.03% CP, 2.47% CF, 5.52% EE and 1.67% Ash which is lower than 8.75% CP, 3.01% CF, 14.82% EE and 3.24% Ash reported by Diarra and Usman (2008); Diarra and Usman (2008) also reported composition of boiled mango seed kernel meal to contain 7.81%CP, 2.94%CF, 15.97%EE and 2.21% Ash which is higher than 6.38% CP, 1.99% CF, 5.47% EE and 1.07% Ash. The decrease in crude protein values as a result of boiling is in line with the observation of reported by Akinmutimi and Onwukwe (2002). This has been attributed to the leaching of nutrients due to boiling. Ether extract of 5.52%, fibre 2.47% and ash 1.67% were all below the reported values of 5.3%, 14.6% and 7.7%, respectively (Palma Castillo and Hurtado, 2009). Naveen *et al*. (2007) reported the proximate of mango fruit pulp alone as 4.2% CP, 6.9% crude fibre, and 2.4% EE. Kansci *et al*., (2008) reported that mango fruit composition varies greatly. It may therefore be normal to have differences among different reports. It is also likely that the factors making the mango fruits to be rejected by humans such as bruises, infections, premature ripping and or premature fallen from the tree etc. contribute in reducing the protein content as compared to some reports above which were not necessarily of rejected mango fruits but rather by-products. It could also be due to varietal differences (Orayaga *et al.,* 2015).

Carcass Characteristic of Broiler Chicken Fed MSKM

The values of dressing percentage of 58.86-67.90% were similar to 60.82-65.22% earlier reported by Joseph and Abolaji (1997) also similar to 62.70-65.20% as reported by Diarra *et al.,* 2011 who fed similar diets to broiler bird. The abdominal fat (0.74-2.53%) was similar to 1.82-1.95% reported by Diarra *et al.,* (2011). The spleen, kidney and liver were also not affected by dietary treatment. Bawa *et al*. (2003) reported that the effects of feeding processed legume grain on organ yield were observed to be the best means of testing processing methods. The result was an indication that soaked and boiled mango seed had no effects on carcass characteristics of the birds and the nutrients were well utilized.

Haematological Indices of Broiler Finisher Fed Differently Processed Mango Seed Kernel Meal

The haematological indices are the reflection of the effect of dietary treatments on the birds. PCV was significantly higher ($p < 0.05$) in treatment 4 birds (boiled mango seed kernel meal), though all the values across the five diets were within the normal range (21 to 45%) reported by Amao and Siyanbola (2013). All the RBC mean values across the treatments falls within the normal range (1.58 to 3.82) reported for broilers by Amao and Siyanbola (2013). This means bird placed on differently processed mango kernel were not anemic nor show sign of polycythemia. The haemoglobin concentration ranged from 5.80-9.13g/dl was similar to 9.58-962g/dl as reported by Diarra and Usman (2008). All the haematological parameters analyzed were comparable to values reported in literature as normal for chickens (Awoniyi *et al*., 2000; Faniyi, 2002).

Conclusion and Recommendation

Mango seed kernel based diets does not affect the carcass characteristics of broiler chickens. Proper assembling and storage of mango seed kernel which will make it more readily available should be encouraged.

Table 1: Composition of Broiler Starter Diets (1-4 weeks)

	Treatments				
Ingredients	**Control Raw**	**Soaked for 24 hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**
	T1	**T2**	**T3**	**T4**	**T5**
Maize	38.86	38.86	38.86	38.86	38.86
Full-fat Soya bean	34.44	34.44	34.44	34.44	34.44
MSKM	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	0.50	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
T OTAL	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
ME (Kcal/Kg)	2,967.86	2,917.	2,917.67	2,917.67	2,917.67
Crude Protein %	23.00	23.00	23.00	23.00	23.00
Crude fibre %	4.60	4.60	4.60	4.60	4.60
Ether Extract %	3.84	3.84	3.84	3.84	3.84
Calcium %	1.39	1.39	1.39	1.39	1.39
Phosphorus %	0.89	0.89	0.89	0.89	0.89
Lysine %	1.66	1.66	1.66	1.66	1.66
Methionine %	0.54	0.54	0.54	0.54	0.54

* Premix: Composition of vitamin per kg is as follows: Vitamin A, 8000iu; Vitamin D31600iu; Vitamin E5iu; Vitamin K 0.200mg; Vitamins B, thaimine B. 0.5mg; Riboflavin B2 4mg; Pyridoxine B6 0.015mg; Niacin 0.015mg; B12 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biofin 0.020mg; chlorine chloride 0.02mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si Co) 0.056g.

MSKM- Mango Seed Kernel meal

ME- Metabolizable Energy

Table 2: Composition of Broiler finisher diets (5-8 weeks)

Ingredients	Treatments				
	Control Raw	Soaked for 24 hours	Soaked for 72 hours	Boiled	Soaked and boiled
	T1	T2	T3	T4	T5
Maize	46.79	46.79	46.79	46.79	46.79
Full-fat Soya bean	26.01	26.01	26.01	26.01	26.01
MSKM	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
T OTAL	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
ME (Kcal/Kg)	2978.32	2,978.32	2,978.32	2,978.32	2,978.32
Crude Protein %	20.00	20.00	20.00	20.00	20.00
Crude fibre %	4.29	4.29	4.29	4.29	4.29
Ether Extract %	3.92	3.92	3.92	3.92	3.92
Calcium %	1.54	1.54	1.54	1.54	1.54
Phosphorus %	0.93	0.93	0.93	0.93	0.93
Lysine %	1.43	1.43	1.43	1.43	1.43
Methionine %	0.40	0.40	0.40	0.40	0.40

* Premix: Composition of vitamin per kg is as follows: Vitamin A, 8000iu; Vitamin D31600iu; Vitamin E5iu; Vitamin K 0.200mg; Vitamins B, thaimine B. 0.5mg; Riboflavin B2 4mg; Pyridoxine B6 0.015mg; Niacin 0.015mg; B12 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biofin 0.020mg; chlorine chloride 0.02mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si Co) 0.056g.
MSKM- Mango Seed Kernel meal
ME- Metabolizable Energy

Table 3: Proximate Composition of Differently Processed Mango Seed Kernel

Nutrients	Treatments				
	Control Raw	Soaked for 24 hours	Soaked for 72 hours	Boiled	Soaked and boiled
	T1	T2	T3	T4	T5
Crude protein	6.03	7.40	8.37	6.38	6.17
Crude fibre	2.47	2.82	2.17	1.99	2.48
Ether extract	5.52	5.45	5.46	5.47	5.24
Ash	1.67	2.19	1.11	1.07	1.57
Moisture	5.79	6.52	7.01	6.16	6.63

Table 4: Carcass Traits (percentage body weight) of Broiler Chickens Fed Differently Processed Mango Seed Kernel Meal

	Treatments					
Parameters	**Control Raw**	**Soaked for 24 hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**	
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**
Live weight (g)	1466.67	1433.33	1650.00	1250.00	1566.67	82.54NS
Pluck weight (g)	1430.67	1396.67	1489.67	1174.33	1507.33	202.33NS
Carcass weight (g)	992.67	947.00	1010.33	726.00	1011.33	150.89NS
Eviscerated weight (g)	1099.67	1038.00	1127.33	811.33	1115.33	140.70NS
Dressing %	67.75^{a}	67.90^{a}	60.42^{ab}	58.68^{b}	64.57^{ab}	3.57*
Heart (%)	0.47	0.49	0.54	0.45	0.53	0.09NS
Lungs (%)	0.69	0.72	0.73	0.65	0.58	0.09NS
Head (%)	2.88	2.61	2.71	2.84	2.66	0.26NS
Legs (%)	4.35	3.77	4.53	4.31	3.93	0.40NS
Spleen (%)	0.16	0.12	0.10	0.10	0.15	0.05NS
Gizzard (%)	2.87	2.96	3.02	2.77	3.14	0.20NS
Large intestinal length (cm)	9.67	9.00	8.67	8.67	9.00	1.03NS
Small intestinal length (cm)	230.00	225.33	214.00	207.00	211.33	10.44NS
Liver (%)	3.41^{a}	3.41^{a}	2.89^{ab}	2.46^{b}	2.65^{ab}	0.37*
Pancreas (%)	0.26	0.38	0.31	0.27	0.32	0.06NS
Caeca length (cm)	17.00	14.67	16.33	15.00	18.00	2.80NS
Kidney (%)	0.73	0.86	0.76	0.78	0.73	0.10NS
Abdominal fat (%)	2.53^{a}	2.18^{a}	0.74^{b}	1.82^{a}	1.82^{a}	0.35 *

^{a,b}: means within the same row bearing different superscripts are significantly different (P<0.05)
NS: Not Significant
SEM: Standard Error of Mean

Table 5: Haematological Indices of Broiler Finisher Fed Differently Processed Mango Seed Kernel Meal

	Treatments					
Parameters	**Control Raw**	**Soaked for 24 hours**	**Soaked for 72 hours**	**Boiled**	**Soaked and boiled**	**SEM**
	T1	**T2**	**T3**	**T4**	**T5**	
Packed cell volume (%)	25.23^{c}	25.10^{c}	26.17^{b}	28.83^{a}	19.33^{d}	0.37*
Haemoglobin (g/dl)	8.13^{b}	7.33^{c}	8.43^{b}	9.13^{a}	5.80^{d}	0.20*
Red blood cell ($\times10^{9}$/l)	1.83^{b}	1.96^{ab}	1.85^{b}	2.07^{a}	1.88^{b}	0.06*
White blood cell ($\times10^{9}$/l)	218.43^{b}	229.10^{a}	214.60^{b}	227.40^{a}	187.83^{c}	2.63*
Mean corpuscular volume (FL)	137.67^{b}	128.13^{c}	142.23^{a}	135.23^{b}	140.93^{a}	1.36*
Mean corpuscular haemoglobin concentration (g/dl)	32.13^{a}	29.07^{c}	32.13^{a}	31.60^{ab}	30.13^{bc}	0.80*
Mean corpuscular haemoglobin (Pg)	44.33^{a}	37.70^{b}	45.17^{a}	42.67^{a}	42.3^{a}	2.04*
Platelet (($\times10^{9}$/l)	9.00^{b}	1.33^{c}	15.33^{a}	2.33^{c}	7.00^{b}	1.03*
Neutrophil (%)	4.47^{b}	4.23^{ab}	3.63^{b}	4.33^{ab}	5.10^{a}	0.39*
Lymphocyte (%)	96.37^{abc}	95.57^{bc}	97.30^{a}	96.63^{ab}	94.83^{c}	0.67*

^{a,b,c,d}: Means within the same row bearing different superscripts are significantly different (P<0.05)
SEM: Standard Error of Mean

Reference

Adewale, R. T., Adeyinka, O. A., Akinyinka, A. O., Damilola, O. O. and Joseph, A. O. (2016) Response of Broiler Chicken to Parboiled Mango Seed Kernel Meal (PMKM) Based Diet Fortified with Vitamins. *International Journal of Livestock Research*, **6** (11), 25- 30

Akinmutimi, A.H. and Onwukwe, C.C (2002). Effect of cooking with various concentrated potash on nutrient compostion of lima beans. *J. Agric. Biotechnol. Environ.* **1**: 1-13

Amao, E.A. and Siyanbola, M.F. (2013) Carcass and physiological response of broilers feddry heat treated mango (*Mangifera indica*) kernel based diets. *International Journal of Livestock Production* **4** (3): 3034.

AOAC (1990). **Official Methods of Analysis** (15th Edition). Association of official analytical chemist, Washington D.C, USA.

Awoniyi, T.A.M., Aletor, V.A., Adebayo, I.A. and Oyekunle, R.O. (2000). Observations on some erythrocyte indices of broiler chickens raised on maggot meal-based diets. In: Ukachukwu S.N, Ibeauchi J.A, Ibe S.N, Ezekwe A.G, and Abasiekong, S.F (Eds). Animal Production in the New Millennium: Challenges and Options.pp.132–134. Proceedings of the 25th Annual Conference of Nigerian Society of Animal Production, Michael Okpara University of Agriculture, Umudike, Nigeria, 19-23 March.

Bauchi State Diary (BSD), (2009). ABU/ICT-Centre database, http//:www.nigeriagalleria.com/Nigeria/statenigeria/bauchistate.

Bawa, G. S., Tegbe, T.S.B., Ogundipe, S.O., Dafwang, L.I. and Abu, E. A. (2003). The Effects of Duration of cooking Lablab seeds on the level of some anti-nutritional factors. Proc. 28th *Annual conference of Nigeria Society of Animal Production Ibadan, Nigeria*. pp. 213-214.

Diarra, S.S. (2014). Potential of mango (Mangifera indica L.) seed kernel as a feed ingredient for poultry: A review *World's Poultry Science Journal.* **70**:279-288.

Diarra, S.S. and Usman, B.A. (2008) Growth performance and some blood variables of broiler chickens fed raw or boiled mango kernel meal. *International Journal of Poultry Science* **7**(4): 315-318.

Diarra, S.S., Saleh, B., Kwari, I.D. and Igwebuike, J.U. (2011) Evaluation of boiled mango kernel meal as energy source by broiler chickens in the semi-arid zone of Nigeria. *International Journal of Science and Nature* **2** (2): 270-274.

Faniyi G.F (2002). Inclusion of discarded cashew kernels in the diets of cockerel chicks. In: Fanimo,A. O. and Olanite, J. A. (eds). Contributory Role of Animal Production in National development. pp.109- 111. Proceedings 7th Annual Conference of Animal Science Association of Nigeria. September 16-19. University of Agriculture, Abeokuta, Nigeria.

Gebremedhn, A and Alemu, B (2015). Review of Mango (*Mangifera indica*) Seed-Kernel Waste as a Diet for Poultry. *Journal of Biology, Agriculture and Healthcare* **5**(11):2224- 3208.

Joseph, J.K. and Abolaji, J. (1997) Effects of replacing maize with graded levels of cooked Nigerian mango-seed kernels (Mangifera indica) on the performance, carcass yield and meat quality of broiler chickens. *Bioresource Technology* **61**: 99-102.

Kansci G, Koubala B.B and Mbome I.L (2008). Biochemical and physiochemical properties of four mango varieties and some quality characteristics of the jams. *J. food process. Preserv*. **32** (4): 644 – 655

Naveen Z, Prasad J.R and Rao Z.P (2007). Chemical composition and i*nvitro* dry matter digestibility of some fruit wastes. Tamilnadu *Journal of Vetenary Animal. Science*. **3**(1): 1-3.

Ojebiyi, O. O., Oladunjoye, I. O., Rafiu, T. A., Shittu, M. D. and Ajayi, O. (2014). Synergistic effects of Hatchery by-products and Cassava Peel Meal mixtures on the Performance of Crossbred Growing Rabbit. *Online Journal of Animal and Feed Research* **4**(4):9 96.

Orayaga, K.T., Oluremi O.A., Tuleun C.D and Carew S.N (2015). The feed value of composite mango (*Mangifera indica*) fruit reject meal in the finisher broiler chickens' nutrition. *African Journal of Food Science and Technology* **6**(6): 177-18.

Palma Castillo O.R and Hurtado EA (2009). Productive behaviour of rabbit during the fattening growth period, fed with mango as partial substitution of the commercial balanced food. *RevistaCientificaUdo Agricola* **9**(4): 968 – 971.

PERFORMANCE OF BROILER STARTER BIRDS FED SORGHUM WITH DIFFERENT ENERGY LEVELS AS REPLACEMENT FOR MAIZE

H. B. USMAN, M. ANANDE AND M. N. SABO

DEPARTMENT OF ANIMAL SCIENCE, FEDERAL UNIVERSITY DUTSIN-MA

Abstract
The effect of substituting maize with sorghum using different energy levels was studied on broiler birds. Broiler chicks were assigned to one of the following experimental diets. T1: maize based diet containing 2,900kcal ME/Kg (control). T2, T3 and T4: were all sorghum based diets 2,900, 3,000 and 3,100 ME kcal/kg respectively. Feed intake, weight gain and feed conversion ratio were measured and determined. The results showed that final weight, weight gain, feed conversion ratio (FCR) and cost of feed per kg gain were similar (P>0.05) among the treatment means. Feed intake differ significantly (P<0.05) among the treatments with T1 having higher feed intake than T3. T2 and T4 have similar (P>0.05) feed intake to both T1 and T3. Total cost of feed consumed (₦/b) differ significantly (p<0.05) with T3 (209.37) having the lowest compared to T1 and T4 (251.76 and 236.71). T2 (215.71) had similar total feed cost to T3 and T4. was statistically similar with T4 having (177.89/kg) compared to the other treatments (213.91, 208.80 and 200.53 for T1,T2 and T3 respectively). In conclusion T4 was the most economical as it had lower FCR and cost per kg gain.
Keywords: Sorghum, maize, energy, broiler, weight gain

INTRODUCTION

Cereals are the most widely available and cheap source of high energy feed ingredients for the African farmer. Energy sources constitute the largest component of poultry diets. Globally, Maize is the most common energy source used in poultry feeds, constituting about 40-60% in poultry rations *(*Dayakar-Rao *et al*., 2003*).* This is mainly because their energy source is starch, which is highly digestible and palatable. The metabolizable energy value of maize is generally considered the standard with which other energy sources are compared (Oluyemi and Roberts 2000). The global maize requirement for poultry was estimated at 3.5 million tones at 2003 and was projected to rise to 31 million tons by 2020 (Dayakar-Rao, *et al*, 2003). Where available, other cereals could contribute to provide the seemingly ever increasing demand by the poultry industry.

In Nigeria, Maize production has never been sufficient to meet the needs of the growing human population, because it is a staple food crop for majority of the population (Iken and Amusa, 2004). Thus there is a continuing shortage of maize for use as feed, necessitating the exploration of other energy sources for livestock. To reduce the overdependence on maize, a number of researchers are exploring the use of cereals such as sorghum and millet as alternative energy sources. Sorghum grain is an interesting energy ingredient in poultry diets due to its nutritional composition, which is very similar to corn. (Louis *et al*, 1991).

Sorghum is grown in large quantity in the northern guinea and dry sub humid zones of Nigeria, where it is the second important cereal crop after maize. Its annual production was estimated at 11,700 million metric tons during the 2010 growing season (FAO 2011). The inclusion of sorghum in poultry diets is gaining interest due to favorable nutritional content of the grain. Sorghum can be used in commercial poultry diets to replace maize as an energy source, because they contain similar metabolizable energy (ME) (Kcal/kg) values (3,672 and 3, 667 for yellow and white maize; and 3, 669 and 3, 550 for yellow and red sorghum, respectively) (Tukur, 2011). Previous studies conducted with broiler chickens showed that feeding sorghum yielded similar and sometimes better results in terms of growth performance and carcass characteristics compared to maize (Cramer *et al.*.' 2003; Nyamambi *et al.*, 2007). However, some varieties of sorghum have high tannin content, which lowers palatability and efficiency of feed utilization (Davies *et al., 2003,* Garcia and Dale, 2006*),* thus limiting its use in poultry feeds. Some varieties of sorghum can contain up to 6% tannin (Doka *et al., 2004;* Dicko *et al.,* 2015*),* which binds dietary protein making it unavailable for absorption. Owing to their astringent taste, tannins have negative effects on feed intake, palatability and digestibility of nutrients, with a consequent decrease in weight gain of birds (Hassan *et al.*, 2003; Makkar, 2003; Kim and Miller 2005). The objective of this research is to determine the performance of broiler birds fed with sorghum using different energy levels

MATERIALS AND METHOD

Location of the Study area

The study was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma lies on latitude 12°26'N and longitude 07°29'E (Abaje *et al.*, 2014).

Experimental Materials and Animals

Ninety-six day old broiler chicks were sourced and kept for one week to acclimatize before randomly allotted to four treatment groups of 24 birds each. Each treatment was replicated thrice with 8 birds per replicate in a completely randomized design (CRD) the treatments were as follows: Diet 1 is maize based mash diet with the ME value of 2900 kcal/kg (T1) which is the control. Diet 2 is sorghum based mash diet with 2,900 kcal ME/kg (T2). Diet 3 is also sorghum based diet with 3000 kcal ME/kg (T3), and Diet 4 is sorghum with 3100 kcal ME/kg (T4). Birds in each replicate were weighed at the beginning of the experiment and subsequently on weekly basis to determine the weight gain of bird. Feed intake was also recorded daily. Feed conversion ratio, total feed cost and feed cost per kg gain were determined. Mortality was recorded. Routine management practices such as medication and vaccination were rightly observed. The birds were given feed and water *ad libitum*. The experiment lasted for four weeks. The composition of the experimental diets is shown in table 1 below. Data generated was subjected to analysis of variance in a completely randomized design using several linear program of the stat view statistical package (SAS, 2002).

Table 1: Composition of the starter experimental diet

Ingredients	T1 (2900kcalMe /kg)	T2 (2900kcalMe /kg)	T3 (3000kcalMe /kg)	T4 (3100kcalMe/kg)
Maize	57	-	-	-
Sorghum	-	55	54	53
Soybean meal	38.8	38.8	38.8	38.8
Limestone	0.5	0.5	0.5	0.5
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Methionine	0.2	0.2	0.2	0.2
Palm oil	-	2	3	4
Total	100	100	100	100

RESULTS AND DISCUSSION

The proximate composition of the experimental diets is shown in table 2. Performance of broiler chicks fed with maize and sorghum-based diets containing varying energy levels is shown in table 3. Initial body weight did not differ between the treatments. Final weight and weight gain were similar ($P>0.05$) among the treatment means. Feed intake differ significantly ($P<0.05$) among the treatments with T1 having higher feed intake than T3. T2 and T4 have similar ($P>0.05$) feed intake to both T1 and T3. The feed intake observed in this study (1754.92-2016.39g/bird) was higher than that (1264-1415g/bird) observed by Bako J. M. (2018). Feed Conversion Ratio (FCR) was similar ($P>0.05$) amongst the treatments. (sorghum with the highest energy level have (1.44) compared to the other treatments (1.71, 1.80, and 1.68 for T1,T2 and T3, respectively)). The FCR value recorded for the maize and sorghum diets with the same energy density (T1 and T2) were statistically similar. The FCR recorded in this study is similar to the report of Bako J. M. (2018) because the birds in this research gained higher in body weight.

Table 2: Proximate Composition of the Starter phase of the Experimental Diet

Parameters	T1 (2900kcalMe /kg)	T2 (2900kcalMe /kg)	T3 (3000kcalMe /kg)	T4 (3100kcalMe/kg)
Dry matter (%)	86.17	88.38	87.66	87.12
Ash (%)	7.54	3.24	4.07	4.48
Ether extract (%)	16.41	6.27	8.18	10.16
Crude fiber (%)	5.23	6.71	4.64	5.10
Crude protein (%)	27.74	30.91	33.11	30.18
Nitrogen free extract (%)	29.25	41.25	37.66	36.85

Table 3: Performance of broiler birds fed with sorghum using different energy levels at the starter phase

Parameters	Maize control (2900Kcal ME)	Sorghum control(2900 Kcal ME)	Sorghum (3000Kcal ME)	Sorghum (3100Kcal ME)	SEM
Initial weight (kg/b)	0.104	0.104	0.104	0.104	0.000
Final weight (kg/b)	1.288	1.150	1.149	1.538	0.161
Total weight gain (kg/b)	1.18	1.046	1.045	1.434	0.161
Total feed intake (kg/b)	2016.39^{a}	1868.38^{ab}	1754.92^{b}	1922.08^{ab}	64.85
Feed conversion ratio	1.713	1.809	1.681	1.444	0.154
Total feed cost (₦/bird)	251.76^{a}	215.71^{bc}	209.37^{c}	236.71^{ab}	7.834
Feed cost per kg gain (₦)	213.91	208.80	200.53	177.89	18.650

Mean with different superscripts along rows are significantly different (p> 0.05) SEM -Standard error of mean

Total cost of feed consumed (₦/bird) differ significantly (p<0.05) with T3 (209.37) having the lowest compared to T1 and T4 (251.76 and 236.71). T2 (215.71) had similar total feed cost to T3 and T4. Cost of feed per kg gain was statistically similar with T4 having (177.89/kg) compared to the other treatments (213.91, 208.80 and 200.53 for T1,T2 and T3 respectively).which make T4 the best and recommended treatment for it is more economical and efficient to farmer.

Conclusion and Recommendation

From the results of this study, feeding sorghum using different energy levels as replacement for maize resulted in similar performance. Sorghum can therefore replace maize in the diet of broiler starter especially with palm oil inclusion.

References

Bako, J. M. (2018). Effect of feeding Germinated Brown Sorghum and Methionine supplementation on performance of broiler chicken. A thesis submitted in partial fulfillment for the award of a Master's Degree in Animal Nutrition and Feed Science in the Faculty of Veterinary Medicine, Department of Animal Production, University of Nairobi.

Cramer, K.R Wilson, K.J. Moritz, J.S. and Beyer, R.S. (2003). Effect of Sorghum-Based Diets Subjected to Various Manufacturing Procedures on Broiler Performance. *Journal of Applied Poultry Research*. 12:404-410.

Dayakar-Rao B., Binu, M. Bharath Kumar, K. A., Karthikeyan, K. Hymajyothi, S., Shahid, P., Ratnavathi, C. V. and Seetharama, N. (2003). Industrial Utilization of Sorghum in India. Status and Prospects. NRCS (National Research Center for Sorghum) Report Number 13: 16pp.Department of Animal production, Faculty of Science and Agriculture,

Davies, A. J., Dale, N. M. and Ferreira, F. J. (2003). Pearl Millet as an alternative feed ingredient in broiler diets. *Journal of Applied Poultry Research,* 12: 137-144.

Dicko, M. H., Gruppen, H., Traore, A. S., Van Berkel, W. J. H. & Voragen, A. G. J., (2005). Evaluation of the effect of germination on content of phenolic compounds and antioxidant activities in sorghum varieties. *Journal of Agriculture and Food Chemistry.* 53, 2581-2588.

Doka, O., Bicanic, D. D., Dicko, M. H. & Slingerlands, M. A. (2004). Photoacoustic approach to direct determination of the total phenolic content in red sorghum flours. *Journal of Agriculture and Food Chemistry*. 52, 2133-2136.

FAO (2011). Food and Agriculture Organization of the United Nations, FAO statistical database http://aps.Fao.org

Hassan, L. A., Elzubeir, E.A. & EL Tinay, A. H. (2003). Growth and apparent absorption of minerals in broiler chicks fed diets with low or high tannin contents. *Tropical Animal Health Production*. 35, 189-196.

Iken, J. E. and Amusa, N. A. (2004). Maize research and production in Nigeria. *Africa Journal of Biochemistry*, 3(6): 302-307.Influence of a E. coli-derived phytase on nutrient utilization in broiler starts fed diets containing varying concentrations of phytic acid. Poult. Sci. 85:82-89.

Kim, H. S. & Miller, D.D. (2005). Proline-rich proteins moderate the inhibitory effect of tea on iron absorption in rats. *Journal of Nutrition*. 135, 532-537.

Louis, G. F., Lewis, A. J. and Peo, E. R. (1991). Feeding value of grain sorghum for the lactating sow. Journal of Animal Science. 69:223-229.

Makkar, H.P.S (2003). Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. *Small Ruminant Research*. 49:241-256.

Nyamambi, B. Ndlovu, L. R. Naik, Y. S. and Kock, N. D. (2007). Intestinal growth and function of broiler chicks fed sorghum based diets differing in condensed tannin levels. *South Africa Journal of Animal Science*, 37(3):202-214.

Oluyemi, J. A. and Roberts, F. A. (2000). *Poultry Production in Warm Wet Climates*. 2nd edition. Spectrum Books Ltd. Ibadan, Nigeria. 244pp.

Tukur, H. M. (2011). *Egg production in Africa*. In: Improving the safety and Quality of Eggs and Egg products. Vol. 1: Egg Chemistry, production and Consumption. Nys, Y. Bain, M. and immerseel, F.V. (eds). Woodhead Publishing Ltd., UK. 27-38.

GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND CARCASS CHARACTERISTICS OF RABBITS FED VARYING LEVELS OF GROUNDNUT HAULM WITH CONCENTRATE

MOHAMMED, J.D., ADAMA, T.Z. AND TSADO, D. N.

Federal University of Technology, Minna Niger State

Correspondence: jiyadanladi2@gmail.com 08036461758

& nmatsado@gmail.com 08037295616

ABSTRACT

The aim of this study was to assess the growth performance, nutrient digestibility and carcass characteristics of rabbits fed varying levels of groundnut haulm (GH) with concentrate. All together, 54 weaner rabbits of 6-7 weeks of an average initial weight of 735.81g were included in completely randomized design and fed six (6) dietary treatments of: 100% concentrate and 0% groundnut haulms (T_1, control), 80% concentrate and 20% GH (T_2), 60% concentrate and 40% GH (T_3), 40% concentrate and 60% GH (T_4), 20% concentrate and 80% GH (T_5) and 0% concentrate and 100% GH (T_6). In most of the treatments, the total feed intake, the body weight and carcass weight showed no significant ($p>0.05$). There were significant difference ($p<0.05$) in visceral organs and sensory characteristics when rabbits are fed groundnut haulms included diets than concentrate diets.

Keywords: Rabbits, groundnut haulms, concentrate, growth, carcass

INTRODUCTION

Food and Agricultural Organization (2004) reported low per capita animal protein consumption in developing countries particularly in humid tropics which calls for improvement in the production of short-cycle animals like rabbit. If rabbits are judiciously managed, they can kindle about six times in a year with the average of 6-7 kittens per kindling (Adeyemo *et al.,* 2013). This improvement is also essential by the rapid population growth with resultant increase in the demand for protein from animals.Rabbits have been identified to play vital role in the supply of quality protein especially in rural and peri-urban areas within the tropics (Egbo *et al*., 2001) this is because, they mature early and their meat has high protein, low fat, low energy and low cholesterol value (Adeyemo *et al.,* 2013). Rabbits have a short generation interval with high litter size and can be raised at the backyard which is well suited to small holder rabbit producers. It is important to note that, feed supply and quality is the major limiting factor to vibrant rabbit production in Nigeria. To make rabbit rearing more viable as a small-scale business, Makinde *et al*. (2014) had advocated the development of alternative feeding materials that are relatively cheap when compared with commercial feeds or conventional feedstuffs. Rabbits can be raised on high fibre feeds and materials that are not utilized by man and since they do not compete with man for grains, they have the advantage over swine and poultry (Adeyemo *et al.*, 2013). One of the non-conventional feedstuff and under-exploited forage feedstuff for rabbits in Nigeria is groundnut haulms which has high crude protein value.

MATERIALS AND METHODS

The experimental animals were sourced from the Rabbitry Multiplication Unit Minna, of the Niger State Ministry of Livestock and Fisheries. Groundnut haulms was sourced from Animal feed sellers, opposite NEPA office Minna. Concentrate was sourced from Sammy ventures, behind U.K. Bello arts theater, Minna. The study lasted for twelve weeks during which the rabbits were served with concentrate diet in the morning (8:00 am) and groundnut haulms (4:00 pm) of a known weight on a daily basis. Water was also provided *ad libitum*. Left over feeds were recorded to determine the daily feed intake.

RESULT AND DISCUSSION

In **Table 1.0** significant statistical differences between treatment and the parameters measured were noticed ($P < 0.05$). The final body weight (BW) of rabbits irrespective of treatment was all doubled their initial BWs. Nonetheless, very significant statistical difference was observed in feed intake observed between the treatments studied. Studies in rabbits have shown that BW tends to increase correspondingly with increase in feed intake, particularly forage (as seen in T_3) (Houndonougbo *et al.*, 2012; Maidala 2016) in which case feed intake have been positively correlated with level of fibre in rations. In these studies, poor digestion and utilisation of protein were reported to be responsible for the poor growth against the expected growth rate. The growth performance in terms of feed intake, body weight gain, final body weight and feed conversion ratio of rabbits fed only concentrate and those on 40% concentrate plus 60% groundnut haulms were similar. This may be attributed to the fact that forage is considered an important feed for rabbits growth and they are capable of digesting leaf protein effectively (Cheeke and Patton, 1982). This finding agrees with Bamgbose *et al*. (2003) who reported that rabbits can perform well with mixed regimen of forages and concentrates up to 50 % reduction without any adverse effect on growth. Also, lyeghe-Erakpotobor *et al*. (2002) observed significant effect of diets on intake of rabbits offered a combination of concentrate, grass and other forages. Similarly, Shiawoya and Musa (2006) reported that feeding of forage like mango, banana and tridax leaves can successfully support growth when fed with concentrate diets for weaner rabbits.

Table 1.0: Growth performance of rabbits feds varying levels of groundnut haulms and concentrate based diets

Parameters (g)	T1	T2	T3	T4	T5	T6	SEM	P-value
Initial body weight	727.11	728.22	741.22	742.22	742.44	784.55	13.93	0.71
Total feed intake	5754.69^{a}	6263.43^{a}	5320.12^{b}	5450.93^{ab}	4903.93^{c}	5197.71^{b}	24.43	0.00
Body weight gain	1033.30^{a}	1000.01^{a}	1100.12^{a}	1031.04^{a}	986.33^{b}	991.51^{b}	32.59	0.02
Final body weight	1760.41^{ab}	1728.23^{b}	1841.34^{a}	1773.26^{ab}	1728.77^{b}	1740.06^{b}	48.26	0.01
Feed conversion ratio	5.56^{a}	6.26^{a}	4.83^{b}	5.28^{ab}	4.97^{b}	5.24^{ab}	0.84	0.03

abc = means in abc = means in the same row carrying different superscript are significantly ($p<0.05$) difference.

The meat sensory properties of rabbits fed groundnut haulms and concentrate based diets showed beneficent (P<0.05) increase in the appearance, tenderness and overall acceptability of the meat (Table 2.0). While significant statistical difference was recorded in the organoleptic properties of fried rabbit meat in this study between the treatments (P<0.05), other studies obtained contrary results (Raïssa *et al.*, 2018;)

Table 2.0: Sensory characteristics of rabbit meat fed varying levels of groundnut haulms and concentrate based diets

Parameters	T1(keys)	T2( )	T3( )	T4( )	T5( )	T6( )	SEM	P-value
Colour	8.33	7.66	7.66	8.00	7.66	7.33	0.47	0.33
Juiciness	8.66	8.66	8.00	7.66	7.66	7.66	0.66	0.22
Appearance	7.66^{a}	8.00^{a}	7.66^{a}	7.33^{a}	7.66^{a}	6.33^{b}	0.48	0.03
Flavour	8.33	7.33	7.33	7.00	7.66	7.33	0.67	0.28
Tenderness	8.66^{a}	7.00^{a}	6.00^{b}	6.66^{ab}	6.00^{b}	6.33^{b}	0.44	0.00
Aroma	7.33	7.00	7.33	7.00	7.33	6.67	0.47	0.93
Overall acceptability	8.33^{a}	8.33^{a}	7.66^{ab}	7.33^{ab}	7.33^{ab}	7.00^{b}	0.62	0.01

ab = means in the same row carrying different superscript are significantly (p<0.05) differe

Conclusion

1. Feeding rabbits solely on concentrate or inclusion of 60% groundnuts haulms to concentrate have similar feed intake, body weight gain, final body weight and feed conversion ratio.
2. Carcass parameters such as carcass weight, dressing percentage, neck length, cervico-thoracic region weight, tail length, heart weight and spleen weight of animals fed only concentrate and those fed with concentrate along with groundnut haulms up to 80% or solely on groundnut haulms were similar. Improvement was observed in lungs

weight, kidney weight and intestine length the rabbits were fed groundnut haulms included diets than when fed solely on concentrates.

3. Sensory characteristics such as colour, flavor, juiciness and aroma are similar between the treatment diets. Additionally, acceptability of rabbit meat fed only concentrate and those fed concentrate along with up to 80% groundnut haulms are similar.

REFERENCES

Adeyemo, A. A., Adeyemi, O. A., Ekunseitan, D. A. and Taiwo O. S. (2013). Effect of concentrate to forage ratio on the performance and haematological parameters of growingrabbits. *Global Journal of Biology Agriculture and Health Sciences,* 2 (2)

Apata, E.S., Soniran. A.G., Ikudoro, F.O., Akinteru, O., Osineye, F. and Doherty, F. (2005). Taste panel socio-economic characteristics and the organoleptic properties of rabbit cooked by five different methods. *Journal of Agriculture, Forestiy and the Social science***. 32j. 139-146.**

Bamghose. A.M., Akinnusi. F.A.O and Adegbenro, *K.A.* (2003). Growth response of weaner rabbits fed concentrates/forage supplement based diet.*Proceeding 18th Annual Conference an/Il/al Science Association of Nigeria. September J6'*']8th,2003, Federal University of Technology, Minna, Nigeria, **98-99.**

Cheeke, P. R. and Patton, A. F. (1983). The significance of fibre in rabbit production. *Journal of Applied Rabbit Research.* **3(3): 20-23.**

Egbo, ML., Doma, U. D and Lacdaks, A. B (2001). Characteristics of small-scale rabbit production and management in Bauchi metropolis.*Proceedings of the 26th Annual Conference of Nigerian Society of Animal production.* March 18th-21st Ahmadu Bello University Zaria,

F.A.O (2004). Food and Agricultural Organization. Year Book, Rome.

Houndonougbo, M. F., Chrysostome, C. A. A. M., Attakpa, S. E., Sezan, A., and Dehou, H. B. (2012). Growth Performance of Rabbits Fed Palm-Press Fibres-Based Diets. *ISRN Veterinary Science*, **1–5**. doi:**10.5402/2012/915729**

Isikwenue, J.O., Akpodiete O.J., Omoye, S.I. &Okagbare, G.O. (2010).The effect of replacing groundnut cake with urea-Treated and fermented brewers dried grain on nutrient digestibility, retention and carcass characteristic of broiler finisher. *Nigeria Journal of Animal products,* **37(1)1-12.**

Iyeghe-Erakpotobor, G. T. (2002). Effect of concentrate and forage type on performance digestibility of growing Rabbits under sub-humid tropical condition. National Animal

Production Research institute Ahmadu Bello University. Shika-Zaria *Asian Journal of Animal and veterinary Advances*, **2(3) 125– 132.**

Maidala, A., Bello, I.B. &Jarmari, S.M. (2016) Comparative Responses of Weaner Rabbits to Concentrate Diets Supplemented with Different Forages. *Journal of Biology and Genetic Research 2 (3): 2545 – 5710*.

Makinde, O.J., Enyigwe, P.C., Babajide, S.E., Atsumbe, J.A., Ibe, E.A. and Samuel, I. (2014). Growth performance and carcass characteristics of Finisher broilers fed rice offal based diets supplemented with exogenous enzyme.*Greener Journal of Agricultural Sciences*. **4(4): 144 -149.**

Malik, A. A.,Balogun, O.O. and Dikko, A.H. (2015). An evaluation of the effect of storage of a locally Produced natural vitamin premix on the performance of laying hens. *Journal of Agriculture, Foresty and Social Science,* **8 (1): 208-214.**

Raïssa1 W.L.M.F., Athanase, O.K., Frank, Y.K. and Sébastien,N. (2018). Effect of mixing two leafy vegetables on the quality of rabbit meat. *European Journal of Biotechnology and Bioscience,* **6(6): 30-36.**

Shiawoya, E.L. & Musa J.A. (2006). Evaluation of the feeding potentials of mango leaves *(Man gfèraindica)* Banana *(Musa spp)* foliage and tridax*(Tridaxprocumbens)* as supplemented to conventional feeds for growing rabbits. *Journal of Agricultural Research and Development,* **5 (1): 1-6.**

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EFFECTS OF FEEDING GRADED LEVELS OF BAOBAB (*Adansonia digitata*) PULP SEED MEAL ON APPARENT NUTRIENTS DIGESTIBILITY AND CARCASS CHARACTERISTIC OF BROILER CHICKENS

***Lawan, A[1]., Olugbemi, T. S.[2]., Duru, S.[2]., Onimisi, P.A.[2] and Maidala, A[1]., Abdullahi U[1]., Abdullahi A.M[1].**
[1]Department of Animal Science Faculty of Agriculture Federal University Gashua. P.M.B. 1005 GashuaYobe State.
[2]Department of Animal Science Faculty of Agriculture Ahmadu Bello University Zaria.
***Email:** melelawan@yahoo.com**. or** lawanmele@gmail.com**. GSM: +2348032980124**

ABSTRACT

The experiment was conducted to evaluate the nutrients digestibility and carcass characteristics of broiler chickens fed graded levels of baobab (Adansonia digitata) pulp meal (BPSM). Three hundred broiler (Anak) chickens were allotted to five treatments replicated thrice with 20 birds per replicate in a completely randomized design (CRD). The inclusion levels of the BPSM in the diets were 0, 10, 20, 30 and 40% for treatment 1 (Control), 2, 3, 4 and 5 respectively. The experiment lasted for four weeks each for the starter and finisher respectively. Data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnet Test. Nutrient digestibility increased with increasing levels of BPSM in broiler chickens diet up to 20% BPSM and then slightly declined afterward and the significant (P<0.05) increase in carcass characteristic was the total reflection of live weight which was significantly higher in birds fed diets containing BPSM

Keywords: Baobab pulp seed meal, Carcass, Digestibility, Nutrients, Broiler chickens

Introduction

The logical solution in meeting meat scarcity in Nigeria is to increase broiler production (Babatunde, 1990). Isiaka (2006) reported that poultry is strategic in addressing animal protein intake shortage in human nutrition because of its high fecundity, fast growth rate, short generation interval and parallel competence in nutrient transformation to high quality animal protein. The total dependence on cereal as a principal energy source in poultry diets is the major problem militating against the expansion of poultry industry. Medugu *et al.* (2011) reported that the tremendous decrease in poultry production is as a result of high cost of protein and energy feedstuffs especially cereal grains (maize) which form the bulk of energy in poultry feeds and are in short supply as a result of industrial and human needs. This has resulted in competition between human and animals for the available feed resources coupled with constant drought. Hence, the high cost of poultry feed has continued to be the major problem in developing countries as feed cost is about 65 – 75% (Nworgu *et al*., 1999) of the total cost of production compared to about 50 – 60% in developed countries (Tackie and Flenscher, 1995). Therefore, all reasonable and practical options deserve thorough

consideration. This has necessitated the renewal of interest in exploring the feasibility of incorporating neglected or underutilized energy feedstuff. Not much has been done in evaluating the potential feed value of some multipurpose tree products such as baobab *(Adansonia digitata).* Baobab fruit contains 50% more calcium than spinach and high in anti-oxidant (NRC, 1994) hence necessitating this research in a bid to seek for an alternative to the inadequate and expensive conventional feedstuffs.

MATERIALS AND METHODS

Source of Baobab Fruit: Baobab fruits used for this experiment were harvested at mature stage which was indicated by the hard brown colour of the ectoderm from the trees using locally made equipment aroundMamudo, Danchuwa, Alaraba and Mele in Potiskum Local Government area of Yobe State, Nigeria.

Processing: Dried baobab fruits were processed by cracking open the hard shell of the baobab fruits using a small hammer to remove the inner contents (epicarp), and pounded using a mortar and pestle while the seed and pulp were separated using a sieve. The pulp were slightly milled and separated from the unwanted coarse material using a fine mesh.

Experimental design and management: Three hundred (300) broiler chicks (Anak) were purchased from Zarm Farm. The birds were vaccinated against Newcastle disease (intra ocularly) on the day of arrival and brooded together for three days using kerosene stoves and electricity bulbs as sources of heat and light. They were fed a common diet during this period. The birds were subsequently weighed and allotted to five dietary treatments. The birds were housed in a deep litter system in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for eight weeks comprising of first four weeks (starter phase) and last four weeks (finisher phase). Both experimental materials and compounded rations were taken to the laboratory for proximate analysis before commencement of the experiment. Birds were vaccinated against Newcastle and Gumboro diseases. Feed and water were provided *adlibitum.*.

Experimental diets: The composition and calculated analysis of the experimental diets are presented in Tables 1 and .2 respectively. The test ingredient was included at 0, 10, 20, 30 and 40% representing 1 (control), 2, 3, 4 and 5 respectively for both the starter and finisher phases respectively. The starter (23% CP; 2900 Kcal/Kg) and finisher (20% CP, 2950 Kcal/Kg) were isonitrogenous and isocaloric and met the recommended crude protein and metabolisable energy requirements as stated by (NRC 1994)

Experimental Site*:* The study was conducted at the Teaching and Research farm (Poultry Unit) of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah of Nigeria with an average

annual rainfall, relative humidity and temperature of 1,100 mm, 75% and 24.4^{O} C respectively, on Latitude 11° 12'N and Longitude 7° 33'E on an altitude of 610m above sea level (Ovimap, 2014).

Digestibility trials: At the end of the of the experiment (56th days), 9 birds per treatment of an average weight (3 birds per replicate) were selected from the five treatment groups for digestibility trial and caged individually, after an adjustment period of seven days. The droppings were collected on a daily basis for seven days while feed intake over the period was recorded. The dropping sample was oven dried at a temperature of about 105^{0}C for 18 hours to reduce the moisture content and to bring the faeces to a constant weight. The total daily collections were pooled, weighed and ground and representative samples of the faeces and experimental diets were taken to the laboratory for proximate analysis according to the procedure of AOAC (1990). They were assayed for apparent digestibility of crude protein, ether extract, crude fiber, and nitrogen free extract. The result was used to calculate the digestibility.

Nutrient digestibility = $\frac{Nutrient\ intake - Nutrient\ in\ feaces \times 100}{Nutrient\ intake}$

Carcass measurement: At the end of the experiment (56th days), three birds representing the average weight were selected from each replicate (nine birds per treatment), labeled and then starved overnight but water was provided. The weights of the birds were recorded in the morning before slaughter. Birds were defeathered by dipping into hot water for few minutes to soften the feather for easy removal. The defeathered birds were eviscerated. The parameters measured were carcass weight, dressing percentage, prime cut and organs weighed were expressed as percentages of carcass weight.

Data Analysis: All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of SAS 9.2 (2002). Significant differences among treatment means were compared using Dunett multiple ranged in the SAS Package.

The model for this design was as follows:

$X_{ij} = \mu + t_i + e_{ij}$

Where: Xij = any observation made in the experiment,

μ = the population mean,

t_i = Effect due to treatment added or treatment effect,

Eij = Experimental error.

RESULTS AND DISCUSSION

Apparent nutrients digestibility

The nutrients digestibility ranged from 81.53 –88.68%, 77.60 – 84.48%, 68.81 – 80.06%, 80.06 – 86.94%, 70.42 – 77.92% and 88.78 – 92.50% (Table 3) for the Dry matter, Crude protein, Crude fibre, Ether extract, Ash and Nitrogen free extract respectively. Birds fed 20% BPSM was found to significantly ($P<0.05$) different from all treatments groups in the mention parameters except for the dry matter, ether extract and nitrogen free extract digestibility which were found to be similar ($P>0.05$) with treatment 1 (0% BPSM) and 2 (10% BPSM). Treatment 5 (40% BPSM) was significantly ($P<0.05$) lower in most nutrients digestibility than all the treatment groups though found to be insignificantly ($P>0.05$) different from treatment 4(30%BPSM), this implies that nutrient digestibility increased with increasing levels of BPSM in broiler chickens diet up to 20% BPSM and then slightly declined afterward. This result agrees with the report of Rafiu *et al*, (2012) who reported higher nutrient digestion in diets containing BPSM in feeding broiler chicken with baobab seed when compared with the control diet. Similar finding was reported by Sola-Ojo *et al*, (2013) in feeding broiler with BPSM though reported insignificant ($P>0.05$) differences in the digestibility of all the nutrients with slightly higher values was recorded in the diet containing higher levels of BPSM. This result shows that BPSM inclusion up to 40% is possible in the broiler diet without any detrimental effects on nutrient digestibility. These was supported by the work of Proll *et al*. (1998) who found that baobab pulp and seed to have high digestibility, biological value (BV), and net protein utilization (NPU) among unconventional tropical crop. This high digestibility, BV, and NPU of baobab pulp and seed could be attributed to the low levels of trypsin inhibitor phytic acid and tannin and the excellent amino acid profile.

Carcass characteristics

The average live weights were 2000g, 2233.33, 2266.70, 2173.30 and 2000.0g (Table 4) for treatment 1 (0% BPSM) control, 2, 3, 4, and 5 respectively (Table 4). Significant ($P<0.05$) higher slaughter weight 2233.33, 2266.70 and 2173.30g were recorded in birds fed 10% BPSM, 20% BPSM, 30% BPSM respectively while significantly ($P<0.05$) lower values 2000.00g and 2000.00g were recorded in birds fed 0% BPSM and 40% BPSM respectively. Carcass weight, dressing percentage and prime cut followed similar trends as the live weight. This result agrees with the work of Sola-ojo *et al*. (2013) who reported that, live weight differed ($P<0.05$) significantly among varying level of BURBSM in the diet of broiler chickens. The internal organs such as heart, gizzard, liver kidney and gastro intestinal tract

length ranged from 0.58 0.55%, 2.94 - 3.34%, 2.35 - 2.64%, 0.46 - 0.52% and 218.83 – 253.83cm respectively. Significantly (P<0.05) higher heart values 0.54% and 0.55% were recorded in birds fed 10% BPSM and 20% BPSM while significantly (P<0.05) lower values 0.51, 0.50 and 0.50% were recorded in birds fed 0% BPSM, 30% BPSM and 40% BPSM. Significantly (P<0.05) higher gizzard values 3.34, 3.25 and 3.20% were recorded in birds fed 20% BPSM, 30% BPSM and 40% BPSM while significantly (P<0.05) lower values 2.94% and 3.08% were recorded in birds fed 0 and 10% BPSM. Significantly (P<0.05) higher liver values of 2.62 and 2.64% were recorded in birds fed 30 and 40% BPSM while significantly (P<0.05) lower value of 2.35% was recorded in birds fed 0% BPSM. No significant (P<0.05) differences were observed in values of 2.48 and 2.49% recorded in birds fed 0 and 10% BPSM. The values recorded for kidney followed a similar trend as liver while significantly (P<0.05) higher gastro intestinal tract length values of 253.83cm and significantly (P<0.05) lower values of 218.83cm were recorded in birds fed 30 and 0% BPSM respectively. The significant increase in carcass characteristic was the total reflection of live weight which was significantly higher in birds fed diets containing BPSM. This study agrees with the findings of Kutlu and Forbes, (1993) who reported that supplemental ascorbic acid (250/kg) increased performance and yields better carcass quantity and quality in birds reared under heat stress condition and also Sola-ojo *et al,* (2011) who reported a significant increase in carcass components as the DURBSM increased in the broiler chicken diets.

Conclusion

Higher apparent nutrients digestibility and best carcass characteristics were recorded in birds fed 20% BSPM. But It can be included in broiler chicken diets up to 40% without detrimental effects on carcass characteristics of broiler chicken.

References

AOAC (1990). Official Methods of Analysis of the Association of Official Analytical Chemist. 15th Edn., Association of Official Analytical Chemists, Washington, DC, USA.

Babatunde, G.M. (1990). The littering Nigerian livestock sector. Its problems and possibilities. Inaugural lecture, University of Ibadan Nigeria.

Isiaka, M.A., Agiang, E.A., Okon, B.J. (2006). Dietary Energy and Crude protein Requirement for chicks of Nigeria local fowl and crossbreed. *International Journal of Poultry Science* 5: 271-274.

Kutlu, A.R., and Forbes, J. M. (1993). Changes in growth and blood parameters in heat stressed broiler chicks in response in dietary ascorbic acid livestock production. Production Science 96: 335 – 350.

Medugu, C.I., Raji, A.O., Igwebuike, J.U. and Barwa, A. (2011). Alternative cereal grains and cereal by – products as sources of energy in poultry diets – *A review Research Opinion in Animal and Veterinary Science* Pp.530 – 542.

NRC. (1994). *Nutrient requirements of poultry* 9th revised edition.Nutritional Academic Press. Washington D.C. USA.

Nworgu, F.C., Adebowale, E.A., Oredein, O.A. and Oni, A. (1999). Prospects and economics of broiler chicken production using two plant protein sources *Tropical Journal of Animal Science*. 2(1): 159 – 166.

Ovimaps (2014). Ovilocation map; Google earth imaginery. Date 6th march 2014.

Proll, J., Petzk, K.J., Ezeagu .I.E. and Metges, C.C (1998). Low nutritional quality of unconventional tropical crops seed in rats. *Journal of Nutrition.* 128:2014–2022.

Rafiu, T.A., Okunlola, D.O., Shitu, M.D., Ookanola, G.O. and Falodun, T.T. (2012). Digestibility and growth performance of broiler chickens fed varying dietary meal of baobab (*Adansoniadigitata*) pulp and seed based diets. In: *Proceeding 17th Annual Conference of the Animal Science Society of Nigeria* from 9th – 13th September 2012 held in Abuja Nigeria. Pp. 442 – 445

SAS (2002). Statistical Analysis System, Inc. User`s Guide. Statistic version for windows.SAS Software, version 9.2 Cary, North Carolina USA.

Sola-Ojo, F.E, Bola, S.A and Usman, T.O (2011). Performance Evaluation of Layer Feed Baobab (*Adansonia digitata*) seed meal based diet. *Journal of Applied Agricultural Resource*. 3:113-122.

Sola-Ojo, F.E. Toye, A.A Bolu,S.A.O. Ojo, V. Okukpe, K.M Alli O.I., Adeyemi, K.D and Garba, S.O. (2013). Effects of Baobab (*Adansonia digita*) seed meal on growth and Morphometric Traits in Broiler Chickens *MSEB Journal.* 13 (1&2): 29-32.

Tackie, A.M. and Flenscher, J.E. (1995). Nutrient value of wild sorghum fortified with (*leucana leucocepphala*) (Wh.lam). Bulletin of Animal for Africa. 47: 223 – 375.

Table 1: Composition and calculated analysis of the experimental diet (starter)

	Inclusion levels baobab pulp-seed meal (% BPSM)				
Ingredient (%)	**0**	**10**	**20**	**30**	**40**
Maize	56.95	47.95	38.50	29.50	20.45
BPSM	0.00	10.00	20.00	30.00	40.00
G/nut cake	20.00	19.00	18.00	17.00	16.50
Soybean meal	19.00	19.00	19.00	19.00	19.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg)	2899.95	2912.98	2904.09	2913.25	2935.20
Crude protein	23.13	23.21	23.23	23.30	23.56
Crude fibre	3.84	4.16	4.46	4.78	5.14
Calcium	1.18	1.28	1.28	1.38	1.25
Av. Phosphorus	0.66	0.64	0.62	0.61	0.59
Lysine	1.02	1.12	1.21	1.31	1.42
Methionine	0.55	0.55	0.53	0.50	0.48
Cost (₦/Kg)	91.00	82.77	78.41	73.07	69.49

*Bio-mix: starter, unit/kg: Vit.A = 25.00IU, Vit.D_3 = 0.500IU, Vit.E = 5.75mg, Vit.K_3 = 0.50mg, Vit.B_1 = 0.45mg, Vit.B_2 = 1.375mg, Niacin = 6.875mg, Panthothenic Acid = 1.875mg, Vit.B_6 = 0.75mg, Vit.B_{12} = 0.038mg, Folic Acid = 0.188mg, Biotin H2 = 0.015mg, Choline = 0.25mg, chloride=7.50mg, Cobalt = 0.05mg, Copper = 0.75mg, iodine = 0.25mg, Iron = 5.00mg, Manganese = 10.00mg, Zinc = 7.50mg, Selenium = 0.05mg, Anti-oxidant = 0.313mg, BPSM = Baobab pulp-seed meal, G = Ground, Av = Available

Table 2: Composition and calculated analysis of the experimental diet (finisher)

	Inclusion levels of baobab pulp-seed meal (% BPSM)				
Ingredient (%)	**0**	**10**	**20**	**30**	**40**
Maize	60.00	52.18	41.95	32.95	24.18
BPSM	0.00	10.00	20.00	30.00	40.00
G/nut cake	20.00	20.00	20.00	20.00	20.00
Soybean meal	15.95	14.00	14.00	13.00	12.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lime stone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg	2934.98	2956.92	2958.38	2970.35	2982.31
Crude protein	21.95	21.57	21.94	21.93	21.91
Crude fibre	3.80	4.17	4.57	4.95	5.33
Ether extract	4.13	4.91	5.67	6.44	7.21
Calcium	1.08	1.08	1.18	1.28	1.28
Av.phosphorus	0.64	0.62	0.60	0.59	0.57
Lysine	1.07	1.09	1.10	1.18	1.26
Methionine	0.53	0.50	0.48	0.46	0.44
Cost (₦/Kg)	91.00	82.77	78.41	73.07	69.49

*Bio-mix finisher supplied/kg: Vit.A = 21.25IU, Vit.D3 = 0.375IU, Vit.E = 2.50mg, Vit.K_3 = 0.50mg, Vit.B_1 = 0.375mg, Vit.B_2 = 0.40mg, Niacin = 1.00mg, Panthothenic Acid = 5.00mg, Vit.B_6 =1.25mg, Vit.B_{12} = 0.375mg, Folic Acid = 0.025mg, Biotin H2 = 0.125mg, Choline 0.225mg chloride = 4.375mg, Cobalt = 0.05mg, Copper = 0.75mg, iodine = 0.25mg, Iron = 5.00mg, Manganese = 10.00mg, Zinc =7.50mg, Selenium = 0.05mg, Anti-oxidant = 0.313mg, BPSM = Baobab pulp-seed meal, G = Ground, Av. = Available

Table 3: Apparent nutrients digestibility of broiler chickens fed graded levels of BPSM .

	Inclusion levels of baobab pulp meal (% BPSM)					
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**
Dry matter	87.38^{ab}	86.56^{ab}	88.68^{a}	86.23^{b}	81.53^{c}	0.49
C/ protein	81.12^{c}	82.76^{b}	84.48^{a}	77.11^{c}	77.60^{d}	0.40
Crude fibre	75.45^{b}	80.66^{a}	78.42^{a}	68.81^{c}	65.88^{d}	1.37
Ether extract	86.94^{a}	84.02^{b}	86.75^{a}	82.78^{b}	80.06^{c}	1.24
Ash	73.94^{b}	77.01^{a}	77.62^{a}	73.96^{b}	70.42^{c}	1.23
NFE	91.48^{a}	92.06^{a}	92.50^{a}	90.14^{b}	88.78^{c}	5.73

^{abcd} = Means within row with different superscript differed significantly (P<0.05).
NFE = Nitrogen Free Extract. C = Crude

Table 4: Carcass characteristic of broiler chickens fed graded levels of baobab pulp-seed.

	Inclusion levels of baobab pulp meal (% BPSM)					
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**
L/Wt (g)	2000.00^{b}	2233.33^{a}	2266.70^{a}	2173.30^{a}	2000.00^{b}	18.10
C/wt (g)	1458.33^{b}	1750.00^{a}	1783.33^{a}	1711.33^{a}	1450.00^{b}	14.05
Dressing %	72.90^{b}	78.36^{a}	78.66^{a}	78.74^{a}	72.50^{b}	0.72
%Organs						
Neck	4.99^{b}	5.75^{a}	6.00^{a}	5.65^{a}	5.20^{b}	0.25
Breast	26.31^{b}	27.01^{b}	27.71^{a}	26.81^{b}	25.85^{c}	0.33
Wing	9.46^{b}	10.01^{a}	10.06^{a}	10.15^{a}	9.24^{b}	0.18
Thigh	13.88^{b}	14.51^{a}	14.96^{a}	14.70^{a}	14.09^{b}	0.23
Drum Stick	12.24^{c}	13.36^{a}	13.38^{a}	13.10^{a}	12.12^{c}	0.35
Back	18.12^{b}	18.75^{a}	18.99^{a}	18.98^{a}	17.72^{b}	0.25
Heart	0.51^{b}	0.54^{a}	0.55^{a}	0.50^{b}	0.50^{b}	0.01
Gizzard	2.94^{b}	3.08^{b}	3.34^{a}	3.25^{a}	3.20^{a}	0.10
Liver	2.35^{c}	2.48^{b}	2.49^{b}	2.62^{a}	2.64^{a}	0.04
Kidney	0.46^{b}	0.45^{b}	0.46^{b}	0.51^{a}	0.52^{a}	0.01
GIT (Cm)	218.83^{b}	248.33^{a}	249.67^{a}	253.83^{a}	244.67^{a}	6.68

^{abc} = Means within row with different superscript differed significantly (P<0.05).
L = Live; C = Carcass; W= Weight; GIT = Gastro intestinal length.

PRODUCTIVE PERFORMANCE OF LAYERS FED KAURA SORGHUM REPLACING MAIZE WITH FULL-FAT SOYA BEAN DIETS

H. Jamilu*[1], U. D. Doma [2], M. L. Egbo[2], M. Abubakar[2], D. Zahraddeen[3], N. A. Jama'a[2] and H. S. Buhari[4],

[1]Faculty of Agriculture, Teaching and Research Farm, Federal University Dutse
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi state, Nigeria
[3]Department of Animal Science, Ahmadu Bello University, Zaria
[4]Collage of Agriculture and Animal Science, Division of Agricultural Collages, Ahmadu Bello University Mando-Road, Kaduna

* Corresponding author email= jamilu167@yahoo.com, Phone number = +2348036305614

ABSTRACT: The experiment was conducted to evaluate the reproductive performance of layer chickens fed dietary levels of kaura sorghum. Five diets (16% CP) were formulated, in which the Kaura Sorghum was included at 0, 25, 50, 75 and 100% levels and the diets designated as treatments T1, T2, T3, T4 and T5 respectively. Kaura sorghum was used to replace maize as a dietary energy source. Three hundred brown pullets were used for the research. They were allotted to five treatments which were replicated four times each with twenty birds per replicate in a completely randomized design (CRD). After flushing for seven days using the experimental diets, initial weights of the birds in each replicate were recorded. Records of feed intake, number of eggs laid and egg mass were taken on daily basis. The result obtained after the research showed that the final body weight and total feed intake were not affected by the dietary treatments. Birds fed diet 4 (75% kaura sorghum) had the highest feed consumption value of 113.33g while the lowest intake was obtained on diet 1(control) with a value of 91.39g. The highest hen-day egg and hen house egg production (72.59% and 70.00%, $P<0.001$) was obtained on diet 5 (100% kaura sorghum). The best feed conversion ratio (1.42) was found on diet 2 while the poorest was obtained on the maize control diet (1.68), even though the value did not differ statistically. It can be concluded that Kaura sorghum in combination with full fat soya bean can completely (100%) replace maize in the diets of laying hens with no deleterious effects on performance parameters.

Key word: Kaura Sorghum

INTRODUCTION

Maize has been the major source of energy in poultry diets. However inadequate production of maize and the intense competition for maize between man and livestock especially in the drier parts of the tropics has made poultry ration to be very expensive. The high cost of commercial diets for poultry due to high cost of maize as the major ingredients, if not addressed will result to lower income to poultry farmers and reduced protein intake among Nigerian populace. One of the major tasks that can be taken to alleviate such a threat is the use of alternative energy sources like kaura sorghum and millet in the drier areas. Researchers like Parthasarathy *et al.,* (2005); and Issa *et al.,* (2007) have reported that sorghum grains can play an important role in poultry feed in the sahelian countries. Other workers, Hancock, (2000), Dawling *et al.,* (2002) and Travis *et al.,* (2006) have shown that sorghum could be a suitable feed stuff in the poultry industry. Sorghum grain is an interesting energy ingredient in poultry diets due to its nutritional composition which is very similar to maize. Layers are raised purposefully for egg production. They are efficient producers of eggs which provide an alternative source of protein and as such

this gives poultry more advantage over other livestock (Ojo, 2000). More so, it was reported that, egg as a product of poultry industry supply about 3.5g of the total 7.2g of animal protein required for individual dietary needs per day (Nicholas, 2014).

MATERIALS AND METHODS

The research was carried out at the Teaching and Research poultry unit of the School of Undergraduate Studies College of Education Azare between the months of February and March 2015. Azare is located in Katagum Local Government Area of Bauchi State. It is located between latitudes 11^0 30'' N and 11^0 10' E. The mean monthly temperature ranges from 20.10 – 22.50^0C in December and January to 30.0 – 32.5^0C in April and May. The temperature of the rainy season remains steady at about 25^0C – 27^0C for the month of June to October. The rainy season in Azare starts in April and lasts upto October with five months of dry season from November to March (Bura, 2000). Five dietary treatments were formulated with kaura sorghum as a replacement for maize using full-fat soyabean as a protein source. Kaura sorghum replaced maize at 0, 25, 50, 75 and 100% in diets 1, 2, 3, 4 and 5 respectively. The full-fat soyabean was mixed with milled kaura sorghum variety and other ingredients to formulate diet with 16% CP. Three hundred (300) brown pullets were used for the research. The birds were allotted to the five dietary treatments which were replicated four times with fifteen (15) birds per replicate in a completely randomized design (CRD). Production performance parameters such as weight change, feed intake, hen day egg production, hen housed egg production and feed conversion ratio were measured. The percent compositions of the various feed ingredients used in formulating the five dietary treatments is presented in Table 1:

Table 1: Ingredients and Percentage Composition of Layer Diets Containing Graded Levels of Kaura Sorghum with Full-Fat Soya Bean as Protein Source

Ingredients	Diets				
	1 (0%)	2 (25%)	3 (50%)	4 (75%)	5 (100%)
Maize	50.00	37.5	25.00	12.50	00.00
Kaura Sorghum	00.00	12.50	25.00	37.50	50.00
Soya bean	16.70	16.70	16.70	16.70	16.70
Wheat offal	20.00	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Limestone	7.0	7.0	7.0	7.0	7.0
Bone meal	3.0	3.0	3.0	3.0	3.0
Premix	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude protein (%)	16.55	16.81	17.05	17.31	17.55
Met.Energy (Kcal/kg)	2551.20	2534.84	2518.34	2501.84	2485.34
Crude fibre (%)	3.66	3.64	3.64	3.64	3.64
Ether extract (%)	3.37	2.87	3.12	1.87	2.87
Calcium (%)	3.71	3.78	3.80	3.89	4.19
Phosporus (%)	0.60	0.65	0.69	0.72	0.80
Methionine (%)	0.37	0.40	0.42	0.44	0.46

Lysine (%)	0.84	0.84	0.85	0.87	0.89

Premix**Vitamin-mineral Premix** contains the following per 2.5 kg: Vitamin A 10,000 IU, Vit. D3 2,000,000IU, Vit E 12,000mg, Vit K3 2,000mg, Vit B1 1,500mg, Vit B2 4,000mg, Vit B6 1,500mg, Niacin 15,000mg, Vit B12 10mcg, Pantothenic acid 5,000mg, Folic acid 500mg, Biotin 20mcg, Cholinechloride 100,000mg, Manganese 75,000mg, Zinc 50,000mg, Iron 20,000mg, Copper 5,000mg, Iodine 1,000mg, Selenium 200mg, Cobalt 5000mg, Antioxidant 125,000mg.

RESULTS AND DISCUSSION

The productive performance of layers fed kaura sorghum replacing maize with full-fat soya bean diets is shown in Table 2. The final body weight and total feed intake were not affected by the dietary treatments. Birds fed diet 4 (75% kaura sorghum) had the highest feed consumption value of 113.33g while the lowest intake was obtained on diet 1(control) with a value of 91.39g. The highest hen-day egg and hen house egg production (72.59% and 70.00%, P<0.001) was obtained on diet 5 (100% kaura sorghum). The best feed conversion ratio (1.42) was found on diet 2 while the poorest was obtained on the maize control diet (1.68), even though the value did not differ statistically. The enhanced hen day and hen house egg production on the kaura sorghum diets could be attributed to the quality of the dietary treatments when compared with maize control diets, (Bawa *et al*., 2003). Also, adequate levels of methionine and lysine have been reported to influence egg production and egg size in laying birds (Bamgbose and Biobaku, 2003).

Table 2: Productive Performance of Layers Fed Dietary Levels of Kaura Sorghum Replacing Maize with Full-fat Soyabean

Parameters	**Diets**					
	1 (0%)	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	**SEM**
Initial wt (kg)	1.50	1.50	1.51	1.51	1.63	1.03^{NS}
Final wt (kg)	2.03	2.04	2.07	2.13	2.05	0.08^{NS}
Total feed intake (kg)	5.30	5.74	5.54	6.15	4.25	0.01^{NS}
Daily feed intake (g)	91.39^{b}	93.33^{b}	101.61^{ab}	113.33^{a}	96.67^{ab}	0.47***
Hen-day egg production (%)	61.60^{b}	67.16^{ab}	62.22^{ab}	62.22^{ab}	72.59^{a}	0.26***
Hen housed egg production (%)	60.00^{b}	65.00^{ab}	60.00^{b}	60.00^{b}	70.00^{a}	0.45***
Feed conversion ratio (FCR)	1.68	1.50	1.55	1.42	1.50	0.03^{NS}
Mortality (Number)	0	0	0	0	0	-

abc = Means bearing same superscripts within the rows are statistically similar (*** = p < 0.001)

SEM = Standard Error of Mean, NS = Not significant (p>0.05)

CONCLUSION AND RECOMMENDATION

From the results obtained in this research it can be concluded that Kaura sorghum in combination with full fat soya bean can completely (100%) replace maize in the diets of laying hens with no deleterious effects on performance parameters. Hence use of Kaura as source of energy in the diets of laying hens is recommended.

REFERENCES

Bamgbose, A. M. and Biobaku, W. O. (2003). Utilization of Cotton seed cake as cake replacement for groundnut cake in layers diets: performance and egg quality characteristics. *Journal of Pure and Applied Science*, **3:** 140-148.

Bawa, G. S. Tegbe, T. S. B., Ogundipe, S. O., Dafwang, I. I. and Abu, E. A. (2003). The effect of duration of cooking lablab seeds on the Level of Some anti-nutritional factors. *Proceeding 28th Annual conference of the Nigerian Society for Animal Production Ibadan*, **28:**213-215.

Dowling, L. F., Ani, C. and Hamaker; B. R. (2002). Economic viability of high digestibility sorghum as feed for market broilers. *Journal for Agro – business*, 94: 1050 – 1058.

Hancock, J. D. (2000). Value of sorghum and sorghum Co – products in the diets for livestock in: Smith, W. and R.A. Fedrick Son (eds.). Sorghum origin, history, technology and production. Willey series crop science. Pp 731 – 751.

Issa, S. hancock, J. D., Tuistra, M. R., Kapran, I. and Kaka, S. (2007). Effects of sorghum variety on growth and carcass characteristics in broiler chicks reared in West Africa. *Journal of poultry science***86:** 69 Pp 69 – 73.

Nicholas, E. J. (2014). Global Economic Crisis and the Nigerian Poultry Industry. Sahara Reports.

Ojo, S. O. (2000). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. *International Journal of Poultry Science*, **2:** 459-464.

Travis, D. K. Tuinstro, M. R. and Hancock, J. D. (2006). Variation in nutritional value of sorghum hybrids with contrasting seed weight characteristics and comparisons with maize in broiler chicks. Crop science. **46**: 695-699.

Parthasarrathy, P. R. Guravo, K. R. Reddy V. S. and Gowda, C. K. (2005). Linking producers and processors of sorghum for poultry feed. *A case study from India. International Crop Research Institution for the Semi Arid Tropics* (ICRISAT) New Delhi, India pp. 12.

CARCASS TRAITS AND RELATIVE ORGAN WEIGHTS OF BROILER FINISHER CHICKEN FED COMMERCIAL FEED SUPPLEMENTED WITH VARYING LEVELS OF BLACK SEED (*Nigella sativa* L.) CAKE

Olayeni, T.B., Adedoja, M.A. and Salaudeen, M.
Department of Animal Production and Health, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. P.M.B. 4000
Corresponding author: tbolayeni@lautech.edu.ng; 08035374267

ABSTRACT
A study was conducted to evaluate the carcass characteristics and relative organ weights of broiler finisher chickens fed commercial feed (vital feed) supplemented with varying levels of black seed (*Nigella sativa* L.) cake. One hundred unsexed day-old broiler chicks (Arbor Acres strain) were purchased from reputable hatchery and randomly allocated to five dietary treatments of 20 birds per treatment in a completely randomized design experiment and the birds were sub-divided into two replicate each. Five diets were formulated such that diet 1,2,3,4 and 5 were supplemented with black seed cake at 0,1,2,3 and 4g/kg levels respectively. At the end of the experiment two birds were randomly selected,from each replicate, tagged and starved. The birds were slaughtered and data were collected on their carcasses and organs. The result of carcass traits showed that Final live weight, Bled weight, Defeathered weight, Eviscerated weight, Carcass weight and Dressing percentage were not significantly ($P>0.05$) affected. The relative carcass cuts such as Neck, Wings, Breast, Thigh, Shanks, Fat and back were not significantly ($P>0.05$) affect by the dietary treatment except the drumstick which showed significant ($P<0.05$) difference. Significant ($P>0.05$) difference was not indicated in the relatives organs weight of the birds across the treatments except that of kidney which was significantly ($P<0.05$) affected by the dietary treatment. It can be concluded that Black seed cake (BSC) supplementation in diets of broiler chickens at 2g/kg level had no negative effects on the carcass and no deleterious effect was observed on their organs.

Keywords: Carcass and Organs, Broiler, Commercial Feed, Black Seed Cake, Additive

INTRODUCTION
In poultry, feed cost account for up to 80% of the total cost of production and is a very important component in determining the extent of poultry survival and profitability (Olugbemi *et al*, 2010). Success on rearing broiler for maximum weight gain is not only depends upon the strain of the birds and management but also on high quality feed (Nazeer *et al*, 2002). Feed additives are assuming a position of prime importance in poultry nutrition. The use of phytogenics feed additives such as local plant materials in recent time is often aimed at improving animal performance by increasing their growth rate, improving feed efficiency and reducing the incidence of diseases (Zomrawi *et al*., 2013) and serve as alternative for growth promoting antibiotics which has been banned by European union due to their resistance against bacteria which are pathogenic to humans (Majeed *et al*., 2010; Nasir and Grasheorn 2010). Removal of antibiotics from the poultry diets may negatively affect profitability of the animals.
One of the alternatives used as feed additives is black seed. Black seed (*Nigella sativa* L.) is also known as Black cumin and grows in Asian and Mediterranean countries. The seed has been experimented with laboratory rodents and reported to have many biological properties including antibacterial activity (El-Kamali *et al*., 1998), antiviral activity (Salem and Hossain, 2010), antiparasitic (Mahmuod *et al*., 2002). A few studies with broiler chickens showed that black seed has significant effect on carcass and organ of the broiler chickens.

Guler *et al*. (2006) and Toghyani *et al*. (2010) reported an increased carcass yield, liver, abdominal fat, breast, thigh, wings and neck weights in broilers by feeding diet having 1% black cumin. However, non-significant values were obtained regarding heart weight. Controversial results were documented by AL-Beitawi *et al*. (2009) who found no improvement in carcass characteristics by feeding different levels of crushed as well as uncrushed *Nigella sativa* seed in broilers, however, Nasir and Grashorn, (2010) reported an increased in breast percentage. Therefore, there is need to conduct studies on the potential use of black seed cake in the broiler diets. The objective of the study is to evaluate the black seed cake supplementation on the carcass traits and relative organs weight of broiler chickens.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomosho, Oyo State in the derived savanna zone of Nigeria.

Collection of Test Ingredient and preparation of experimental Diets

Black seed cake (BSC) was purchased from a local market in Saki, Oyo State and supplemented in the diets directly without any further processing. Five Experimental diets were formulated using commercial feed concentrate (Vital feed ®), maize and wheat offal. The diets were supplemented with black seed cake (BSC) such that diets 2,3,4 and 5 were supplemented 1, 2, 3 and 4g/kg BSC respectively. Diet 1 served as the control diet with no BSC supplementation.

Experimental animal, Design and management

One hundred (200) unsexed day-old broiler chicks (Arbor acres strain) were purchased from reputable hatchery (AMO farm) in Oyo State. The chicks were weighed individually and randomly allocated to five dietary treatments in a Completely Randomized Design Experiment (CRD). Each treatment was replicated four times with ten birds per replicate. Feed and water were given *ad libitum*. Other management practices and vaccination programs were strictly adhered to.

Data collection

Carcass and Organs Evaluation

The carcass and organs were determined at the end of 6 weeks by selecting randomly, four birds from each replicate in each treatment. The selected birds were tagged and starved overnight. Before slaughtering, the individual weight of the birds was recorded and slaughtered by severing the jugular vein around the neck. The bled weight of an individual bird was recorded. The carcasses were defeathered, eviscerate, and the weights were measured immediately and the weights of the carcass were also recorded. The visceral organs such as liver, pancreas, spleen, kidney, proventiculus, and heart were removed and weighed and expressed in percentage relatives to the carcass weight. The carcasses were cut into various parts (head, neck, back, thigh, breast, shank, drumsticks and wings) and their weights were expressed in percentage relative to the carcass weight. In addition, the dressing percentage was calculated using the formula below.

$$\text{Dressing percentage (DP)} = \frac{\text{Carcass weight}}{\text{Final live weight}} \times 100$$

$$\text{Relative cut parts weight} = \frac{\text{Weight of the cuts}}{\text{Carcass weight}} \times 100$$

$$\text{Relative organ weight} = \frac{\text{Weight of organs}}{\text{Carcass weight}} \times 100$$

Data Analysis

Data generated from the experiment were subjected to one way analysis of variance (ANOVA) using the general linear model of (SAS, 2007) while the significant means among the treatments were separated using Duncan Multiple Range Test of the same statistical package at 5% significant level.

Table 1: Gross composition of experimental diets

Ingredients (Kg)	**Black seed cake supplementation level (g/kg)**				
	T1 (0g)	**T2 (1g)**	**T3 (2g)**	**T4 (3g)**	**T5 (4g)**
Maize	50	50	50	50	50
Concentrate	30	30	30	30	30
Wheat offals	20	20	20	20	20
Black seed cake	-	+	+	+	+
Total	100	100	100	100	100
Calculated analysis					
Metabolizable energy (kcalME/kg)	2901	2901	2901	2901	2901
Crude protein (%)	19.4	19.4	19.4	19.4	19.4
Crude fibre (%)	4.5	4.5	4.5	4.5	4.5
Ether extract (%)	5.1	5.1	5.1	5.1	5.1
Calcium (%)	1.0	1.0	1.0	1.0	1.0

Broiler finisher Concentrate used contains: Fat Max: 8.0%, Calcium: 3.0%, Potein Min: 36.0%, Metabolisable Energy- 2700Kcal/kg.

RESULTS AND DISCUSSION

Results of the carcass traits of broiler finisher chickens fed commercial feed supplemented with varying levels of Black seed cake (BSC) is shown in Table 2. It was observed that Final live weight, Bled weight, Defeathered weight, Eviscerated weight, Carcass weight and Dressing percentage were not significantly ($P>0.05$) affected by the dietary treatments. Despite this, the birds fed diet supplemented with black seed cake at 2g/kg had numerical higher value when compared with other treatment groups. Relative carcass cuts e.g Neck, Wings, Breast, Thigh, Shanks, Fat and back were not significantly ($P>0.05$) affected by the dietary treatment except the drumstick which showed significant ($P<0.05$) difference. Birds fed diets supplemented with black seed cake at 2, 3, and 4g/kg levels respectively compared with the control. Their values were significantly ($p<0.05$) higher than those on 1g/kg black seed cake level. This observation supports the reports of AL-Beitawi *et al*. (2009) who found no improvement in carcass characteristics by feeding different levels of crushed as well as uncrushed Black seed in broilers diets. Although, Al-Beitawi and Goushein, (2008) observed significant improvement in the final live weight of broilers fed diets supplemented with black seed at 1.5% inclusion level. Carcass weight and dressing percentage were improved in birds fed diets supplemented with 1g and 2g/kg Black seed cake respectively and this support findings of Guler *et al*. (2006) and Toghyani *et al*. (2010) who reported an increased carcass yield in broilers by feeding diet having 1% black seed. Improved in cut-up parts weights was observed across the treatments and significant differences was observed in drumstick. This indicated that Black seed cake might have a good effect on enhanced availability of mineral metabolism because black seed contained macro-minerals (mg/100gm) i.e Ca (572), P (540), Mg (264), Na (17.8) and K (810) (Cheikh-Rouhou *et al*., 2007).

The results of relative organ weights of broiler finisher chickens fed commercial feed supplemented with varying levels of Black seed cake (BSC) is shown in Table 3. It was observed that there were not significant (P>0.05) differences in all parameters measured across the treatments except the relative weight of kidney which was significantly (P<0.05) affected by the dietary treatments. Relative weights of proventriculus of the birds fed diets 3, 4 and 5 were similar (P<0.05) and their values fall between 0.61 to 0.71%. Birds fed diet 5 had the highest value of spleen while the birds fed diet 2 had the lowest value. Relative weight of pancreas ranged from 0.44 to 0.54% and the birds fed diet 2 had lowest numerical value (0.44%). However, similarity observed in the relative weights of organs showed that black seed cake have immune-stimulant effects thus maintain broiler chicken in good health. In particular, thymoquinone and dithymoquinone obtained from *Nigella sativa* extract showed important properties against antibacterial, antioxidant, and anti-inflammatory agent (Al-Saleh *et al*., 2006). The disagreement of these studies may be explained in the light of different doses, species and / or age of birds. The highest percentage of supplementation in this study was quite low (0.04%) when compared with previous supplementation levels used by Guler *et al*. (2006) and Toghyani *et al*. (2010) that shows that in this study the choice of 4g/kg could be cost effective when compared with previous studies where higher levels were used.

Table 2: Carcass traits of broiler finisher chickens fed commercial feed supplemented with varying levels of Black seed cake (BSC)

Parameters (g)	**Black seed cake supplementation level (g/kg)**					
	T1 (0g)	**T2 (1g)**	**T3 (2g)**	**T4 (3g)**	**T5(4g)**	**SEM**
Final live weight	1788.50	1735.75	1845.50	1694.75	1617.75	34.06
Slaughtered weight	1722.50	1671.25	1768.25	1628.25	1553.75	71.93
Defeathered weight	1652.00	1603.00	1689.25	1558.75	1490.25	66.20
Eviscerated weight	1336.75	1345.00	1394.75	1284.25	1228.75	28.81
Carcass weight	1208.25	1225.75	1260.50	1160.25	1107.00	26.45
Dressing percentage (%)	67.54	70.53	68.65	68.43	68.46	0.58
Relative cut-parts weight (%)						
Neck	4.62	4.66	4.60	4.41	4.50	0.99
Wings	11.30	10.67	11.00	11.40	11.30	0.12
Breast	33.69	36.18	34.66	33.31	38.83	0.43
Thigh	15.56	15.57	15.64	15.36	15.62	0.75
Drumstick	14.60[a]	13.22[b]	14.53[a]	14.37[a]	14.55[a]	0.19
Shanks	6.24	5.53	6.16	6.00	6.21	0.12
Fat	1.08	0.61	0.96	0.71	0.10	0.18
Back	18.34	17.94	19.28	19.01	18.50	0.34

[a,b]- means in the same row bearing different superscripts differed significantly (P<0.05). SEM – Standard error of mean.

Table 3: Relative organs weights of broiler finisher chickens fed commercial feed supplemented with varying levels of black seed cake

Parameters	Black seed cake supplementation level (g/kg)					
	T1 (0g)	T2 (1g)	T3 (2g)	T4 (3g)	T5 (4g)	SEM
Proventiculus	0.61	0.61	0.70	0.71	0.71	0.03
Gizzard	4.42	4.14	4.15	3.94	4.32	0.13
Liver	3.26	3.05	2.82	3.11	3.07	0.08
Spleen	0.13	0.10	0.14	0.14	0.16	0.01
Kidney	0.84^{ab}	0.95^{ab}	0.75^{b}	1.02^{ab}	1.09^{a}	0.02
Pancreas	0.54	0.44	0.48	0.54	0.49	0.02
Heart	0.71	0.63	0.63	0.70	0.65	0.02
Lung	0.94	0.91	0.81	0.86	0.94	0.03

[a,b]- means in the same row bearing different superscripts differed significantly (P<0.05). SEM – Standard error of mean.

CONCLUSION

The results obtained from the study revealed that Black seed cake (BSC) supplementation in diets of broiler chicken at 4g/kg level had no deleterious effects on the carcass characteristics and indicate that their organs were in good health state.

REFERENCES

AL-Beitawi, N. and EL-Ghousein, S.S. (2008). Effect of feeding different levels of *Nigella sativa* seeds (black cumin) on performance, blood constituents and carcass characteristics of broiler chicks. *International Journal of Poultry Science,* 7:715-721.

AL-Beitawi, N.A., El-Ghousein, S.S. and Nofal, A.H. (2009). Replacing bacitracin methylene disalicylate by crushed *Nigella sativa* seeds in broiler rations and its effects on growth, blood constituents and immunity. *Livestock Science*, 125:304-307

Al-Saleh, I.A., Billedo, G., Inam I.E. (2006). Level of selenium, DL-α- tocopgerol, DL-γ-tocopherol, all transretinol, thymoquinone and thymol in different brands of *Nigella sativa* seeds. *Journal of Food Composition Analytical*, 19:167-175.

Cheikh-Rouhou, S., Besbes, S., Lognay, G., Blecker, C., Deroanne, C. and Attia, H. (2007). Sterol composition of black cumin (*Nigella sativa* L.) and aleppo pine (*Pinus halpensis* Mill.) seed oils. *Journal of Food Composition Analytical*, 21: 162–168.

Duncan, D. B. (2007). Multiple range and multiple F – test. Biometrics 11: 1-42.

El-Kamali, H.H., Ahmed, A.H. and Mohammed, A.H., (1998). Antibacterial properties of essential oils from *Nigella sativa* seeds, *Cymbo-pogon citratus* leaves and *Pulicaria undulataaerial* parts. Fitoterapia 69, 77–78.

Guler, T., Dalkilic, B., Ertas, O.N. and Ciftci, M. (2006). The effect of dietary black cumin seeds (*Nigella sativa* L.) on the performance of broilers. *Asian-Australia Journal of Animal Sciences*; 19: 425-430.

Mahmoud, M.R., El-Ahbar, H.S. and Saleh, S., (2002). The effect of *Nigella sativa* oil against the liver damage induced by Schistosoma Mansoni infection in mice. *Journal of Ethnopharmacology*, 79, 1–11.

Majeed, L.H.A., Abdelati, K.A., Al Bagir, N.M., Alhaidary, A.,Mohamed, H.E. and Beynen, A.C., (2010). Performance of broiler chickens Fed diets containing low inclusion levels of black cumin seed. *Journal of Animal Veterinary Advance*, 9 (21), 2725–2728

Nasir, Z. and Grashorn, M.A. (2010). Effects of *Echinacea purpurea* and *Nigella sativa* supplementation on broiler performance, carcass and meat quality. *Journal of Animal Feed Science*, 19:94–104.

Nazeer, S.M., Talat, N.P., Shahid, A. and Zulfiqar, A. (2002). Effect of yucca saponin on urease activity and development of ascites in broiler chickens. *International Journal of Poultry Science*, 1(6), 174-178.

Olugbemi, T. S., Mutayoba, S. K. and Lekule, F. P. (2010). Effect of Moringa (*Moringa oleifera*) inclusion in cassava based diets fed to broiler chickens, *International Journal of Poultry Science*, 9 (4): 363 –367.

Salem, M.L. and Hossain, M.S. (2010). Protective effect of black seed oil from *Nigella sativa* against murine cytomegslovirus infection. *International Journal of Immunopharmacology*, 22:729-740.

SAS (2007). Institute Inc. SAS Technical Report Package 234 SAS/STAT Software. The GEMOD Procedure. Release 6.09, SAS Institutes Inc. Cary, NC.USA.

Toghyani, M.A., Geisari, G., Ghalamkari, M. and Mohammadrezaei. (2010). Growth performance, serum biochemistry and blood hematology of broiler chicks fed different levels of black seed (*Nigella sativa* L.) and peppermint (*Mentha piperita*). *Livestock Science*, 129: 173-178

Zomrawi, W.B., Abdel Atti, K.A.A., Dousa, B.M. and Mahala, A.G. (2013). The effect of dietary ginger root powder (*Zingiber officinale*) on Broiler chicks performance, Carcass Characteristics and serum Constituents. *Journal of Animal Science*. 3 (2): 42-47.

PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWER RABBITS FED GRADED LEVELS OF CASSAVA LEAF (*Manihot esculenta*) MEAL

Lalabe, B. C., Wafar, R. J., Mary, S. I., Agyo, A, and Odunze, I. N.
Department of Animal Production and Health, Federal University Wukari.

Abstract
The study was to determine the effect of feeding graded levels of cassava leaf (Manihot esculenta) meal in place of full fat soya bean meal on the performance and carcass characteristics of grower rabbits. Fresh cassava leaves were shade dried to a constant weight and milled. Sample of the cassava leaf meal were subjected to proximate analysis to determine the nutrient composition and the anti-nutrients content. Eighteen grower rabbits were weighed and randomly assigned to 3 dietary treatments (T1, T2 and T3) containing 0, 10 and 20% cassava leaf meal respectively in a 3×6 completely randomized design. Diet T1 served as the control diet with 0% CLM. Diets T2 and T3 contained 10 and 20% CLM. Feed and water were provided ad-libitum for 56 days. The result of the performance revealed no significant difference (P>0.05) in the total weight gain (731.33-743.33g); average daily weight gain (13.06-13.27g); total feed intake (2675.00-2912.00g); average daily feed intake (47.77-52.00g) and the feed conversion ratio (3.75-3.92). There were no significant difference for the cut parts, visceral organs, and small and large intestine length. No adverse effect was observed on the rabbit as a result of the anti-nutrient in the test diets. The result showed high yield of live weight, carcass weight and skin with 10% cassava leaf meal. This study suggests that replacement of soybean meal with up to 20% cassava leaf meal will increase the carcass weight, live weight, skin weight and visceral organs development at a lower cause.

KEYWORDS; Cassava leaf meal, Grower rabbits, Performance, Cut parts, anti-nutrients.

Introduction

Increased competition for available conventional feedstuff and its high cost have led to animal nutritionists, scientists and agriculturists having the need for research into the use of non-conventional feedstuffs that are cheap, readily available and possible substitute for more expensive protein and energy sources (Obun and Adeyemi,2012).

The feeding cost constitutes about 80% of the total cost of intensive production in livestock industry (Tewe et al., 2002). Hence the focus is on alternative feedstuff which could be either substituted directly for cereals or can be included a certain level to attain a comparable production quality with the conventional cereal without deleterious effect on the animal health (Ukachukwu, 2008).Cassava which is widely cultivated in the tropics appears to be one of the possible alternatives for overcoming these chronic high feed cost in livestock industry (Ukachukwu, 2008).

Ravindran and Ravindran (1988) reported that the yield of cassava leaves can be as much as 4.6 tones dry matter per ha taken as a by-product of root harvest. Cassava leaves as a protein source can be combined with low-protein cassava peels and used in rabbit feeding. Both are wastes constituting disposal problems especially where large quantities of cassava plants are harvested and processed.
Cassava leaf contains some anti-nutritional factors like cyanogenicglucosides, tannin, saponins, etc which are toxic to the animals when consumed without reducing the concentration of the toxins. Studies by Ravindran *et al* 1987).has demonstrated the possibility of producing cassava leaf meal with low cyanide levels..
There has been increased awareness of rabbit meat production in developing countries as a means of alleviating animal protein shortages. Although protein can be sourced from plants, the place of animal protein remain unequal, due to its balanced amino acid profile.

Materials and Methods

The research was conducted at the Rabbitry Unit of the Teaching and Research Farm of the Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari, Taraba State. Wukari is located at latitude $7^0$51 N orth and Longitude $9^0$47 East (Wikipedia, 2011). Fresh cassava leaves *(Manihot esculenta)* were harvested from the farms around Wukari. The leaves were washed and dried under shade for three days to a constant weight. The dried cassava leaves were milled and put into an airtight container. Sample of the milled cassava leaves was taken for proximate analysis and anti-nutrient content determination. Three diets were formulated using Cassava Leaf Meal (C.L.M.) in replacement for full fat soybean as shown in Table 1. Diet 1 served as a control with 0% CLM, while diet 2 and 3 contained CLM at 10 and 20% inclusion levels respectively.

Eighteen (18) 4-5 weeks old female rabbits of mixed breeds were used in an 8 weeks feeding trial. The animals were randomly assigned to three experimental diets on the basis of equal mean live weight to three treatments groups each with six rabbits in a Completely Randomized Design (CRD). Each group had three replicates with two rabbits per replicate.

The rabbits were housed in a wood-wire hutches equipped with feeders and drinkers. The experimental diets, fresh forages (*Camelina bengalensis*) and water were provided ad-libitum. The rabbits were allowed to acclimatize to their various hutches for one week during which they were de-wormed and given antibiotics.

The data collected were feed intake, body weight, feed cost/kg gain and mortality. Other data collected were Head, heart, lungs, kidney, liver, spleen, stomach, large intestine, small intestine, caecum, and pancrease. Data collected was subjected to statistical analysis using Analysis of Variance (ANOVA). Differences between mean was separated using LSD.

Result and Discussion

The crude protein and energy levels of the formulated diets (Table 1) were 20.17% and 3006.06 Kcal/kg for Diet 1, 18.665% and 2914.59Kcal/kg for Diet 2 and 17.15% and 2814.74Kcal/kg for Diet 3.The respective crude fiber for diets 1, 2 and 3 are 4.79%, 5.09% and 5.25%. The feed cost per kilogram diet progressively decreased from N139.62 (Diet 1) to N126.05 (Diet 2) and N112’47 in Diet 3.

Table 1. Percentage Composition of the Experimental Diet for Grower Rabbits.

Diets Ingredients	T1 control	T2 10% CLM	T3 20% CLM
Maize	36.40	36.40	36.40
Full fat soybean	31.60	28.44	25.28
CLM	-	3.16	6.32
Maize offal	27.70	27.70	27.70
Bone meal	3.00	3.00	3.00
Premix	0.50	0.50	0.50
L- methionine	0.25	0.25	0.25
L- lysine	0.25	0.25	0.25
Salt	0.30	0.30	0.30
Total	100.00	100.00	100.00
CALCULATED CHEMICAL COMPOSITION			
Metabolizable energy (Kg/Kcal)	3006.06	2914.59	2814.74
Crude protein (CP)	20.17	18.66	17.15
Crude fibre (CF)	4.79	5.09	5.25
Feed cost/kg diet (₦)	139.62	126.05	112.47

The result of the performance of rabbits fed graded levels of cassava leaf meal is as shown in Table 2. The result showed no significant difference (P > 0.05) in total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio. The Average Daily Feed Intake of 47.77-52.00g recorded for this study is found to be lower than the value range of 65.00-81.69g (Adeyemi et.al.2014) when he fed graded levels of Unfermented Cassava Leaf: Peel Meal Mix as a replacement for Maize to grower rabbits. The result is however similar to the value range of 45-55g observed by Ozung et.al. (2012) who fed Paw-Paw Peel Meal Based Diets to Weaner Rabbits.

The Average Daily Weight Gain (13.06-13.27g) is lower than that of 20.07-16.92g as reported by Adeyemi et.al. (2014) when he fed graded levels of Unfermented Cassava Leaf: Peel Meal Mix as a replacement for Maize to grower rabbits.

The numerically lower Feed Intake values noticed in the test diets could be attributed to the low palatability in the test diets as a result of the Cassava Leaf Meal portion included in them. The numerically lower Feed Conversion Ratio recorded in Diet 2 revealed that the test diet containing 10% was better utilized than the control Diet and Diet 2.

Table 2. Performance Characteristics of Grower Rabbits Fed Cassava Leaf Meal Based Diets.

PARAMETERS (g)	T1 (0%)	T2 (10%)	T3 (20%)	SEM
Initial Weight	1056.67	1085.33	1091.67	18.18^{ns}
Final Weight	1800.00	1816.67	1833.33	10.64^{ns}
Total Weight Gain	743.33	731.33	741.67	41.66^{ns}
Average Daily Weight Gain	13.27	13.06	13.24	0.73^{ns}
Total Feed Intake	2912.00	2675.00	2843.33	55.50^{ns}
Average Daily Feed Intake	52.00	47.77	50.77	2.78^{ns}
Feed Conversion Ratio	3.92	3.75	3.87	0.36^{ns}

NS= Not Significantly Different (P>0.05)
S.E.M.= Standard Error Mean

The result of the carcass characterization is presented in Table3. The result indicated no significant difference (P > 0.05) between the test and the control diets in all the parameters considered for carcass characterization.

The result of the carcass characteristics was found to be similar with values reported by Ekpo*et al*.,(2016) who fed graded levels of pumpkin based diet to rabbits. However, the insignificant difference of the carcass characteristics for the different studies mentioned above may be that the fibre content in the diets did not impair nutrient utilization, hence no adverse effect on carcass characterization was observed.

Table 3. Carcass Characteristics of Rabbits Fed Cassava Leaf Based Diets

Parameters % live weight	(0%) CLM	T2 (10%) CLM	T3 (20%) CLM	SEM
Live weight	1600.00	1800.00	1683.33	82.21ns
Carcass weight	1500.00	1716.67	1616.60	92.30ns
Dressed weight	803.33	916.67	918.18	37.71ns
Dressed percentage	50.22	50.88	54.76	1.85ns
Skin	118.00	142.24	128.42	14.01ns
Tail	8.91	11.48	8.04	1.68ns
Feet	45.48	34.77	33.15	2.84ns
Head	129.43	130.36	121.82	21.13ns
Stomach	64.16	67.49	72.52	9.54ns

Visceral organs (% live weight)				
Liver	2.55	2.90	2.80	0.43ns
Lungs	0.77	0.62	0.60	0.10ns
Kidney	0.62	0.63	0.62	0.07ns
Caecum	6.42	6.76	5.21	0.52ns
Heart	0.23	0.26	0.25	0.02ns
Small intestine	79.50	44.98	64.05	13.40ns
Small intestine (cm)	314.67	314.33	356.33	14.27ns
Large intestine	36.44	34.71	34.41	2.83ns
Large intestine (cm)	89.33	87.33	86.33	2.19ns

ns: Not significant (P>0.05)

SEM: Standard Error Mean.

Conclusion

The study showed that Cassava Leaf Meal can replace Full Fat Soybean Meal in the diets of grower rabbits up to 20% inclusion level without any adverse effects on their performance, carcass characterization and at a reduced cost.

Referrence

Adeyemi, O.A., Adesanya, P.A., Eniolorunda, O.O., Sogunle, O.M., Egbeyale, L.T. and Njoku,C.P. (2014). Performance of Growing Rabbits Fed Diets Containing Fermented and Unfermented Cassava Leaf: Peel Mix as Replacement for Maize. *Malaysian Journal of Animal Science, 17 (1). Pages* 61-72.

Aduku, A.O. and Olukosi, J.O. (1990) Rabbit Management in the tropics.*Living book series.G. U. Publications, Abuja, Nigeria*.5-20.

Bone, F. J. (1979).Anatomy and physiology of farm animal.Reston, U.S.A.

Ekpo, I.S. Udia, V. S. Ogundu, E. C. Sam, I. M. and Eyoh, G.D. (2016).Carcarss traits of crossbred rabbit bucks fed diets supplemented with pumpkin stem waste. *European Journal of Advanced Research in Biological and Life Sciences.* 3: 2056-5984.

Igoche S.G.(2006).The effect of tiger nuts (*Cyperusesculentus*) rejects based diets on carcass weight and haematological parameters of growing rabbits.Thesis submitted to the Department of Animal Production, University of Agriculture Makurdi, Nigeria

Obun, C.O. and Adeyemi, O. A. (2012). Effects of raw and toasted *Danielliaoliveri*Rolfe seed meal as replacement for groundnut meal on the performance of broiler chickens. *RevistaCientífica UDO Agrícola*12 (4): 947-954.

Ozung P.O., Ubua,.J.A.., Anya. M.I., Nsa, E.E., Ebegbulem, V.N., and Etim, S.E.,(2012).Evaluation of Growth Performance and Some Heamatological Characteristics of Weaned Rabbits Fed PawPaw Meal Based Diets in Cross River Rain Forest Zone. *International Journal of Science and Nature, (I.J.S.N.),* Vol. 3(4)2012;784-787

Ukachukwu S. N. (2008): Effect of composite cassava meal with or without palm oil and/or methionine supplementation on broiler performance. *Livestock Research for Rural Development*, 20 (4): 1–10.

Tewe O. O. and Bokanga M. (2001): Cost-effective cassava plant-based ration for poultry and pigs. In: Pro-chemical composition and metabolizable energy. *Livestock Research for Rural Development,* 17: Article. 125. Available at http://www.cipav.org.co//Irrd/ Irrd17/11/hang 17125.htm

Ravindran V., Ravindran G. (1988): Changes in the nutritional composition of cassava (*Manihotesculenta*Crantz) levels during maturity. *Food chemistry*, 27: 229–239.

Ravindran V., Kornegay E.T., Rajaguru, A. S. B. (1987). Influence of processing methods of storage time on the cyanide potential of cassava leaf meal. *Anim Feed SciTechnol*17 227-234

Effects of Rumen Epithelial Scrapings Inclusion In Diets For Grower Rabbits

Adedoyin A. A.

Department of Agricultural Education, Biotechnology Unit.
The College of Education, Lanlate, Oyo State, Nigeria. (Former Emmanueal Alayande College of Education, Oyo, Lanlate Campus).
E-mail: akintundedoyin@yahoo.com or adedayoakintude1@gmail.com
Gsm: 08139396741

Abstract

Twenty-five (25) Crossbred grower rabbits were used to assess the effects of Rumen Epithelial Scrapings (RES) inclusion in the diets for rabbits. The five treatment groups consisting of five replicates of one rabbit per replicate in a Completely Randomized Design (CRD). The dietary treatments comprised graded levels of RES at 0, 2.5, 5, 7.5 and 10% in T_1, T_2, T_3, T_4 and T_5 diets respectively. Total feed offered was 100g/rabbit/day. Feed intakes were similar ($P<0.05$) across the dietary treatments, 1, 2, 3, and 4. Daily weight gain and feed to gain ratio were not affected ($P<0.05$) by increasing rumen epithelial scrapings except in T5 (10% RES) that recorded (10.01) and (8.51) respectively. Lower feed cost/kg significantly reduced ($P<0.05$) the cost/kg gain (₦) in diets 2 (₦444.4), 3 (₦447.7) and 4 (₦449.5) compared with the control diet 1(₦450). Conclusively, grower rabbits can utilize up to 7.5% rumen epithelial scrapings based diets without any adverse effect on performance.

Keywords: Grower rabbits, rumen epithelial scrapings, feed to gain ratio, cost/kg gain, inclusion

Introduction

There is an increasing interest in rabbit production in the developing countries, as a means of producing meat from forages and agricultural by-products in the tropics (Babayemi *et al.*, 2014; Adedoyin and Bamimore, 2018). Rabbits are especially well adapted to backyard rearing systems, with little capital and fodder resources which are usually limiting factors in animal production. Rabbits reared according to the techniques appropriate to the environment can do much to improve the family diet of many of the most needy rural families, while at the sametime supplying them with a source of income. With more advance bio-technology rabbit production can also help to supply big City meat markets. It has infact been stated that hindgut digestion which takes place in the rabbit is a superior adaption for dealing with wide varieties of feed staffs (Iyeghe-Erakpotobor and Esiero, 2010). However, to ensure sustainability in livestock production there is a need to optimize usage of the by-products of the abattoir as sources of nutrients for farm animals (Abubakar, 1998). A number of slaughterhouse byproducts are presently being wasted, such as rumen epithelial scrapings, blood, meat scraps, etc. Rumen contents can be prepared as a few material either by sun-drying involves spreading the material on any heat absorbing surface and constantly raking it to facilitate uniform drying. Ensiling involves mixing rumen contents with other ingredients such as molasses and packing the mixture tightly in silos or other suitable containers under anaerobic conditions (Adedoyin *et al.*, 2013). Abubakar (1998) opined that rumen contents are a good source of vitamins, especially the B vitamins. And that the dried material contains 15.43% crude protein, 1.91% ether extract, 39.08% crude fibre, and 31.71 Nitrogen free extract (NFE). Thus, the objectives of this study is to evaluate the nutritional values of rumen epithelial scrapings based diets for grower rabbits.

Materials and Methods

A total of twenty-five, four to five weeks old crossbred rabbits of mixed breeds (New Zealand white and Chinchinlla) and sexes, obtained from I.A.R.T, Ibadan, Oyo State were randomly assigned to treatment
(n = 5 rabbits per treatment). The rabbits of average initial weight of 450g were individually housed and maintained in battery cages in an open sided house. Rumen Epithetical Scrapings (RES) were obtained from Bodija market abattoir, Ibadan. The RES are then dried and grounded separately to a fine powder and replaced with groundnut meal at 0, 2.5, 5, 7.5, and 10% w/w in treatment 1(control), 2, 3, 4 and 5 respectively (Table 2). Body weight and feed intakes were determined weekly while feed to gain ratio was estimated as outlined by Olomu (2011). Feeding was done in the morning at 08:00 hours in earthen flat bottom pots. The concentrate and forage were offered to give a total of 100g feed/rabbit/day. Feed wastage and/left over were measured daily before the morning feeding so as to determined the total feed intake for eight weeks, water was provided ad libitum in plastic drinkers (Iyeghe-Erakpotobor, 2012). Mortality ratio were also calculated as percentage of total Number of rabbits per group. Data collected were subjected to the analysis of variance test, (2007). Means of significant result was compared by Duncan's. Proximate analysis of the rumen epithelial scrapings were analyzed according to the procedures described by AOAC (1990).

Table 1: Proximate Composition(%) of Rumen Epithelial Scrapings and Groundnut meal.

Nutrients %	Rumen Epithelial	Groundnut Meal
Moisture	3.99	7.32
Crude Protein	66.14	43.12
Crude Fiber	1.66	5.9
Ether	4.33	12.01
Ash	4.01	4.48
Nitrogen Free Extract	9.98	11.12

Table 2: Composition of Concentrate Diets fed Grower Rabbits

Ingredient	Replacement levels of Rumen Epithelial Scrapings (RES)				
	T_1 (0%RES)	T_2 (2.5%RES)	T_3 (5%RES)	T_4 (7.5%RES)	T_5 (10%RES)
Maize	45.0	45.0	45.0	45.0	45.0
Groundnut meal	36.50	34.0	31.5	29.0	26.5
Rumen Epithelial	-	2.5	5.0	7.5	10.0
Maize offal	15.00	15.00	15.00	15.00	15.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin/Mineral Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analyzed Composition					
Crude Protein	18.10	18.31	18.55	18.67	18.97
Crude Fibre	9.80	9.14	8.80	8.16	8.50
Met. Energy(Kcal/ME/kg)	2450	2403	2389	2400	2409

Table 3: Performance of Grower Rabbits fed Rumen Epithelial Scrapings Based Diets

Parameter	Replacement levels of Rumen Epithelial Scrapings (RES)					
	T_1 (0%RES)	T_2 (2.5%RES)	T_3 (5%RES)	T_4 (7.5%RES)	T_5 (10%RES)	SEM
Initial Weight (g)	449	450	449	451	450	0.05
Final Weight (g)	1039	1049	1031	1028	1011	0.72
Feed intake	75.3^{bc}	78.01^{b}	79.11^{ab}	81.80^{ab}	85.2^{a}	10.9
Weight Gain	10.53^{a}	10.69^{a}	10.39^{b}	10.30^{b}	10.01^{c}	0.5
Feed to Gain	7.15^{bc}	7.29^{b}	7.61^{b}	7.94^{b}	8.51^{a}	0.99
Cost/kg-Feed(₦)	630^{a}	609^{b}	588^{c}	566^{d}	545^{c}	0.04
Cost/kg-gain(₦)	450.5	444.4	447.7	449.5	463.8	-

abc… means with different superscripts along rows the significantly different (P>0.05)
SEM – Standard Error of Mean

RESULTS AND DISCUSSION

Performance of grower rabbits fed different levels of rumen epithelial scrapings (RES) is shown in Table 3. Feed intakes were similar with a slight increase with an increasing levels of Rumen Epithelial Scrapings (RES) from 2.5 to 7.5% in the diets 2, 3, and 4. Similar intakes observed in the diets 2 (78.01), 3 (79.11) and 4 (81.8) for grower rabbits fed 2.5 to 7.5% RES could indicate a threshold of intake which might have been approached as the forage level increased. This could probably also suggests, an inability of the rabbits to further increase their gastrointestinal tract capacity to accommodate any further increase in feed intake as RES level increased from 2.5 to 7.5% level as also suggested (Iyeghe-Evakpotobor *et al.*, 2012). Daily weight gain and feed to gain ratio were not affected (P>0.05) by increasing RES except in T5 (10% RES) that recorded (10.01) and (8.51) respectively. A significant lower weight gains of grower rabbits fed diet 5 (10% RES) in this study compared to others (diets 1, 2, 3, and 4) could be as a result of the depressing effect of increasing rumen epithelial scrapings (RES) in the diet. Also, that possibly an increased level of RES brought about on rich bacteria protein a drastic changes in the biological functions of grower rabbits, poor feed efficiency and utilization, disturbances in metabolism of energy, mineral and vitamin balances, and enzymatic reactions with an impaired fermentative mechanisms in the cecum (NAP, 1991; Nwagu and Iyeghe-Erakpotobor, 2012; Adedoyin *et al.*, 2013) Lower feed cost/kg gain obtained with increasing level of RES up to 7.5% in the diet indicates the potential of reducing cost of producing rabbits by increasing the level of rumen epithelial scrapings in the diet of grower rabbits.

CONCLUSION

It is concluded from this study that grower rabbits can utilize up to 7.5% rumen epithelial scrapings diet based without any adverse effect on performance. Also, that lower feed cost and cost/kg weight gain were obtained.

REFERENCES

A.O.A.C. (1990). Official Methods of Analysis 13th Edition *Association of Analytical Chemists Washington DC*

Abubakar, M. M. (1998) Slaughterhouse by-products for sustainable livestock production in the tropics. *In: Strategies and Tactics of Sustainable Agriculture in the Tropics (STASAT) Vol. 1* (Eds. M. A. Badejo and A. O. Togun (1998) College Press, Ibadan and Enpract Consultants, Lagos, Nigeria.

Adedoyin, A. A. and Bamimore, I. A. (2018). A guide to selected mini-livestock farming. *In: Introduction to Agricultural System: Principles and Practices. Department of Agricultural Education, The College of Education, Lanlate, Oyo State, Nigeria. Pg 78- 91*

Adedoyin, A. A. Onilude, A. A., Tewe, O. O. and Mosobalaje, M. A. (2013). Nutritional Enhancement of whole Cassava Starch Residue by biodegradation with Fungi Spp. *Elixir Inter. Journal of Biotechnology 60:16064-16068*

Babayemi, O.J. ,Abu O.A. and Opakunbi A (2014). Integrated Animal Husbandry for Schools and Colleges. *Positive Press, Ibadan, Nigeria 299pp.*

Iyeghe-Erakpotobor, G.T., Tudunwada, I.K. Tijjani, A. Muhammad, I. R. and Bello, N. (2012). Influence of level of groundnut haulms and feeding systems on performance of growing rabbits. *Nigerian Journal of Animal Production. Vol 39(1) pp. 64-73*

Nwagu, F. O. and Iyeghe-Erakpotobor, G. T. (2012). Protein and Energy partitioning for growth by rabbits fed soybean cheese waste diet and lablab hay. *Nigerian Journal of Animal Production. Vol. 39 (1) pp. 54-63*

Olowu, J. M. (2011). Monogastric Animal Nutrition: Principles and Practice. *2nd Edition St. Jackson Publishing. Benin City Nigeria.*

SAS Institute (2007). SAS Users' Guide Statistics *Version 6.12 Edition SAS Institute. Inc. Carry, NC.*

The National Academics Press (1991). Micro Livestock: Little-Known Small Animals with a promising Economic Future. *National Academy of Sciences. xx 448 pp*

EFFECT OF DIFFERENT HEAT TREA TMENT OF BAOBAB (*Adansonia digitata*) SEED AS AN ALTERNATIVE PLANT PROTEIN SOURCE ON HAEMATOLOGICAL AND BLOOD CHEMISTRY OF LOCAL TURKEY

L. A. SAULAWA, M. G. GARBA, M. N. SABO AND A. UMAR

DEPARTMENT OF ANIMAL SCIENCE, FEDERAL UNIVERSITY DUTSIN-MA

ABSTRACT

An experiment was conducted to evaluate the effect of boiling time of baobab (*Adansonia digitata*) seed meal as a partial replacement of soya beans meal on anti-nutritional factors, haematological and blood chemistry of local turkey. Raw baobab seeds were boiled for 30, 60, 90 and 120 minutes. The boiled baobab seed meals (BBSM) were used to replace 10% of soya beans meal. Seventy five poults were randomly selected and allocated to treatment diets with 15 poults per treatment and 5 poults per replicate. Proximate analysis of the experimental diets and anti-nutritional factors of the raw and boiled (30, 60, 90 and 120mins) BBSM were carried out. On the 9th week of the feeding trial, blood was collected from the poults for haematological and blood chemistry assays. The results obtained showed there was general reduction in the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) as a result of different boiling time of raw baobab seed. Monocyte count was different ($P<0.05$) among the treatment means with 30 mins BBSM having the highest count. The 30 mins BBSM recorded higher ($P<0.05$) creatinine compared the other treatments. Alkaline phosphate content was higher ($P<0.05$) for the control and 30 mins BBSM compared to 120 mins BBSM. It can be concluded that boiling reduces the content of anti-nutritional factors of raw baobab seeds and assisted the growing turkey in handling the anti-nutritional factors.

Keywords: Baobab, Local Turkey, Haematological, Blood chemistry, turkey

INTRODUCTION

Protein is a global index for measuring well-being of a country (Abdu, 2012). The basic sources of protein in Nigeria are the ruminant and the non-ruminant. The ruminant animals' production is seriously in dangerous stage due to insurgency in the north-east, cattle rustling in the north-west, and seasonal fluctuation of feed which resulted in reducing the supply of protein sources, the next alternative are poultry sources, but poultry is seriously affected by high cost of feed due to high competition between man, industries and poultry. Protein source is the major scarce and expensive ingredient in poultry production there by taking 75-80% of the total cost of production. Hence the need to source for alternative but promising feedstuffs. One of such alternative is baobab (*Adansonia digitata)* seed. Baobab (*Adansonia digitata*), locally called kuka (Hausa) and luru (Yoruba), which is another non-conventional feed stuff that is readily available in Nigeria particularly in the North. The use of legumes as a component of poultry feed has been limited by the content of anti-nutritional factors (ANF). Abdu (2012) and Saulawa *et al* (2014) reported that the inclusion of above 10% raw Baobab seed meal as plant proteins in diets of broilers leads to a significant impairment of growth and other undesirable physiological and biochemical alterations.

The examination of blood gives the opportunity to investigate the presence of several metabolites and other constituents in the body of animals and it plays a vital role in the physiological, nutrition and pathological status of an organism *(*Aderemi, 2004*). According to* Afolabi, *et al,* (2010), changes in haematological parameters are often used to determine various status of the body and to determine stresses due to environmental, nutritional and/or pathological factors. Hence, this study was conducted determine the effect of different time of hot water treatment on proximate composition and anti-nutritional factors of baobab and also its effect as a partial replacement for Soybeans on haematological and blood chemistry parameters of local turkey.

MATERIALS AND METHOD

Experimental Site

The study was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma lies on latitude 12°26'N and longitude 07°29'E (Abaje *et al.*, 2014).

Processing of Baobab Seeds

The raw seeds of baobab were collected from Dutsin-ma market and were divided into five parts and boiled at different time interval. Boiling was carried-out according to the recommendation of Ukachukwu, *(*2000) for *Mucuna cochinchinensis*. The equal quantity seeds were boiled for 30mins, 60mins, 90mins and 120mins using equal vol. of water differently. Thereafter, they were brought down and a basket was used to drain the seeds and allowed them to sun dry.

Experimental Animal, their Management and Data Collection

One hundred (100) day old turkeys were housed and brooded in a deep litter. All routine management practices were strictly adhered to. At the end of the fifth (5) week (brooding period), 75 birds were allotted to five (5) experimental diets and replicated three times in a completely randomized experimental design. Diet was soybeans based (control), while 10% boiled baobab seeds boiled for 30, 60, 90 and 120 minutes were used to quantitatively replace equivalent weight of soya beans meal in diets 2, 3, 4 and 5 respectively. Feed and water were given *ad libitum* throughout the experimental period which lasted for nine (9) weeks.

Table 1 Composition of the Experimental Diets (%)

	Period of boiling (minutes)				
	0	**30**	**60**	**90**	**120**
Ingredient	**(T1)**	**(T2)**	**(T3)**	**(T4)**	**(T5)**
Maize	60.2	60.2	60.2	60.2	60.2
Soybean	26.00	16.00	16.00	16.00	16.00
BBSM meal	0.00	10.00	10.00	10.00	10.00
GNC	10.00	10.00	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lim	1.00	1.00	1.00	1.00	1.00
Salt	0.3	0.3	0.3	0.3	0.3
Premix	0.3	0.3	0.3	0.3	0.3
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Total	100.00	100.00	100.00	100.00	100.00
Feed cost N/kg	148.96	139.76	139.86	139.91	139.96
Calculated Analysis					
Crude protein (%)	21.56	18.57	18.70	18.57	18.47
Energy (ME kcal/kg)	2915.5	2793.29	2792.39	2780.29	2779.49
Crude Fibre (%)	2.79	2.82	2.68	3.22	2.97
Calcium (%)	1.16	1.16	1.16	1.16	1.16
Phosphorus (%)	0.67	0.69	0.69	0.69	0.69
Fat	2.63	2.08	3.04	2.96	2.98
Methionine	0.46	0.43	0.43	0.43	0.43
Lysine	1.27	1.12	1.12	1.12	1.12
Determined Analysis					
Dry matter	94.28	94.60	93.88	94.26	94.31
Crude protein	17.82	18.04	17.96	17.99	18.00
Crude fibre	9.24	8.98	9.11	9.25	8.80
Oil	4.48	4.36	4.52	4.19	4.39
Ash	6.03	5.88	5.07	5.46	7.47
Nitrogen free extract	56.7	57.5	57.2	57.3	55.6

On the 9th week of the feeding trial, 3 poults were randomly selected from each dietary replicate for blood collection. Blood was collected from the sub-clavicular vein of each poult using a scalp vein needle set. About 5ml of blood was collected into two (2) sets of three sterilized glass tubes/bottles containing Ethylene Diaminetetra-acetic Acid (EDTA) for Haematological studies. Blood samples for serum biochemical studies were collected into plain containers for serum separation.

Haematological parameters measured were red blood cell (RBC), haemoglobin (Hb), white blood cell counts (WBC), packed cell volume (PCV), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular Haemoglobin (MCH) and mean corpuscular Volume (MCV) were all determined. Serum biochemical parameters considered were total serum protein, serum albumin, glucose, cholesterol, creatinine, urea, serum glutamate oxaloacetate transfarase (SGOT), alkaline phosphate (ALP) and serum glutamate phosphate transfarase (SGTP). Data from the experiment are subjected to one way analysis of variance (ANOVA) using SAS software (SAS 1999).

RESULTS AND DISCUSSION

Table 2 shows the result of different anti-nutritional factors obtained in both raw and boiled baobab seeds. There was general reduction in the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) as a result of different boiling time of raw baobab seed though reduction varies in degree with different boiling period. The highest percentage reductions in trypsin is T5 (1.98), tannin T4 (1.08) and in phytate T4 (2.79) were observed when the raw baobab seed were boiled with different boiling period.

The haematology parameters of turkey fed boiled baobab seed meal for different duration is shown in table 3. The result shows that RBC, Hb, PCV, WBC, Neutrophills, Lymphocyte and MCHC were not affected (P<0.05) by the feeding baobab seed meal boiled for various duration a replacement for soyabean meal.

Table 2 Effect of hot-water treatment on the anti-nutritional factors of baobab seeds (mg/kg)

Anti-nutritional factors	Boiling Time(mints)					
	0	**30**	**60**	**90**	**120**	**± SEM**
Tannin	2.88[a]	2.96[a]	2.38[b]	2.30[b]	1.98[c]	0.03
Phytate	1.60[a]	1.48[b]	1.50[ab]	1.08[c]	1.11[c]	0.04
Trypsin inhibitors	3.43 [a]	3.30[b]	2.98[c]	2.79 [d]	2.81[d]	0.03

a, b, c, d, e, = Means within rows with different superscript are significantly different (p<0.05).

Table 3 Haematological values of Turkey Fed Experimental Diets

	TREATMENT					
PARAMETERS	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Red blood cell (RBC) $x10^6$/mm	5.40	5.20	5.73	5.27	5.27	0.23
Haemoglobin (HB) g/dl	10.63	10.45	10.97	10.53	10.30	0.46
Packed cell volume (PCV) %	32.00	31.50	33.00	31.67	31.00	1.38
White blood cell (WBC)$x10^3/mm^3$	10.73	9.90	9.63	6.30	10.23	2.34
Mean corpuscular volume (MCV) mm^3	59.21 [ab]	60.58[a]	57.52 [b]	60.10 [a]	58.98 [ab]	0.66
Mean corpuscular haemoglobin %	19.67[ab]	20.10[a]	19.12[b]	19.99[a]	19.59[ab]	0.21
Mean corpuscular haemoglobin concentration	33.22	33.18	33.24	33.26	33.22	0.05
Band	1.00	1.oo	1.33	0.00	1.00	0.87
Neutrophils %	15.00	7.50	7.00	12.33	10.33	3.47
Lymphocytes %	78.67	82.00	85.33	86.33	85.00	4.07
Monocytes %	5.33[b]	9.00[a]	4.00[bc]	1.00[c]	3.00[bc]	1.01
Eosinophil %	0.00 [b]	0.50[ab]	2.00[a]	0.33[ab]	0.67[ab]	0.57
Basophils %	-0.00	0.00	0.00	0.00	0.33	0.15

a,b,c,d means in the same row with different super scripts are significantly (P<0.05) different
SEM – Standard error of means

Monocyte count was different (P<0.05) among the treatment means with 30 mins BBSM having the highest count. 90 mins BBSM recorded the lowest which is statistically lower P<0.05) than the control and the 30mins BBSm but similar (P<0.05) with both 60 and 120 mins BBSM. Eosinophil count of the 60 mins BBSm was significantly higher (P<0.05) than that of the control but similar with the other treatments. The 30, 90, and 120 mins BBSM had similar Eosinophil count with the control. MCV was affected by the feeding of BBSM to growing turkey with 30 and 90 mins BBSM having hiher MCV than 60 mins BBSM.The control and 120 mins BBSM have similar MCV with the 30, 60,

and 90 mins BBSM. Similar to MCV, MCH was higher than the 30 and 90 mins compared to 60 mins BBSM. The control and the 120 mins BBSM have similar MCH with the 30, 60, and 90 mins BBSM.

The result of the serum biochemistry of growing turkey fed BBSM is shown in table 4 all the parameters considered as shown in the table were not affected except for creatinine and alkailine phosphate (ALP). The 30 mins BBSM recorded higher (P<0.05) creatinine compared the other treatments.The control, 60, 90, and 120 mins BBSM had similar (P>0.05) creatinine content. Alkaline phosphate content was higher (P<0.05) for the control and 30 mins BBSM compared to 120 mins BBSM. The 60 and 90mins BBSM had similar (P>0.05) alkaline phosphate with both the control and 30 mins BBSM and the 120 mins BBSM.

Table 4: Serum Biochemical Indices of Turkey Fed Experimental Diets

	TREATMENT					
PARAMETERS	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Total protein	3.07	3.90	3.60	3.40	3.60	0.26
Albumins	35.33	37.33	35.67	37.33	38.00	3.46
Globulins	37.00	42.00	35.67	35.67	34.00	4.31
Serum glutamate oxaloacetate (SGOT)/(AST)	17.67	21.00	19.67	19.33	15.00	6.31
Serum glutamate phosphate (SGPT)	7.67	6.50	7.33	10.67	4.50	3.98
Creatine	23.33 [b]	54.00 [a]	28.00 [b]	30.00 [b]	17.50 [b]	6.76
Alkaline phosphate (ALP)	67.67 [a]	66.67 [a]	52.67 [ab]	48.33 [ab]	43.50 [b]	6.80
Total serum protein (TSP)	72.33	56.33	71.33	73.00	72.00	7.91

a,b,c,d means in the same row with different super scripts are significantly (P<0.05) different
SEM – Standard error of means

Conclusion and Recommendation

From the results of this study it can be concluded that boiling reduces the content of anti-nutritional factors (tannin, phytate and trypsin inhibitors) of raw baobab seeds. Boiling of raw baobab seeds for more than 30 mins assisted the growing turkey in handling the anti-nutritional factors. Hence, monocyte count and serum creatinine content decreased with increased boiling time. It is recommended that 10% raw baobab seeds boiled for a minimum of thirty minutes can be used to replace soyabean meal in diets of growing turkey.

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REFERENCES

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology*; Vol. 6, No. 2; 2014

Abdu, L.S 2012. Chemical and nutrient evaluation of Baobab (*Adansonia ditata)* seed meal as alternative protein source broiler diet. Ph. D Dissertation. Micheal Okpara University of agriculture, Umudilke, Abia State.

Aderemi F. A (2004). Effects of replacement of heat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology ans serum biochemistry of pullet chicks. *Tropical Journal of Animal Science, 7 147 – 153.*

Afolabi, K.D Akinsoyimu, A.O Olajide, R. and Akinleye S.B (2010). *Haematological parameters of the Nigerian local grower chicnkens fed varying dietary levels of palm kernel cake (P.247)* Proceedings of 35th Annual Conference of Nigerian Society for Animal Production.

Saulawa, L.A, Yaradua A.I, and Shuaibu, L. (2014). Effect of different Processing methods on proximate, mineral and anti-nutritional factors content of Baobab (*Adansonia digitata*) seeds. *Pakistan Journal of Nutrition*, 13(6): 314-318.

Ukachukwu, S.N (2000). Chemical and nutritional evaluation of *Mucuna cochichinensis* (Lyon Beans) as an alternative protein ingredients in broiler diets (Phd) thesis, University of Nigeria Nsukka.

GROWTH PERFORMANCE OF JAPANESE QUAILS (*Coturnix coturnix japonica*) FED DIETS CONTAINING VARYING DIETARY LEVELS OF PROTEIN AND ENERGY

Zakari, A.* Alabi, O.J. and Aremu, A.

Department of Animal Production, Federal University of Technology, Minna.

***Corresponding author email: adamuzakari7790@gmail.com; +2349033998083**

Abstract

An experiment was conducted to evaluate the effect of diets containing varying levels of crude protein (20, 22, 24 and 26%) and metabolizable energy (2600, 2800, 3000 and 3200 kcal/kg) on growth performance of growing Japanese quail. A total of 576 two-week old quail chicks were assigned into 16 treatments. Each treatment were replicated three times and each replicate had 12 birds using a 4 by 4 factorial in a completely randomized design. Data on growth performance were recorded during 6 weeks of age. Results of the study showed that both the main and interaction of varying dietary protein and energy levels had no effect on the growth performance of Japanese quails. It could, thus, be recommended that the lowest protein (20 %) and energy (2600 kcal ME/kg) levels be used in the diets of Japanese quails for optimal growth performance since their performance is similar even at the highest protein and energy levels.

Keywords: *Japanese quail, Crude protein, Metabolizable energy, Performance*

Introduction

The world population is growing at an alarming rate. According to PRB (Population Reference Bureau) Projects, Africa's population will be more than double to 2.6 billion by 2050 and will account for about 58 percent of the global population increase by that date (Rosen *et al.*, 2014). With this population and the increased concern over low dietary animal protein supply. There is urgent need to increase the animal protein supply. This has led to search for animal that can supply the needed protein. If there is to be progress in this, effort must be placed on identification of alternative food resources that can meet to pace of the population growth (Rosen *et al*, 2014). The incorporation of game birds has been recommended, particularly for developing countries (Geldenhuys *et al.*, 2013) and one of the game birds that has identified is quail.

Quail has attained economic importance as an agricultural species producing eggs and meat that are enjoyed for their unique flavor. They have low maintenance cost because of their small body size (80-300 g), short generation interval having three to four generations in a year). Quail birds are more resistance to diseases and they have high egg production, thus they are an excellent laboratory animal because of their short generation interval. However, the nutritional requirement of this birds for the tropics have not been well established. Studies has shown that the nutrient of birds varies from species to species and from one location to another. Presently, in Nigeria, the diets fed to quail are mostly based on 24 and 20 % of crude protein for rearing and production, respectively, as recommended by NRC (1999) and there are also variations in the dietary crude protein and energy recommendations for quails.

Woodard *et al*., (1973) reported that quail can be raised on turkey starter diets containing 25 – 28 % crude protein while Lee *et al*. (1977) on the other hand indicated that dietary crude protein level of 24 % is needed in starter diet for quail and the protein content may be reduced to 20 % by 3rd week of age. Nwokedi *et al*. (2010) observed that when four crude protein levels of 20, 22, 24 and 26% were evaluated for Japanese quails, birds on 20 % crude protein level resulted in best performance from 1 to 42 days of age. Murakami *et al*. (1993) discovered that 18% crude protein was adequate at the laying phase this is, however, lower than the 20% recommended by NRC (1994) and 22.42%

recommended by Pinto *et al*. (1998).Report of Reda *et al*. (2015) indicated that Japanese quail fed crude protein and energy levels of 22 % and 2900 kcal ME/kg, respectively, as adequate during the first few weeks of growth. While Jahanian and Edriss (2015) reported that Japanese quail fed CP and energy levels of 26 % and 3000 kcal ME/kg, respectively, for the same period.

For the review above, that there are variations in the Japanese quail requirements for energy and protein. The variation might be attributed to region (climatic), breed of quails, time of rearing among others. This study will therefore, determine the effect of four different energy (2600, 2800, 3000 and 3200 Kcal) and four dietary protein levels of 20, 22, 24 and 26 % on the growth performance of Japanese quail raised under intensive management system in Nigeria (a tropical country).

Materials and Methods

The study was conducted at the teaching and Research Farm of Animal Production Department Federal University of Technology Minna, Niger state. Minna lies between latitude $9^0 15^1$ and $9^0\ 45^1$ N and between longitude $6^0\ 15^1$ and $6^0\ 45^1$ of the equator. The mean annual rainfall is between 1200 and 1300 mm and mean temperature ranges from 38 – 42°C

A total of five hundred and seventy-six (576) two weeks old Japanese quails obtained from the National Veterinary Research Institute, VOM, Nigeria. The two-week old quail chicks were assigned into 16 treatments. Each treatment was replicated thrice and each replicate had 12 birds using a 4 by 4 factorial arrangement in a completely randomized design. The experimental diets were corn-soybean based with 4 levels of protein (20, 22, 24 and 26% CP) at either of 4 levels of energy (2600, 2800, 3000 and 3200 kcal ME/kg diet). The composition of the experimental diets is presented in Table 1. The birds in all the treatments were subjected to similar management practices throughout the six weeks experimental period.

Initial weights were determined at the start of the experiment with the aid of salter weighing scale (SGF 400) balance and thereafter at weekly intervals. The final weight was also taken by weighing the birds in each replicate on the last day of the experiment using the same weighing balance. The weight gain was calculated by subtracting the initial weight from the final weight. In addition, the feed intake was calculated by subtracting the feed remaining from the total feed supplied each day before serving fresh one. The feed conversion ratio was also calculated by dividing feed intake by weight gain.

Data Analysis. All data generated were analyzed using two-way analysis of variance (ANOVA) and where significant differences occurred, the means was separated using Duncan Multiple Range Test as contained in the SAS package (2015), version 15.0.

Table 1. Ingredients composition of the Experiment

Ingredient	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
Maize	40.00	40.00	45.00	50.00	40.00	42.00	46.00	45.00	40.00	44.00	44.00	40.00	40.00	40.00	40.00	40.00
G/Cake 44%	4.00	4.00	4.00	4.00	6.00	4.00	4.00	4.00	18.00	11.00	5.00	9.00	13.00	12.00	10.00	8.00
Full fat soya	30.00	30.00	31.00	30.00	31.00	36.00	34.00	34.00	24.00	31.00	36.00	36.00	22.00	32.00	31.00	30.00
Fish meal	3.00	3.00	3.00	3.00	4.00	3.00	4.00	4.00	4.00	4.00	5.00	4.00	10.00	6.00	8.00	10.00
Rice offal	18.00	16.00	8.00	2.00	14.00	10.00	4.00	2.00	9.00	5.00	3.00	0.00	10.00	4.00	2.00	0.00
Limestone	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Palm oil	0.00	2.00	4.00	6.00	0.00	0.00	3.00	6.00	0.00	0.00	2.00	6.00	0.00	1.00	4.00	7.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DI-Methione	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	100.0	100.00	100.00	100.00	100.0	100.0	100.0	100.0	100.00	100.0	100.00	100.0	100.00	100.0	100.00	100.0
Calculated analysis																
CP	20.00	20.00	20.00	20.00	22.00	22.00	22.00	22.00	24.00	24.00	24.00	24.00	26.00	26.00	26.00	26.00
ME	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.0	3200.0	2600.0	2800.0	3000.00	3200.0
% EE	8.37	10.06	11.78	13.26	8.52	9.00	11.31	13.86	7.70	8.47	10.77	14.22	7.52	9.54	11.97	14.40
% CF	9.82	9.04	6.08	3.80	8.44	7.07	4.72	3.92	6.83	5.32	4.46	3.44	6.87	4.98	4.04	3.11
Avail P %	0.47	0.46	0.46	0.45	0.50	0.47	0.49	0.48	0.50	0.50	0.52	0.49	0.65	0.55	0.60	0.65
% Lysine	1.29	1.28	1.31	1.29	1.39	1.42	1.43	1.42	1.41	1.47	1.54	1.54	1.60	1.60	1.65	1.69

Key: CP = Crude protein, **ME =** Metabolism energy, **EE =** Eater extract, **CF =** Crude fiber, **Avail P =** Available protein, **G/cake** = Groudnut cake, **T** =Treatment

Results and Discussion

The main effect of dietary protein and energy levels on the growth performance results of Japanese quails is presented in Table 2. All the growth performance parameters measured there were no significant differences observed between the treatment group on the performance value recorded.

The interaction results between protein and energy levels on performance were presented in Table 3. There were similar in the main performance of the Japanese quail in all the parameters. The interaction of protein and energy on all the performance parameters was not significant.

Table 2: Main effect of dietary protein and energy on growth performance of Japanese Quails

Treatments	Initial Weight	Final weight	Weight Gain	Daily weight Gain	Total feed intake	Daily feed Intake	FCR
Effect of crude protein							
20.00	20.23	84.16	63.94	1.52	892.89	21.26	2.00
22.00	20.27	84.83	64.56	1.53	893.01	21.26	1.98
24.00	20.25	84.63	64.38	1.53	915.44	21.80	2.02
26.00	20.24	84.06	64.82	1.54	903.16	21.50	2.04
SEM	0.02	0.66	0.65	0.02	20.92	0.50	0.06
p. value	0.81	0.81	0.83	0.82	0.85	0.85	0.93
Effect of energy							
26.00	20.26	83.91	63.65	1.52	928.44	22.11	2.04
28.00	20.24	84.14	63.90	1.53	926.41	22.06	2.07
30.00	20.24	84.94	64.70	1.54	883.61	21.04	1.96
32.00	20.26	84.53	64.27	1.53	865.95	20.62	1.94
SEM	0.03	0.66	0.65	0.02	20.92	0.50	0.06
p. value	0.86	0.71	0.70	0.68	0.12	0.12	0.34

Table 3: Interaction effect of dietary protein and energy on growth performance of Japanese Quails

Protein	Energy	Initial weight	Final weight	Weight Gain	Daily weight Gain	Total feed Intake	Daily feed intake	FCR
20.00	26.00	20.21	84.35	64.14	1.54	875.90	20.85	1.92
	28.00	20.21	83.56	63.35	1.51	935.44	22.27	2.11
	30.00	20.25	84.71	64.50	1.54	880.58	20.97	1.95
	32.00	20.29	82.80	62.55	1.49	879.63	20.94	2.01
22.00	26.00	20.25	85.15	64.86	1.54	982.17	23.38	2.17
	28.00	20.21	85.29	65.04	1.55	910.70	21.68	2.00
	30.00	20.33	85.25	63.31	1.55	842.45	20.06	1.85
	32.00	20.25	83.64	63.31	1.51	836.71	19.92	1.89
24.00	26.00	20.25	83.62	63.37	1.51	954.00	22.71	2.08
	28.00	20.25	83.89	63.14	1.51	937.74	22.33	2.12
	30.00	20.25	85.89	65.64	1.56	883.80	21.04	1.82
	32.00	20.25	85.62	65.37	1.50	886.20	21.10	1.94
26.00	26.00	20.25	85.28	65.03	1.55	901.70	21.47	1.98
	28.00	20.25	84.33	64.04	1.53	921.75	21.95	2.06
	30.00	20.25	82.89	62.64	1.49	927.93	22.09	2.12
	32.00	20.21	83.74	63.53	1.50	861.25	20.51	1.94
SEM		0.06	1.31	1.30	0.03	41.85	1.00	0.11
p. value		0.98	0.63	0.61	0.62	0.70	0.68	0.64

Conclusion

Results of the study showed that both the main and interaction of varying dietary protein and energy levels had no effect on the growth performance. It could be recommended that the lowest protein (20 %) and energy (2600 kcal ME/kg) levels be used in the diets of Japanese quails for optimal performance since their performance is similar even at the highest protein and energy levels. Further study on the digestibility and economic of production can be carried out to ascertain the effect on the quails.

REFEREES

Geldenhuys, G., Hoffman, L. C., and Muller, N. (2013). Gamebirds: A sustainable food source in Southern Africa? *Food Security,* **5**(2), 235–249.

Jahanian R. and Edriss M.A (2015) Metabolizable energy and crude protein requirements of two Quail species (Coturnix japonica and Coturnix ypsilophorus).*The Journal of Animal and Plant Sciences,* **25**(3): 603- 611.

Lee, T.K., Shim, K.F. and Tan, E.L. (1977a). Protein requirement of growing Japanese quails in the tropics. *Singapore. J. Poultry Industry.*, **5**: 70-81.

Murakami, A. E., Moraes, V. M. B., Ariki, J., Junqeira, O. M., Kronka-S.da, N., Barbosa-da-Moraes V. M. and Do- Nascimento-Kronka (1993). Level of protein and energy diets for laying Japanese quail *(Coutrnix coutarnix Japonica). Revista - da- Sociedade-Brasileira -de-Zootecnia* **22**(4): 541-551.

NRC (1999). *Quail. In: Micro-livestock's – Little known small animals with a promising economic future*. National Research Council, Academy Press, Washington D.C. pp. 147- 155.

NRC (1994). *Nutrient Requirements of Poultry*. National Research Council, National Academy Press, Washington, D. C., 9th Revised Edition. Pp. 234

Nwokedi, M.N., Sekoni. A.A. and Alphonsus, C. (2010). Evaluation of optimal energy and protein requirement of Japanes quails (Coturnix coturnix japonica) for growth and carcass characteristics. In: O.J Ifut., U.A. Inyang., I.P. Akpan and I.E Ebeso (Eds). Diversifying Nigerian Economy Animal production option. *Proceedings of the 15th Annual Conference of the Animal Science Association of Nigeria, 13-15th Sept, 2009,Uyo,* 503-507.

Pinto R., Ferreira A.S. Albino L.F.T. and Gomes, PC. (1998). Níveis de proteína e energia para codornas japonesas em postura. In: 35th Reunião Anual da Sociedade Brasileira de Zootecnia; FMVZ- UNESP – Botucatu – *São Paulo.* **5**. (4): 147-149.

Reda F.M, Ashour E.A, Alagawany M and Abd El- Hack M.E (2015) Effects of Dietary Protein, Energy and Lysine Intake on Growth Performance and Carcass Characteristics of Growing Japanese Quails. *Asian J Poultry Sci,* **9**: 155-164.

Rosen, S., Meade, B., Fuglie, K., and Rada, N. (2014). International food security assessment, 2014-2024. Economic Research, 2014, 2024.

SAS Institute Inc., Cary, NC. 2003 SAS. 2003. SAS Institute Inc., Cary, NC, USA.

Woodard, A.E., Abplanalp, H., Wilson, W.O. and Vohra, P. (1973). *Japanese quail husbandry in the laboratory (Coturnix coturnix japonica)*. Department of Avian Sciences, University of California, Davis, 22 pp.

MONETARY COST ANALYSIS OF REPLACEMENT VALUE OF ACHA (*Digitaria exilis* Staph) FOR MAIZE IN BROILER CHICKENS DIETS

Wumnokol, D.P, Latu, M. Y and Magaji, S.T
Department of Animal Health and Production Technology, College of Agriculture, P.M.B 001 Garkawa, Plateau State, Nigeria
Email: satimagaji2009@yahoo.com

ABSTRACT
An experiment was conducted to investigate the cost of replacement value of acha (Digitaria exilis Staph) for maize in broiler diets. Five diets were formulated which unprocessed acha replaced maize at 0, 25, 50, 75 and 100% for the starter and finisher phase. Two hundred and twenty-five unsexed marshal broiler chicks were weighed and randomly allotted to five dietary treatments with three replicates per diet. Treatment 1 had the highest monetary value of ₦240.32 as cost of the feeds as compared to Acha with monetary value of ₦215.29, ₦223.05, ₦232.72 and ₦238.85 in feed 2,3,4 and 5 respectively (25%,50%,75% and 100% Acha); this trend indicated that the diets consisting of Acha had lower feed cost. The money saved from the production of the birds indicated that more money was saved in feed 3 (50% Acha) in the process of production. It can be concluded that unprocessed acha could replace maize especially at 50% level of inclusion in the diets of broilers with concomitant reduction in cost of feed/kgLWG.
Keywords: Acha, replacement, broilers

INTRODUCTION

The state of nutrition of the populace in Nigeria is predominantly marked by inadequate protein intake both in quantity and quality. The shortage has given rise to high price of animal protein (Taiwo *et al*., 2005). The high cost of animal proteins is mainly due to unavailability and high cost of raw material for feed industry especially maize. Abundant animal production also hinges on availability of cheap, available, acceptable and balance feeds. Feed quantity and quality affect how many animals can be raised and how fast they can reach the market weight. Depending on locality feed input is 80-90% the cost of producing eggs, chickens, pigs and rabbits (Aduku, 1992). Therefore, the potential of non-conventional feed resources must be assessed with the objectives of expanding the feed-base for the livestock, and thereby, reducing the cost of feeding farm animals.

The problems of high feeds cost calls for more research in developing new feed resource and upgrading the conventional ones. Preston and Leng (1986) rightly suggested that it is a better objective to make livestock production with available resources. The cost and sometimes scarcity of maize which is the conventional energy source of feedstuff has warranted the need to find alternative sources of energy to meet the demand by feed mill industries. In a bid to find alternative energy sources for broiler diets Agboola (1992) and Ogundipe *et al*. (1990) reported that millet competes favorably with maize in terms of percentage crude protein and percentage ash with no significant adverse effects on the performance of the birds.

Acha (*Digitaria exilis* Staph) is said to be the oldest indigenous West African cereal with cultivation dating back to 500BC but it is not known in a wild state Purseglove (1975). Acha (*Digitaria exilis* Staph) is popularly grown in about six States of Nigeria namely, Plateau, Nassarawa, Bauchi, Kaduna, Kebbi, Niger and the Federal Capital Territory (F.C.T). The crop is the staple food in some of these areas where the very small grain processed into different menus. The greatest diversity of this crop in Nigeria, exist mostly in Plateau State (Kwon-Ndung, 2003). Certain Acha varieties mature so fast that they are ready for harvest long before all other grains, making it to reduce misery, during "hungry times" (Kwon-Ndung, 2003).

In view of the economic value of Acha enjoyed by the rural farmers and its potential for increasing feed supply, the crop has received little attention from national and international scientists. Acha (*Digitaria exilis* Staph) deserves a much greater recognition because it can serve as food crop for the future and a good alternative source of energy for broilers. The objective of this study therefore was to analyze the monetary cost of replacement value of acha (*Digitaria exilis* Staph) for maize in broiler chicken diets.

Materials and Method

Acha (*Digitaria exilis* Staph) was bought in Mushere District of Bokkos Local Government Area of Plateau State. Yellow maize, soyabeans and salt were obtained from local market in Garkawa while bone meal, methionine, lysine, vitamins premixes and drugs were purchased from Jos town. Marshall Broiler chicks numbering 225 were obtained from Zartech Farms, Bukuru in Jos, Plateau State. Feed formulation was done manually and mixing was done in Plateau State College Agriculture, Garkawa feed mill.

The birds were brooded for one week which led to removing of the weak birds and 225 birds were finally used for the experiment. Five diets for the starter was formulated in which Acha replaced maize at 0, 25, 50, 75 and 100% levels designated as diet 1, 2, 3, 4 and 5 respectively. The CP content for starter was 23 crude proteins with maize at 45% in the control diet for the starter. The 225 Marshall birds were randomly assigned to five (5) treatments containing three (3) replications with 15 birds. Tables 1 and 2 showed the percentage composition of broiler starter and finisher.

Data collected were analyzed for cost value of feed per live weight using variance (ANOVA) techniques. Where significant differences were detected, means were separated using the Duncans New Multiple Test (DNMRT).

RESULTS AND DISCUSSIONS

The values of feed cost in naira (₦) per kilograms of feed (Table 3) ranged from 44.15 – 47.03, as the level of Acha (*Digitaria exilis* Staph) increases in the diet, feed cost per kilogram of diet decreases, though not very much due to the low differences in cost price of both ingredients in consideration. The total feed cost for rearing the birds from 1 – 8 weeks was presented in Table 3. The value ranged from ₦215.29 - ₦240.32 from treatment 1, 2, 3, 4 and 5 respectively. Treatment 1 has the highest value of ₦240.32 cost of the feeds; this trend indicated that the diets consisting of Acha had lower feed cost. The money saved from the production of the birds indicated that more money was saved in feed 3 (50% Acha) in the process of production.

It was found that the more the Acha inclusion, the feed intake increases and the less the cost of production. Acha has the advantage in storing ability over maize. The general trend showed that using unprocessed acha grains can reduce the cost of production of broiler chickens which was shown by the fact that least feed cost, high (diet 3) weight gain/kg and more in diet 5 money was saved in diet 3 (₦33.57) and diet 5 (₦31.91). Alabi *et al*. (2014) in a similar research stated that the inclusion of rice husk supplemented with commercial enzymes in the diets of broilers reduced the cost of production and hence increased profit. Similarly, an inclusion of Cassava peels up to 75% showed no adverse effect on the performance of broiler finishers and could lead greater reduction in cost (Abubakar and Ohinege, 2011).

In conclusion, Acha (*Digitaria exilis* Staph) could completely replace maize in broiler diet. Feed cost per kg body weight gain decreases with increases levels of Acha (*Digitaria exilis* Staph) in broiler diets and it was more profitable to produce broilers at 50% level of inclusion.

Based on the results, it was recommended that Acha (*Digitaria exilis* Staph) is a suitable substitute and also an alternative energy source to conventional maize for broiler production, particularly if purchased during the harvesting period.

REFERENCES

Abubakar, A and Ohinege, P. Z (2011). Replacement value of Cassava peels for Maize in the diets of broiler finishers. *Sokoto Journal of Veterinary Science* 9 (2).

Aduku, A.O. (1992). *Practical Livestock Feeds Production in the Topics.* S. Asekpome and C. Publishers. Samaru, Zaria pp1.

Agboola, S.S. (1992). Technologies for small scale storage of grains in Nigeria. (Food storage, *Processing and Utilization* (ODRI *occasional paper No. 1 pp 22-27*).

Alabi, O. O, Atteh, J. O, Adesumo, O.I and Ogundele, O.O (2014). Cost benefits of replacement of maize with rice husk supplemented with grindazyme, nutriseaxyla or roxazymes enzyme supplementation in the diet of Arbou Acres broilers. *International Journal of Applied Agriculture and Agriculture Research*. 10 (1 -2)

Kwon-Ndung, E.H. (2003) Acha Germplasm Resources Management Strategies for Nigeria. National Cereal Research Institute (NCRI) Badeggi, Niger State.

Ogundipe, S.O, Aduku, A.O, Muazu, M.J, Oyejola, A.A and Mijindadi, N.B. (1990).Replacement value of pearl millet for maize in broiler rations. *Journal of Animal Production Research*, 10(1); 57-65

Preston, T.R and Leng, R.A (1986). Feeding Systems based on Crop Residue and Agro Industrial By-products matching Livestock Production Systems to Available Resources. ILCA Press Addis Ababa pp 178-223.

Pursglove, J.W (1975). Monocotyledon. Longman Groups Ltd. England.

Taiwo, A.A., Adejujabe, A.D., Adebowale, E.A., Oshotan, J.S., and David, O.O. (2005). Performance and Nutrient Digestibility of Weaned Rabbits Fed Forages Supplement with Concentrate.*Nigerian Journal of Animals Production,* **32**(1): 74-78.

Table 1: Percentage Composition of Broiler Starter (1-5 weeks) diets (23% cp)

Ingredients	**1**	**2**	**3**	**4**	**5**
	% Level of Replacement of Maize by Acha				
	0	**25**	**50**	**75**	**100**
Yellow Maize	45	33.75	22.5	11.25	0
Acha	0	11.25	22.5	33.75	45
Soya bean (full fat)	39	39	39	39	39
Wheat offal	5	5	5	5	5
Fish meal	7.8	7.8	7.9	7.8	7.8
Bone meal	2.5	2.5	2.5	2.5	2.5
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated Analysis					
ME (Kcal/Kg)	2776/100	2764	2758	2745	2738
Crude Protein (%)	23.52	23.28	23.08	22.00	22.00
Crude Fibre (%)	3.88	3.86	3.95	4.03	4.13
Calcium (%)	0.85	0.92	0.99	0.99	1.1
Total p (%)	0.55	0.55	0.56	0.56	0.56
Lysine (%)	1.44	1.41	1.42	1.35	1.32
Methonine (%)	0.48	0.46	0.43	0.41	0.38
Cystene (%)	0.34	0.32	0.30	0.29	0.27
Met + cys (%)	0.82	0.78	0.73	0.70	0.65

Premix used biomix. Each kg of premix contained the following ingredients. Vit. A. I.U 5,000,000.00 Pantothenic acid (mg) 4,000; Vit. D3 I.U 1,000,000 Biotin (mg), 32 Vit E (mg) 20,000 Vit.B12 (mg), 10Vit, K3 (mg) 1,000 folic acid (mg), 4,000 Vit.B1 (mg) 1,200 Choline Chloride (mg), 1,200 Vit B2 (mg), 2,400 manganese (mg), 4,000 Vit. B6(mg), 2,400 Iron (mg), 20,000 Niacin (mg), 16,000 Copper (mg), 800 Cobalt (mg), 100 Iodine (mg), 620 Selenium (mg), 40.

Table 2: Percentage Composition of Broiler Finisher (5-9 weeks) diets (20%cp)

Ingredients	**1**	**2**	**3**	**4**	**5**
	% Level of Replacement of Maize by Acha				
	0	**25**	**50**	**75**	**100**
Yellow Maize	50	37.5	25	12.5	0
Acha	0	12.5	25	37.5	50
Soya bean (full fat)	31.8	31.8	31.8	31.8	31.8
Wheat offal	10	10	10	10	10
Fish meal	5	5	5	5	5
Bone meal	2.5	2.5	2.5	2.5	2.5
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
ME (Kcal/Kg)	30.35	2975	2925	2876	2824
Crude Protein (%)	20.35	20.34	20.80	19.00	19.00
Crude Fibre (%)	4.10	3.71	3.42	3.12	2.83
Calcium (%)	0.84	0.92	1.0	1.0	1.1
Total p (%)	0.53	0.51	0.53	0.54	0.55
Lysine (%)	1.19	1.16	1.13	1.10	1.06
Methonine (%)	0.40	0.38	0.35	0.32	0.30
Cystene (%)	0.31	0.29	0.27	0.25	0.23
Met + cys (%)	0.71	0.67	0.57	0.57	0.53

Premix used biomix. Each kg of premix contained the following ingredients. Vit. A. I.U 5,000,000.00 Pantothenic acid (mg) 4,000; Vit. D3 I.U 1,000,000 Biotin (mg), 32 Vit E (mg) 20,000 Vit.B12 (mg), 10Vit, K3 (mg) 1,000 folic acid (mg), 4,000 Vit.B1 (mg) 1,200 Choline Chloride (mg), 1,200 Vit B2 (mg), 2,400 manganese (mg), 4,000 Vit. B6(mg), 2,400 Iron (mg), 20,000 Niacin (mg), 16,000 Copper (mg), 800 Cobalt (mg), 100 Iodine (mg), 620 Selenium (mg), 40.

Table 3: Cost analysis of broilers production using graded levels of Acha based diets

	1	2	3	4	5
	Levels of replacement of maize by Acha (%)				
Parameters	**0**	**25**	**50**	**75**	**100**
Total feed intake (kg)	5.11	4.64	4.9	5.19	5.41
Feed cost per N/kg	47.03	44.00	45.52	44.84	44.15
Total cost of feed consumed N/kg	240.32	215.29	223.05	232.72	238.85
Total weight gain (kg)	1.65	1.81	1.99	1.98	2.10
Feed cost (kg) live weight gain	145.32	118.94	112.08	117.54	113.74
Money saved	-	26.71	33.57	28.1	31.91
% Saving	-	18.15	22.87	19.12	21.73

PERFORMANCE OF BROILER CHICKENS FED RED SORGHUM VARIETY REPLACING MAIZE AT THE STARTER PHASE

H. S. Buhari*[1], *A. S. Muhammad[2], A. S. Naibi[2], N. A. Jama'a[2] and H. Jamilu[3],*
[1]Collage of Agriculture and Animal Science, Division of Agricultural Collages, Ahmadu Bello University Mando-Road, Kaduna
[2]Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Bauchi state,
[3]Faculty of Agriculture, Teaching and Research Farm, Federal University Dutse.
** Corresponding author email=hayatusanibuhari@gmail.com, Phone number = +2348025238920*

ABSTRACT
The study was designed to investigate the performance attributes of chickens fed different levels of red sorghum variety as replacement for maize. Two hundred and twenty five (225) unsexed day old broiler chicks were allotted to five treatments containing red sorghum replacing maize at 0,25,50,75 and 100% levels of inclusion designated as diets 1,2,3,4 and 5 respectively in a completely randomized design (CRD). The results obtained after the research did not show any significant difference across the five diets. It is concluded that red sorghum variety can completely (100%) replace maize without compromising productive performance. Red sorghum variety is recommended as a suitable alternative to maize as dietary energy source in broiler chickens production.

INTRODUCTION

Livestock consumes more than a third of all the world's grains particularly maize (Omale and Igwe, 2006). Maize has remained the chief source of dietary energy in compound feeds and constitutes about 50-60% in most poultry diets. Despites its worldwide production, a stiff competition for the usage of maize by humans, livestock and industries persists. This is simply because, maize is high in energy and forms the standard (100) against which other cereal grains is compared (Atteh, 2002). Sorghum (*sorghum bicolor*) is a drought tolerant crop able to withstand a wide range of environmental conditions and has limited industrial uses in Nigeria.This high demand for maize by man and consequently the high prices has made the use of other alternative energy sources like Red sorghum imperative. Sorghum grain has proven to be a suitable feedstuff for use in animal diets (Hancock, 2000; Dowling *et al.*, 2002; Cramer *et al.*, 2003; Travis *et al.*, 2006; Medugu *et al.*, 2010). One major constraint to the use of sorghum in poultry feeding is its tannin content which exerts anti-nutritive on birds.

MATERIALS AND METHODS

Experimental site:

The experiment was conducted at the poultry unit of the Teaching and Research Farm of the College of Agriculture and Animal Science, Mando-Kaduna Division of Agricultural Colleges, Ahmadu Bello University, Zaria. Kaduna State is located within the North-West Geo-Political Zone of Nigeria. Kaduna State is found in the Northern Guinea Savannah Zone of Nigeria (COMPASS, 2009). The state has two main seasons; dry and rainy seasons. The rainy season covers the month of April-October and the dry season covers November-March. The mean annual rainfall is 700-900 mm for the Northern Zone, 690-1031 mm for the Central Zone and 900-1300 mm for the Southern Zone (KADP, 2003). The temperature ranges from 24.4^{o}C to 30.4^{o}C, with the hottest months being March and April while the coldest months are December and January. August use to record the highest relative humidity (99%) and February has the lowest (57%) (KADP, 2003).

Experimental Diets

Five experimental diets of 23% CP were formulated in which red sorghum variety replaced maize at 0, 25, 50, 75 and 100% levels coded as diets 1,2,3,4 and 5 respectively. Yellow maize was replaced by red sorghum as the source of energy while the major sources of protein in the diets were roasted full-fat soya beans (FFSB) and fish meal. The percent and proximate compositionsof the experimental diets are presented in Table

Table 1: Ingredients and Calculated Analysis of Diets Containing Different Energy Sources Fed toBroiler Chickens at theStarter Phase (1-4 weeks of age)

	Diets				
Ingredients	**T1(0%)**	**T2(25%)**	**T3(50%)**	**T4(75%)**	**T5(100%)**
Yellow maize	47.00	35.25	23.50	11.75	0.00
Red sorghum	0.00	11.75	23.50	35.25	47.00
Roasted soya bean	33.50	33.50	33.50	33.50	33.50
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
+Premix	0.20	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
ME(Kcal/kg)	2926.58	2910.84	2895.09	2879.35	2863.60
Ether extract (%)	4.18	4.48	3.92	4.04	3.83
Crude fibre (%)	4.37	4.70	3.62	4.09	3.93
Calcium (%)	1.72	1.73	1.82	1.73	1.73
Phosphorus (%)	0.95	0.95	0.96	0.95	0.96
Lysine (%)	1.57	1.57	1.56	1.48	1.54
Methionine (%)	0.76	0.75	0.75	0.84	0.74

+NB: A bio-organics nutrient supplement containedVit. A; 4000000 i.u,Vit. D3; 800000 i.u, Vit. E; 9200mg; Niacin 11000mg; Vit.B2 2000mg; Vit.B6, 1200mg; Vit.B12 6mg; Vit. K3 800mg; Pantothenic acid 3000mg; Biotin 24mg; Folic acid 300mg; Choline Chloride 120000mg; Cobalt 80mg; Copper 1200mg; Iodine 400mg; Iron 8000mg; Manganese 16000mg; Selenium 80mg; Zinc 12000mg; Anti-oxidant 1250.00mg.

Experimental Birds:
Two hundred and twenty-five (225) Armor breed of broiler chickens were used for the research. They were allotted to the five treatments in three replicates with fifteen birds per replicate in a completely randomized design (CRD).

RESULTS

The performance of broiler chickens fed dietary levels of red sorghum variety is presented on Table 2. All the performance parameters (Daily feed intake, Daily weight gain and Feed conversion ratio) were not affected by the dietary treatments. This finding is in conformity with the reports of Nyannor *et al.* (2007) who stated that the growth performance of broiler chickens was equally supported by maize and sorghum, since sorghum grains compares quite favorably with maize in terms of nutritional quality. It is also similar to the reports of Kawu (2010), who stated that low tannin sorghum is similar to maize in its nutritional value and gives response equivalent to that observed in maize diets.

Table 2: Performance of Broiler Chickens Fed Red Sorghum Variety Replacing Maize at the Starter Phase (1-4 weeks)

Parameters	Diets					
	T1(0%)	T2(25%)	T3(50%)	T4(75%)	T5(100%)	SEM
Daily feed intake (g)	66.54	67.66	71.35	69.04	67.87	1.42 NS
Daily weight gain (g)	21.17	23.78	24.44	23.09	22.05	1.44 NS
Feed conversion ratio	3.20	2.85	2.94	3.01	3.10	0.19 NS
Mortality (Number)	3	2	0	0	3	-

SEM= Standard Error of Mean, NS= Not Significant

DISCUSSION

The productive performance of broiler chickens fed red sorghum based diets showed no significant differences in the starter. This indicates that red sorghum variety can substitute maize weight for weight in the diets of broiler chickens without compromising the performance of broiler birds.

CONCLUSION AND RECOMMENDATION

It is concluded that red sorghum variety can completely (100%) replace maize without compromising productive performance. Red sorghum variety is recommended as a suitable alternative to maize as dietary energy source in broiler chickens production.

REFERENCES

Atteh, J. O. (2002). **Principles and Practice of Livestock Feed Manufacturing.***Adlek Printers,* Ilorin, Nigeria. Pp. 13-17.

Cramer, K. R., K. J., Wilson, J. S. Moritz and R. S. Beyer, (2003). Effect of sorghum based-diets subjected to various manufacturing procedures on broiler performance. *J. Appl. Poult. Res*., **12:** 404-410.

Dowling, L. F., C. A. and B. R. Hamaker (2002). Economic viability of high digestibility sorghum as feed market broilers. Agron. J., **94:** 1050-1058.

Hancock, J. D., (2000). Value of sorghum and sorghum co-products in the diets of livestock. In: Sorghum Origin, History, Technology and Production (W. Smith and R.A. Fredericksen, Eds.), Wiley Series Crop Science, pp: 731-751.

Kaduna State Agricultural Development Project (KADP) (2003). Annual Report.

Kawu, Y. U. (2010). Replacement value of gayamba millet variety for maize in broiler chickens diets. Unpublished MSc Thesis, Abubakar Tafawa Balewa University,Bauchi, Nigeria.

Medugu, C. J., I. D. Kwari, J. U. Igwebuike, I. Nkama, I. D. Mohammed and B. Hamaker, (2010). Carcass and blood components of broiler chickens fed sorghum or millet as replacement for maize in the semi-arid zone of Nigeria. *Agricultural sand Biological Journal of North America,* **1:** 326-329.

Nyannor, E.K.D., Adedokun, S.A., Hamakeg, B.R., Ejeta, G. and Adeola, O. (2007): Nutrtional and evaluation of high digestibility sorghum for pigs and broiler chickens *Journal of Animal Science.* **85:**196 – 203.

Omale, O. A. and Igwe, C. U. (2006).The nutritive, anti-nutritive, and hepatoxic properties of sorghumin Nigeria.*Pakistan Journal of Nutrition,***7**(1):85- 89.

Travis, D. K., M. R. Tuinstr and J. D. Hancock, (2006). Variation in nutritional values of sorghum hybrids with contrasting seedweights characteristics and comparisons with maize in broiler chicks. Crop Science, **46:** 695-699

BIOCHEMICAL AND HAEMATOLOGICAL INDICES OF WEANER RABBITS FED SORGHUM BREWERS DRIED GRAIN (SBDG)

Ayandiran, S.K[1]., Adedokun, M.A[1]., Odeyinka, S.M[2]., Adekunle, I[1]., Kazeem, A.A[1]. and Okunlola, N.A[1].

[1]Department of Animal Health and Production Technology, The Oke-Ogun Polytechnic Saki
[2]Department of Animal Sciences, Obafemi Awolowo University
Corresponding author: skayandiran@gmail.com
+2348062748481

ABSTRACT

This study evaluated the biochemical and haematological indices of weaner rabbits fed sorghum brewer's dried grain (SBDG). Forty mixed breeds of rabbits (4-8weeks) were allotted into four experimental treatments in a completely randomized design. Four concentrate diets were compounded by replacement of maize with the inclusion of SBDG at 0, 20, 30 and 40%. The diets were fed to the rabbits at 5% of their body weight respectively. The diets containing SBDG (20%, 30% and 40%) had similar ($p>0.05$) value of glucose, total protein, globulin, albumin, AST and ALP. Animal fed diet 20%SBDG (85.63) had significantly highest ($p<0.05$) ALT compared to 0%SBDG (69.58), 30%SDBG (63.13) and 40%SBDG (58.99). The bilirubin total was significantly higher ($p<0.05$) than diets 0%SBDG and 30%SBDG.Rabbits fed diet 30%SBDG had significantly highest PCV value (36.65), followed by 40%SBDG (34.75), 20%SBDG (34.59) and 0%SBDG (35.55). The RBC was significant higher ($P>0.05$) in rabbits fed diets 30%SBDG (6.49) and 20%SBDG (6.14) than 0%SBDG (4.83) and 40%SBDG (4.20) whereas, the WBC count was significantly higher ($P>0.05$) in rabbits on diet 40%SBDG and 0%SBDG than 30%SBDG and 20%SBDG. It could be concluded that the total replacement of maize with SBDG in the diet of rabbits had no deleterious effect on the biochemical and haematological indices.

INTRODUCTION

Feed cost among other cost of production accounts for over 50% of intensively reared rabbit in the tropics (Ogunsipe *et al*., 2011). This can be attributed to high cost of conventional feed sources in formulated concentrate diets (Olomu, 2011). Their seasonality as well as competing demand by man as food and industrial raw material has not helped in this regard. Several studies have revealed that the development and utilization of unconventional feedstuffs can greatly reduce the overdependence on conventional feed sources and subsequently reducing the cost of production of livestock. A characteristic of such alternative feedstuff should be its non-competitive usage with man, brewery by-products fall into this category (Dowling *et al*., 2003). These alternative feed sources have been utilized successfully by several animal nutritionists in the formulation of feed which include the use of cassava peel meal in rabbits (Adegbola and Oduozo, 1992). Therefore of sorghum brewers waste (SBW) is derived from sorghum used solely. It is relatively cheap as large quantity is produced in local gin production (Awika *et al.*, 2001). It does not require much of additional processing such as grinding before being incorporated into livestock diets. The examination of blood provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body and it plays a vital role in the physiological, nutritional and pathological status of the animal (Aderemi, 2004). Hence, this study evaluates the biochemical and serum of rabbits fed sorghum brewers dried grain.

MATERIALS AND METHODS

Forty weaners rabbits of mixed sexes aged 4 - 6 weeks were used for the experiment. The rabbits were raised in hutches fitted with feeders and drinkers at The Oke-Ogun Polytechnic Saki, Teaching and Research Farm. There was two-week adaptation period during which the rabbits were treated against parasitic infestation with ivermectin subcutaneous and multivitamin added to their water. The forty rabbits were randomly allotted into four treatments (10 per treatment) in a completely randomized design. Fresh and wet local sorghum brewers waste was sourced from reputable local brewery in Saki metropolis, oven-dried for three days and store in polythene bags for subsequent use. Four concentrate mash diets were compounded by replacing of maize with LSBDG at 0%, 20%, 30% and 40% levels respectively. The diets were fed to rabbits at 5% of their body weight. On the last day of the experiment, blood samples were taken from the goats using 5 ml syringe. One ml blood sample was

collected into labelled sterile bottles containing anticoagulant free bottles, allowed to coagulate at room temperature and centrifuged at 3000 rpm for 10 minutes. The serum concentration of cholesterol, aspartate aminotransferase (AST), alkaline phosphate (ALP) and albumin were determined using commercial laboratory kit (Randox Laboratories Ltd, U.K). The red blood cell (RBC), white blood cell (WBC) and the packed cell volume (PCV) were determined using the method of Adedapo *et al*. (2007). Data collected were subjected to one-way analysis of variance procedure of the general linear model (SAS, 2008). The mean was separated using the Duncan Multiple Range Test.

Table 1: Table 1: Gross composition of the experimental diets

Ingredients	0%SBDG	20%SBDG	30%SBDG	40%SBDG
Maize	40.00	20.00	10.00	-
SBDG	-	20.00	30.00	40.00
Wheat offal	21.50	21.50	21.50	21.50
Groundnut cake	25.00	25.00	25.00	25.00
Palm kernel cake	10.00	10.00	10.00	10.00
Bone meal	2.00	2.00	2.00	2.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Vitamin premix	0.50	0.50	0.50	0.50

RESULTS AND DISCUSSION

Table 2: Biochemical indices of rabbits fed SBDG

Parameter	0%SBDG	20%SBDG	30%SBDG	40%SBDG	SEM
Glucose (g/dl)	111.40	129.35	101.40	78.95	9.79
Total Protein (g/dl)	5.23	5.19	6.59	6.60	0.32
Globulin (g/dl)	1.86	1.58	1.40	1.76	0.12
Albumin (g/dl)	4.38	4.60	5.20	5.75	0.39
Creatinine (g/dl)	1.62^{b}	4.25^{a}	4.00	2.00^{b}	0.56
SOD (u/ml)	62.29^{a}	46.64^{b}	42.91^{b}	41.96^{b}	5.39
AST (m/l)	18.89	22.76	16.81	18.18	0.94
ALT (m/l)	69.58^{ab}	85.63^{a}	63.13^{b}	58.99^{b}	4.35
ALP (m/l)	55.66	50.44	64.40	38.92	4.76
Bilirubin Total (mg/dl)	4.77^{b}	9.31^{a}	4.28^{b}	9.87^{a}	1.04

Table 3: Haematological parameters of rabbits fed SBDG

Parameter	0%SBDG	20%SBDG	30%SBDG	40%SBDG	SEM
Packed cell volume (%)	35.55^{ab}	34.59^{b}	36.65^{a}	34.75^{b}	0.61
Haemoglobin (g/dl)	13.55^{b}	11.85^{c}	15.80^{a}	11.48^{c}	0.66
Red blood cell ($x10^{12}$)	4.83	6.14	6.49	4.20	0.85
White blood cell ($x10^{9}$)	6.65	4.80	5.90	6.75	0.49
Lymphocyte (%)	55.90	53.80	56.20	51.90	1.47
Middle cell (%)	4.15^{ab}	1.35^{b}	1.90^{b}	7.85^{a}	1.04
Granulocyte (%)	0.38^{b}	0.35^{b}	0.30^{b}	3.95^{a}	0.58
Haematocrit (HCT)	34.45^{c}	47.40^{a}	35.55^{c}	40.55^{b}	1.97
MCV	50.65	50.90	54.75	53.10	1.25
MCH	4.12	4.25	4.23	4.34	0.06
MCHC	65.35^{a}	32.53^{b}	15.00^{c}	29.00^{b}	10.82
Platelet	49.68	27.32	38.99	43.36	4.39

Blood is an important index of physiological, pathological and nutritional status in the organism (Olorode *et al*., 2007). The glucose values in this study were relatively similar to 111.13 – 124.93 reported by Terzungwe *et al.* (2013) for rabbits fed *Moringa oleifera* leaves. The total protein content reported in this study were slightly higher than the range (4.81- 5.48g/dl) reported by Odetola *et al.* (2012). The glubolin concentrations were lower than the values (2.55 – 2.77) reported by Olabanji *et al.* (2007). The albumin was similar to value recorded by Ayandiran *et al.* (2019) for rabbits fed bread waste and Moringa based diet. Mean values of ALT for rabbit fed SBDG were close to the normal range of (48.5-78.9) reported by Mutruka and Rawnsley (1997). The serum enzyme activities above the normal range are abnormal and are an indication that the animal might have suffered liver and/or kidney damage. The PCV in this study were lower than 43.30-46.77 (Federick, 2010) but higher than 32.25-34.78 reported by Ayandiran (2019). The RBC values (4.20-6.49) obtained in this study were close to the normal ranges of 5.0-8.0 as reported by (Ahamefule *et al*., 2008). The WBC values were slightly higher than 5.13-5.60 (Yakubu *et al*., 2008). Furthermore, the MCV values were close to the reference values of (60.00-69.00) reported for apparently healthy rabbits (Madirabbit, 2011); but higher than 32.75-34.00 reported by Bitto *et al*. (2006). The MCH values reported in this study was relatively low compared to the values reported (19.85-20.06) by Togun *et al*. (2007) while Njidda *et al*. (2006) posited that MCV, MCH and MCHC are used in diagnosing anaemic conditions. The lymphocyte values obtained were however above the stipulated values obtained were however above 41.0-53.5 reported by Aderemi *et al.* (2014) for rabbits fed Soybean with *Tephrosia linearis* meals.

CONCLUSION

It could be concluded that the total replacement of maize with SBDG in the diet of rabbits had no deleterious effect on the biochemical and haematological indices.

REFERENCES

Adedapo, A. A., Omoloye, O. A. and Ohore, O. G. (2007). Studies on the toxicity of an aqueous extract of leaves of *Abrus precatorius* in rats. *Onderstepoort Journal of Veterinary Research*. 74: 31-36. Adegbola, T.A and Oduozo, R.O. (1992). Nutrient intake, digestibility and performance of rabbits fed varying levels of fermented and unfermented cassava peel meal. *Journal of Animal Production*, 12: 41-47.

Aderemi, F. A. (2004). Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biochemistry of pullet chicks. *Trop. J. Anim. Sci*., 7:147- 153.

Aderemi, F., Adewumi, K., Babayemi, J and Adedokun O (2014). Replacement Effects of Soybean with Tephrosia Linearis meals on performance, carcass characteristics, nutrient digestibility and blood components of rabbit. *Agric. sci. dev*., Vol(3), No (11), November, 2014. pp. 366-369. Ahamefule F.O., I.A Obua, Ukweni M.A., Oguike M.A and Amaka R.A. (2008). Haematological and biochemical profile of weaner rabbits few raw or processed pigeon pea seed meal-based diets. *Afri. J. Agri. Res.*, 3 (4): 315-319.

Awika. J.M., Rooney, LW. and Waniska, R.D. (2001). Potential of specially sorghum bran fractions as a source of antioxidants. *The American Association of Cereal Chemists*. Charlotte Convention Centre, October 14-18, 2001, Charlotte North Carolina.

Ayandiran, S.K., Odeyinka, S.M and Odedire, J.A. (2019). Effect of bread waste and *Moringa oleifera* leaves (BWMO) in the basal diet of Rabbits. *Bulletin of Animal Health and Production in Africa*. 67 (2):

Bitto, I.I., Arubi, J.A and Gumel A.A. (2006). Reproductive tract morphometry and some haematological characteristics of female rabbits fed pawpaw peel meal based-diets. *African Journal of Biomedical Research*, 9 (3): 199-204.

Dowling, L.F., Arndt, C. and Haymaker, B.R. (2002). Economic viability of high digestibility sorghum as feed for market broilers. *Agronomy J*., 94: 1050-1058.

Federick, (2010). Effect of Moringa leaf meal on nutrient digestibility, growth, carcass and blood indices of weaner rabbits. A thesis submitted to the school of graduate studies, Kwame Nkrumah University of Science and Technology, Kumasi, in partial fulfilment of the requirements for the award of Master of Science degree in Animal Nutrition.

Medirabbit. (2011). Complete blood count and biochemical reference values in rabbits. Retrieved from www.medirabbit.com, 22nd July, 2016, 12:30pm.

Mitruka, B.M. and Rawnsley, H.M. (1977). Clinical, biochemical and haematological reference values in normal and experimental animals. Masson Publishing, USA, Inc., 83:134-135.

Njidda, A.A, Igwebuike, J.U and Isidahomen, C.E (2006). Hematological parameters and carcass characteristics of weaning rabbits fed grade levels of molasses. *Global Journal of Agric. Sci*., 5 (7): 167-172.

Odetola, O. M., Adetola, O. O., Ijaduola, T. I., Adedeji, O. Y and Adu, O. A. (2012). Utilization of moringa (*Moringa oleifera*) leaves meal as a replacement for soya bean meal in rabbit's diets. *Scholarly Journal of Agricultural Science*. 2(12), pp. 309-313.

Ogunsipe, M. H., Akinbani, A. S., and Ibidapo. I. (2011). Performance evaluation and economics of production of rabbits fed graded levels of Gliricidia leaf protein concentrate as replacement for groundnut cake protein. *Inter. J. Agric. Sci., Res. Tech*., 2011; 1(2):67-72.

Olabanji, R. O., Farinu, G. O., Akinlade, J. A. and Ojebiyi, O. O. (2007). Growth performance and haematological characteristics of weaner rabbits fed different levels of wild sunflower (*Tithonia diversifolia Hems L A. Gray*) leaf blood meal mixture. *Proc. of 32nd Animal Conf. of Nig. Soc. for Anim. Prod.*, 207-209.

Olomu, J. M. (2011). Monogastric animal nutrition: Principles and Practice. Second edition.ST. Jackson Publishing, Benin City, Nigeria. pp 87.

Olorode, BR, Adeniran, RA, Abiola, JO (2007): Effect of graded levels of *Moringa oleifera* seed meal on haematological values and organ weight of broiler chicken. *Tropical J. Animal Sci*. 10 (1-2); 63- 67.

SAS, (2008). SAS Users Guide Statistics, SAS inc. Cary, North Califonia, 2008 edition.

Terzungwe A., Adakole H. A. and Lois K. I. (2013). Physiological responses of rabbits fed graded levels of *Moringa oleifera* leaf meal (MOLM): Some aspects of haematology and serum biochemistry. *Archives of Applied Science Research*, 2013, 5 (2):172-176 (http://scholarsresearchlibrary.com/archive.html)

Togun, V.A., Oseni, B.S.A, Ogundipe, J.A., Arewa, T.R., Hammed, A.A., Ajonijebu, D.C., Oyeniran, A., Nwosisi, I. and Mustapha, F. (2007). Effect of chronic lead administration on the haematological parameters of rabbit- a preliminary study. *Proc. of the 41st conf. of the Agric. Soc. of Nig*., 341.

CARCASS AND GUT CHARACTERISTICS OF BROILER BIRDS FED SORGHUM AS A REPLACEMENT FOR MAIZE

ZAGI, S. P., *BELLO A. MUSA and AJIGHJIGH, D. T.*
Department of Agricultural Science Education, School of Vocational and Technical Education, Aminu Saleh College of Education Azare, P. M. B. 044, Bauchi State, Nigeria.
Corresponding Author's E-mail: *spzagi@gmail.com Tel: +234-7064291541*

ABSTRACT
A feeding trial was conducted at the Aminu Saleh College of Education Azare Teaching and Research Farm, Bauchi State to evaluate the dietary response of broiler birds fed sorghum in place of maize at various inclusion levels. A total of one hundred and five day old chicks were used for the study. Five experimental diets were formulated and designated as T_1 (control), T_2, T_3, T_4 and T_5. The birds were randomly allotted to five experimental treatments of twenty one birds per treatment while each treatment was replicated three times (seven birds per replicate) in a completely randomized design (CRD). The result of growth performance revealed that average daily weight gain were significantly ($p<0.05$) influenced by the dietary treatments. Birds fed 25% sorghum had superior weight gain compared with other treatments. Daily fed intake was however not influenced ($p>0.05$) by the dietary treatments. There were significant ($p<0.05$) difference in the cut parts measured except the weight of chest and wings. Birds fed 75% sorghum had lowest values in wing weight while birds fed 100% sorghum had lowest values in chest weight. Carcass weight were significantly ($p<0.05$) different across dietary treatments. Organs weight and length were not significantly ($p>0.05$) different across dietary groups except in small intestine length. It was concluded that 25% sorghum can be included in the diet of broilers without adverse effect on growth performance of broilers. However, T2 with 25% sorghum is recommended, since birds on this diet had the best performance and carcass characteristics.
Keywords: Broiler, Day-old chicks, Sorghum, Diet, Treatment

INTRODUCTION
Due to increasing meat consumption and a growing population, animal production is increasing in the world (Food and Agriculture Organization of the United Nations FAO, 2016). This increase is realized through fewer, but larger farms (large animal units and high stocking densities and with large numbers of animals per farm) in upper middle-income countries and high income countries (Lowder *et al.,* 2016). Commercialization in the poultry industry and generally in the agriculture sector has increasingly become popular in East Africa, mainly as an entrepreneurial response to income growth in the region (Katongole *et al.,* 2013). According to FAO (2013), chicken meat production in Africa between 2006 and 2013 increased steadily by almost 5% per year. With regard to number of animals, poultry production (with broilers being the most commonly reared poultry species) is one of the largest livestock sectors in the world (Silvera, 2017). Broiler production is one of the livestock industries that offers the highest turnover rate and quicker returns on investment either in small, medium or large scale production (Afolayan *et al.,* 2014). Poultry birds especially broilers play a significant role in the provision of animal protein required by man to meet his daily protein intake (Maidala and Istifanus, 2012). The increased demand of poultry meat has directed breeding focus towards a fast growing broiler with increased feed efficiency and greater final weights (Petracci and Cavani, 2012). Within the age of six weeks, female birds gain weight up to 175-200g and the males weigh between 125-150g (Akintunde *et al.,* 2017). Female births start laying eggs at 5-6 weeks of age and continue up to twenty two weeks of which the egg weighs about 9-10g (Akintunde *et al.,* 2017). There are also essential in poultry production being fundamental attributes for assessing growth and feed efficiency as well as important yardstick in management and economic decision making (Assan, 2015). This study was carried out to determine the effect of sorghum replacement for maize on the performance and carcass characteristics of broilers.

MATERIALS AND METHODS
Experimental site
The study was conducted at the poultry unit of the Department of Agricultural Science Education Teaching and Research Farm, Aminu Saleh College of Education Azare, Bauchi state.

Experimental birds and management

One hundred and five day-old broilers chicks purchased from Amo farm, Kano state were used for the seven weeks experiment. The chicks were brooded conventionally in a deep litter system using electric bulb (200wattt) as a source of heat and light. The chicks were brooded for fourteen days. Medications, vaccinations and other routine management practices as described by Abdo *et al.* (2015) were strictly followed. The birds were weighed on commencement of the experiment to obtain the initial weight and 21 birds were randomly selected and allotted to each of the five treatments of 3 replicates each (7 birds per replicate) making a total of 105 birds. The birds were fed diets containing 0, 25, 50, 75 and 100% graded levels of red sorghum, both at starter and finisher phases.

Experimental diets

The sorghum and maize used for the experiment was bought from a local market in Azare, Katagum L.G.A of Bauchi state. The dried feed ingredients were grounded using hammer mill and mixed together to homogenized, packed in a sack and stored at room temperature (Wafar and Tarimbuka, 2016). Diets were formulated by using Pearson square method. Two basic diets comprising of the starter and finisher diets were formulated. The diets were formulated in order to meet the broilers nutritional requirements, based at nutritional program recommendation by Rostagno *et al.* (2011). The nutritional and energy levels, as well as the feed composition of the diets involved in all treatments were based on the four nutritional stages (pre-starter, starter, grower and finisher). Five experimental diets were formulated using sorghum as energy source and as replacement for maize. Maize was replaced with sorghum at dietary inclusion levels of 0, 25, 50, 75 and 100% designated as T_1 (control), T_2, T_3, T_4 and T_5 respectively.

Chemical analysis

Samples of each diet fed to the birds (starter and finisher) were analyzed to determine the dry matter, crude protein, crude fibre and ether extract according to the method of AOAC (2006). The analysis was conducted at Central Laboratory Services Unit, National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria.

Data Collection

Data were collected on weekly weight changes was determined by weighing the birds on weekly basis and weight gain was calculated by subtracting the weight of the previous week from that of the current week. The feed intake was determined by subtracting the left-over feed from the feed offered, while feed conversion ratio was calculated as average feed intake divided by average /weight gain. The mortality was recorded daily and the weights of all the dead birds were taken in order to minimize an error in feed conversion ratio. It was expressed as percentage mortality at the end of the experiment for corresponding treatment group.

Statistical Analysis

The experimental design was completely randomized design. The data obtained from the study were subjected to analysis of variance (ANOVA) procedure (Steel and Torrie, 1980). Significant means were separated using Duncan's Multiple Range Tests (Duncan, 1955). All statistical analyses were carried out using SPSS (2012) package (statistical package for social sciences) procedure.

RESULTS AND DISCUSSION

The percentage composition of broiler starter and finisher's diet are shown in table 1 and 2. The result of cut parts of broilers chicken fed with sorghum as replacement for maize (1-7 weeks) is presented in table 3. The cut parts revealed significant difference ($p<0.05$) in pectoral muscle (8.94-12.01%), back (3.62-6.44%) and thigh (11.45-14.95%). Table 4 revealed the result of carcass and offal characteristics of broiler chickens fed with sorghum to replace maize (1-7 weeks). The result unveiled that the live weight gain ranged from 1600- 2150g which was significant ($p<0.05$) and the result is comparable (1925-2200.0g) reported by Adamu *et al.* (2012). The values recorded for dressed weight ranged from 50.04-58.38% which was significant ($p<0.05$) across dietary treatment. The dressed weight is lower than (66.20-71.11%) recorded by Bakoshi *et al.* (2014). This could be attributed to the source of the chicks used for the experiment. The plucked weight ranged between 1466-1900g and were found to be statistically significant ($p<0.05$) this result is comparable (1750.0-2025.0g) reported (Adamu *et al.* (2012). The result agreed with the work of Bakoshi *et al.* (2014) but contradicts that of Medugu *et al.* (2010a) who observed no significance ($p<0.05$) in carcass yield of broilers fed sorghum

compared with maize. Similarly, the organs weight (%) has no significant difference (p>0.05) on the two energy sources in the heart and legs (3.82-6.75%), gizzard (1.19-1.40%), heart (0.17-0.29%), lungs (0.29-0.35%), pancrease (0.8-0.12%), liver (1.33-1.79%), small intestine (0.65-1.01%), large intestine (1.47-2.38%), caecum (0.31-0.46%) and proventriculus (0.24-0.33%). This result agreed with the work of other authors (Medugu *et al.*, 2010b; Mohammed *et al.*, 2013). The values recorded for the organs weight in the proventriculus, lungs, small intestine, large intestine and liver are higher than the values recorded by Ibitoye *et al.* (2012) in a similar experiment elsewhere.

CONCLUSION

The complementary nature of maize for sorghum as energy sources in feeding broilers in Nigeria can be encouraged as it does not affect most of the growth and carcass characteristics, this will reduce the cost and diversify the feed ingredients used as energy feedstuff.

Table 1: Composition of broiler starter diets

Graded level of sorghum and maize (%)					
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	45.99	34.49	22.99	11.49	-
Sorghum	-	11.49	22.99	34.49	45.99
Soybean	34.51	34.51	34.51	34.51	34.51
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Calculated analysis					
ME (Kcal/kg)	2986	2970	2856	2936	2920
Crude protein	23	23	23	23	23
Crude fibre	3.14	3.07	3.00	2.90	2.82
Calcium	1.55	1.56	1.52	1.54	1.57
Phosphorus	0.90	0.89	0.89	0.89	0.89
Methionine	0.40	0.40	0.40	0.40	0.40
Lysine	1.20	1.23	1.23	1.23	1.23

Table 2: Composition of broiler finisher diets

Graded level of sorghum and maize (%)					
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	54.67	41.00	27.34	13.67	--
Sorghum	-	13.67	27.34	41.00	54.67
Soybean	27.83	27.83	27.83	27.83	27.83
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total					
Calculated analysis					
ME (Kcal/kg)	3007	2985	2963	2840	2918
Crude protein	20.00	20.00	20.00	20.00	20.00
Crude fibre	4.26	4.16	4.07	3.97	3.88
Calcium	1.47	1.47	1.47	1.47	1.47
Phosphorus	0.71	0.71	0.71	0.71	0.71
Methionine	0.35	0.35	0.35	0.35	0.35
Lysine	0.52	0.50	0.50	0.50	0.50

Table 3: Cuts part of broiler fed with sorghum as replacement for maize (1-7wks)

Parameter	**Diets**					**SEM**
	TRT1	**TRT2**	**TRT3**	**TRT4**	**TRT5**	
Pectoral muscle (%)	12.01	10.46	10.91	8.94	11.38	*4.21
Wings (%)	4.72	5.25	5.29	5.16	6.21	NS
Back (%)	5.84a	6.33a	5.99a	3.62b	6.44a	*3.21
Chest (%)	3.65	4.27	3.55	3.96	3.39	NS
Thigh (%)	11.45	13.22	13.22	12..97	14.95	*3.12

SEM = Standard Error of mean; * = ($p<0.05$); ab = means being symbolic as statistically significant and NS = Not significant

Table 4: Carcass and Offal characteristics of broiler chickens fed with sorghum to replace maize (1-7 wks)

Parameter	Diet					SEM
	TRT1	TRT2	TRT3	TRT4	TRT5	
Live weight (g)	2000a	2150a	1800b	1600b	1883b	*
Slaughter weight (g)	1866a	2016a	1700b	1533b	1800b	*
Plucked weight (g)	1833a	1900a	1650b	1466b	1750b	*
Dressed weight (%)	50.04b	58.38a	55.30b	50.66c	56.04a	*
Head and Legs (%)	4.29	4.66	4.01	3.82	6.75	NS
Abdominal fat (%)	0.72	0.58	0.79	0.82	0.59	NS
Gizzard (%)	1.40	1.19	1.30	1.25	1.36	NS
Heart (%)	0.17	0.29	0.27	0.26	0.26	NS
Lungs (%)	0.35	0.35	0.29	0.25	0.31	NS
Pancrease (%)	0.12	0.11	0.11	0.10	0.08	NS
Liver (%)	1.38	1.33	1.34	1.47	1.79	NS
Small intestine (%)	0.74	1.01	0.79	0.65	0.68	NS
Large intestine (%)	2.38	1.47	2.14	1.86	1.79	NS
Caecum	0.34	0.31	0.34	0.41	0.46	NS
Small intestine (cm)	72.67b	110.00a	81.00b	78.60b	76.33b	*
Large intestine (cm)	153.33	112.00	137.33	97.67	146.33	NS
Prevenculus (%)	0.33	0.24	0.28	0.31	0.31	NS

SEM= Standard error of mean; * = ($p<0.05$); ab = mean being significant; a = statistical significant; NS = Not significant

REFERENCES:

Abdo, M., Mengistu, U. and Kefyalewa, G. (2015). Effects of replacing maize with sorghum on growth performance and feed efficiency of commercial broiler chicken. *Journal of Verterinary Science and Technology,* **6** (3): 1-5

Adamu, M. S., Kubkomawa, H. I., Doma, U. D. and Duduwa, A. T. (2012). Carcass and gut characteristics of broilers fed diets containing yellow sorghum *(Sorghum bicolor)* variety in place of maize. *International Journal of Sustainable Agriculture,* **4** (1): 8-11.

Akintunde, A. R., Taphee, D. G., Inuwa, I. and Danladi, Y. (2017). Effect of soaked and fermented sorghum as a replacement for maize on performance and carcass characteristics of Japanese quail (*Coturnix coturnix japonica*). *Journal of Animal Production Research*, **29** (1): 200-209.

Afolayan, M., Bawa, G. S., Sekoni, A. A., Abeke, F. O. and Daramola, S. T. (2014)**.** Effect of inclusion level of African Locust Bean (*Parkia biglobosa*) pulp on growth parameters of egg type chicken (0- 20 weeks). *Nigerian Journal of Animal Science,* **16** (1): 51-60.

AOAC (2006). **Association of Official Analytical Chemists.** Official methods of analysis of the AOAC (Horwitz, W. Editor). 20th Edition. (3) Arlington Va. U.S.A.

Assan, N. (2015). Methodology and factors influencing the association of body weight, performance parameters with linear body measurements assessment in poultry. *Scientific Journal of Pure and Applied Sciences,* **4:** 200 – 210.

Bakoshi, A. M., Maidala, A. and Gumai, S. A. (2014). Evaluation of carcass yield and gut characteristics of broiler chickens fed three partially sprouted sorghum varieties as a replacement for maize. *Journal of Environment Technology and Sustainable Agriculture,* **2** (1): 33-41.

Duncan, D. B. (1955). Multiple ranges and multiple F-test. *Biometrics.* **11**: 1-42.

Food and Agricultural Organization FAO (2013). *FAO Statistics: Food and Agricultural Organisation of the United Nations.*http://faostat.fao.org/site/573/default.aspx#ancor.

Food and Agricultural Organization of United Nations FAO, 2016.

Ibitoye, E. B., Olerede, B. R., Jimoh, A. A. and Abubakar, H. (2012). Comparative performance and organ relative weight of broiler chickens fed three sources of energy diet. *Journal Animal Production Advances,* (5): 233-238.

Katongole, C. B., Nambi-Kasozi, J., Lumu, R., Bareeba, F., Presto, M., Ivarsson, E. and Lindberg, J. E. (2013). Strategies for coping with feed scarcity among urban and periurban livestock farmers in Kampala, Uganda. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS),* **113** (2): 165-174.

Lowder, S. K., Skoet, J. and Raney, T. (2016). The Number, Size and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide. *World Development,* **87:** 16-29.

Maidala, A. and Istifanus, J. A. (2012). The role of micro livestock in alleviating protein deficiency and poverty reduction in Nigeria. **In:** Dantata, I. J., Maidala, A. and Garba, A. R. (Eds). Proceedings of 2nd National conference of school of vocational and technical education, College of Education Azare. Bauchi state

Medugu, C. I., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. and Hamaker, B. (2010a). Carcass and blood components of broiler chickens fed sorghum or millet as replacement for maize. *Agriculture and Biology Journal for North America,* **1** (3): 326-329.

Medugu, C. I., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. and Hamaker, B. (2010b). Performance and economics of production of broiler chickens fed sorghum or millet as replacement for maize. *Agriculture and Biology Journal for North America,* **1** (3): 321-325.

Mohammed A. Ahmed, Bakheit M. Dousa and Khadiga A. Abdel Atti (2013). Effect of substituting yellow maize for sorghum on broiler performance. *Journal of World's Poultry Research,* **3** (1): 13-17.

Petracci, M. and Cavani, C. (2012). Muscle growth and poultry meat quality issues. *Nutrition,* **4:**1-2.

Rostagno, H. S., Albino, L. F. T., Donzele, J. L. (2011). Tabelas brasileiras para aves e suinos: compoosicao de alimentos e exigencias nutricionais. Vicosa: UFV, 251. P

Silvera Anna (2017). Automatic Welfare Assessment in Broilers with focus on Human-Animal Relationship and Lameness. Doctoral Thesis. Faculty of Veterinary Medicine and Animal Science, Department of Animal Environment and Health, Uppsala Swedish University of Agricultural Sciences, Uppsala. Pp. 61.

SPSS (2012). Statistical package for the social sciences. Ver. 16.0 SPSS Inc.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of statistics 2nd Edition. A biometrical approach. McGraw Hill Book Company. Inc. New York.

Wafar, R. J., Tarimbuka, L. I. (2016). Effects of quantitative substitution of maize with sun-dried Irish potatoes peel meal on growth and economic performance of weaner rabbit. Proceedings 21 Annual Conference of Animal Science Association of Nigeria 18 – 22, 2016, Port Harcourt Pp. 845-849.

EFFECT OF NITROGEN LEVELS ON YIELD AND QUALITY OF *PENNISETUM PEDIACELLATUM* FORAGE IN YOBE STATE, NIGERIA

[1]Abdullahi, U., [2]Amodu, J. T., [3]Hassan, M. R., [1]Maidala, A., [1]Lawan, A., [1]Abdullahi, A. M., [2]Ishiaku, Y. M., [2]Ahmed, S. A., [4]Munza, B. M. & [1]Raymond, B. J.

[1]*Federal University Gashua, Yobe State, Nigeria*

[2]*National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria*

[3]*Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria*

[4]*Department of Animal Science, University of Maiduguri, Nigeria*

Corresponding Author: abuusman030@gmail.com; +2348035579765

ABSTRACT

The experiment was conducted to evaluate the effect of nitrogen fertilizer on forage yield and quality of *Pennisetum pediacellatum* under rainfed in Gashua, Yobe State. The experiment was laid out in Randomized Complete Block Design, with plot divided into three main plots and replicated three times measuring 3 x 2 m^2. The three fertilizer rates are 100kg, 125kg and 150 kg per hectare, respectively. Forage yield and percentage of proximate compositions were significantly ($P < 0.05$) affected by the fertilizer rates. The highest fresh (29,444kg/ha) and dry (3,828 kg/ha) matter yield were recorded in 150kg N/ha fertilizer rates. Similarly, the highest crude protein (19.94%) and ash contents were observed with plots receiving 150kg N/ha rate whereas 100kg N/h fertilizer level had higher values for Crude fibre (32.11%) and ether extract (1.15%). The experiment reveals that among all fertilizer rates, 150kg N/ha had the best forage yield and proximate composition than the other fertilizer rates. It is therefore, recommended that 150kg N/ha fertilizer rate be used for enhanced forage productivity and better animal performance in Gashua, Yobe State.

keywords: *Pennisetum pediacellatum, fertilizer rates, forage yield, proximate composition*

INTRODUCTION

In most of the tropical regions of the world, strategic provision of feed to meet up with the nutrient requirement of livestock animals have been a major problem faced by ruminant animal keepers, especially during the dry season. In the small farmers' perspective, this requirement is provided through the basal supply of natural pasture grasses (Odedire and Babayemi, 2016) which are characterized by poor nutrients and low yield as they grow on infertile and erosion degraded soils (Babayemi and Bamikole, 2006). Since the forages on the rangelands in these areas provide feed which are not adequate for the ruminant animals, the Fulani herdsmen migrate to other places where feed is in abundance. The movement of these Fulani herdsmen on many occasions has resulted in clashes with farmers (Nweze *et al*., 2012).

Tropical grasses have the ability for high yield and the nutrients are simultaneously enhanced when treated with organic or inorganic fertilizers or established with nitrogen-fixing shrubs or tree legumes (Abdullahi *et al.,* 2018). Unfertilized grasses had been described to be less nutritive as forage for ruminant animals (Bamikole *et al*. 2004). Nitrogen (N) fertilisers application has been shown to increase DM yield, herbage metabolisable energy (ME) and crude protein (CP) and decrease water-soluble carbohydrate (WSC) content (Coblentz *et al*., 2017)). Such effects may be advantageous for the production of higher DM yields for silage, while improving, or at least maintaining herbage nutritive quality.

Pennisetum pedicellatum (Trin.) belongs to the *Poaceae* family and tribe *Paniceae*. It is annual and commonly known as *Kyasuwa* grass. It is also indigenous and occurs naturally in tropical and subtropical Africa (Bogdan, 1977). The grass is palatable and could be fed fresh, as silage or directly grazed on the field (Woodard *et al*., 1991). Information on the yield and nutritive value of this grass as influenced by nitrogen level are not available or scarce in the study area, hence this study was designed to evaluate the effect of nitrogen levels on forage yield and quality of *Pennisetum pedicellatum* (Trin.) in Gashua, Yobe state Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was conducted during the 2019 rainy season at the Teaching and Research Farm of the Department of Animal Science, Federal University Gashua, Yobe. The major vegetation type of the area is the Sahel savannah, it consists of open thorny savannah with short trees and grasses. It is located between longitudes 10° 02' and 11° 11'E and latitudes 12° 48' and 12° 88' N. The climate is characterized by high temperature and seasonal rainfall and the mean minimum temperature ranges between 10 -12°C in December/January, while the mean maximum is about 34-40°C in March-May. The mean rainfall is between 300-500 mm per annum and is unimodal and lasts mostly from June to September while the dry season starts from October to May (NEAZDP, 2015). The soil characteristic in the study area was sandy loam, very low in organic carbon (1.344 g/kg) an nitrogen (0.21 g/kg), moderate in available phosphorus (9.81 g/kg) and high in exchangeable potassium (1.71 cmol/kg)

Land Preparation, Experimental Layout and Treatments

A land area of 12m x 9m was used for the experiment. The field was cleared, ploughed and harrowed to provide a clean seedbed for the ease of planting and germination. The plot was divided into three main plots and replicated three times measuring 3m x 2m and 1m in-between the plots in a Randomized Complete Block Design (RCBD).

Biomass yield (kg DM/ha)

Plants within 0.5 m^2 quadrant in the plots were cut at 10 cm above the ground level with a sickle to determine the forage yield at eight weeks after sowing. The cut forages were immediately weighed to determine fresh weight after which they were oven-dried at a temperature of 65^oC for 48 h to determine the forage dry matter yields. Forage dry matter yields were calculated using the formula reported by Akpensuen *et al*. (2019) as stated below:

Forage dry matter yield (kg DM ha-1) = Fresh weight (kg) x Oven dried weight (DM%) × 40,000
There are 40,000 quardrat (0.5m-2) per hectare

Chemical analysis

Forage was collected, processed and analysed for dry matter by oven drying at 60^oC for 48hours. Nitrogen Free Extract (NFE) was determined by calculation [NFE = 100 - (%CP + %CF + %EE + %Ash)]. Nitrogen was analyzed by the Kjeldahl method (AOAC, 2005) and crude protein calculated as %CP = %N *6.25, ash by burning in a furnace at 550^oC for 3 hours and crude fat by soxhlet extraction according to A.O.A.C. (2005) method.

Statistical analysis

The results obtained were subjected to analysis of variance using General Linear Model Procedure (Proc. GLM) of SAS (2005). Significant ($P<0.05$) differences among treatment means were compared by using Duncan Multiple Range Test (Duncan, 1955) of the SAS package.

RESULTS AND DISCUSSION

The forage yield of Kyasuwa (*Pennisetum pedicellatum* Trin.) was affected by the application of nitrogen fertilizer (Table 1). Application of 150kg N/ha rate increased ($P<0.05$) forage yield which was 27.17 % higher than with 100kg N/ha. The increase in forage yield with increased nitrogen level could be attributed to the production of taller plants with maximum photosynthetic areas (Mbahi and Gende, 2016; Subrahmanya *et al*., 2017). Kumar *et al*. (2015) reported that fertility level of 150kg N/ha should be used to obtain maximum fodder yield. This agrees with the report of Shahin *et al*. (2013) who recorded increase in fresh and dry forage yield with increasing levels of nitrogen fertilizer application. Similar results were also obtained by Bhilare *et al*. (2010) and Ayub *et al.* (2017). The mean (3408.16 kg/ha) dry matter yield observed in this study was higher than the value (3010kg /ha cut at 8weeks after sowing) reported by Mbahi and Gende (2016).

The crude protein (CP) content increased ($P<0.05$) with increasing level of nitrogen fertilizer with the highest CP value observed (19.94%) in treatment receiving 150kg N/ha (Table 1). It implies that as the level of nitrogen increases the CP content increases, this is because nitrogen promote rapid

growth, chlorophyll formation and protein synthesis. The result corroborates with that reported by Meena *et al.* (2017) who reported that the crude protein content of grasses significantly increases with the addition of urea fertilizer. Crude protein content obtained in this study was higher than the one (7.81%) reported by Mbahi and Gende, (2016).

There was significant (P<0.05) increase in ash concentration as the levels of nutrient increase up to 150kg N/ha. The maximum level of ash (17.54%) was recorded at 150kg N/ha fertility rate. The crude fibre, ether extract and nitrogen free extract concentration within the forage were affected negatively by nitrogen fertilization. The least values for CF (27.58%) and NFE (22.87%) were recorded in plots fertilized with 150kg N/ha. This might be due to higher crude protein content of *Pennisetum pediacellatum* at higher nutrient levels and protein content is negatively correlated with crude fibre. This agrees with reports of VanSoest (1982) and Coblentz *et al*. (2017) that nitrogen fertilizer results in increased concentration of CP with concomitant reductions in water-soluble carbohydrates and crude fibre.

Table 1. Effect of Nitrogen Levels on Forage Yield and Quality

Parameters	**Nitrogen level**			
Forage yield (kg /ha)	**100kg N/ha**	**125kg**	**150kg**	**SEM**
Fresh forage yield	21,444.00^{c}	25,778.00^{b}	29,444.00^{a}	2,276.00*
Dry forage yield	2,788.00^{c}	3,609.00^{b}	3,828.00^{a}	308.84.00*
Proximate compositions (%)				
Dry matter	18.30^{c}	20.17^{b}	21.02^{a}	0.40*
Crude protein	17.19^{b}	17.20^{b}	19.94^{a}	0.34*
Crude Fibre	32.11^{a}	29.91^{b}	27.58^{c}	0.66*
Ether extract	1.15^{a}	1.09^{b}	1.07^{c}	0.01*
Ash content	15.16^{c}	16.96^{b}	17.54^{a}	0.26*
Nitrogen free extract	34.06^{a}	34.84^{a}	22.87^{b}	7.54*

Means followed by similar letters within a row are not significantly different

CONCLUSION AND RECOMMENDATION

The result of this study indicated that application of 150kg N/ha gave highest fresh (29,444kg/ha) and dry (3,827.8kg/ha) weights, crude protein (19.94%) and ash (17.4%) contents whereas 100kg N/ha fertility level had relatively higher crude fibre (32.11%) and nitrogen free extract (34.06%). It is therefore, recommended that 150kg N/ha fertilizer rate be used for enhanced forage productivity and better animal performance in Gashua, Yobe State.

REFERENCES

Abdullahi, U., Amodu, J. T., Hassan, M. R., Abdullahi, A. M., Ishiaku, Y. M., Ahmed, S. A., Salisu, S. G., Jibril, U. S. and Munza, B. M, (2018) Forage Yield Potential of Double-red Maize (*Zea mays* l.) Intercropped with Tephrosia (*Tephrosia bracteolata* Guill and Perr.) In Shika Northern Guinea Savannah. *Journal of Animal Production Research,* 30(2):177-192

Akpensuen, T. T., Amodu, J. T. Tanko, R. J., Luka, J. S., Namo, O. A. T. and Hassan, M. R. (2019). Dry Matter Yield and Quality of Two Temperate and Two Tropical Forage Legume Hays Harvested at Early Flowering in Jos, Nigeria. *Asian Journal of Advances in Agricultural Research,* 9(3): 1-12

AOAC, (2005). Official Method of Analysis. International, Association of Official Analytical Chemists, 24th edition Washington D.C. USA. pp: 200- 210.

Ayub, M., Nadeem, M.A., Tanveer, A., Tahir, M. and Khan, R.M.A. (2017). Interactive effect of different nitrogen levels and seeding rates on fodder yield and quality of pearl millet. *Pakistan Journal of Agricultural Science,* 40: 39-33.

Babayemi, O. J. and Bamikole M. A. (2006) Supplementary value of *Tephrosia bracteolata, Tephrosia candida, Leucaena leucocephala* and *Gliricidia sepium* hay for West African dwarf goats kept on the range. *Journal Central European Agriculture,* 7 (2): 323-328

Bamikole, M. A., Akinsoyinu, A. O., Ezenwa, I., Babayemi, O. J., Akinlade, J. and Adewumi, M. K. (2004). Effect of six weekly harvests on the yield, chemical composition and dry matter degradability of *Panicum maximum* and *Stylosanthes hamata* in Nigeria. *Grass and Forage Science*, 59: 357 – 163

Bhilare, R.L., Pathan, S.H., Damame, S.V. (2010). Response of forage pearl millet varieties to different nitrogen levels under rainfed condition. *Journal of Maharashtra Agricultural University*, 35 (2), 304–306.

Bogdan, A.V. (1977). *Pasture and Fodder Plants (Grasses and Legumes)*, Longman Press, New York, U.S.A. pp. 1-39; 229 – 31.

Coblentz, W. K., Akins, M. S., Cavadini, J. S. and Jokela, W. E. (2017.)Net effects of nitrogen fertilization on the nutritive value and digestibility of oat forages. *Journal of Dairy Science*, 100 (3): 1739–1750

Duncan, D. B. (1955). Multiple Range and F-tests. *Biometric*, 11:1-42.

FAO. (2011). Food and Agriculture Organisation Grassland Index: A searchable catalogue of grass and forage legumes. Food and Agriculture Organisation. [Accessed 23 June, 2015] Available:www.fao.org/ag/AGP/AGPC/doc/GBASE/Default.htm

Kumar, R., Singh, M., Tomar, S.K., Meena, B.S. and Rathore, D.K. (2015). Productivity and nutritive parameters of fodder maize under varying plant density and fertility levels for improved animal productivity. *Indian Journal of Animal Nutrition Research*, 50: 199-202.

Mbahi, T. F. and Gende, H. (2016). Effect of stage of harvest on dry matter yield and nutritive value of *Pennisetum pedicellatum*, *andropogon gayanus* and *Chloris gayana* as fodder in Adamawa State, Nigeria. *International Journal of Agriculture and Biosciences*, 5(6): 337-340. www.ijagbio.com

Meena, B. S., Nepalia, V., Dilip, S., Shukla, K. B, Meena, G. L. (2017)Production capacity of single cut fodder sorghum genotypes under varying fertility levels. Forage Research, 43(2):162-164.

Nasiru M, Onifade OS. (2008). Effect of phosphorus levels on the production of grass/legume swards in the Northern Guinea Savanna Zone of Nigeria. Proceedings of the 13th Annual Conference of the Animal Science Association of Nigeria (ASAN), September 15-19th, 2008, Ahmadu Bello University. Zaria.-Nigeria. 621-624.

North East Arid Zone Development Programme [NEAZDP], (2015). Meteorological Data of Nine Local Government Areas in Northern Yobe State, 1992 – 2014. NEAZDP Hydromet station, Garin Alkali.

Nweze B. O., Ekwe, O.O. E., Alaku, S. O. and Omeje, S. I. (2012). Productivity of two indigenous Nigerian cattle breeds and crossbreed under range grazing. *World Journal of Life Sciences and Medicinal Research*, 2(1): 18 - 24

Odedire, J. A. and Babayemi, O. J. (2016). Preliminary study on Tephrosia candida as forage alternative to Leucaena leucocephala for ruminant nutrition in Southwest Nigeria. *Livestock Research for Rural Development*, 9:1-10

SAS, (2005). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N. C., USA

Shahin, M.G., Abdrabou, R.T., Abdelmoemn, W.R. and Hamada, M. M. (2013). Response of growth and forage yield of pearl millet (*Pennisetum glaucum*) to nitrogen fertilization rates and cutting height. Annals of Agricultural Science, 58(2), 153–162

Subrahmanya, D.J., Kumar, R., Tyagi, N., Ram, H., Singh, M., Meena, R.K., Tamta, A. and Pandey, A.K. (2017). Yield of Fodder Maize (*Zea mays*) and its Chemical Composition under Varying Plant Densities and Nutrient Management. *Indian Journal of Animal Nutrition*, 34 (4): 425-429

Van Soest, P. J. (1982). Nutritional Ecology of the Ruminant. Cornell Univ. Press, Ithaca, NY.

Van Soest, P. J., Robertson, J. B., and Lewis, B. A. (1991). Method for directory Neutral detergent fibre and Non-starch polysaccharides in relation to Animal Nutrition. *Journal of Dairy Science*, 74:3583-3597.

Woodard, K. R. and Prince, G. M. (1991). Forage yield and nutritive value of Elephant grass as affected harvest frequency and genotype. *Agronony Journal*, 83: 341-346.

CHEMICAL COMPOSITION, *IN VITRO* TOTAL GAS AND METHANE PRODUCTION OF CONCENTRATE DIETS CONTAINING *Gliricidia sepium*

***O. O. Adelusi, M. T. Balogun, E. E. Igonor, D. E. Olaniyan, K. M. Stephen & A. O. Oni**
Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Nigeria.
**Corresponding author: adelusioludotun@gmail.com*

ABSTRACT
The present study evaluated the *in vitro* gas production and post-incubation parameters of concentrate diets containing varying levels of *Gliricidia sepium* leaves (GS) (0%, 10%, 20% and 25%). The experiment was set up in a completely randomized design.Gas production was measured at 3, 6, 9, 12, 15, 18 and 24 hours of incubation and the methane was estimated at the end of the 24th hour of incubation, volatile fatty acid profile was measured and post incubation calculations was carried out. Data obtained were analysed using one way analysis of variance. The result obtained showed that the crude protein content of diets increased as the inclusion of GS increased ($P<0.05$) from 0 to 25% (10.90% to 14.71%) while NDF values reduced ($P<0.05$) as the reduced as the inclusion increased (49.94% to 42.69%). Total gas and methane production at 24 hours were not affected ($P>0.05$) by inclusion of GS. Also, DMD and OMD values were not affected ($P>0.05$) by the inclusion of GS in the diets. This study concludes that when *Gliricidia sepium* is used at inclusion level of 10% or more, it has potential to modify the rumen thereby reducing gas production during fermentation resulting in higher post-ruminal nutrient utilization.
Keywords: Gliricidia, *in vitro*, methane, digestibility, diets.

INTRODUCTION
Ruminant livestock raised in the tropics tend to exhibit cyclical variation in the quantity and quality of the available forages (Bamikole and Babayemi, 2008). This is so because, during the dry season, ruminant feeding systems depend on poor quality tropical foliage Poor nutrition results in low production performance, slow growth rate, loss of body condition and increased susceptibility to diseases and parasites. These poor quality forages are usually augmented with crop residues or agro-industrial by-products (Oni *et al*., 2012) and a number of browse plants worldwide serve as alternative feedstuffs for livestock (Rinehart, 2008; Fayemi *et al*., 2011). As a result, animals under semi-intensive and free-range systems have been observed feeding on them (Isah *et al.,* 2007). Proteinaceous legumes like *Gliricidia sepium* are abundantly found in the tropics and considered as high quality leguminous forage due to its high protein content with good amino acid profile. The incorporation of such resources into concentrate diets for ruminant feeding in combination with other crop residues and agro-industrial by-products will help combat both the challenge of dry season low feed quality and might also lead to a reduction in the cost of protein ingredients used in formulating ruminant diets.The *in vitro* method of feed evaluation for ruminants has gained wider acceptance due to its ease of adoption, repeatability, minimized use of animals and the decrease in funding of the in vitro evaluation of feeds (Getachew *et al.,* 2005).The objective of this study was to evaluate the chemical composition, *in vitro* total gas and methane production of concentrate diets containing *Gliricidia sepium* leaves.

Materials and Methods
The experiment was carried out at Animal Nutrition Department Laboratory, Federal University of Agriculture Abeokuta, Ogun state, Nigeria. The experimental design was a completely randomized design (CRD) with four concentrate diets formulated through the use of *Gliricidia sepium* leaves (GS) at varying levels (0%, 10%, 20% and 25%) along with cassava peel, cassava leaves, palm kernel cake, rice bran, wheat offal, salt, oyster shell and sulphur. Rumen fluid was collected using the method of collection described by Babayemi *et al* . (2006). Rumen liquor was collected from cattle into warm insulated flasks and used as the source of inoculums The *in vitro* gas production procedure by Menke and Steingass (1988) was employed for the experiment. A sensitive scale was used to measure 200mg of substrate, replicated five times and were placed into 50ml calibrated plastic syringes fitted with

plungers. The rumen fluid (inoculum) was filtered through layers of cheesecloth and mixed with buffer at a ratio of 1:2 (v/v), and resazurin dye was added to sustain the activities of microbes. Fifteen millilitres of the buffered inoculums was then added to each syringe containing the milled samples and the gas released was read directly on the graduated syringe. The syringes were placed in an incubator kept at 40°C along with blank syringes containing only 15ml of the buffered inoculums. The syringes were shaken at regular intervals to simulate rumen motility. Gas production was recorded for 24 hours of incubation at 3-hour intervals. The volume of methane gas from each sample was determined by dispensing 2mls of 0.4 sodium hydroxide (NaOH) in to the sample at the end of 24 hours of incubation (Fievez *et al* ., 2005). Analysis of chemical composition was done according to the methods of AOAC (2000).

Data obtained from this experiment were analysed using one-way analysis of variance option of the SPSS (IBM SPSS Statistics 23) software. Treatment means were statistically compared using Duncan's Multiple Range Test to identify differences between means and significant differences were declared if $p<0.05$.

Results and Discussion

Chemical composition of concentrate diets containing varying levels of *Gliricidia sepium* leaves is presented in Table 1. The result shows that there were significant ($P<0.05$) variations across the various levels of inclusion. Dry matter (91.19%), NDF (49.94%) and ether extract (4.39%) and metabolizable energy (8.19 MJ/kg) values were higher ($P<0.05$) in the control diet (0% GS) while the highest ($P<0.05$) crude protein value (14.71%) in the diet containing 25% GS. It is observed that the dry matter values reduced with increase in the level of GS while the NDF values also followed the same trend. The lowest ($P<0.05$) DM and NDF values were obtained in diets containing 25% GS (89.15% and 42.69%).

Table 1: Chemical composition of concentrate diets containing varying levels of *Gliricidia sepium* leaves

Parameters	0%	10%	20%	25%	SEM	P-value
Dry matter (%)	91.19^{a}	89.74^{b}	89.38^{c}	89.15^{c}	0.243	0.00
Crude protein	11.25^{d}	10.90^{c}	13.70^{b}	14.71^{a}	0.487	0.00
NDF	49.94^{a}	47.47^{b}	43.46^{c}	42.69^{d}	0.897	0.00
ADF	28.77^{c}	35.53^{a}	30.89^{b}	31.14^{b}	0.746	0.00
ADL	5.19^{c}	6.00^{b}	6.22^{b}	6.91^{a}	0.191	0.00
Ash	12.40^{c}	16.24^{a}	14.22^{b}	13.29^{c}	0.436	0.00
Ether Extract	4.39^{a}	2.55^{b}	3.22^{b}	3.53^{c}	0.204	0.00
ME (MJ/Kg)	8.19^{a}	7.53^{c}	7.69^{b}	7.72^{b}	0.075	0.00

The effect of inclusion of *Gliricidia sepium* at various levels on in vitro gas volume is presented in Table 2. Volume of gas produced at 6th and 12th incubation hour is significantly different ($P<0.05$) with 0% Gliricidia having the highest value in both period. At other time of incubation, volume of gas produce is not significantly ($P>0.05$) affected by the inclusion levels of *Gliricidia sepium*. The highest gas volume at 24th hour of incubation is (20.67ml) obtained from the control diet.

Table 2: Effects of inclusion of *Gliricidia sepium* on *in vitro* gas production

Incubation time	0%	10%	20%	25%	SEM	P-value
3	0	0	0	0	0.000	-
6	1.33^{a}	0.67^{ab}	0.00^{b}	0.00^{b}	0.195	0.01
12	10.67^{a}	8.33^{ab}	5.67^{b}	5.33^{b}	0.830	0.04
18	18.00^{a}	14.00^{ab}	12.00^{ab}	11.67^{b}	1.076	0.03
24	20.67	17.00	16.33	15.33	1.150	0.43

The effect of *Gliricidia sepium* on in vitro post incubation parameters is shown in Table 3. It shows that there is no significant difference (P>0.05) among the organic matter digestibility (OMD), CH4, %CH4 and dry mater digestibility (DMD).

Table 3: Effects of inclusion of varying *Gliricidia sepium* on *in vitro* post incubation parameters

	Levels of Gliricidia inclusion					
Parameters	0%	10%	20%	25%	SEM	P-value
CH4	6.67	5.00	4.00	4.33	0.492	0.24
%CH4	32.23	30.45	24.79	27.25	1.969	0.61
DMD (%)	81.67	83.33	81.67	95.00	2.784	0.28
OMD (%)	39.12	35.96	36.49	36.00	0.961	0.67

SEM: Standard error of mean

Dry matter (DM) values obtained in this study are similar to the range of 85.70 to 95.86 % reported by (Asaolu*et al.,* 2012) for fodder, with the lowest at 25% Gliricidia. The CP content range between 10.9 and 4.71% which is above the minimum level for maintenance of 7.70 % for goats (NRC, 1981), with the highest obtained at 25% Gliricidia (14.71%) and low at 10% Gliricidia (10.9). The CP is in agreement with the minimum of 8 % CP observed by (Norton 1994) to provide the ammonia levels required by rumen microbes for optimum activity. The CP (10.90-14.71%) and the in vitro digestibility (81.67-91.00%) is not in agreement with the range of (18-30 %CP) and (60-65% DMD) reported by Cook *et al*. (2005). Organic matter digestibility value was observed to be the highest at 0% Gliricidia. Feedstuffs that are inherent with certain anti-nutritive factor had been reported to be low in organic matter digestibility (Aregheore and Abdulrazak, 2005).

This study result is in accordance with report given by Gillespie (1998) that NDF is inversely related to the plants' digestibility. The higher the NDF (49.94) the lower the plant's digestibility (81.67) and vice versa. The values obtained for the various Gliricidia levels may imply a moderately high cell wall contents with all having different effects on the various level of Gliricidia and expressed on Dry matter (DM) basis.

The inclusion of *Gliricidia sepium* at various level does not affect the gas production with the lowest value of methane at 20% inclusion of *Gliricidia sepium*. Changes in methane production with increasing inclusion levels of *Gliricidia sepium* can be attributed to the tannin content which was also reported by Jayanegara *et al.* (2011). It has also been observed that a decrease in CH_4 production occurs with the inclusion of *Gliricidia sepium* in ruminant diets (Sebata *et al*., 2011). In addition, it was reported that with an increase in tannin concentration in browse species, a reduction effect on methane production was found (Sultan *et al*., 2012). The impact of tannins on methane production varies with tannin chemical structure (plant origin) as well as with its concentration.

CONCLUSION AND RECOMMENDATIONS

From the results of this study, it can be concluded that the chemical composition of diets were improved by inclusion of *Gliricidia sepium* leaves. It was also noted that gas production reduced as the inclusion increased. It is recommended that *Gliricidia sepium* leaves can be included in concentrate diets for ruminants at values above 10% of the total feed. Further studies are therefore recommended to investigate the response of animals in a feeding trial to these diets.

REFERENCES

Aregheore EM, Abdulrazak SA (2005). Estimation of organic matter digestibility and metabolizable energy content of agro-industrial wastes using *in vitro* gas production. *Nig. J. Anim. Prod.* 32 (1): 79- 87.

Asaolu, V., R. Binuomote, J. Akinlade, O. Aderinola and Oyelami, O., 2012. Intake and growth performance of West African dwarf goats fed *Moringa oleifera, Gliricidia sepium* and *Leucaena leucocephala* dried leaves as supplements to cassava peels. *J. Biology, Agriculture and Healthcare*. 2 (10) 76-88.

Babayemi, O. J., 2006. Antinutritional factors, nutritive value and in vitro gas production of foliage and fruit of *Enterolobium cyclocarpum*. *World J. Zool*., 1(2): 113-117.

Babayemi, O.J., Bamikole, M.A. (2008). Supplementary value of *Tephrosia bracteolata, Leucaena leucocephala*, and *Gliricidia sepium* hay for West African dwarf goats kept on Range. *Journal Central European Agriculture*, 7(2): 323-328.

Cook B, Pengelly B, Brown S, Donnelly J, Eagles D, Franco A, Hanson J, Mullen B, Partridge, I Peters, M and Rainer Schultze-Kraft (2005) *Tropical Forages – an interactive selection tool*. Sustainable Ecosystem, Department of Primary Industries and Fisheries (DPIandF Queensland),

Fayemi P.O., Onwuka C.F.I., Isah O.A., Jegede A.V., Arigbede O.M., Muchenje V. (2011). Effects of mimosine and tannin toxicity on rabbits fed processed *Leucaena leucocephala* (Lam) De Wit. Leaves. *African Journal of Agricultural Resources*. 6(17): 4081-4085.

Fievez, V.O., Babayemi, J.O. and Demeyer, D. (2005). Estimation of Direct and Indirect Gas Production in Syringes; A tool to Estimate Short Chain Fatty Acid Production Requiring Minimal Laboratory Facilities. *Anim. Feed Sci. Tech.* 123 (1): 197-210.

Getachew, G., Depeters, E.J., Robinson, P.H., Fadel, J.G., (2005). Use of an *in vitro* rumen gas production technique to evaluate microbial fermentation products. *Animal Feed Science and Technology*, 123-124: 547-559.

IBM SPSS 2015. Statistics Version 23. IBM Corporation.

Isah O. A., Omorogiuwa L. E., Akinnusi A. O. (2007). Proximate, mineral and fibre composition of some common browse plants eaten by free roam village goats in Edo State. *Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production, Calabar, Nigeria*.

Jayanegara, A., Wina, E., Soliva, C.R., Marquardt, S., Kreuzer, M., Leiber, F. (2011). Dependence of forage quality and methanogenic potential of tropical plants on their phenolic fractions as determined by principal component analysis. *Animal Feed Science and Technology.* 163: 231-243.

Menke, K.H. and Steingass, H., 1988. Estimation of the energetic feed value obtained from chemical analysis and *in vitro* gas production using rumen fluid. *Anim. Res. Dev*. 28: 7–55.

Norton, B.W., (1994). *The nutritive value of tree legumes. In: Forage tree legumes in Tropical Agriculture*. Gutteridge, R.C., and Shelton, H.M. (Eds.) CAB International, UK, Pp. 177-191.

NRC (National Research Council), (1981). *Nutrient Requirement of Goats: Angora, dairy and meat goats in temperate and tropical countries.* Nutrient Requirements of Domestic Animals No. 15 NRC, Washington DC, USA.

Oni, A. O., Arigbede, O. M., Sowande, O. ., Anele, U. Y., Oni, O. O., Onwuka, C. F. I., Onifade, O. S., Yusuf, K. O., Dele, P. A. And Aderinboye, R. Y. (2012). Haematological and serum biochemical parameters of West African dwarf goats fed dried cassava leaves based concentrate diets. *Tropical Animal Health and Production*, 44: 483 – 490.

Rinehart L (2008). Ruminant nutrition for Graziers. NCAT Agriculture specialist, IP318.

Sebata, A.; Ndlovu, L.R.; Dube, J.S. (2011). Chemical composition, in vitro dry matter digestibility and in vitro gas production of five woody species browsed by Matebele goats (*Capra hircus* L.) in a semi-arid savanna, Zimbabwe. *Animal Feed Science and Technology* 170: 122-125.

Sultan, S.; Kushwaha, B.P.; Naga, S.K.; Mishra, A.K.; Singh, A.; Anele, U.Y. (2012). In vitro ruminal fermentation, protein and carbohydrate fractionation, methane production and prediction of twelve commonly used Indian green forages. *Animal Feed Science and Technology* 178: 2-11.

EFFECT OF CINNAMON (*Cinamonum cassia*) POWDER ON *IN VITRO* METHANE PRODUCTION AND FERMENTATION OF MAIZE STOVER-BASED SUBSTRATE

R. Y. Aderinboye, T. A. Salami, O. O. Adelusi, K. O. Adebayo, R. M. Akinbode & C. F. I. Onwuka

Department of Animal Nutrition, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

ABSTRACT

Methane (CH_4) production and fermentation of a maize stover-based substrate in response to inclusions of cinnamon powder (CNP) were evaluated using the *in vitro* gas technique. Substrate (200 mg) consisting of maize stover and concentrate in ratio 6: 4 was incorporated with CNP at levels of 0, 15 and 30 mg/g dry matter (DM) to make three different treatments. These were incubated *in vitro* in 100 ml glass syringes at 39℃ for 48 h with total gas and CH_4 production measured. Dry matter degradability (DMD), partitioning factor, microbial biomass and volatile fatty acids were also determined. Results showed that CNP reduced ($P < 0.05$) total gas volume, CH_4 production and DMD s with the least reduction at 30 mg/g DM inclusion. The partitioning factor increased ($P < 0.05$) with inclusion of CNP at both levels of inclusion. It was concluded that, inclusion of cinnamon powder at 15 and 30 mg/g DM has potentials to reduce CH_4 production in maize-stover based diet. The higher fermentation efficiency implied that cinnamon powder reduced the amount of gas produced per gram of substrate degraded which implied better rumen fermentation efficiency.

Keywords: Maize stover, *in vitro*, fermentation, methane, cinnamon.

INTRODUCTION

Maize stover is one of the abundant crop residues for ruminant feeding, particularly during the dry seasons (Methu *et al*., 2001; Tang *et al*., 2011). Limitations to feeding these fibrous carbohydrates to ruminants include low digestibility and CH_4-shifted digestion (Gemeda and Hassan, 2015). Ruminants fed crop residues produce more CH_4 than those fed high quality forages (Berhanu *et al*., 2019). Rumen CH_4 asides from posing a threat to the environment via increase in greenhouse gas emissions, also reduces feed energy utilization by ruminants. It accounts for up to 12% loss of dietary gross energy intake (Chaudhry and Khan, 2012) or up to 15% depending on the diet (Patra *et al*., 2010). With the value of crop residues as feed resource for ruminants, it is beneficial to optimize their utilization by reducing CH_4 emission attributed to their digestion within the rumen. Spices are recognized as potential agents to reduce enteric CH_4 emission due to the presence of plant secondary metabolites which exert antimicrobial activities (Patra *et al*., 2006; Khan and Chaudhry, 2010; Chaudhry and Khan, 2012). According to Khan and Chaudhry (2010), they can be used to enhance the utilization of low quality forages and reduce nutrient wastages by ruminants. This study therefore, evaluated the effect of cinnamon powder on CH_4 production and rumen fermentation of maize stover-based diets for ruminants.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Animal Nutrition laboratory of the Federal University of Agriculture, Abeokuta. The area is located in the South-western zone of Nigeria and falls within Latitude 7°13'23.8" N and Longitude 3°26'25.4" E (Google map, 2018).

Preparation of cinnamon powder

Cinnamon sticks were sourced from a local market within Abeokuta and was ground to pass through 1 mm sieve. Ground samples were stored at room temperature in air-tight glass container for subsequent use for chemical analysis and for *in vitro* study.

Experimental diets used as substrate

The substrate degraded consisted of 60% Maize stover and 40% concentrate (DM basis). Cinnamon powder was included in the substrate as feed additive at varying levels of 0, 15 and 30 mg/g DM to make three different experimental treatments. The maize stover used was collected from a maize field after the harvesting of maize grains. Samples (n=3) of the maize stover were chopped, weighed and

oven-dried at 60℃ until constant weight for DM determination and subsequently milled through 1 mm sieve. The compounded concentrate consisted of 44% wheat offal, 38% rice bran, 15% brewers' dried grain, 2% bone meal and 1% salt. Concentrate samples (n=3) of known weight were similarly oven-dried for DM determination.

In vitro total gas and CH_4 production measurement

The *in vitro* total gas production was measured using the *in vitro* gas technique (Menke and Steingass, 1988). Approximately 200 mg of substrate was weighed into 100 ml glass syringes using ten syringes per treatment. Each of the syringes were filled with 30 ml inoculum. The inoculum was a mixture of a medium solution and rumen liquor at ratio 2: 1. The tip of the syringes were fitted and sealed with a rubber tube to prevent escape of gas. The syringes were incubated at 39℃ for 48 h with gas readings recorded at three hours interval from 0 to 48 h. The incubation procedure was handled under continuous anaerobic conditions. Four blanks were included in the run to correct for gas production not arising from feed degradation. Methane was determined (n=4 per treatment) at 48 h incubation according to Fievez *et al.* (2005).

Determination of dry matter degraded and fermentation parameters

At 48 h incubation, contents of each syringe (n=6 per treatment) were filtered through Whatman filter paper (grade 1, 11µm pore size). The supernatants were collected into tubes and used for total volatile fatty acids determination following the titration method of Barnett and Reid (1957). The filtered residues were oven-dried at 105℃ overnight to determine DM degraded. The DM degradability (mg/g DM) was then calculated as difference between dry matter content of substrate incubated and that of its residue. Partitioning factor and microbial biomass production were estimated according to Blummel *et al*. (1997).

Chemical analysis

Dried samples of maize stover, concentrate, and CNP were analyzed for proximate and fibre composition following the procedure of AOAC (2000) and Van Soest *et al*. (1991), respectively. Metabolizable energy was estimated according to De Boever *et al.* (1997). Samples of cinnamon powder were further analyzed for phytochemical constituents such as tannin, saponin, flavonoids, oxalate, alkaloids and total phenol following standard procedures.

Experimental design and statistical analysis

The experiment was laid out as a completely randomized design. All data were subjected to one-way analysis of variance (SAS, 2002). Significant differences were accepted at $P \leq 0.05$. Significant means were separated using Duncan multiple range test (SAS, 2002).

RESULTS AND DISCUSSION

Chemical composition of diets used as substrate is presented in Table 1. Maize stover had a high neutral detergent fibre, acid detergent fibre and low crude protein which is typical of maize stover as previously reported (Fon *et al*., 2012). The concentrate with a higher crude protein content served as an additional source of protein. Phytochemicals in CNP is shown in Table 2. Cinnamon powder contained a high flavonoids content followed by saponin and tannin. These phytochemicals are plant secondary metabolites (PSM) described as naturally occurring biochemical compounds in plants and considered to serve as defense mechanism for plants survival (Bodas *et al*., 2012).

Table 1. Chemical composition (%) of experimental maize stover and concentrate

Parameters	Maize stover	Concentrate
Dry matter[1]	38.12	95.43
Crude protein	5.27	15.04
Organic matter	92.20	93.64
Neutral detergent fibre	68.75	51.32
Acid detergent fibre	37.28	23.70
Acid detergent lignin	11.53	8.86
Metabolizable energy (MJ/kg DM)[2]	12.32	12.68

[1]On as-received basis; [2]Estimated according to De Boever *et al*. (1997)

Table 2. Phytochemical composition (g/kg) of cinnamon powder

Parameters	Concentration
Tannin	56.36
Flavonoids	72.08
Total phenolic acid	44.10
Saponin	60.21
Oxalate	1.45
Alkaloids	32.32

Total gas volume, CH_4 production and DM degradability reduced ($P < 0.05$) with CNP inclusion in maize stover-based substrate at both 15 and 30 mg/g DM inclusion levels while total volatile fatty acids and microbial biomass were unaltered ($P > 0.05$) compared to the control (Table 3). The reduction effect suggested inhibition of microbial activity to ferment substrate since gas production in the rumen is a direct product of substrate fermentation by rumen microbes. Similar reduction effect of cinnamon on CH_4 and DM degradability from wheat-based substrate was reported by Chaudhry and Khan (2010). The observed reduction effect of CNP was attributed to the antimicrobial properties of phytochemicals in CNP. Condensed tannins have been reported to reduce methanogenesis through direct toxic effect on methanogenic archaea (Bodas *et al*., 2012). Saponin reduction effect on methanogenesis was linked to inhibition of protozoa activity (Bodas *et al*., 2012). Antimicrobial effect of flavonoids on dry matter degradation and methane production *in vitro* has similarly been reported (Oskoueian, 2013). A higher ($P < 0.05$) partitioning factor was observed with increasing levels of cinnamon powder. Partitioning factor is a measure of fermentation efficiency (Jimenez-Peralta *et al*., 2011). This implied that less gas was produced per unit of substrate degraded suggesting better utilization of organic matter in substrate.

Table 3. *In vitro* methane production and fermentation of maize stover-based substrate containing varying levels of cinnamon powder

	Levels of CNP in substrate degraded				
Parameters	**0**	**15**	**30**	**SEM**	***P*-value**
In vitro dry matter degraded, mg/g	345.0[a]	249.2[b]	236.7[b]	18.30	0.019
In vitro total gas production, ml/g DM	162.5[a]	136.7[b]	124.2[b]	5.52	0.006
CH_4 production, ml/g DM	57.5[a]	29.6[b]	28.1[b]	3.63	<0.001
Partitioning factor	3.3[b]	4.1[a]	4.5[a]	0.16	0.034
Microbial biomass production (mg/g DM)	218	184	175	13.42	0.399
Total volatile fatty acids (mM/100 ml)	12.19	11.41	10.95	0.37	0.394

[a,b]Means along the same row with different superscripts are significantly different ($P < 0.05$); CNP: cinnamon powder

CONCLUSION AND RECOMMENDATION

From this study, 15 and 30 mg of cinnamon powder per gram of maize stover-based substrate reduced CH_4 production and dry matter degradation similarly, with no change in total volatile fatty acids and microbial biomass *in vitro*. Inclusion level of 15 mg/g DM can therefore be recommended for mitigating methane production in ruminant diets based on maize stover. However, studies *in vivo* are required to confirm the effects of these reductions on animal performance.

REFERENCES

AOAC. 2000. Official Methods of Analysis. The Association of Official Analytical Chemists, 17th Edition Gaithersburg, MD, USA.

Barnett, J. G. and Reid, R. L. 1957. Studies on the production of volatile fatty acids from grass by rumen liquor in an artificial rumen. The volatile fatty acid production from grass. *J. Agric. Sci. Cam.* 48: 315-321.

Berhanu, Y., Olav, L., Nurfeta, A., Angassa, A. and Aune, J. B. 2019. Methane emissions from ruminant livestock in Ethiopia: promising forage species to reduce methane emissions. *Agriculture* 9 (6): 130.

Blummel, M., Steingass, H., Becker, K. 1997. The relationship between *in vitro* gas production, *in vitro* microbial biomass yield and N incorporation and its implications for the prediction of voluntary feed intake of roughages. *Br. J. Nutr.* 77: 911 – 921.

Bodas, R., Prieto, N., Garcia-Gonzalez, R., Andres, S., Giraldez, F. J., Lopez, S. 2012. Manipulation of rumen fermentation and methane production with plant secondary metabolites. *Anim. Feed Sci. Technol*. 176: 78 – 93.

Chaudhry, A. S. and Khan, M. M. H. 2012. Impacts of different spices on *in vitro* rumen dry matter disappearance, fermentation and methane of wheat or ryegrass hay based substrates. *Livest. Sci.*146: 84- 90.

De Boever, J. L., Cottyn, B. G., De Brabandar, D. L., Vanacker, J. M. and Boucque, C. V. 1997. Prediction of the feeding value of maizesilage by chemical parameters, in vitro digestibility and near infra-red spectroscopy (NIRS). *Anim Feed Sci Technol*, 66: 211-222.

Fievez, V., Babayemi, O. J. and Demeyer, D. 2005. Estimation of direct and indirect gas production in syringes: a tool to estimate short chain fatty acid production requiring minimal laboratory facilities. *Anim. Feed Sci. Technol.* (123 – 124) 197 - 210.

Fon, F.N. and I. V. Nsahlai. 2012. The *in vitro* fermentation of maize stover as affected by faecal bacteria obtained from ungulates. *S. Afr. J. Anim. Sci.* 42(5): 478-482.

Gemeda, B. S. and Hassen, A. 2015. Methane production of two roughage and total mixed ration as influenced by cellulase and xylanase enzyme addition. *Sci. Agric.* 72: 11-19.

Jimenez-Peralta, F. S., Salem, A. Z. M., Mejia-Hernandez, P., Gonzalez-Ronquillo, M., Albarran-Portillo, B., Rojo-Rubio, R. and Tinoco-Jaramillo, J. L. 2011. Influence of individual and mixed extracts of two tree species on in vitro gas production kinetics of a high concentrate diet fed to growing lambs. *Livest. Sci.* 136: 192-200.

Khan, M. M. H. and Chaudhry, A. S. 2010. Chemical composition of selected forages and spices and the effect of these spices on in vitro rumen degradability of some forages. *Asain-Aust. J. Anim, Sci.* 23 (7): 889 – 900.

Menke, K. H. and Steingass, H. 1988. Estimation of the energetic feed value obtained by chemical analysis and invitro gas production using rumen fluid. *Anim. Res. Dev*. 28:7–55.

Methu, J. N., Owen, A. L., Abate, A. L. and Tanner, J. C. 2001. Botanical and nutritional composition of maize stover, intakes and feed selection by dairy cattle. *Livest. Prod. Sci.* 71: 87 – 96.

Oskoueian, E., Abdullah, N. and Oskoueian, A. 2013. Effects of flavonoids on rumen fermentation activity, methane production and microbial population. *BioMed Res. Int.* Article ID 349129, 8 pp

Patra, A. K., Kamra, D. N. and Agarwal, N. 2006. Effect of spices on rumen fermentation, methanogenesis and protozoa counts in *in vitro* gas production test. International Congress Series 1293: 176-179.

Patra, A. K., Kamra, D. N. and Agarwal, N. 2010. Effects of extracts of spices on rumen methanogenesis, enzyme activities and fermentation of feeds *in vitro*. *J. Sci. Food Agric*. 2010; 90: 511–520.

SAS. 2002. Statistical analysis system version 9.1. SAS Institute Inc, Cary

Tang, S. X., Li, F. W., Gan, J., Wang, M., Zhou, C. S., Sun, Z. H., Han, X. F. and Tan, Z. L. 2011. Effects of sown season and maturity stage on *in vitro* fermentation and *in sacco* degradation characteristics of new variety maize stover. *Asian-Aust. J. Anim. Sci.* 24 (6): 781 - 790

Van Soest, P. J., Robertson, J. B., Lewis, B. A. 1991. Methods for dietary fibre, neutral detergent fibre, and non-starch polysasccharides in relation to animal nutrition. J. Dairy Sci. 74: 3583 – 3597.

PROXIMATE AND MINERAL COMPOSITION SCREENINGS OF *Clitoria ternatea* LEAVES AND SEEDS

***Alalade, J.A.,[1] Fabule, S.A[2]., Okunlola, O.O[1] & Adebisi, I. A[1]**
., [1]*Department of Animal Health and Production, Oyo State College of Agriculture and Technology, P.M.B. 10, Igbo Ora. Oyo State*
[2]*Department of Animal Production and Health, Ladoke Akintola University of Technology, P.M.B. 400, Ogbomoso, Nigeria.*
*Corresponding author: alaladeja16@gmail .com Phone no: 08033664270

ABSTRACT

The leaves and seeds of *Clitoria ternatea* were evaluated for the proximate, mineral and anti-nutritional composition. Atomic absorption spectrometry were used in determination of the seeds and leaves for Phosphorus (P%), Potassium (K%), Magnesium (Mg%), and Calcium (Ca%) were also determined using appropriate technique. The result of proximate analysis indicate that leaves and seed have high crude protein (26.75% and 48.30%), dry matter (93.82% and 90.50%), Ash (6.90% and 7.50%), crude fiber for both leaves (11.70%) and seed (8.10%) while the ether extract for leave (5.31%) and seed (7.90%). Mineral analysis indicate the *Clitoris ternatea* leave and seeds contained some essential mineral such as %P (0.40%) leave and (0.35%) seeds, %K (1.13%, 0.78%), % Mg (0.30%, 0.26%) and %Ca (0.37%, 0.34%)for leave and seeds for *Clitoris ternatea*. The overall result suggested that *Clitoria ternatea* leaves and seed is of high nutritionally quality due to high protein and mineral contents.

Keywords: *Clitoris ternatea*. Proximate, Mineral Composition, leaves and seeds

Description of Problem

Livestock usually derive most of their dietary nutrient from plant materials. However, as a result of high temperature region in the tropics, it stimulates the growth and aging of the plants with a consequent fall in nutrients and digestibility. This changes in nutritional quality results in very irregular growth and marked fluctuation in seasonal weights gains of the animals (Smith *et al.,*1989). A large number of leguminous leaves and seeds are able to meet the nutrient requirements of small ruminants for production (Akinlade *et al.,*2004). The *Clitoria ternatea* is a high – quality protein-rich legume, a tropical "alfalfa" often referred to as a protein bank that can be grown at low cost (Cook *et al.,*2005). *Clitoria ternatea* is palatable and has high nutritive value, with a higher leaf nitrogen percentage and lower acid digestible fibre than most other tropical legumes. As a result of poor nutrition which is major constraint to livestock production, especially during the dry season when available feed quantity is low and quality extremely poor (Alhassan, 1987). There is need to mitigate the problem with the use of sown and purposely managed pastures. The shortage of feed for ruminants can be solved through cultivation of forage crops with better nutritional values than the existing feed resources. This can be achieved with the establishment of leguminous forage (Poppi and McLennan, 1995). Furthermore, to improve livestock productivity in Nigeria, sustainable solutions to essential deficiencies in feed availability and quality are required. A number of pasture legumes such as *Centrosema, Desmodium, Canavalia* and *Glycine* have been tried in Nigeria, but the minor information is on *C. ternatea* compared with those legumes mentioned above. The objective of the study was to assess the nutritional contents of *C. ternatea* leaves and seed.

Materials and Methods

Experimental Site

The experiment was conducted at Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igboora in the derived Savannah zone of Nigeria. The College is located within $7^0$15'North and $3^0$30' East of the equator with an average annual rainfall of 1278mm and average annual temperature of 27^0C (Sanusi, 2011).

Collection of Plant Materials
The leaves and seeds of *Clitoria ternatea* were all obtained from pasture demonstrated unit, Teaching and Research Farm. The seeds were then separated from their shells, dried appropriately, milled with blender and stored in air-tight containers until required for analysis.

Proximate Analysis and Mineral Analysis
The leaves and seeds were analyzed for moisture content, ash, crude fat, crude protein and crude fiber were determined in accordance with the Standard Methods of the AOAC, (1990).
The minerals such as K, P, Mg, Ca, Fe and Zn were determined by the atomic absorption spectrophotometric method. Phosphorus was determined spectrophotometrically using the vendates solution (Sekine, *et al.* 1965).

Statistical Analysis
The data collected were subjected to Student T test of SAS package.

RESULTS AND DISCUSSIONS
Proximate composition
The proximate composition of both leaves and seed of *Clitoria ternatea* is shown in Table 1. The high dry matter content obtained on both seeds and leaves of *Clitoria ternatea*. The percentage ranged (90.50 – 93.82%), indicating high shelf – life of the leave and seed hence long storage would not lead to much spoilage due to its susceptibility to microbial attack especially of drying. The percentage Crude Protein of leaves (26.95%) and seeds (48.30%) were above 17.5% recorded for *Stylosanthes hamata* leaves (Akinlade, *et al*., 2007). The higher crude protein recorded for both seed and leaves of *Clitoria ternatea* in the present study above 7% CP requirement for ruminant animal which will provide ammonia requirement by the rumen microorganism to support optimum microbial activity. The Ash content value of *C. ternatea* leave (6.90%) and seed (7.50%) were observed to be higher than value (0.11%) reported for *Mucuna utilis* leaves by Ujowundu *et al*., (2010), The ash values for both seed and leaves obtained for the present study fell within the range of 3.0 – 9.65% (Okoli, *et al*., 2001). Ash content useful in assessing the quality grading of mineral element present in the *C. ternatea* leave and seeds. Ether extract content of *C. ternatea* seed (7.90%) and leaves (5.31%) which were higher than (1.89%) reported for *Canavalia ensiformis* leaves (Akinlade, *et al*., 2007). Also higher than the 1.9% Ether extract for lablab seed (Osman, 2007).The Crude Fiber content of *C. ternatea* leave (11.70%) and seeds (8.10%) were lower compared with (14.80%) of *Mucuna utilis* leaves reported by Ujowundu, *et al* (2010) and 23.80% for *Stylosanthes hamata* (Akinlade, 2004). Arukwe *et al,* (2012) reported that 3.10% obtained for *Persea ameneansn* seed but lower than 8.10% recorded for *C. ternatea* seed. The crude fiber content of both seed and leaves samples did not fall within the range of 15 – 20% recommended for improved intake and production in finishing ruminant (Buxton, 1996).

Table 1: Proximate contents of seed and leaves of *Clitoria ternatea*

Proximate (%)	Leaves (%)	Seeds (%)
Dry matter	93.82	90.50
Crude protein	26.95	48.30
Ash	6.90	7.50
Ether extract	5.31	7.90
Crude Fibre	11.70	8.10

Mineral composition
The mineral analysis of both leaves and seeds of *Clitoriaternatea* indicated their richness in Phosphorus, Potassium, Magnesium, Calcium and Iron in Table 2.The mineral analysis of a plant gives the idea of possibility either the plant should be used for any feeding trial purpose. The phosphorus content for leave (0.40%) and seed (0.35%) were higher compared to the NRC recommended value of 0.15% for Phosphorus (NRC. 1985). The level of Phosphorus in both the seed and the leaves of *C. ternatea* was consistently above the 0.2% level which would satisfy livestock

dietary maintenance requirement (NRC. 1985). The value of Potassium (%K) in both seed (0.78%) and leave (1.13%) were higher than (0.46%K) for *Canavalia ensiformis* leaves by (Akinlade, *et al.*, 2007) and for seed of *Brachystegia eurycoma* harms (0.25%) in the present investigation the level of %K in *C. ternatea* leaves was over 0.18% recommended for grazing animals (McDowell, 1985). Potassium help to maintain body weight and regulate water and electrolyte balance in the blood and tissue (NRC, 1985). Magnesium (Mg) content for leave (0.30%) and seeds (0.27%) both were higher than value 0.20% reported for *Canavalia ensiformis* leave by (Akinlade, *et al.*, 2007). The higher forage and seed Mg level found in this present study were above 0.12 – 0.20% of requirement of ruminants diet suggested by NRC, (1985).The Calcium (Ca) content of both seed (0.34%) and leave (0.27%) were higher than (0.09%) observed in *Canavalia ensiformis* leave by (Akinlade, *et al.*, 2007). The leaves and seed Ca values found in this study were considered adequate for the optimum performance of ruminants. The values of both leaves (0.37%) and seed (0.34%) of %Ca for *Clitoria ternatea* would meet the theoretical Ca requirement of 0.30% %Ca diet needed for all forms of production in ruminants (ARC, 1980).

Table 2: Mineral composition of seed and leaves of *Clitoria ternatea*

Mineral Content	Leaves	Seeds
Phosphorus (%)	0.40	0.35
Potassium (%)	1.13	0.78
Magnesium (%)	0.30	0.27
Calcium (%)	0.37	0.34

CONCLUSION AND RECOMMENDATION

It can be concluded from the results from this study that the *Clitoria ternatea* leaves and seed appeared to have the potential as feed supplements. Higher content of protein and minerals contents would make them good protein supplements to poor quality roughages especially during the dry season of the derived savannah zone of Nigeria.

REFERENCES

Alhassan, W. S., 1987. Studies on untreated crop residue utilization in Red Sokoto (Maradi) goats. Goat production in the humid tropics. Proc. Workshop, University of Ife, Ile Ife, Nigeria, 20-24/7/1987.

Akinlade, J. A., Farinu, G. O., Aderinola, O. A., Ojeleye, T. Y. and Tona, G. O. 2004. Nutritive value of *Stylosanthes guianensis* and *hamata* in derived Savannah zone of Nigeria. *Science Focus.* Vol. 9. Pp. 145 – 149.

Akinlade, J. A., Farinu, G. O., Taiwo, A. A., Aderinola, O. A., Adebayo, T. A., Ojebiyi, O. O. and Olaniran O. A. 2007. Agronomic and nutritive evaluation of Jack bean (*Canavalia ensiformis*) for fodder in the derived Savannah zone of Nigeria. *International Journal of Agricultural Research.* Vol. 2, No. 12. Pp. 1059 – 1063.

AOAC. 1990. Official Method of Analysis Association of Official Analytical Chemists. Pp. 66 – 88. 15th Edition. Washington, D. C. USA

ARC. 1980. The Nutrients Requirements of Ruminant Livestock. 4th ed. Pp. 73 – 310. CAD International, Wallingford.

Arukwe, U; Amadi, B.A; Duru, M. K.C., Agomuo, E. N; Adindu, E. A; Odika, P.C; Lele, K.C; Egejuru, L and Anudike, J. (2012): Chemical composition of Perseaamericana leaf, fruit and seed. International Journal of Research and Reviews in Applied Sciences **11**(2):355-358.

Buxton, D. R. 1996. Quality related characteristics of forages as influed by plant

Cook, B. G., Pengelly, B. C., Brown, S. D., Donelly, J. L., Eagles, D. A., Franco, M. A., Hanson, J., Mullen, B. F., Partridge, I. J., Peters, M., Schultze – Kraft, R. 2005. Tropical Forages. CSIRO, DPI & F (Old), CIAT and ILRI, Brisbane, Australia.

NRC. 1985. Nutrients requirements of beef cattle (17th edition) National Academy Press, Washington D. C. USA.

Okoli, I. C., Ebere, C. S., Emenalom, O. O., Uchengbu, M. C. and Esonu, B. O. 2001. Indigenous livestock paradigms revisited 11: An assessment of the proximate value of most preferred indigenous browses of South Eastern Nigeria. *Tropical Animal Production Investigation*. Vol. 4, No. 2, Pp. 99 – 107.

Osman, M. A. 2007. Effect of Different Processing Methods on Nutrient Composition, Anti-nutritonal factors, and in vitro Protein Digestibility of *Dolichos*Lablab Bean (*Lablab purpuresus* (L) Sweet). *Pakistan Journal of Nutrition*. Vol. 6, No. 4. Pp. 299-303. ISSN 1680 – 5194 © Asian Network for Scientific Information, 2007.

Poppi, D. P. and McLennan, S. R. 1995. Protein and Energy Utilization by Ruminants at Pasture. *Journal of Animal Science*. Vol. 73. Pp. 278 – 290.

Sanusi, W. A. 2011. Effect of Poverty on Parturition in Non – Farm Activity in Ibarapa Local Government Area of Oyo State. Nigeria IJAART (1 & 2). Pp. 86 – 95.

Smith, C.W., Goldstein, M.L and H. K. Wong (1989). Whistler Wave Bursts Upstream of the Uranian Bow Shock. *Journal of Geophysical Research, A94, 17,035-17,048 (1989)*

Ujowundu, C.O., O.E. Okafor, N.C. Agha, L.A. Nwaogu, K.O. Igwe and C.U. Igwe (2010). Phytochemical and chemical composition of *Combretum zenkeri* leaves. J. Med. Plants Res., 40: 965-968.

PERFORMANCE OF LABLAB (*Lablab purpureus* L.) AS INFLUENCED BY PHOSPHORUS FERTILIZER RATES AND INTER-ROW SPACING IN THE NORTHERN GUINEA SAVANNA, NIGERIA.

[1]Bature, M. S., *[1]Bala, A.G., [1]Hassan, A. H & [1]Tinau, A.T

[1]Division of Agricultural Colleges, College of Agriculture and Animal Science, Ahmadu Bello University, Mando, Kaduna State, Nigeria.

*Corresponding authour: balaaminu@gmail.com; agbala@abu.edu.ng ; +2348068928548

ABSTRACT

An experiment was conducted to evaluate the forage yield of Lablab (*Lablab purpureus L*) during the 2018 cropping season at the Teaching and research farm of the College of Agriculture and Animal Science, Ahmadu Bello University, Mando Road, Kaduna. Treatments consisted of three phosphorus fertilizer rates (0, 20, and 30 kg/ha) and three plant spacing (20cm x 30cm, 25cm x 30cm, and 30cm x 30cm), laid out in a 3x3 factorial arrangement in a randomized complete block design with three replications. The results of the experiment showed that phosphorus fertilizer rates significantly ($p<0.05$) affected plant height, number of leaves/plant and dry forage yield at 6 and 9 weeks after sowing. However, number of leaves was not affected by phosphorus fertilizer application rates across the sampling periods. Plant spacing at (25cm x 30cm and 30cm x 30cm) have significantly increased ($p<0.05$) plant height and total dry forage yield. It can be concluded that 30kg /ha of phosphorus fertilizer application rate and plant inter-row spacing at 30cm x 30cm, produced the highest dry forage yield of Lablab. Famers in Northern ecological zone of Nigeria can adopt the application of phosphorus fertilizer at 30kg/ha and using wider spacing of 30cm x 30cm for better yield of Lablab, thereby increasing farm output and animal performance.

Key words: Lablab, phosphorus rates, plant spacing, forage, yield

INTRODUCTION

In Nigeria, Lablab (*Lablab purpureus* L.) as forage crop is grown mostly in research and experimental farms. Despite the importance of *Lablab* in our diet and as feed for livestock, the yield obtained by farmers in Nigeria is low, because of the problem of neglecting good cultural practices such as fertilizer application and plant spacing. To achieve maximum yield of *Lablab*, agronomic factors must be at their optimum, such as phosphorus fertilizer application rates and plant spacing (Karachi, 1997). Phosphorus fertilizer plays significant roles in increasing the plant height, number of leaves and dry forage yield of *Lablab*. Similarly, management of *Lablab* using intra-row spacing has been used to increase its productivity (Pandita and Randhawa, 1994). The objectives of the study were to determine the effect of phosphorus fertilizer rates (0kg/ha, 25kg/ha, and 30kg/ha) and inter-row spacing at different level (20cm x 30cm, 25cm x 30cm and 30cm x 30cm) on growth components and yield of *Lablab*.

MATERIALS AND METHODS

The study was conducted at the pasture and range unit of teaching and research farm, College of Agriculture and Animal Science, Ahmadu Bello University, Mando Road- Kaduna. The farm is located at an elevation of 676m and latitude of 10°35'N and longitude of 7°25' E (GPS, 2018). The experiment was laid out in a 3 x 3 factorial arrangement in a randomized complete block design (RCBD) with three replications. There were three phosphorus rates (0kg/ha, 20kg/ha, and 30kg/ha) and three plant inter-row spacing (20cm x 30cm, 25cm x 30cm, and 30cm x 30cm). The Seeds of *Lablab purpureus* were planted at about 2 cm depth using a seed rate of 10 kg/ha. Planting took place when rain was established in July 2018. First and second weeding were carried out manually with hoe at 3 and 6 weeks after sowing, respectively. There was a total of 27 plots inform of basins measuring $4m^2$ with 1m inter-row path way. The growth components and yield parameters measured were as follows:

a) Plant height; the height of 5 tagged plants in each plot will be measured from the ground level to the tip of the plant using a meter rule at 6 and 9 weeks after sowing.
b) Number of leaves per plant; these will be obtained by counting and recording the average of 5 tagged plants in each plot.
c) Dry forage yield: Total fresh weight (TFW) of the material cut will be weighed immediately using

a hanging scale to determine the fresh forage yield. A sample of 150–200g fresh material (FWss) will be weighed, oven dried at 65°C for 48hrs and reweighed (DWss) to give an estimate of the dry-matter production during this period using the formula below by Tarawali *et al*., 1995.

Dry matter (kg/ha) = TFW x (DWss / FWss) x 10

Where: TFW = total fresh weight from 1 m^2 in g

FWss = fresh weight of the subsample in g

DWss = dry weight of the subsample in g

Data on plant height, number of leaves and dry forage yield were collected and subjected to analysis of variance by using procedure of Statistical Analysis System (SAS, 2003).

RESULTS AND DISCUSSION

Table 1 shows that, at 6 WAS application of phosphorus (30kg/ha) produced the tallest plants than the other rates, but at 9 WAS application of 20kg/ha and 30kg/ha of phosphorus fertilizer significantly ($p<0.05$) produced the longest lablab plants than the control. The effect of spacing on plant height shows that at 6 and 9 WAS, plant spacing of 30cm x 30cm produced the longest lablab plant, but statistically at par with application of phosphorus at 25cm x 30cm. The highest number of leaves of lablab was produced at 30kg/ha, but was statistically similar with application of 20kg/ha of phosphorous. Similarly, at 6 WAS, phosphorus fertilizer application rates at 30kg/ha statistically produced the higher dry forage yield of lablab, than at 0kg/ha and 20kg/ha. At 6 and 9 WAS, plant inter-row spacing of 20cm x 30cm produced the lowest dry matter yield of lablab plant. The results showed that plant height, number of leaves and dry mater yield significantly produced better results using phosphorus fertilizer rates at 20kg/ha and 30kg/ha. This might be related to plants having access to greater share of available nutrients (response to phosphorus) in the soil which resulted in improved growth performance. This is in consonance with the findings of Tanko *et al*., (2013) in which they reported that plant height and dry matter yield of lablab was better at 30kg/ha phosphorus fertilizer rate. Plant inter-row spacing significantly affected the performance of lablab. Plant inter-row spacing of 30cm x 30cm from the research, significantly gave tallest plant, higher number of leaves and dry mater yield of lablab. This is in line with the findings of Ahmed *et al.* (1988) who stated that wider plant spacing in lablab, recorded the highest plant height.

Table 1: Effect of phosphorus fertilizer rates and inter-row spacing on plant height and number of leaves of Lablab at 3, 6 and 9 weeks after sowing

	Plant height (cm)		Number of leaves		Dry forage yield (kg/ha)	
Treatment	6 WAS	9 WAS	6 WAS	9 WAS	6 WAS	9 WAS
SSP kg/ha						
0	29.93^{b}	36.29^{b}	13.20^{b}	16.60^{b}	59.33^{b}	89.02^{c}
20	33.42^{b}	42.89^{a}	15.53^{ab}	17.53^{ab}	104.46^{ab}	156.72^{b}
30	37.32^{a}	43.79^{a}	16.60^{a}	18.93^{a}	163.06^{a}	244.60^{a}
SEM	3.88	5.58	3.01	9.00	72.87	12.63
Spacing (cm)						
20 x 30	28.27^{b}	34.72^{b}	14.80	16.67^{b}	39.95^{c}	59.93^{c}
25 x 30	32.74^{ab}	41.84^{ab}	14.30	18.27^{ab}	65.24^{b}	97.87^{b}
30 x 30	35.10^{a}	42.91^{a}	14.33	26.00^{a}	82.78^{a}	135.62^{a}
SEM	3.88	5.58	3.01	9.00	72.87	12.63

Means within a column of any set of treatment group with unlike latters are significantly different at ($p<0.05$), SEM = Standard Error of Mean, WAS = Weeks after sowing.

CONCLUSION

Based on the findings of the study, famers could plant lablab using 30kg/ha phosphorus fertilizer application rate at wider inter-row plant spacing of (30cm x 30cm) for better growth components and forage yield.

REFERENCES

Ahmed, A., Farooqi, A. A and Bojappa, K. M (1988). Effect of Phosphorus and spacing on growth, yield and essential oil content in fennel (*Foeniculum vulgare* Mill.). *Indian Perfumer,* 32 (4) : 301-305.

GPS, (2018). Geo-Positioning System (GPS). Garmin extres 12 channel Garmin.

Karachi, M. (1997). Growth and Nutritive value of LabLab purpureus accessions in semi and Kenya Tropical Grasslands, Vol. 31 1997 P. 2140218.

Pandita, U. K and Randhawa, K. S (1994). Row spacing and leaf cutting in relation to forage production of fenugreek. *Seed Research,* 22(2) : 122-129.

SAS. (2003). SAS/STAT. Guide for personal computer version, 6th Edition. Statistical Analysis System Institute, Inc. Cary, North Carolina, USA.

Tanko, S. D., Malami, B. S., Bodinga, B. M., Ahmed, H. G and Yahaya, B. A (2013). Influence of Intra row spacing on growth and fodder yield of Lablab (*Lablab purpureus* [L]) in Semi – Arid Sokoto Nigeria. *Nigerian Journal of Basic and Applied Science,* 21(4): 267-272

Tarawali, S. A., Tarawali, G., Larbi, A. and Hanson, J. (1995).*Methods for the Evaluation of Legumes,* Grasses and Fodder Trees for Use as Livestock Feed. ILRI Manual 1. ILRI (International Livestock Research Institute), Nairobi, Kenya. Pp 1-12

PROXIMATE COMPOSITION OF RED FINGER MILLET VARIETY

[*]Bot, M.H., [**]Bawa, G.S., [**]Omage, J.J. & [**]Onimisi, P.A.
**Federal College of Animal Health and Production Technology, NVRI, Vom, Plateau State.*
***Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State.*
[*]***Correspondent Author:*** *maryambot@yahoo.co.uk*

ABSTRACT
The aim of determining the proximate analysis of red finger millet/*Tamba* (*Eleusine coracana*) was to ascertain its nutritional composition and its ability to be used as feed ingredient. Proximate analysis of red finger millet was carried out at the biochemistry laboratory of the department of Animal Science, Ahmadu Bello University, Zaria. The result of the analysis revealed that it contained Dry Matter-88.48; Crude Protein (CP)-13.98; Ether Extract (EE)-3.70; Crude Fiber (CF)-6.67; Ash-4.90; Nitrogen Free Extract (NFE)-59.22. Therefore, it can be concluded that finger millet is a nutritious feed resource and can be incorporated into animal feed. It is recommended for farmers to use it by incorporating it into livestock feed because of the prospects it has shown in the proximate analysis result.

Key words: Finger millet, Proximate, Feed resource, Analysis, Nutrients

INTRODUCTION
The term millet is derived from the French word "mille'' which means thousand, with a handful of millet containing up to 1000 grains (Shahidi and Chandrasekara, 2013). *Eleusine coracana* is called *kpana* by the Beroms, *tamba* in Hausa (Fernandez *et al.,* 2003). Millet belongs to the group of small seeded species of cereal crops or grains which are annual plants (Shiihii *et al*., 2011). The grain belongs to the family Poaceae which originated in Ethiopia and the sub-family *Chloridodeae* (Pradeep&Sreerama, 2015; Sood *et al*., 2016; Ramashia *et al*., 2018). The brown cultivar is utilized for brewing traditional opaque beer in Southern Africa (Sood *et al*., 2017). The grain is a semi-arid region crop cultivated in dry areas with limited rainfall and can adapt to various agro-climatic conditions (Gull *et al*., 2014). Hence, it is important to look at ways of how to economically and effectively substitute some of the conventional feed resources since they are becoming scarce and beyond the reach of the small and medium entrepreneur farmers. Hence, the proximate analysis to find out the nutritional contents of red/brown finger millet so that farmers can be encouraged to adopt its usage.

MATERIALS AND METHOD
Source of finger millet
The grain which is popularly called finger millet or *tamba* locally was purchased from Ganawuri local market located in Riyom local Government Area of Plateau State and Manchok in Kaduna State.

Determination of finger millet proximate composition
The proximate composition of finger millet was carried out at the biochemistry laboratory of the department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. The analysis was carried out according to the standard method of (AOAC, 2005).

RESULTS AND DISCUSSION
The proximate analysis results obtained for red finger millet revealed that it had a crude protein of 13.98%, The value obtained here is higher than 9.1g/100g recorded byRavishankar *et al*., (2003); D'Andrea *et al.* (1999) who reported 7.3%; Chethan and Malleshi, (2007) 5-8%, Gull *et al.,* (2015), Gupta *et al.,* (2011) 7.5 – 9.56, brown/red 8.7 g /100 g (Rao, 1994) for other members of the millet family, such as foxtail millet (10.29%), burnyard millet 6.93% (Verma *et al*., 2014), These differences could be due to the variations experienced in geographical locations and soils where the finger millet was planted or the amount of rainfall in those areas. Therefore, this high CP of red finger millet makes it a very nutritionally important ingredient for animal feed, since protein is very vital for normal functioning of the entire body system. Proteins are essential components of the diet needed for survival of animals and humans; their basic function in nutrition is to supply adequate amount of

required amino acids (Pugalenthi *et al*., 2004).

The ether extract or crude fat obtained from the analysis of red finger millet revealed that it had 3.70%. This is higher than what was reported by Ravishankar *et al*., (2003) 1.2g/100g, David *et al*., (2014) 0.83%, 1-2% (Chethan and Malleshi, 2007), 1.3-1.8% (Bhatt *et al*., 2003; Lupien, 1990). However, it is comparable to what was obtained 2.1% (Anthony *et al*., 1996).The differences and variations seen may be as a result of different methods of laboratory analysis by different laboratory personnel that carried out the analysis. High fat ingredients are suggested for inclusion in weight gaining diets because of the energy embedded in them. Leeson, (1997) reported that fats are widely used energy sources in addition to improving the consistency and palatability of mash feed.

The result of the proximate analysis revealed Ash content of 4.90% for red finger millet, this is higher than what was reported by David *et al*., (2014) 2.37%; 1.7% (Rao, 1994). The differences recorded may be due to the different types of fertilizer used and the methods of application found in those areas. This suggests that red finger millet has more content of inorganic or mineral in it. This result agrees with what was reported by Singh and Raghuvanshi, (2012) that the Ash content in finger millet is higher than what was obtained in the commonly used cereal grains.

The result of crude fiber showed that Red finger millet had 6.67%, This is higher than what was reported in foxtail millet 4.25% and burnyard millet 2.98% (Verma *et al*., 2014); 72% obtained by D'Andrea *et al* (1999). These wide variations could be as a result of using different cultivars on different soils with various rainfalls ranges, probably the stage of maturity at which the crop was harvested. Crude fiber is nutritionally important as it aids the absorption of trace elements in the gut and elimination of undigested waste through the bowel (Abolaji *et al*., 2007).

The nitrogen free extract (NFE) obtained from the result revealed that red finger millet had 59.22% which is lower than 72% obtained by D'Andrea *et al* (1999); 77.9g/100g (Ravishankar *et al*., 2003). These wide variations could be as a result of using different cultivars on different soils with various rainfalls.

Table 1: Proximate composition Finger millet (*Eleusinecoracana)*(%)

Parameter	**Composition**	
	Red colour	**Black colour**
Dry matter	88.48	87.55
Crude protein	13.98	13.14
`Ether extract	3.70	3.10
Crude fiber	6.67	7.02
Ash	4.90	4.36
Nitrogen Free Extract	59.22	59.84

REFERENCES

Abolaji, O.A., Adebayo,A.H. and Odesanmi, O.S. (2007). Nutritional qualities of three medi plants parts in (*Xylopiaaethiopica, Bligiasapida and Parinaripolyandra*) commonly used by pregnant women in the western part of Nigeria. *Pakistani Journal of Nutrtion,* 6(6): 665-668.

Association of Official Analytical Chemists (AOAC) (2006).*Official method of analysis*. (15th edition). Washington D.C. USA.

Bhatt, A., Singh, V., Shrotria, P.K., Baskheti, D.C. (2003). Coarse grains of Uttaranchal: Ensuring sustainable food and nutritional security. *Indian Farmers Digest.* Pp. 34-38.

Anthony, U. Sripriya, G. Chandra, T.S. (1996). Effect of fermentation on the primary nutrients in finger millet (*Eleusine coracana*) *J. Agric. Food Chem.*, 44 (9), pp. 2616-2618

Chethan S., Malleshi N.G. (2007). Finger millet polyphenols optimization of extraction and the effect of pH on their stability.*Food Chem.*105 862–870. 10.1016/j.foodchem.2007.02.012 [Cross Ref]

David, B.M., Michael, A., Doyinsola, O., Patrick, I. and Abayomi, O., (2014). Proximate composition, mineral and phytochemical constituents of finger millet (*Eleusine coracana*).*International Journal of Advanced Chemistry.*,**2**(2):171-174.

D'Andrea, A.C., Lyons, D.E., Mitiku Haile, and Butler, E.A. (1999).Ethnoarchaeological Approaches to the study of prehistoric Agriculture in the Ethiopian highlands of Van der Veen. Ed., *The exploitatinof plant resources in ancient Africa*.*Kluwer Academic*: Plenum publishers, New York.

Fernandez, D.R, Vanderjagt, D.J., Millson, M., Huang Y-S., Chuang, L-T., Pastuszyn, A. and Glew, R.H. (2003). Fatty acid, amino acid and trace mineral composition of *Eleusine coracana* (Pwana) seeds from northern Nigeria. *Plant foods Human Nutritio*. Volume 58:1. pp 1-10. http://doi.org/10.1023/B:QUAL. 0000040323.67330.cb Kluwer Academic Publishers, Printed in the Netherlands.

Gull, A., Jan, R., Nayik, G. A., Prasad, K., & Kumar, P. (2014). Significance of finger millet in nutrition, health and value added products: a review. *Journal of Environmental Science, Computer Science and Engineering and Technology*, 3(3): 1601-1608.

Gull, A. Nayik, G.A., Prasad, K. and Kumar P. (2015).Nutritional, Technological and medical approach of Finger millet (E*leusine coracana*).*Journal of cogent food and Agriculture,* Vol. 1, issue 1.http://doi.org 10.1080/23311932.2015.1090897

Gupta, N., Gupta, A.K., Sing, N. K. and Kumar, A. (2011). Differential expression of PBF D of transcription factor in different tissues of three finger millet genotypes differing in seed protein content and colour. *Plant MolBiol Rep.* 29:69–76.

Leeson, J.D. (1997). *Commercial Poutry Nutrition.*2nd Edition. Summer Published University books, Canada.

Lupien, J.R. (1990). *Sorghum and millets in human nutrition.* FAO, ICRISAT. At: ao.org. p. 86.

Pradeep, P. M., & Sreerama, Y. N. (2015). Impact of processing on the phenolic profiles of small millets: Evaluation of their antioxidant and enzyme inhibitory properties associated with hyperglycemia. *Journal of Food Chemistry*, 9: 455-463.

Pugalenthi, M. Vadivel, U. Gurumoorthi, P. Jonardhanan, (2004). Comparative Nutriritional evaluation of little known legumes, *Tamarindus indica*, *Erythrina indica* and *Sesbaniabispinosa*. *Tropical. Subtropical Agroecosystem*. 4: 107-123.

Rao, P.U. (1994). Evaluation of protein quality of brown and white ragi (*Eleusine coracana*) before and after malting.*Journal of Food Chem*. 51: pp. 433-435.

Ravishankar, C. R., Prakash, P. and Ramappa, H. K., (2003).*Grain yield and nutritional composition in promising finger millet (Eleusine coracana Gaertn.)* varieties. Recent Trends in Millet Processing and Utilisation., 1: 121-122.

Shahidi, F., & Chandrasekara, A. (2013). Millet grain phenolics and their role in diseases risk reduction and health promotion – review. *Journal of Functional Foods*, 5(2), 570-581.

Shiihii, S. U., Musa, H., Bhati, P. G., & Martins, E. (2011).Evaluation of physicochemical properties of *Eleusine coracana* starch.*Nigerian Journal of Pharmaceutical Sciences*, 10(1): 91-102.

Singh, P. and Raghuvanshi, S. (2012). Finger millet for food and nutritional security.*African Journal of food Science*. 6(4): 77-84.

Sood, S., Komar, A., Babu, B. K., Gaur, V. S., Pandey, D., Kant, L., &Pattnayak, A. (2016).Gene, discovery and advances in Finger millet [*Eleusine coracana* (L.)Gaertn.].Genomics-An important nutri- cereal of future. Frontiers in Plant Science, 7:1-17.

Sood, S., Kant, L., & Pattnayak, A. (2017).Finger millet [*Eleusine coracana* (L.)Gaertn.]: a minor crop for sustainable food and nutrition. Mini Review.*Asian Journal of Chemistry*, 29(4): 707-710.

Verma, S., Srivastava, S. and Tiwari, N. (2014) Comparative study on nutritional and sensory quality of barnyard and foxtail millet food products with traditional rice products.*J Food Sci. Technol:*doi 10.1007/s13197-014- 1617-y.

EFFECT OF HOT WATER AND SULPHURIC ACID PRE-TREATMENT ON TOTAL GERMINATION OF HORSE TAMARIND (*Leucaena leucocephala)* SEEDS AT DIFFERENT IMMERSION TIME

[1]Hassan, A. H., *[1]Bala, A. G., [1]Bature, M. S., Sulaiman, A & [1]Tinau, A.T
[1]Division of Agricultural Colleges, College of Agriculture and Animal Science, Ahmadu Bello University, Mando, Kaduna State, Nigeria.
*Corresponding authour: balaaminu@gmail.com; agbala@abu.edu.ng ; +2348068928548

ABSTRACT
A laboratory experiment was conducted to access the effect of immersion period in hot water and sulphuric acid pre-treatments on total germination of *Leucaena leucocephala* seeds. The experiment was arranged in a factorial combination of three (3) immersion time (for 2, 4 and 6 minutes) and pre-treatment methods (hot water at 80°C and diluted sulphuric acid at 10%) in a Completely Randomized Design with four (4) replicates. Results shows that immersing *Leucaena* seeds in hot water for 6 minutes recorded higher seed germination percentage (82.5%) followed by immersing seeds for 4 minutes (65%). The least seed germination percentage (35%) was recorded at 2 minutes. Total germination values increased as increasing immersion time up to 6 minutes. However among the immersion periods of the acid treatments, the highest germination percentage was recorded when seeds were soaked for 2 minutes (50%) followed by soaking in 4 minutes (25%) and 6 minutes (25%). It is therefore concluded that immersion of Immersing *Leucaena* seeds in hot water for 6 minutes was the best option to obtain rapid germination.
Keywords: *Leucaena,* germination, seeds, immersion

INTRODUCTION
Certain crops produce seeds with a characteristic thick wax layer covering the seed coat, thus preventing the easy penetration of moisture into the cotyledons, and hence inhibit germination, a phenomenon called seed dormancy. Seed dormancy refers to a state in which the viable seeds fail to germinate when provided with conditions normally favorable to germination such as adequate moisture, appropriate temperature regimes and light (Schmidt, 2000). Seeds of legumes such as *Leucaena leucocephala* are generally considered to have physical dormancy (Jayasuriya *et al.*, 2013). *Leucaena* is fast growing multi-purpose drought resistance tree species that is widely cultivated around the world for its highest wood production and wide ranges of uses which includes ruminants feed (Yige *et al*., 2012). Supplementing animal fed with dried *Leucaena* leaves will lead to higher weight gain (Rubanza *et al*., 2007). Notwithstanding, the planting and successful adoption of this drought tolerant forage is limited to some extent by water impermeability of the seed coat or 'hardseededness', caused by one or more water-impermeable layers of palisade cells in the seed or fruit coat (Baskin *et al.,* 2000). In nature, this seed coat dormancy may be overcome by abrasion, fire, drying, freezing/thawing, high or widely fluctuating soil temperatures and microbial activity (Baskin and Baskin, 1998). Thus several techniques to reduce the hard seed coat of forage seeds have been investigated over the years but little information is available on the immersion time to various seed treatment methods. Therefore, this study was conducted to evaluate the effect of hot water and sulphuric acid pre-treatment on total germination and germination period of *Leucaena leucocephala* seeds at different immersion time in Mando-Kaduna State.

MATERIALS AND METHOD
The laboratory trial was conducted in 2019 at the Entomology Laboratory of the College of Agric and Animal Science, Mando, Kaduna. Mature seeds of *Leucaena* were harvested from the The experiment was arranged in a factorial combinations of three (3) immersion time (for 2, 4 and 6 minutes) and pre-treatment methods (hot water at 80°C and diluted sulphuric acid at 10%) in a Completely Randomized Design with four (4) replicates. Ten seeds of *Leucaena* were placed in each petri dish (9cm diameter) lined with one layer of filter paper. The filter papers were moistened with addition of distilled water throughout the experimental period. The petri dishes were kept on laboratory table at room temperature of (30-36°C) and covered with lid to prevent moisture loss by evaporation. The seeds under hot water and sulfuric acid scarification were gently stirred periodically during the treatments,

then the seeds were washed repeatedly in running tap water until they were considered safe to handle. After that, the seeds were spread in a thin layer for shade drying. Total germination was measured as:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds in petri dish}} \times 100$$

Data collected on were analysed using simple percentages.

RESULTS AND DISCUSSION

Immersing *Leucaena* seeds in hot water for 6 minutes recorded higher seed germination percentage (82.5%) followed by immersing seeds for 4 minutes (65%). The least seed germination percentage (35%) was recorded at 2 minutes. Total germination values increased as increasing immersion time up to 6 minutes. The unappreciable effects of immersing the seeds for lesser periods like the 2 and 4 minutes compared to the 6 minutes might be due to the low permeability or imbibitions of water and oxygen caused by short time exposure to hot water (Rincon *et al.*, 2003). However among the immersion periods of the acid treatments, the highest germination percentage was recorded when seeds were soaked for 2 minutes (50%) followed by soaking in 4 minutes (25%) and 6 minutes (25%). This indicates that immersion of seeds in sulphuric acid for 2 minutes quickly ruptured the seed coats, thereby resulted in high total germination (Bala, 2019). The author reported that, the harmful effect of immersing sulfuric acid for 4 and 6 minutes indicates that prolonged immersion of the seeds was injurious to seeds as the acid may damage the vital parts of the embryo.

Table 1. Effect of hot water and sulphuric acid pre-treatment on total germination and germination period of *Leucaena leucocephala* seeds at different immersion time

Immersion period	Immersion in 80°C H_2O	Immersion in 10% H_2SO_4
	Total germination (%)	Total germination (%)
2 minutes	35.00	50.00
4 minutes	65.00	25.00
6 minutes	82.50	25.00

C= Centigrade, H_2O=Warer, H_2SO_4= Hydrogen tetraoxosulphate (vi) acid

CONCLUSION

From the results obtained in this study, it was concluded that immersion of *Leucaena* seeds in hot water for 6 minutes was the best option to obtain rapid germination. It is therefore recommended that farmers should use hot water scarification to break the hard seed coat of *Leucaena* most especially where there is need for bulk pre-treatment.

REFERENCE

Bala, A.G., Ayodele, E.S., Yakubu, A., Ibrahim, A., Hassan, M. R., Tanko, R. J., Amodu, J. T., Al-Habib, I.K., Sulaiman, A and Allahbamu, C. (2019). Implication of Immersion Periods in Hot Water and Sulpuric Acid Pre-Treatments on Germination Indices of *Centrosema pubescens* Seeds in Kaduna State, Nigeria. In: Grassland Development: A panacea to ending Farmers/Herders misunderstanding in Nigeria. Eds. S.B. Abdu, J.T. Amodu, M.R. Hassan and Y.M. Ishiaku. Proceedings of the 3rd biennial conference: *Society for Grassland Research and Development in Nigeria on 3rd – 6th November, 2019 at National Animal Production Research Institute Shika, Zaria, Nigeria*. Pp. 145-148.

Baskin, C. C and Baskin, J. M (1998) Seeds: Ecology, biogeography and evolution of dormancy and germination. Academic Press, San Diego, 666 pp

Baskin, J. M., Baskin, C. C and Xioajie, L. I (2000): *Taxonomy, anatomy and evolution of physical dormancy in seeds*. Plant Species Biology 15:139-152

Jayasuriya, G. K. M. G., Wijetunga, A. S. T. B., Baskin, J. M and Baskin, C. C (2013): Seed dormancy and storage behavior in tropical Fabaceae: a study of 100 species from Sri Lanka. Seed Science Research 23, 257–269

Rincon, R., Culebro, N., Gutierres F.A. and Dendooven, L. (2003). Scarification of seeds of Acacia angustissima Mill Kuntze and its effect on germination. *Seed Science Technology*., 31 : 301 – 30

Rubanza, C. D. K., Shem, M. N. S. S., Bakengesa, S. S, Ichinohe, T and Fujihara, T. (2007): Effects of *Acacia nilotica, A. polyacantha and Leucaena leucocephala* leaf meal supplementation on performance of Small East African goats fed native pasture hay basal forages. *Small Ruminant Research* 70: 165–173.

Schmidt, L. (2000). *Dormancy and pre-treatment*. Guide to handling of tropical and subtropical forest seeds. Danida Forest Centre. Denmark. 2000:4

Yige, C., Fangqing, C., Lei, L and Shunbo, Z. (2012): Physiological Responses of *Leucaena leucocephala* Seedlings to Drought Stress. Procedia Engineering 28: 110 – 116.

CHEMICAL COMPOSITION OF MILLET PANICLE WASTE ENSILED WITH POULTRY MANURE AT GRADED LEVELS

N. kadi[2], Muftau, M. A[1]
Department of animal science, KSUSTA, Kebbi State

ABSTRACT
Millet panicle waste was ensiled with poultry dropping at graded levels; 90:10, 80:20, 70:30, 60:40 (millet panicle waste/poultry dropping) representing B, C, D and E respectively, and 100:00 (control) treatment A. The material ensiled were put in polythene bags replicated three times, the sample were sealed and allow fermentation to take place for a period of 21 days. The resultant silage was analyzed for pH, Crude protein (CP), Crude fiber (CF), Either Extract (EE), ash and Nitrogen Free Extract (NFE). There were significant differences ($p<0.05$) in all the parameters measured except that of Dry matter (DM). Ensiling millet panicle waste increased pH, CP, ash, EE, and NFE, but reduced CF with increased proportion of poultry dropping. Treatment C has the highest CP (4.38) and DM (93.50), with lower CF (1652) compared with control treatment with (33.73). The result suggested that ensiling millet panicle waste with poultry dropping improve its feeding value.

INTRODUCTION
Proper nutrition is necessary for optimum livestock production; unfortunately, there is shortage of forage supply during dry season for ruminant animal especially in the northern part of Nigeria. (Ruthender, 1980). There are many agricultural crop residues with great potential for ruminant feeding. One of such is millet by product known as millet panicle waste.

Presently, the consumption of millet is becoming more pronounced in the most of the northern region especially in villages and semi urban areas where there is availability of millet panicle waste especially during dry season in northern part of Nigeria when people engage in processing of millet. The panicle waste are thrown everywhere during this period of processing. Millet panicle waste is obtainable from processing of millet which is not use for any purpose. The waste are dumped in the water ways causing environmental havoc by blocking drainages or burnt by local people which causes additional environmental pollution by increasing the global warming effect.

Silage making is considered as a technology that increase livestock productivity and minimizes resource degradation and viable option for conserving succulent feeds (Muhammad et *al.,* 2008).
In view of this, the utilization of millet panicle waste as feed for ruminants will drastically reduce the above mentioned problems as well as solving the problem of feed scarcity especially in the dry season. The aim of this study is to find out the chemical composition of millet panicle waste ensiled with poultry droppings at different graded levels

MATERIALS AND METHODS
The experiment was conducted within the Animal Science laboratory of Kebbi State University of science and Technology.

Collection and preparation of experimental materials
Millet panicle waste was collected from processing points identified within and around Aliero LGA. All foreign materials (stones, irons, polythene) were removed. Poultry manure was obtained from Labana poultry farm Aliero. The collected millet panicle waste and poultry manure were sun dried to a constant weight by spreading on a concrete floor.

Ensiling procedure
The dried millet panicle waste used for silage was packed in a polythene bags to make compaction easier. (Ogunlolu *et al*; (2010). Millet panicle waste was ensiled with poultry manure in proportions, 100:00, 90:10, 80:20, 70:30 and 60:40, representing treatment A, C, D, and E respectively. Fifteen Polythene bags were used as laboratory silos (Ogunlolu *et al*; 2010). The samples were ensiled for 21 days in triplicates; masking tape was used to further seal the polythene bags after filling with weighed materials and compressed.

At the expiration of the ensiling period, the polythene bags were opened and top most materials was scooped off to avoid contamination with partially ensiled materials. The samples were taken using forceps from each ensiled polythene bag for pH determination and chemical analysis.

Experimental design and Data Analysis
A complete Randomized design (CRD) was used as outlined by Steel and Torrie (1980). There were five treatments designated as A, B, C, D and E with three replicates each.

Proximate analysis
Crude protein (CP) where measured using kjeldhl method (Nx6.25) while other proximate constituents, Either extract (EE), Ash, Crude fiber (CF) and Nitrogen Free Extract (NFE) were measured according to procedure described by AOAC (2005).

Data analysis
Data were analyzed using the general linear model procedures of the (SPSS 2007), and mean separation was done using Duncan multiple range test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

Table 1: pH properties of ensiled millet panicle waste

Treatments		**pH**
A	100:00	5.45^{c}
B	90:10	5.71^{c}
C	80:20	6.11^{bc}
D	70:30	7.69^{ab}
E	60:40	8.45^{a}
SEM		9.39

abc: means on the same row with different super scripts are significantly ($p<0.05$) different

Table 1: present the pH reading of the silage. Significant differences ($p<0.05$) were observed among the treatments. The highest pH was recorded in treatment E(8.45) with the least in treatment in treatment A. (4.45). This is in accordance with the findings of Rasool *et el*. (1998) Who reported an increase in initial and subsequent pH in sudax grass ensiled with 30% broiler litter and 9%molasses.

Table 2: Proximate analysis millet panicle waste

	Treatments					
Parameters	A (0%)	B (10 %)	C (20 %)	D (30%)	E (40%)	SEM
DM	94.00	92.50	93.50	92.00	91.75	12.27
CP	3.15^{d}	3.68^{c}	4.38^{a}	3.99^{b}	3.98^{b}	0.069
CF	33.73^{d}	22.46^{c}	19.30^{b}	21.06^{bc}	16.52^{a}	7.89
EE	4.25^{ab}	4.05^{ab}	4.95^{ab}	3.25^{c}	5.51^{a}	7.89
ASH	4.25^{d}	6.75c	8.25^{b}	12.25a	11.75a	8.74
NFE	20.47^{d}	75.32^{b}	77.63^{a}	972.02^{c}	72.77^{c}	10.39

abcd: means on the same row with different superscripts are significant ($p<0.05$) different.

Table 2: shows the proximate composition of millet panicle waste. There is no significant ($p<0.05$) difference in the dry matter among the treatments. However, the highest value was obtained in treatment A (94:00) and the least was recorded in treatment E (91.75). This contradicts with Al Rokayan *et al*. (1998) who reported an increase in the dry matter when broiler litter was ensiled with sorghum forage in the proportions of 0:100, 25:75, 35:65, and 45:55.

The values of CP of the resultant silage was observed to have increased ($p<0.05$) with increase proportion of poultry droppings. The CP was highest in treatment C (4.38) than B, D, and E although

the increase was not steady across the treatments. This is in line with Ngele *et al*. (2006) who reported an increase in the CP when rice straw was treated with broiler litter at different ratios.

There was significant difference ($p<0.05$) in CF composition of the silage among the treatments. CF of all treatments is lower than the control, the CF was observed to decrease with increased proportion of poultry dropping from (22.46) in treatment B to (16.52) in treatment E. This is in accordance with the findings of Rasool *et al*, (1998) who observed decreased in CF when sudax grass was with broiler litter and molasses.

The EE components of the treatments were significantly ($p<0.05$) affected, the highest EE was recorded in treatment E (5.51) and the least was recorded in treatment D (3.25). The result of this study agreed with that of Mthiyan *et al*. (2001) who observed an increase in EE composition of sugar cane top ensiled with broiler litter and that of Ngele *et al* (2006).

Ensiling millet panicle waste with poultry dropping increases ($p<0.05$) ash content of the resultant silage. Treatment D has highest value (12.25) compared with treatment E, C, B and the control which has least value of (4.25). This is in agreement with the findings of Al Rokayan *et al*. (1998) and that of flachowsky and Hennig (1990) who observed a linear increase in ash content with increased proportion of broiler litter.

Nitrogen Free Extract of the millet panicle waste ensiled with poultry dropping increases ($p<0.05$) with the increase in the level of poultry dropping with treatment C having the highest value (77.63) and the least was recorded in treatment A (20.47). This observation agreed with the findings of Baba *et al*. (2010).

CONCLUSION

Poultry dropping improved the nutritive value by increasing the CP and lowering the CF of the waste.

REFERENCES

A.O.A.C. (2007). Official Methods of Analysis. Association of Analytical chemists, 18th edit. Gaithersburg, M.D.

Al Rokayan, S.A., Z. Naseer and S. M. Chaudlary. 1998. Nutritional quality and digestibility of sorghum broiler litter silage. Animal Feed.Sc. Tech. 75: 65– 73

Baba, M., T. Uba and A. R. Halim. 2010. Nutritional value of Kyasuwa Hay (Penniharac and chemically treated animal excreta for ruminants– A review Biol. Waste, 31: 17–36

Mthiyane . D.M.N., I. V. Nsahlai and M. L. K. Bonsi. 2001. The nutritional composition, fermentation characteristics, in Sacco degradation and fungal pathogen dynamics of sugar cane tops ensiled with broiler litter with or without water.Anim. Feed. Sci. Tech> 94 : 171–185

Muhammad, I. R., Abdu, M. L.L,. Iyegbe-Erakpotobo, G. T and Sulaiman, K. A. 2009. Ensiling quqlity of Gamba grass fortified with tropical legumes and its preference by Rabbits. *Res. J. of. Appl. Sci*. 4(1) : 20-23

Ngele, M. A., T.A Adebola and S.E.S. Bogoro, (2006). Nutritive value of rice straw treated with poultry litter. Proceedings of the 31st Annual conference of Nigerian society for Animal production, March 12-15. BayeroUniversityKano, pp:18-21

Ogunlolu, B. T. Jolaosho, A. O. Akintola, T. O. and Aniwe, P. O. (2010). Effects of Length of Storage and Moisture of Cassava Peel, Pineapple Residues and Guinea Grass On Mineral content of Silage Proceddings of the 35th Annual Conference of the Nigeria Society of Animal Production 14th -17th March, 2010, University of Ibadan. Pp 489-490.

Rasool, S., M. A. sail, Ahsan–ul–Haq and A. Jamil 1998. Chemical changes during ensilingof Sudax fodder with broiler. Anim. Feed. Sci. Tech. 72: 347-352.

SPSS. 2007. Statistical package for Social Sciences. Inc. Chicago, IL.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of Statistics. A Biometrical Approach, 2nd Edition. McGraw – Hill, New York.

INTERCROPPING MULTIPURPOSE TREES (MORINGA, ALBIZIA AND LEUCAENA) WITH MAIZE AND ITS UTILIZATION AS DRY SEASON FEEDS FOR RUMINANTS IN SOUTHERN GUINEA SAVANNAH, NIGERIA

D.O Ogunbosoye[1,*] & Afe A.I[2]

*[1]Department of Animal Production, Fisheries and Aquaculture, Kwara State University, Malate Nigeria: [2]Department of Crop Production, Kwara State University, Malete, Nigeria; *Corresponding author (olufunflory@gmail.com); Phone No. +2348038262722*

ABSTRACT

A field trial was carried out to investigate the suitable cropping pattern in browse trees (Moringa, Albizia, and Leucanea)/maize system and their utilization as dry season fodders. Full population of browse trees were intercropped with full population and fifty percent population of maize in a 2x3 factorial in split plot arrangement and replicated four times. Cropping pattern involving combinations of full population of browse trees and maize recorded higher plant height than those involving intercropping combination of 50% full population. Sole maize significantly had longer cobs than those at the intercrops. There was no significant difference in maize cob length between the three cropping patterns. Number of seed/cob of maize at combination of 50% full maize with browse trees were higher than when full population of maize was intercropped. Intercropping involving maize at full population produced higher grain yield than 50% full population. The highest grain yield (2.33t/ha) at the intercrop was obtained at combination of full population of maize with Albizia. Sole maize significantly performed better than the intercrop in grain yield. All the browse species evaluated at the intercrops were high in crude protein concentration with moderate value of Neutral Detergent Fiber (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL). The three browse plant species were accepted by the goats toward the end of the experiment indicating the browse species intercropped with maize to be a suitable feed for ruminants to ameliorate dry season feed deficit and enhances food security through the production of maize.

Key words: browse trees, cropping pattern, dry season, feed scarcity, goats

INTRODUCTION

Ruminants play a significant role in the lives of rural farmers, providing milk, meat, animal traction, manure for crop production, cash from sales of animal products and a safety net of capital assets against misfortune in harsh weather. However, poor nutrition has been the main factor limiting ruminant production in the tropic due to unavailability of feed all year round.

The use of multipurpose trees such as Moringa, Albizia and Leucaena in livestock production in Nigeria cannot be over emphasized in solving feed shortage. Composition of feed given to animals has a very significant influence on animal performance such as reproduction, milk production, quality and growth performance. Adegbola (2002) observed that poor performance of ruminants during dry season was as a result of poor quality roughages fed to these animals without supplementation with concentrates or quality forages. The conventional feed resources (grains) available during the lean period are very expensive to feed ruminants because of the competition with man for sustainability (Akinmuti 2004). This situation has indeed necessitated the search for cheap, readily available feed materials that can meet the nutritional requirements of farm animals and less competitive. Most of the multipurpose trees (MPTS) have hitherto not been systematically exploited for strategic year round livestock production; especially during dry season to boast an improved productivity. The MPTS are considered to be repository of quality nutrients under good management and both palatability and digestibility will be enhanced.

Voluntary intake of tropical grasses can be a major constraint to ruminant performance in the tropics. The solution to this problem may be through the incorporation of tree fodders as feed supplements to improve the rumen environment, which can lead to increased forage intake. A lot of studies have been carried out on few of the browse trees, and the most prominent ones are *Leucaena leucocephala. Gliricidia sepium, Albizia odoratissima* (Ogunbosoye and Babayemi 2010). However, in ruminant

production practices, a common practice is to offer a variety of tree fodders as supplements, either separately or with grasses (Sandoval-Castro *et al.*2005). Therefore, to obtain sufficient and good quality feed for the ruminant, a strategy has to be developed to assess the value of these parameters as predictors of forage preference, and their values in designing feed for effective management of the available browse plants. Preference assessment or otherwise called acceptability is a fast and cheaper means of assessing fodder plants in a short period of time (Sandoval-Castro *et al*. 2005). Therefore, this research was focused on the establishment and utilization of browse trees intercropped with maize by ruminants.

MATERIALS AND METHODS

Establishment at the permanent site

The experiment was laid out in a 2x3 factorial in split plot arrangement and replicated four times. The treatment consisted of Moringa, Abizia and Leuceana as the main block while various population of maize constituted the sub-plot. Poultry manure was applied at the rate of 7.5t/ha at 2weeks before transplanting. Seedlings were transplanted at four weeks old to the main field at a spacing of 4.0m x 4.0m. Maize was introduced to the browse trees at one week after transplanting.

Chemical composition of browse trees

Crude protein, crude fibre, ether extract and ash contents of the browse plants were determined (AOAC 2000), acid detergent fibre (ADF), neutral detergent fibre (NDF), and acid detergent lignin (ADL)were assessed using the method proposed by Van Soest et al. (1991)

Acceptability study

The study was carried out at the sheep and goat unit of Teaching and Research farm, College of Agriculture, Kwara State University. Nine adult female red Sokoto goats were used in a cafetarian feed preference study which lasted for 14 days with 7 days of adaptation. The initial weight of the animals were between 15-17 kg at10-12 months old. They were housed in groups in well ventilated open pens capable of accommodating animals with the feeders and drinkers. The forages were harvested fresh and 3 kg of each was introduced to the animals in different containers. Each plant replicated thrice in order to have access to the plants. The positioning of the plants in the pens were changed daily to avoid conditioning and learning effects by the animals sticking to the same feed in the particular position. The feeding of the animals was monitored for 2 hours (0800-1000) daily. Average daily intake was calculated. Coefficient of preference (COP) was determined as the ratio of individual intake of the forage and the average intake. Forage with COP less than unity is considered not accepted, while COP greater than unity is well accepted (Babayemi 2007; Ogunbosoye and Otukoya, 2014)

Data collection and statistical analysis

The following data were collected for analysis; plant height of browse trees were taken at 6 and 8 weeks after transplanting (WAT), stem girth at 8 WAT. Maize data collected were plant height and stem girth at 6WAT, number of cobs per plant, cob length, number of grains per cob weight of 1000 grains and grain yield. On acceptability study, intake and COP of browse plants records were taken. Data were subjected to analysis of variance using SAS (2010) package and treatment means compared using Duncan's Multiple Range Test of the same statistical package. This was done where results were significant at 5% level of probability.

RESULTS

The significant interaction effect of cropping pattern and population density on plant height, stem girth and days to 50% flowering of maize intercropping is presented in Table 1. Generally, cropping pattern involving combinations of full population of browse trees and maize recorded higher plant height than those involving intercropping combination of 50% full population. The significant interaction effect of cropping pattern and population density on cob length, cob circumference, number of seeds per cob weight of 1000 grains and grain yield in moringa, albizia and leucaena maize intercropping is presented in Table 2. Sole maize had longer cobs than those at the intercrops. Irrespective of the population density, there was no significant difference in maize cob length between

the trees cropping patterns. Number of seed/cob at combination of 50% full maize with browse trees were higher than when full population of maize was intercropped. Intercropping involving maize at full population produced higher grain yield than 50% full population. The highest grain yield (2.33t/ha) at the intercrop was obtained at combination of full population of maize with Albizia.
The chemical composition of the browse foliage is shown in Table 3. The dry matter content of the browse plants ranged between 29.8% in*Moringa oleifera* and 44.00% in *Leucaena leucocephala.* The value obtained in these plants was lower in moringa when compared with others. The crude protein (CP) contents of *Albizia odoratissima, Leucaena leucocephala* and *Moringa oleifera* are 16.3%, 21.03%, and 28.75%, respectively. The highest CP value was obtained from moringa, a non-leguminous plant while the other two are legumes. The crude fibre values were from 10.16% in moringa to 15.87% in albizia and leucaena had 14.34%. Plant materials contain a group of substances, insoluble in water and organic compounds like ether. These are referred to as lipids and act as stores of energy. The highest value of ether extract was obtained in moringa (8.20%) which is an indication of high energy feed. Ether extract is the lipid component and the energy derived from it is utilized by the animal for body maintenance and production and the least value was obtained in *Leucaena leucacephala* (3.44%). The ash contents of browse plants range from (6.50% to 16.55%). The ash content of any feed is a measure of mineral level. The values of ash content was lowest in *leucaena leucocephala*, a legume but higher value was obtained in moringa, a non-leguminous plant.

The fibre fraction of the foliage of browse species shows that *Moringa oleifera* leaves had the highest neutral detergent fibre (NDF) value of 28.85% while the least (25.3%) was recorded for Albizia odoratissima. Acid detergent fibre (ADF) ranged from (13.34% to 22.0%) *M. olivera* and *A. odoratissima* respectively. Acid detergent lignin ranged between 7.55 to 11.0% with the *Albizia odoratissima* having the highest value and leucaena the least value.

The daily free choice intake of browse plants is presented in Table 4. The animals consumed more moringa from the inception of the study far above other fodders. As the day progressed, intake of other browse trees was improving. Similar trend was observed in the coefficient of preference (COP) values. In this study, *Albizia odoratissima* and *Leucaena leucocephala* were not initially consumed as expected. But looking at the coefficient of preference (COP) which is the ratio of individual intake and the average intake of individual forages, the COP was getting better till the end of the study.

DISCUSSION

The complementary effects as observed in this study were an indication of high potential of low-cost approach to sustain agricultural production and reduce environmental degradation. The intercropping advantage as observed in this study is consistent with the works of earlier researchers on intercropping involving maize and arable crops such as: cowpea/ maize (Afe, and Olofintoye, 2013), maize/sesame (Mkamilo, 2004). According to Nair (2007), the system is based on the premise that land use systems that are structurally and functionally more complex than either crop or tree monocultures result in greater efficiency of resource capture and utilization (nutrients, light, and water), and greater structural diversity that entails a tighter coupling of nutrient cycles. The significant difference observed among the browse trees in this study could be attributed to differences in their growth habits. Naturally, moringa is a fast growing plant compared to albizia and leucaenea and was able to compete for natural resources particularly light interception better than the other browse trees. This is evident in the taller maize height in maize/moringa intercrop.

The CP levels of the browse species agreed with the report of Ogunbosoye and Babayemi (2012). This result, however, falls within the minimum and maximum protein requirement for ruminants in the tropics (Minson 1990). The ash values were high, suggesting substantial mineral deposited in the browse plants. In earlier studies, Ogunbosoye and Babayemi (2012) obtained similar enhanced ash contents in browse plants. Values obtained for NDF, ADF and ADL corroborate those reported for some browse species in Nigeria (Larbi *et al*. 1996).

The observed marked preference towards *Moringa oleifera* during the two hours preference study may be due to its high crude protein with low crude fibre. Moreover, Bamikole *et al*. (2004) observed

that when five species of ficus were introduced to goats in a cafeteria feed preference study; the animals were able to make their choice among the ficus trees as a result of preferential taste by the goats. It is therefore concluded that the three browse plant species can be successfully established and intercropped with arable crops like maize to alleviate dry season feed scarcity being encountered by ruminant animal farmers and the arable crop (maize) could serve as additional food to the farmers.

REFERENCES

Adegbola, A.A. (2002). Nutrient intake, digestibility and rumen metabolites in bulls fed straw with or without supplements. *Nigerian Journal of Animal Production*. 29: 40-46.

Afe, A.I, Olofintoye J.A. (2013). Response of cowpea cultivars of contrasting maturity dates to varying component population ratios of maturity maize. *Journal of Agriculture and Biodiversity Research.* Vol. 27) pp 137-143.

Akinmutimi, A.H. (2004). Evaluation of sword bean (*Canavaliagladiata*) as an alternative feed resource for broiler chickens. Ph.D thesis Michael Okpara University of Agriculture, Umudike.

Association of Official Analytical Chemist (AOAC, 2000). Official Methods of Analysis 17th ed. Association of Analytical Chemists. *Washing*, DC

Babayemi, O.J. (2007). In vitro fermentation characteristics and acceptability by West African Dwarf goats of some dry season forages. *African Journal of Biotechnology* Vol. 6 (10), pp. 1260-1265

Bamikole, M.A, Ikhatua, U.J, Arigbede, O.M, Babayemi, O.J, Etela, I. **(**2004). An Evaluation of the Acceptability as forage of some Nutritive and Anti-nutritive Components and of the Dry Matter Degradation Profiles of Five Species of Ficus. *Tropical Animal Health and Production*, 36; 157-167.

Larbi A, Smith JW, Adekunle IO, Kurdi, I.O (1996) Studies on the multipurpose fodder trees and shrubs in West Africa: variation in the determination of forages quality in Albizia and Paraserianthes. *Agroforestry Systems*.33.29-39.

Minson, D.J. (1990). Forage in Ruminant Nutrition. Academic Press London, N.Y

Mkamilo, G.S. (2004) .Maize-sesame intercropping in Southeast Tanzania: Farmers' Practices and Perceptions, and Intercrop Performance. PhD Thesis, Wageningen University, Netherlands.

Nair PKR. (2007).The coming of age of agroforestry. *Journal of the Science of Food and Agriculture 87*(9) 1613-1619.

Ogunbosoye, D.O and Babayemi O.J (2010). Potential values of some non-leguminous browse plants as dry season feed for ruminants in Nigeria. *African Journal of Biotechnology* vol. 9 (18), pp 2720-2726.

Ogunbosoye, D.O and Babayemi, O.J. (2012). The utilization of some tropical browse plants by pregnant West African dwarf goats in southern Nigeria. *International journal of Environmental Sciences,* vol 1 No.4 224-229.

Ogunbosoye, D.O and Otukoya, K.O. (2014).Evaluation of Preference and Intake of Browse Species by West African dwarf goats in Nigeria. *International journal of innovative research and development*. Vol 3 168-175.

Sandoval-Castro, C.A, Henry, L,Lizarraga-Sanchez, Francisco J. Solorio- Sanchez. (2005).Assessment of tree fodder preference by cattle using chemical composition, *in vitro* gas production and *in situ* degradability. *Animal Feed Science and Technology.* 123-124, 277-289.

SAS. 2010. Statistical Analysis System. SAS/STAT users' guide. Version 8. SAS Institute Inc. Cary, NC

Van Soest, P.J, Robertson, J.B and Lewis, B. (1991). Methods for dietary fiber, and non-starch polysaccharides in relation to animal nutrition, *Journal of Dairy Sci*ence 74, 3587-3597.

Table 1: Interactive effects of cropping pattern and population density on plant height, stem girth, of moringa, albizia, and leucaena and days to 50% flowering of maize in a moringa, albizia, leucaena/maize intercropping.

Cropping pattern	Plant Height (cm)		Population density Stem Girth (cm)		Days to 50% Flowering	
	100	50	100	50	100	50
MA/MO	168.35a	166.95a	1.54b	1.58d	57.03	57.47
MA/AA	159.14b	157.18b	1.75b	1.78c	56.90	56.10
MA/L	152.70b	148.83b	1.35c	1.53d	57.93	57.3
SMO	149.12c	149.12b	7.52a	7.52a	-	-
SAA	49.00d	49.00c	1.33c	1.33c	-	-
SL	46.21d	46.21c	1.35c	1.33c	-	-
SM	158.56b	158.56b	1.72b	1.72b	57.03	57.03
CV (%)	7.8	6.5	12.2	9.3	8.2	7.249

Values with the same letter on the row are not significantly different at 5% level of probability by Duncan Multiple Range Test. MA=maize, MO=moringa, AA=albizia, L=leucaena, SMO=sole moringa, SAA=sole albizia, SL=sole leucaena, SM=sole maize

Table 3: Interactive effects of cropping pattern and population density on cob length, cob circumference, numbers of seeds per cob, weight of 1000 grains and grain yield in a moringa, albizia, leucaena/maize intercropping

Cropping pattern	Cob length	Cob circumference	Numbers of seed per cob	Population density Numbers of seed per cob	Weight of 1000 grains	Weight of 1000 grains	Yield	Yield
	100	50	100	50	100	50	100	50
MA/MO	17.42a	16.23a	488.53c	488.43c	231.00b	233.90b	2.10c	1.96c
MA/AA	17.30a	17.17a	509.97b	511.33b	256.37b	257.50b	2.33b	2.34b
MA/L	17.30a	17.22a	503.3b	506.20b	234.23b	232.80b	2.22c	2.10c
SM	18.57a	18.57a	567.57a	567.57a	273.03a	270.03a	2.53a	2.53a
CV (%)	6.8	8.9	9.2	7.249	8.3	12.0	3.6	13.0

Table 4: Chemical composition of the tree forages

Parameters (%)	Albizia	Leucaena	Moringa
DM	43.6	44.0	29.8
CP	16.3	21.03	28.75
CF	15.95	14.34	10.16
Ash	6.71	6.50	16.65
EE	5.90	3.44	8.20
NDF	25.90	26.2	28.85
ADF	22.0	18.5	13.34
ADL	11.0	08.44	7.55

Table 5: Preference study of goats fed fresh Albizia, Leucaena and Moring plants

	Daily forage intake (kg) and coefficient of preference (COP)													
	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Forage	Intake	COP	Intake	COP	Intake	COP	Intake	COP	Intake	COP	Intake	COP	Intake	COP
AO	0.37b	0.38	0.63b	0.3b	0.82b	0.33b	1.24b	0.71b	1.36b	0.69	2.66b	0.98b	2.97	1.0
LL	0.3b	0.31	0.88b	0.42b	1.16b	0.46b	1.3b	0.74b	1.5b	0.76	2.97a	1.03ab	2.93	1.0
MO	2.2a	2.3	2.67a	1.28a	3.0a	1.2a	3.0a	1.72a	3.0a	1.5	3.0a	1.04a	3.0	1.0
SEM	O.19	0.2	0.09	0.04	0.11	0.04	0.08	0.04	0.03	0.02	0.05	0.01	0.03	0.00

a,b = means on the same row with the same letter are not significantly different (P>0.05)

EVALUATION OF PHYTOCHEMICAL AND NUTRIENT COMPOSITIONS OF HOG PLUM (*SPONDIAS MOMBIN*)

Bishir, B. B.,[1] Adamu, H.Y.,[2] Abdu S.B.[2] & Aliyu, A.M.[1]
Corresponding author: bishirbellobakori@gmail.com. 07069068696
[1]National Agricultural Extension and Research Liaison Services, ABU, Zaria
[2]Department of Animal Science, Faculty of Agriculture, ABU, Zaria

ABSTRACT:
The phytochemical and proximate compositions of *Spondias mombin* leaves were determined using standard methods. The results of the phytochemical analyses showed the presence of phytate (1.01mg), oxalate (0.47mg), tannin (0.38mg) and saponin (2.70mg).The results of proximate compositions shows that the leaves were rich in nutrients such as dry matter was 94.57%,Crude protein 13.36%,crude fibre 10.34%, ash 9.86%, ether extract 2.95%, Nitrogen free extract 67.87% and organic matter 84.71%. The findings indicate that *S. mombin* leaves is a potential source of highly nutritious feed stuff and phytomedicine. They are of nutritional, clinical and veterinary relevance considering the diverse ethnopharmacological uses of the plant in different parts of the world. In conclusion, this study shows that leaves of *S. mombin* are potential source of pharmacologically active phytochemicals. It has also revealed that the leaves are important source of nutrients for domestic animals.

Keywords: *Spondias mombin*, phytochemical and proximate composition.

INTRODUCTION
Spondias mombin is a deciduous tree, usually 20 meters high, its bark is greenish-brown, thick, rough, often deeply grooved, with blunt, spine-like projection. The trunk branches 2-10m above ground level to form a spreading crown up to 15m in diameter. They are dull light orange to yellow or brown in colour, but turn yellow on ripening and contain 3-6 small seeds. The leaves are alternate, once pinnate with an odd terminal leaflet and stipules are absent but have rachis of 30-70cm long. Leaflets are up to 5-10 pairs, apex long acuminate, asymmetric and truncate with entire margins and glabrous leaves (FAO, 1982).The tree thrives under conditions with altitude ranging from 0-587m in a very dry soil, gravelly loam, sandy, or partly clay, throughout much of sub-tropical. Mean annual rainfall suitable for growth is over 1500mm. The bark is used as a purgative and in local application is used for leprosy (Kerharo and Bouquet, 1950). The bark decoction is used for severe cough, causing relief through vomiting. The dry pulverized bark is applied as a dressing to the circumcision wound. The bark contains a certain amount of tannin. A decoction of the mashed leaves is used by the Igbo (Nigeria) for washing a swollen face. The leaves, ground with sugar, are rubbed on the mouth and gums. A leaf infusion is a common cough remedy or used as a laxative for fever with constipation. A leaf decoction is used for gonorrhea. They are also used for leprosy and when crushed with lemon, they are effective on worms among children. A decoction of pounded leaves is used as an eye lotion and the juice pressed from young, warm leaves is given to children for stomach troubles. Hog plum (*Spondias mombin*) is a small deciduous tree plant occurring in a great variety of humid tropical climates. Its fruits, bark, leaves and roots are of great importance agriculturally and otherwise (Oladele, 2008). The leaves are more readily available and cheap especially during the dry seasons when most other forages are in short supply (Aregheore *et al*., 2003).

MATERIALS AND METHODS
Sample Collection and Preparation
The Hog plum *(Spondias mombin*) fresh leaves were collected from Bakori, Bakori Local Government Area, Katsina State. The fresh leaves were spread under the shade and allowed to dry for ten (10) days. All foreign materials such as branches and dead leaves were removed from the sample. The dried leaves were ground into a fine powder using a mechanical grinder, packaged in glass jars and stored at 4^0C until analysis (Ojiako and Akubugwo, 1997).

Quantitative phytochemical Analysis

Prior to quantitative phytochemical analysis, phytochemical screening was carried out on the plant's leaf extract using standard methods as described by Sofowora (1982) and A.O.A.C. (2005). The percentage compositions of saponins, tannins and phytate were determined accordingly to the methods of Harborne (1973) and Treas and Evans (1989). Oxalate content was determined by Spectrophotometric methods of Hang and Lantzsch (1983).

Proximate Analysis:
The hog plum dry leaves were analyzed for ether extract (EE) by soxhlet for 8 hours at 60^0C and crude protein (CP) was determine using micro khedjahl method. The dry matter (DM), crude fibre (CF), ash and nitrogen free extract (NFE) were also analyzed according to standard method of A.O.A.C (2005). The analysis was conducted in the Biochemistry Laboratory, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria.

Results
The results of phytochemical analysis revealed the presence of phytate, oxalate, tannin and saponin, with their quantitative estimations in every 100g of *Spondias mombin* powdered dry leaves, phytate (1.01mg), oxalate (0.47mg), tannin (0.38mg) and saponin (2.70mg) (Table 1) The quantitative estimations (in percentages) of the proximate compositions are shown in Table 2. The dry matter 94.57%, Crude protein 13.36%, crude fibre 10.34%, ash 9.86%, ether extract 2.95%, Nitrogen free extract 67.87% and organic matter 84.71% were obtained

DISCUSSION
Basically, the leaves of *S. mombin* make an excellent fodder for goats, sheep cattle especially during the dry seasons and drought, the leaves are more readily available and cheap especially during the dry seasons when most other forages are in short supply and dried leaves can be stored for long periods of time (Aregheore *et al*., 2003).The results of anti-nutritional factors of *S. mombin* leaf shows that there was low content of phytate (1.01mg), oxalate (0.47mg), tannin (0.38mg) and saponin (2.70mg), which is highly tolerable by ruminants (Kumar 1991), who observed that sheep ingesting up to 0.9mg hydrolysable tannins per kilogram body weight showed no toxicity. These phytochemicals exhibit various pharmacological and biochemical actions when ingested by animals. Saponin is a known anti-nutritional factor that can reduce the uptake of certain nutrients including cholesterol and glucose at the gut through intra-lumenal physicochemical interaction or other yet unidentified activity (Price *et al.,* 1987).The nutritional compositions of *S. mombin* leaves were found to be rich in dry matter (94.57%), Crude protein (13.36%), crude fibre (10.34%), ash (9.86%), ether extract (2.95%),Nitrogen free extract (67.87%) and organic matter (84.71%),the good distribution of nutrients in the leaves may explain its use as one of the forage feed given to domestic animals. Findings have established it as a potential source of highly nutritious feed stuff, medicine and phytomedicine, (Ayoka *et al*., 2006; Njoku and Akumefula, 2007; Ayoka *et al*., 2008; Arif and Fareed, 2010; Igwe *et al*., 2010). The *S. mombin* leaves are also of great nutritional value (Oladele, 2008).In conclusion, this study shows that leaves of *S. mombin* are potential source of pharmacologically active phytochemicals. It has also revealed that the leaves are important source of nutrients for domestic animals.

Table 1: Chemical composition of Hog plum leaf meal

Parameter (%)	Values
Dry matter	94.57
Organic Matter	84.71
Crude protein	13.36
Crude fibre	10.34
Ether extracts	2.95
Ash	9.86
Nitrogen free extract	67.87

Table 1: Anti-Nutritional factor of Hog plum leaf meal

Composition	mg/100g
Phytate	1.01
Oxalate	0.47
Tannins	0.38
Saponin	2.70

REFERENCES

AOAC. (2005). Official Methods of Analysis, Association of Official Analytical Chemist, 17th Edition, Washington D.C. U.S.A.

Aregheore, E. M. Abdulrazak, S. A. Fujihara, T., (2003). Evaluation of some agri-industrial by-products available in Samoa for goats. Asian-*Australian Journal Animal Science*, 16(11): 1593-1598

Arif, M. and Fareed, S. (2010). Pharmacognostic investigation and authentication of potentially utilized fruit *Spondias mangifera* (wild). *International Journal of Pharmaceutical and Clinical Research* 2(1): 31-35.

Ayoka, A. O., Akomolafe, R. O., Akinsomisoye, O. S. and Ukponmwan, O. E. 2008. Medicinal and Economic Value of *Spondias mombin*. *African Journal of Biomedical Research*, 11(2): 129-136.

Ayoka, A. O., Akomolafe, R. O., Iwalewa, E. O., Akanmu, M. A. and Ukponmwan, O. E. (2006). Sedative, antiepileptic and antipsychotic effects of *Spondias mombin* L. (Anacardiaceae) in mice and rats. *Journal of Ethnopharmacology*, 103(206): 166–175.

FAO (1982). Fruit bearing forest trees. FAO Forestry paper 34, FAO, Rome.

Hang, W. and Lantzsch, H.J. (1983). Comparative methods for the rapid determination of oxalate and phytate in cereal products. *Journal Science Food Agriculture*, 34:423-1426.

Harborne, I.B. (1973). Phytochemical Methods: *A guide to Modern Techniques of Plant Analysis*. 2nd edition chapman and hall, New York, Pp: 88-185.

Igwe, C. U., Onyeze, G. O. C., Onwuliri, V. A., Osuagwu, C. G. and Ojiako, A. O. (2010). Evaluation of the chemical composition of the leaf of *Spondias mombin* Linn from Nigeria. *Australian Journal of Basic Science*, 4(5): 706 -710.

Kerharo, and Bouquet, (1950) phytochemistry and pharmacology. *Useful Plants of West Tropical Africa*, 2:67–68.

Kumar, R. (1991). Anti-nutritional factors: the potential risks of toxicity and methods to alleviate them. Proceeding of F.A.O Expert consultation held at the Malaysian Agricultural Research and Development institute, Kuala Lumpur, Malaysia. P150.

Njoku P. C. and Akumefula M. I. (2007). Phytochemical and nutrient evaluation of *Spondias mombin* leaves. *Pakistan Journal of Nutrition*, 6(6): 613-615.

Ojiako, O.A. and Akubugwo, E.I. (1997). An Introductory Approach to Practical Biochemistry. CRC Publishers, Nigeria, pp: 46-85.

Oladele, E.O.P. and Oshodi A.A. (2008). Effect of fermentation on some chemical and nutritive properties of berlandier nettle spurge (*Jatropha cathartica*) and physic nut of (*Jatropha curcas*) seeds. *Pakistan Journal of Nutrition*, 7:292-296.

Price, K.R., Johnson, I.T. and Fenwick, G.R. (1987).The chemistry and biological significance of saponins in foods and feeding stuffs. Crit. Rev. *Food Science Nutrition*, 26(1):27-135.

Sofowara, E.A. (1982). Medicinal Plants and Traditional Medicines in Africa. John Wiley and Sons Ltd, Nigeria, Pp 64-79.

Trease, G.E. and Evans, W.C. (1989). .*Pharmacognosy*.13 Edn.BacilliereTinall Ltd, London, P57.

EFFECT OF WATERING VOLUME AND PLANTING DENSITY ON FODDER YIELD OF SELECTED TROPICAL CEREALS IN HYDROPONIC PRODUCTION

***Odedire, J.A., Akinropo, T.F. & Akinleye, J.A**
Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Osun State. 220005
**Corresponding author: akinropotobifestus@gmail.com*

ABSTRACT
The study was conducted to evaluate the effect of watering volume and planting density on the fodder yield of selected tropical cereals in hydroponic fodder production. Guinea corn (*Sorghum bicolor*), Millet (*Pennisetum glaucum*) and Wheat (*Triticum aestivum*) were used for the study. The experiment was laid out in a 3x3x3 factorial design with grain type, planting densities and watering volume as the three factors. The cereals were employed in hydroponic fodder production and data obtained were subjected to factorial analysis of variance and significantly ($P<0.05$) different means were separated using Duncan multiple range test of SAS (2003). Results indicated Guinea corn had the highest ($P<0.05$) mat depth and fodder yield with 3.65cm and 145.02% respectively, while wheat recorded the least values.Planting density also improved ($P<0.05$) mat depth and fodder yield, while Watering volume only impacted ($P<0.05$) on the cereals mat depth and fodder yield up till 500ml.The study concluded that cereal type, planting density and watering volume influenced mat depth and fodder yield in hydroponic forages.

Keywords: Hydroponic forages, guinea corn, millet, wheat,Mat depth, Fodder yield

INTRODUCTION
Human population increase is putting pressures on the available land for grazing and farming activities. This has resulted in recurrent clashes between cattle herders and settled crop farmers when competing for the available limited resources. There is therefore the need for a sustainable approach to ameliorate this recurrent clashes (Odedire, 2018). One of such approach is the use of hydroponic technology to grow forages for cattle and other grazing livestock, especially during the period of feed scarcity that is more crisis - prone. The potential of hydroponic fodder as a feed resource for livestock feeding is big, due to its high yielding ability and improved nutritive values of grains employed in the production system (Odedire *et al*, 2019). This study aimed to evaluate the effect of watering volume and planting densities on some selected cereal grains in the tropics.

MATERIALS AND METHODS
The experiment was conducted at the Animal Ecology Laboratory of the Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife. A locally adapted hydroponic chamber (Odedire, 2018) was employed for this experiment which lasted 21 days.The experiment was laid out in a 3x3x3 factorial design, where the factors were the selected cereal grains (Wheat, Millet and Guinea corn); Planting density (0.56, 0.83 and 1.11 kg/m^2); and watering volume (250, 500 and 750ml) giving a total of 27 treatments which were replicated thrice.The grains were procured from a local market in Ile-Ife. The grains were sorted, washed, disinfected with hypochlorite and the disinfected grains were spread out in a 60cm×30cm×6cm perforated galvanized sheet tray and covered with aluminium foil for 24 hours. The trays were then placed in the hydroponic chamber and watering was done thrice daily for the 7 days after which the hydroponic forages were harvested. Daily weight changes were recorded and Fodder yield was calculated according to the method of Fazaeli *et al.*, (2011) where:

$$\text{ForageYield}(\%) = \frac{\text{Weight at harvest (kg)} - \text{Weight at planting (kg)}}{\text{Weight at Harvest (kg)}} \times 100$$

Mat depth (clustered and intertwined roots) of the hydroponic fodder was measured with the aid of a graduated ruler. All data collected were subjected to analysis of variance and significantly ($P<0.05$) different means were separated using Duncan multiple range test of SAS (2003).

RESULTS AND DISCUSSION

Table 1 shows the mat depth and fodder yield of the selected grains' hydroponic fodders.There were significant differences (P<0.05) among the means of the mat depth and fodder yield.Mat depth ranged from 1.23cm (millet) to 3.65cm (guinea corn). Highest fodder yield was obtained for guinea corn (145.02%) and the least (26.54%) obtained for wheat.The result showed that guinea corn performed better than millet and wheat in this study. Millet and wheat have been reported to be highly susceptible to mould infestation (Myers, 1974). The cereals employed in this study were sourced from the open market which might have affected seed purity and germination capacity. The fodder yield recorded in this study were lower than reported values (Sneath and McIntosh, 2003; Naik *et al.*, 2013)but higher than the values reported by Odedire *et al.*, (2019). Variation in the hydroponic forage yield may be attributed to the purity of seed and degree of mould infestation.The fodder yield for wheat was the lowest as wheat has been reported to be highly susceptible to *Fusarium spp*. (Saharan and Neaf, 2008).

Table 1: Fodder yield and mat depth of the selected cereals used in hydroponic trials

Cereal type	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
Guinea corn	3.65^{a}	3.51^{a}	145.02^{a}
Millet	1.23^{c}	2.85^{b}	88.62^{b}
Wheat	3.19^{b}	1.87^{c}	26.54^{c}
P value	0.017	0.01	0.01

^{abc,} Means within Column with different superscript are significantly different (p<0.05)

Table 2: Effect of planting density on mat depth and fodder yield

Planting Density (kg/m^2)	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
0.56	2.39^{c}	2.03^{c}	69.77^{c}
0.83	3.23^{b}	2.81^{b}	87.05^{b}
1.11	4.64^{a}	3.39^{a}	103.35^{a}
P value	0.001	0.0001	0.0001

^{abc,} Means within Column with different superscript are significantly different (P<0.05)

Table 3: Fodder yield and mat depth as affected by watering volume

Watering volume(ml)	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
750	3.50^{a}	2.93^{a}	95.68^{a}
500	3.43^{ab}	2.78^{a}	86.95^{ab}
250	3.33^{a}	2.53^{b}	77.55^{b}
P value	0.0342	0.0219	0.0126

^{abc,} Means within Column with different superscript are significantly different (P<0.05)

Table 4: Effect of factors and their interaction on the fodder yield parameters

Parameters	Cereal type (P Value)	Planting Densities (P Value)	Watering Volume (P Value)	CT*PD (P value)	CT*WV (P value)	WV*PD (P value)	CT*PD*WV (P value)
Mat Depth(cm)	0.017	<.0001	0.37	<.0001	0.1423	0.012	0.0349
Folder yield (kg)	0.01	<.0001	0.002	<.0001	<.0001	0.001	0.0001
Percentage Increase in sprouted folder yield (%)	0.01	<.0001	0.013	<.0001	<.0001	<.0001	<.0001

*CT*PD: Cereal type * Planting Densities; CT*WV: Cereal type* Watering Volume; WV*PD: Watering Volume* Planting Densities; CT*PD*WV: Cereal type * Planting Densities*Watering Volume*

Table 2 shows the effect of the Planting density on the Mat depth and Yield of the hydroponic fodder. There were significant differences ($P<0.05$) among the means of mat depth and fodder yield, as the values of both the mat depth and fodder yield nearly doubled when planting density was increased from 0.56 to 1.11kg/m^2. Increasing the watering volume from 250ml to 500ml improved ($P<0.05$) the mat depth and the fodder yield of the cereals but the results of 500 and 750 ml were similar ($P>0.05$). The implication is that watering volume beyond 500ml will create a water logging effect if the tray has no facility for drainage which would eventually result in seed degeneration. The result obtained for the optimum watering volume contrasts Al-Karaki, (2010)who reported that about 1.5-2 litre is required to produce 1 kg of green fodder hydroponically, but agrees with the submission of the author that hydroponically grown fodder requires less amount of water to produce 1 kg green fodder in comparison to 73, 85 and 160 litres to produce 1 kg of green fodder of barley, alfalfa, and Rhodes grass under field conditions respectively.Table 4 shows the interaction effect of the factors on the mat depth and fodder yield. All the factors (watering volume, planting density and cereal types) significantly affect hydroponic fodder yield and mat depth production.

CONCLUSION

It was concluded from this study that Mat depth and Fodder yield are influenced by Watering volume, Planting densities and Cereal type. Guinea corn (*Sorghum bicolor*) gave the best performance among the cereals studied and Planting density of 1.11kg/m^2 with Watering volume of 500ml is recommended for optimum performance.

REFERENCES

Al-Karaki G. N. and Al-Momani, N. (2010). Evaluation of some barley cultivars for green fodder production and water use efficiency under hydroponic conditions," *Jordan Journal of Agricultural Sciences*. 7(3): 448-456

Fazaeli, H. A. Golmohammadi, A. A. Shoayee, N. Montajebi, and S. Mosharraf, S.H.(2011). Performance of feedlot calves fed hydroponics fodder barley. *Agricultural Science and Technology Journal* 13:367-375.

Lorenz, K. (1980). Cereal sprouts: composition, nutritive value, food applications.*Crit. Rev. Food Sci.* Nutr.13 (4): 353-385.

Myers,J.R.(1974).Feeding Livestock from the Hydroponic Garden.AgricultureDepartment.Phoenix, Arizona State University.

Naik P K, Dhuri R B, Swain B K and Singh N P. (2013). Nutrient changes with the growth of hydroponics fodder maize. *Indian Journal of Animal Nutrition* 29:161-163

Odedire J.A. (2018). Preliminary Investigation of Some Common Cereals as Sources of Hydroponic Fodder in the Tropics. *Proceedings of the 43rd Annual Conference of the Nigerian Society for Animal Production* held at the Federal University of Technology, Owerri, 18th – 22nd March, 2018. Pp.812 – 814.

Odedire J.A., Akinropo, T.F. and Oyarinde, O.D. (2019). Yield and Nutritive Value of Hydroponic Fodders as influenced by Frequency of Watering. *Proceedings of the 44th Annual Conference of the Nigerian Society for Animal Production* held at University of Abuja, Abuja, 21st–24th March, 2019. Pp.207 – 211.

Saharan, M.S. and Naef, A. (2008). Detection of genetic variation among Indian wheat head crab pathogens (*Fusarium spp,*/isolates) with microsatellite markers.*Crop protection*27: 1148 -1154. http:doi.org/10.1016/j.cropro.2008.01.008

SAS (2003). Statistical Analytical System institute SAS/STAT User's guide. SAS Institute, Cary North Carolina, USA.

Sneath R and Mclntosh F. 2003. Review of Hydroponic Fodder Production for Beef Cattle. Queensland Government, Department of Primary Industries, Dalby, Queensland. 54pp.

EFFECT OF ORGANIC AND INORGANIC MANURE ON CHEMICAL COMPOSITION AND *IN SACCO* DEGRADABILITY OF GAMBA GRASS (*ANDROPOGAN GAYANUS*) HARVESTED AT FOUR WEEKS

[1]ONWIH, E.E & [2]MILLAM, J.J

[1]Department of Animal Science, University of Abuja.[2]Department of Animal Science Adamawa State University Mubi.

Corresponding author: orokstar@gmail.com

ABSTRACT

This study was aimed at assessing the long time effect of organic and inorganic manure (control, pig waste, poultry litter, cow dung and NPK fertilizer) on the nutritive value and digestibility using the nylon bag technique. The experiment was carried out at the teaching and research farm University of Ibadan between March and September 2014. Seedlings of *A. gayanus* were planted on a total land area of 1382.5m^2 which was cleared and subdivided into 30 sub plots of 4m x 4m with 1m within and between plots respectively. The experiment was laid out in a completely randomized design of five manure treatments i.e cow dung, pig waste, poultry litter, NPK 15:15:15 and control. The Manure type affected ($p<0.05$) CF, ASH ADF and NDF but had no ($p>0.05$) effect on CP, DM and NFE and potential degradability. It was recommended from this study that farmers should adopt the use of organic manure of animal origin such as pig waste, cow dung and poultry litter respectively as a viable alternative for ease of establishment of this grass species as livestock feeds in order to remove competition with humans on conventional feed stuff.

Keyword: *Andropogan gayanus*, manure, digestibility.

INTRODUCTION.

It is the portion of the digestive tract known as the rumen and its distinctive population of microorganism that provides ruminants with the genetic potential to derive energy from widely varying fibrous feeds. The nutritional values of forage species are low in the dry seasons compared to the wet season Buxton, (1996). Concentrations of nutrients according to McDowell *et al.,* (1983) in forage plants are dependent upon the interaction of a number of factors. Such as plant species, soil type, plant age, pasture management and climate. Most soil used to grow plants, including ornamentals, grass and vegetables, needs its basic nutrients replenished over time. Fertilizers boost the soil's reserves of elements essential to the healthy growth and development of plants. Although conventional and organic fertilizers both add needed nutrients to the soil, organic fertilizer differs because it is derived from natural sources as opposed to being synthetically manufactured. Although organic and synthetic fertilizers add the same nutrients to the soil, organic fertilizers work in a different way. Organic fertilizers work double duty by providing required nutrients to growing plants while also feeding the soil. In Nigeria, forage species still serve as source of essential elements for grazing animals. However, little information is available on the nutrient status of grazing animals and of the forages upon which they subsist. Onyeonagu *et al*., (2013) It therefore becomes essential to replenish the soil with the nutrient elements to increase the forage production, improve nutrient quality of forage and to enhance establishment of range land. Farmers mostly use inorganic fertilizer but the usual unavailability of these fertilizers alongside it high price and potential pollution effect on the environment makes organic manure a veritable alternative.

MATERIALS AND METHOD

The experiment was carried out at the teaching and research farm of the University of Ibadan. An area of 1382.5m^2 was mapped out ploughed and allowed to rest for a period of two weeks before harrowing. The area was divided into two blocks and each block was subdivided into 60 sub plots of 4m x 4m with 1m within and between plots respectively. The grass seedlings were planted at a depth of 2cmwith a spacing of 1m x1m within and between rows with a total of 16 planting spots per plot. The grasses were planted in the month of March and were cut back to a height of 15cm for data collection in the month of July. Basal application of manures (treatment) was done three weeks after the emergence of the grass.

The experiment was laid out in a completely randomized design CRD Weed control was done manually with the use of a hoe throughout the experimental period.

Chemical composition: Crude protein, crude fibre, ash and ether extract were determined according to the method of AOAC (1990) and fibre analysis was carried out using the method of Van Soest *et al.* (1991).

Determination of Degradability

In determining the degradability of the experimental grass, the rumen degradability study of the grass were carried out at the intensive care unit of the Department of Animal Science University of Maiduguri using two fistulated bulls fitted with a stable cannulae.

Procedure

3g of the milled sample were weighed into a nylon bag each measuring 5x10cm with a pore size of 50microns. The nylon bags with the samples were inserted in to the rumen via the cannulae with the use of a sample holder. The sample holder was perforated to allow the movement of rumen microbes in and out of the sample holder as well as coming in contact with the feed sample but not the sample bags out of the holder. The sample holder serves as a confinement for the nylon bags for easier evacuation /removal of the bags from the rumen after incubation. The nylon bag with the sample is incubated for a period of 6, 12, 18,24,36,48 and 72 hours respectively to be incubated (digested) then evacuated. After evacuation of the nylon bag from the rumen of the bull, the cannulae and area surrounding it was cleared of rumen content, spillage and disinfected with the use of a disinfectant (dettol) the nylon bag with the sample was rinsed under tap water immediately to stop further fermentation. The residue was the oven dried at 60°c for 24 hours and weighed. The degradability was calculated as the difference in weight between the initial weight of the sample and the final weight of the sample before and after incubation respectively (McDonald 1995). Dry matter disappearance was determined as

$$\% \text{ DMD} = \frac{A - B}{A} \times 100$$

Where A= initial weight before incubation, B= final weight after incubation.

3.3 Statistical Analysis

Data obtained were subjected to Analysis of Variance (ANOVA) using SAS (2010) and means were separated using Duncarn multiple range test of the same package.

RESULTS AND DISCUSSION

Chemical composition of *ANDROPOGON GAYANUS*

TABLE 1. Main effect of manure type on chemical composition of *Andropogon gayanus kunt (g/100g)*

TREATMENT	CP	CF	EE	DM	ASH	ADF	NDF	NFE
CONTROL	7.9600^{b}	24.4889^{a}	6.2433^{c}	39.3889^{a}	5.1633^{a}	51.0833^{a}	58.8833^{a}	17.1956^{a}
NPK	8.2311^{ab}	23.60889^{c}	6.54222^{ab}	40.1889^{a}	4.8722^{bc}	49.8000^{b}	57.7667^{b}	16.5567^{a}
CD	8.2656^{ab}	23.52^{d}	6.48444^{b}	39.6444^{a}	4.94556^{b}	50.9833^{a}	58.7000^{a}	17.2811^{a}
PL	8.7800^{a}	23.72333^{b}	6.50667^{ab}	40.1333^{a}	4.84778^{c}	50.333^{ab}	58.9667^{a}	16.0089^{a}
PW	7.8922^{b}	23.6733^{bc}	6.63111^{a}	40.3667^{a}	4.71889^{d}	50.6833^{ab}	57.9833^{b}	16.7178^{a}

,b,c: means on the same column with different super superscript are significantly different($p<0.05$).
CD= cow dung, PW= pig waste, PL= poultry litter, NPK fertilizer, SEM= Standard error of mean.

The neutral detergent fibre (NDF) which is a measure of the plant cell wall content is the chemical component of the feed that determines its rate of digestibility. NDF is inversely related to plant digestibility (Mc Donald *et al*.1995; Gillespie 1998.) NDF in grasses results in longer retention time and reduces feed intake by ruminants. The higher the NDF the lower the plant digestible energy. The NDF value observed in this study was lower than 75% reported by Babayemi and Odedire (2008). The highest value of 58 .966 % was recorded at poultry litter treated A. gayanus was lower than 60%

reported by Babayemi and Odedire (2008) for A gayanus.. ADF value ranges between 49.80- 51.08% This variation may be due to the fact that the complete plant at harvesting period was chopped and milled together for this analysis. Bamikole and Babayemi *et al.,(*2006) also reported that stages of harvesting , storage, fertilizer application, soil fertility, climate and region could affect chemical composition. The dry matter content ranges between 39.38.- 40.36%. The crude protein content of the grasses were significantly different ($p<0.05$) the crude protein value obtained in this study ranges between 7.89- 8.78% .The variation in CP with that of the cited authors could be as a result of change in climate as well as the nitrogen content of the soil. Bamikole and Babayemi (2006) observed that Cp of grasses intercropped with legumes increases as a result of nitrogen fixation in to the soil by legumes. The crude fiber content varies significantly ($p<0.05$) which ranges between 23.52-24.48%.The value was lower than that reported by Mohammed *et al* .,(2002) who reported 31% CF in hay of A gayanus. Crude fiber content tends to increase as the plant matures Waziri *et al.*,(2013) reported that CF increases as plant matures this makes the plant tensile, strong, erect for exposure to needed sunlight , maturation of seeds and easy harvesting. The ether extract varies significantly ($p<0.05$) across the treatments with respect to harvesting stage (maturity). The value obtained in this study ranges between 6.24-6.63% The value obtained was lower than 9.20 repoted by Waziri *et al*.,(2013) Ether extract found mainly on the leaves of plants assists in the formation of protective layers constituent of many membrane and major source of stored energy. The ash content value ranges from 4.71-5.16%. The value obtained was lower than 10.50 reported by Babayemi and Odedfire(2008) and also lower than the range of 7- 12% as observed by AFRIS (1980) and Duke (1983) although there was no specification on the stage of maturity for the determination of their ash values. The difference could be due to high absorptive capacity of mineral elements from the soil by the plant and its perennial nature. These study observe that the ash value tends to increase as the plant matures since the organic matter content of plants are determined by the difference in ash content in percentage from 100. It's a clear indication that the lower the ash content the higher the organic matter.

Dry Matter Disappearance

Table 2 Main effect of manure type and age at harvesting on Percentage disappearance of *Andropogon gayanus Kunt(% ml/200mg)*

TREATMENT	6HRS	12HRS	18HRS	24HRS	36HRS	48HRS	72HRS
CONTROL	47.767[a]	49.875[a]	55.484[a]	61.323[a]	70.946[a]	77.731[a]	79.032[a]
NPK	49.122[a]	52.161[a]	57.173[a]	63.402[a]	74.032[a]	80.731[a]	82.321[a]
CD	49.475[a]	52.846[a]	57.769[a]	64.020[a]	74.643[a]	81.354[a]	82.961[a]
PL	48.898[a]	52.156[a]	56.906[a]	62.971[a]	72.280[a]	78.926[a]	80.427[a]
PW	49.170[a]	52.479[a]	57.510[a]	64.489[a]	74.336[a]	81.174[a]	82.651[a]

The dry matter disappearance observed in these study was within the range of 79.032- 82.961% The 72hr period of incubation was the period in which grasses were expected to reach their potential degradability as reported by Orskov and Mc Donald (1979).

Effective Dry Matter Degradability

Rumen turnover rate which is the sum of passage rate and degradation rate in the rumen are not only influenced by intrinsic plant characteristics but also by extrinsic factors with in the rumen environment such as rumen pH, rumination, absorption and stimulation of microbial population At 72hrs incubation periods the cow dung treated forages had higher dry matter degradability value than the control. The digestibility of a feed stuff is defined by the potential degradability of the material, the rate of degradation of this potential degradable fraction and its residence time in the rumen (Orskov *et al., 1980*).

CONCLUSION

These study shows that *A.gayanus* can be cultivated in south western Nigeria with the use of organic manure to obtain a high quality yield that can meet the nutrient needs of grazing animals at a lower cost and higher yield compare to the use of inorganic manure which has high cost and low long time effect on the soil. These study shows that *A.gayanus* responds well to organic manure and yields high nutritional content and digestibility. This was observed in the rate of disappearance from the nylon bag with respect to incubation period with organic manure treated forages showing the highest rate of potential degradability.

REFERENCES

AFRIS(1980) *A. gayanus* and *P. pedicellatu.,* htm, Animal Feed Resources Information System pp1-5

AOAC,(1990). Official Methods of Analysis of the Association of Official Analytical Chemists.15th edition, Kenneth Helrich (ed.), Arlington, Virginia, pp. 40-50, 70, 80-81, 237-238.

Babayemi O.J, Bamikole M.A, Omojola A.B (2006) Evaluation of the nutritive value and free choice intake of two aquatic weeds (Nephrolepisbiserarte and spirodelapolyrhiza) by WAD goats. Tropical and sub-tropical agro-ecosystem 6 : 15 - 22.

Babayemi, O.J. and M.A. Bamikole, (2006). Effects of *Tephrosia candida* DC leaf and its mixtures with Guinea grass on in vitro fermentation changes as feed for ruminants in Nigeria. Pakistan Journal of Nutrition, 5(1):14 - 18.

BABAYEMI Olaniyi Jacob*, Musbau Adungbe BAMIKOLE (2006). Nutritive value of Tephrosia Candida seedin west African dwarf goats. Journal of Central European Agriculture Vol 7 No 4

Buxton DR (1996). Quality related characteristics of forages as influenced by plant environment and agronomic factors. Anim. Feed Sci. Technol. 59:37-49.

Babayemi OJ, Bamikole MA (2006). Supplementary value of *Tephrosia bracteolata*, *Tephrosia candida*, *Leucaena leucocephala* and Gliricidia, septum hay for West African dwarf goats kept on range. J. Cent. Eur. Agric. 2:323-328.

Duke A J (1980) .Hand Book of Energy Crops, Unpublished. Pp 1-4.

Gillespie JR (1998). Animal Science. Delmar publishers, International Thompson Publishing Company, p. 1204.

Mc Donald, I. (1981). A revised model for the estimation of protein degradability in the rumen. *J. Agric. Sci*. (Camb) 96:251-252.

McDowell, L.R., M. Kiatoko, J.E. Bertrand, H.L. Chapman, F.M. Pate, F.G. Martin and J.H.Conard. (1982). Evaluating the nutrition status of beef cattle from four soil order regions of Florida: II. Trace minerals. *J. Anim. Sci.*, 55: 38-47.

McDonald P, Edwards RA, GreenHalgh JFD, Morgan CA (1995). Animal nutrition, 5th edition, Longman, U.K., 607 pp

Odedire JA, Babayemi OJ (2008). Comparative studies on the yield and chemical composition of *Panicum maximum* and *Andropogon gayanus* as influenced by *Tephrosia candida* and *Leucaena leucocephala*. Livest Res Rural Dev, 20(2): 1-8.

Onyeonagu, C. C., Obute, P. N. and Eze, S. M (.2013) Seasonal variation in the anti-nutrient and mineral components of some forage legumes and grasses African Journal of Biotechnology Vol. 12(2), pp. 142-149, 9 January, 2013

Ørskov, E.R. and I. McDonald (1979). The estimation of protein degradability in the rumen from incubation, measurement weighed according to rates of passage. *J. Agric sci*. (Cambridge). 92:499-503.

Van Soest PJ, Robertson J B, Lewis B A (1991) Methods for dietary fibre, neutral detergent fibre, and non starch polysaccharides in relation to animal nutrition. J Dairy Sci 74:3583-3597

Waziri A. E, Anka S A, Bala A Y and Shehu H (2013). A comparative analysis of nutrient and mineral elements content of Andropogan gayanus Kunt and Pennisetum pedicellatum Trin Nigeria journal of basic and applied science 21(1) 60- 64

EVALUATION OF SELECTED CEREAL STOVER HAYS FOR NUTRIENT COMPOSITION AND *IN VITRO* GAS PRODUCTION IN WUKARI, NIGERIA

***A.J., Amuda[1], R.T., Binuomote[2] & R.D., Isaac[1]**

[1]Department of Animal Production and Health, Federal University Wukari, Taraba State.

[2]Department of Animal Production and Health, LAUTECH, Ogbomosho, Oyo State. ***Corresponding author:*** *A. J. Amuda; E-mail: aademolajoseph@gmail.com; +2348039288427*

ABSTRACT

An experiment was conducted to determine the nutrient composition and *in vitro* gas production from six (6) cereal stovers hays in Teaching and Research Farm of Federal University, Wukari, Taraba State, Nigeria. Fresh stovers of maize, sorghum, pearl millet, finger millet, rice and acha were harvested, chopped and air-dried in late October and early November, 2018. The experimental design was Completely Randomised Design (CRD) and each treatment (each stover) was replicated three times. The *in vitro* gas production was carried out in laboratory using standard technique. The results showed that DM, CP, CF, NFE, EE, Ash, OM, CHO and fibre fractions (NDF, ADF, ADL),cellulose and hemicellulose of the selected cereal stovers hay were significantly ($P < 0.05$) different from each other except for ether extract (EE) that was similar across the treatments. Sorghum stover hay (T_3) had the highest DM value of 92.69% while T_1 had the highest CP contents of 11.78% CP. However, T6 had the highest CF value (34.00%) of all the selected cereal stovers. The *in vitro* gas production parameters such as CH_4, TGV, FE, OMD, (DMD, SCFA and ME varied significantly ($P < 0.05$) across the treatments. The TGV was highest (24.67ml) in T_2 (finger millet stover) and least (16.67ml) in T_3 (sorghum stover). The results of this study indicated that T_1 (rice stover hay) had over all best nutrient composition and *in vitro* gas production assessment.

Keywords: Cereal stovers, chemical composition, hay, *in vitro* gas production, ruminants

INTRODUCTION

In feeding livestock, the aim is to provide the animals with a balanced ration throughout the year with sufficient nutrients to meet the animal's nutrient requirements for maintenance and production. The major constraint to livestock production is feed both in quality and quantity. In Nigeria, forage and fodder supply during the dry season and drought periods is a very important factor limiting livestock productivity. Shortage of feed resources often imposed major constraints on the development of animal production in the tropics and sub-tropics. Considerable quantities of crop residues are generated every year in most developing countries in the tropics and sub-tropics which are suitable for feeding livestock. An intensive feeding system based on locally available agro-industrial by-products and crop residues is an alternative promising feeding system to rear ruminants economically. Ruminants because of their rumen physiological adaptation can utilise inexpensive agro-industrial by-products and crop residues to meet their feed requirements for maintenance, growth, and production. Agro industrial byproducts and crop residues in the diets of ruminants support growth, lactation and result in the production of human edible food. Although most have low nitrogen content, more fibre as well as low nutrient density, effective processing can raise their nutritive value (Areghore, 1994). Little information is available on the extent to which small holder farmer in Nigeria use crop residues as livestock feed. It is very likely, however, that these resources are under-utilised. Even when they are utilised, farmers may not be able to incorporate them efficiently into their year-round livestock feeding programmes because they lack suitable storage facilities and technical know-how on treatment and processing methods and on formulating feed ration. The selected cereal stovers hay (maize, sorghum, pearl millet, finger millet, rice and acha) are major food crops cultivated in northeast Nigeria. Most of these cereal stovers are left on the field to waste after harvesting the main crops.

Consequently, there is need to examine their potential feed value for ruminant animals production. Thus, a study was carried out to determine the chemical composition and evaluate nutritive value of selected cereal stover hay using *in vitro* fermentation technique.

MATERIALS AND METHODS

Experimental Site

The study was carried out at Teaching and Research Farm of the Federal University Wukari Taraba State, North-East Nigeria. Wukari is located on Latitude 7^0 51^1 North and Longitude $9^{tl}47^1$ East. Wukari is situated at elevation 189 metres above the sea level and has a mean annual rainfall of 1300mm. The maximum annual temperature ranges between 30^0C and 39.4^0C while the minimum annual temperature is between 15^0 and 23^0C (Oyatayo *et al*., 2015).

Harvesting and Hay Making

Freshly harvested green cereal stovers (maize, sorghum, pearl millet, finger millet, rice and acha) were collected from Crop Production Teaching and Research Farm of Federal University Wukari and processed into hay. The harvesting was done in the month of October and November 2018 and the samples were collected in batches. Harvested cereal stovers were chopped with cutlass into 3-5cm size (for easy drying). Thereafter, the chopped materials were air-dried under shed for two weeks on concrete. The chopped cereals stover were constantly turned-over to ensure uniform drying and prevent mouldness and loss of nutrients. The chopped cereal stovers were then weighed and divided into equal portions (1kg) and each of the cereal stover serve as experimental treatment making six treatments. Treatment A = Maize Stover (MS); Treatment B = Sorghum Stover (SS); Treatment C = Pearl Millet Stover (PMS); Treatment D = Finger Millet Stover (FS); E = Rice Stover (RS) and F = Acha Stover (AS). All were replicated three times in a completely randomized design. However, the samples for laboratory analysis were oven dried at 65^oC and milled by 'MG 123' grinder. The samples were ground in the laboratory with hammer mill of 1mm sieve and subjected to chemical analysis for determination of dry matter (DM), organic matter (OM), crude protein (CP), crude fibre and nitrogen free extract as described by AOAC (2002). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were assayed by the method of Van Soest *et al,* (1991). Hemicellulose was calculated as the difference between NDF and ADF and cellulose as the difference between ADL and ADF.

In vitro study

The rumen fluid was collected through the suction method by means of the hose from three West African Dwarf (WAD) goats under the same feeding regime. The animals were fed with 40% concentrate feed (40% corn, 10% wheat offal, 10% palm kernel cake, 20% groundnut cake, 5% soybean meal, 10% dried brewers grain, 1% common salt, 3.75% oyster shell and 0.25% fish meal) and 60% Guinea grass. The rumen fluid was collected into a thermos flask that had been pre-warmed to a temperature of 39^0C before morning feeding and taken to the laboratory. It was filtered through a four-layered cheese cloth into a warm flask, flushed with carbon dioxide (CO2) gas, and stirred using an automatic stirrer. Incubation was done as reported by (Menke and Steingass, (1988) using 120ml calibrated syringes in three batch incubation at 39^0C into 200mg sample in the syringe was introduced using 30ml inoculums containing strained rumen liquor and buffer ratio (1: 4 v/v) under continuous flushing with CO2. The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24hr. At post incubation period 4ml of NaOH (10 M) was introduce to estimate methane production as reported by Fievez et al., (2005). The volume of the gas produced at intervals was recorded. Metabolisable energy (ME) was calculated as ME = 2.20 + 0.136 GV + 0.057CP + 0.0029CF (Menke and Steingass, 1988). Organic matter digestibility (OMD) = 14.88 + 0.889 GV + 0.45 CP + 0.651 XA. Short chain fatty acids (SCFA) as 0.0239GV - 0.0601(Getachew et al., (1998) was also obtained, where GV, CP, CF and XA are total gas volume (ml/200mg DM), crude protein, crude fibre and ash, respectively. Data collected were subjected to Analysis of Variance (ANOVA) using statistical package for social sciences(SPSS) version 23 and significant means were separated by the use of Duncan' Multiple Range Test.

RESULTS AND DISCUSSION

Chemical composition of selected cereal stovers hay

Table 1 showed the chemical composition of selected cereal stovers hay (Rice, Finger millet, Sorghum, Maize, Pearl millet and Acha). The T_1 (rice stover hay) ($p<0.05$) was significantly higher both in crude protein (11.78%) and ash content (14.40) while T_4 (Maize stover hay) was significantly $P<0.05$) higher (34.00%) in CF compare to other cereal stover hays. Similarly, T_3 (sorghum stover hay) was significantly ($P<0.05$) higher in DM (92.69%), OM (91.65%) and CHO (80.73%) respectively. The crude protein contents which was the major nutrient of the selected cereal stovers hay ranged (8.90 -11.78%) was higher than the critical value of 7.0% recommended by National Research Council (NRC 1981) and also higher than the minimum CP level of 7% required for optimum rumen function (Van Soest, 1994).

Tab le 1: Chemical composition (g/100g DM) of selected cereal stovers hay

Treatments

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Dry Matter	92.56^{ab}	91.69^{c}	92.69^{a}	92.10^{bc}	92.14^{bc}	91.91^{c}	0.30
Crude Protein	11.78^{a}	11.70^{a}	9.60^{b}	8.90^{b}	9.35^{b}	9.05^{b}	0.92
Crude Fibre	31.62^{a}	32.00^{a}	31.05^{b}	31.55^{b}	31.53^{b}	34.00^{a}	1.67
Nitrogen Free Extract	40.52^{c}	43.55^{b}	48.42^{a}	48.15^{a}	43.71^{bc}	44.95^{ab}	2.33
Ash	14.40^{a}	11.50^{b}	8.35^{c}	10.75^{b}	14.20^{a}	10.80^{b}	0.72
Ether Extract	1.15	1.25	1.20	1.15	1.20	1.20	0.11
Organic Matter	85.60^{b}	76.94^{c}	91.65^{a}	89.25^{b}	85.80^{b}	89.78^{b}	1.06
Carbohydrate	72.81^{c}	75.55^{b}	80.73^{a}	79.20^{a}	75.25^{b}	78.95^{a}	1.31

a,b,c= means on the same row with different superscripts are significantly ($P<0.05$) different.

T_1 = Rice stover, T_2 = Finger millet stover, T_3 = Sorghum stover, T_4 = Maize stover, T_5 = Millet stover, T_6 = Acha stover, SEM = Standard Error of Mean

Fibre fraction of selected cereal stovers hay

Presented in Table 2 is the fibre fractions (NDF, ADF, NDS, ADL, Cellulose and Hemicellulose) of selected cereal stovers. There were significant ($P<0.05$) differences among treatments, except for ADF which was similar across the treatments. Fibre fractions (NDF, ADF, ADL) and cellulose were significantly ($P<0.05$) higher in T_5 (Pearl millet stover hay) compare to other cereal stovers hay. The fibre fractions, cellulose and hemicellulose of the selected cereal stovers hay are relatively low, therefore ruminants can digest them.

Table 2: Fibre fractions (g/100g DM) of selected cereal stovers hay

	Treatments						
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**SEM**
NDF	65.05^{abc}	65.41^{ab}	63.81^{bc}	63.21^{c}	66.52^{a}	66.26^{a}	1.20
ADF	45.32^{b}	45.66^{b}	45.01^{b}	44.16^{b}	47.51^{a}	44.34^{b}	1.11
NDS	0.36^{d}	1.83^{d}	9.83^{a}	8.09^{b}	0.87^{d}	4.0^{c}	1.04
ADL	22.03^{b}	21.49^{b}	21.61^{b}	21.41^{b}	23.05^{a}	21.64^{b}	0.58
Cellulose	23.28^{b}	23.17^{b}	23.40^{b}	22.75^{b}	24.46^{a}	22.71^{b}	0.58
Hemillulose	19.69^{ab}	20.75^{ab}	19.13^{b}	19.05^{b}	19.01^{b}	21.92^{a}	1.63

a,b,c = means on the same row with different superscripts are significantly ($P<0.05$) different.

T_1 = Rice stover (RS), T_2 = Finger millet stover (FMS), T_3 = Sorghum stover (SS), T_4 = Maize stover (MS), T_5 = Pearl Millet stover (PMS), T_6 = Acha stover (AS), NDF = Neutral Detergent Fibre, ADF = Acid Detergent Fibre, NDS = Neutral Detergent Soluble, ADL = Acid Detergent Fibre, SEM = Standard Error of Mean

In vitro fermentation parameter of selected cereal stovers hay

Table 3 showed the *in vitro* gas fermentation parameter of selected cereal stovers hay. The parameters observed differs significantly ($P<0.05$) across the treatments. The *in vitro* gas fermentation technique

provided a useful basis from which metabolisable energy (ME), organic matter digestibility (OMD), short chain fatty acid (SCFA) and methane (CH_4) production of feeds samples be measured. The values of ME (5.14-6.23) obtained among the treatments were significant. The *in vitro* fermentation technique has been widely used to evaluate the energy value of several classes of feed (Getachew *et al.,* 1998).The OMD is said to be a measure of degradability potentials of the microbes on the substrate in the presence of sufficient ammonia nitrogen (NH_3-N) that has influence on bacteria fermentation. The values (45.54-52.58%) obtained were higher than ranged values (35.45 - 46.0%) reported by Falola *et al.,* (2015) for vetiver grass *(Chrysopogon zizanioides L., Roberty)* and 36.45 - 45.93%) reported by Alasa *et al.,* (2010) for *Panicum maximum* intercropped with two cultivars of *Lablab purpureus.* Similarly, SCFA ranged values (0.36 - 0.53ml) obtained in this study were higher than the ranged values (0.31 - 0.36ml) reported by Alasa *et al.,* (2010) but relatively inclined to range values (0.42 - 0.68ml) reported by Falola *et al.,* (2015).The ranged values of OMD, DMD, ME, SCFA and TGV indicated that the cereal stovers are degradable, digestible and could provide energy to ruminants animals.

Table 3: *In vitro gas* fermentation parameters of selected cereal stovers hay

Parameters	Treatments						
	T_1	T_2	T_3	T_4	T_5	t_6	SEM
TGV (ml)	18.67^{b}	24.67^{a}	16.67^{b}	18.00^{b}	18.67^{b}	17.33^{b}	5.94
CH_4 (%)	13.33^{b}	17.33^{a}	9.33^{c}	10.67^{c}	11.33^{c}	12.00^{b}	5.14
FE (g/GVml)	4.07^{ab}	2.86^{c}	5.62^{a}	3.62^{b}	3.84^{b}	3.59^{b}	2.17
OMD (%)	47.30^{ab}	52.58^{a}	45.54^{b}	49.64^{ab}	47.30^{ab}	46.12^{b}	5.75
DMD (%)	74.67^{a}	69.80^{ab}	66.77^{ab}	69.67^{ab}	70.93^{a}	61.40^{b}	7.60
ME (MJ/Kg DM)	5.42^{ab}	6.23^{a}	5.14^{ab}	5.78^{a}	5.42^{ab}	5.24^{ab}	0.89
SCFA (^ml)	0.39^{b}	0.53^{a}	0.34^{c}	0.45^{ab}	0.39^{b}	0.36^{b}	0.16

a,b,c= means on the same row with different superscripts are significantly ($P<0.05$) different.

T_1 = Rice stover, T_2 = Finger millet stover, T_3 = Sorghum stover, T_4 = Maize stover, T_5 = Pearl millet stover, T_6 = Acha stover, TGV =Total Gas Volume, CH_4 = Methane, FE = Fermentation Efficiency, OMD = Organic Matter Digestibility, DMD = Dry Matter Degradability, ME = Metabolisable Energy, SCFA = Short Chain Fatty Acid, SEM = Standard Error of Mean

CONCLUSION

It was concluded from this study that rice stover hay (T_1) was higher in nutrient (crude protein), dry matter and DMD as revealed by chemical composition and *in vitro* gas production compare to other stover hays.

REFERENCE

A.O.A.C. 2002. Official methods of Analysis of the Official Analytical Chemists, 17th Edition (Horwitz, W., ed.), Association of Official Analytical Chemists, Washington D.C.

Alasa, M.C, Akinsola, S.O, and Babayemi, O.J (2010). Chemical composition and in vitro gas production of *Panicum maximum* intercropped with two cultivars of *Lablab purpureums.* Babayemi, O.J., Abu, O. and Ewuola, E.O. (Eds). Proceedings of the35th Nigerian Society for Animal production, 14 - 17th March. 2010; 587-590.

Aregheore, E. M. 1994. Potential of crop residues in Ruminant nutrition during the hot dry season in *Zambia Journal of Agricultural Science* 4; 39-42.

Falola, O.O., Adedeji, O. Y., Saka, A.A. Areegbe, A.O and Adisa, A.F. (2015). *In vitro* Evaluation of 4, 6 and 8 Weeks Re-growths of Vetiver Grass (Chrysopogon zizanioides L. Roberty). Proceedings of 40th Annual Conference of Nigerian society for animal production NAPPRI/Ahmadu Bello University, Zaria 2015. Pp. 464 - 467.

Getachew, G., Blummel, M., Marker, H. P. S. and Becker, K. 1998. *In vitro* gas measuring Techniques for assessment of nutritional quality of feeds. A review. *Animal Feed Science Technology,* 72: 261 - 281

Menke, K. H. and Steingass, H. 1988. Estimation of the energetic feed value from chemical analysis and *in vitro* gas production using rumen fluid. *Animal. Research. Development.* 28: 7 - 55.

NRC 1981. Nutrient Requirements for goats. Angora dairy and meat goat in temperate and tropical countries. National Research Council, National Academy of Science Press. Washington, DC., U.S.A.

Oyatayo T. K., Songu A. G., Amos A. G. and Ndabula C (2015). Assessment of heavy metal concentration in hand dug well water from selected land uses in Wukari Town, Wukari, Taraba state Nigeria. *Journal of Geoscience and Environmental protection* (3): 1-10.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. (1991). Methods for dietary fiber-neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science.* 74: 3583 - 3597.

COMPARATIVE NUTRITIONAL AND ANTI–NUTRITIONAL COMPOSITION IN CUCUMBER (*CUCUMIS SATIVUS*) AND SPONGE GOURD (*LUFFA AEGYPTICA*) SEED MEALS.

Obun, C. O., OLUSIYI, A.J. and Audu, A

Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari, PMB 1020, Kastina Ala Road Wukari, Taraba State

Corresponding Author: obunotu@yahoo.com Phone: 08032452529

ABSTRACT

The proximate, anti-nutrient and amino acid concentrations of *Luffa aegyptica* and *Cucumis sativus* decorticated seed meals were determined using methods described by Benitez (1989); Anhwange *et al*. (2004) and AOAC (2006). Results of the investigation revealed the moisture content 3.75-4.43%, protein (32.18-33.92%), crude fibre (6.01-7.42%), crude fat (29.38-34.37%), ash (4.55-4.89%) and NFE (15.3-23.79%) respectively. The anti-nutrient components for *C. sativus* are low for oxalate (0.05%), alkaloid (1.38%),phytate (0.05%) and tannin(15.38%) except for saponin (1.29%) compare with values of 0.08% oxalate, 2.98% alkaloid, 0.07% phytate, 24.64% tannins and 0.33% saponin) obtained for *L.aegyptica seed meal.* The amino acid compositions of *C.sativus* and *L.aegyptica* seed meals were comparable with arginine (6.54-7.37g/100g) and leucine (6.60-6.89g/100g) the most concentrated essential amino acids while the glutamic acid (12.57-13.47g/100g) was the most concentrated non-essential amino acid. The study shows that *C.sativus* and *L aegyptica* seed contain sufficient amount of nutrients and minimal constituents of anti-nutrients. These seeds are potential sources of food and feed for human and livestock.

Keywords: Proximate composition, Anti-nutrients, Amino Acid, *Luffa aegyptica, Cucumis sativus seed*

INTRODUCTION

The family *Cucurbitaceae* consists of members commonly known as melons and gourds that include cucumbers, squashes, luffa and melons (Azzez, *et al*., 2013), consisting of climbing and scrambling herbs with either simple or branched tendrils. *Luffa aegyptica* grows well in a well-drained soil that is rich in organic waste. The leaves are oval, simple, deeply five to seven lobed- dentate, dark green and frequently hairy. The fruits are smooth and cylindrical shaped with white flesh. The mature fruits are the source of the spongy reticulated material used for sponges and filters and for stuffing pillows, saddles and slippers, for bathing and cleaning dishware (Oboh and Aluyor, 2009). Several studies on the nutrient and anti-nutrients have been reported in *Luffa aegyptica* seed meal (Dairo, 2008; Abitogun *et al*. (2010). The *Cucurbita pepo'L* (commonly known as Cucumber fruit*s)* has been essential crop in the Andes since the pre-columbian era. It is a seasonal crop used as human food, the fruit is eaten fresh, processed in different ways as dried, frozen, fried, candied or pickled (Teotia, 1992) while the seeds are utilized directly for human consumption as snacks after salting and roasting in Arabian countries (Al khalifa, 1996). Studies have shown that fruits and vegetables contain among other vital nutrients, an appreciable quantity of carbohydrate, proteins, fats, fibers, and phytochemicals (Kubola *et al*., 2011). Despite the numerous nutritional benefits from fruits only a small portion of plant material is utilized directly for human consumption (El-Adawy *et.al*.1999), the remainder part may be converted into nutrient for either food or feed or into fertilizer. However, there is paucity of information on the amino acid and anti-nutrients of the luffa seeds grown in the study area. Hence this study was designed to determine the proximate, amino acids and the anti-nutrient contents of luffa and cucumber seed meals to encourage the utilization by human and as animal feed to reduce large quantity of waste seeds.

MATERIALS AND METHODS

Luffa aegyptica fruits were collected from experimental plots of department of Forestry and Wildlife management and its environs while *cucumber* fruits were collected from the Department of Crop Protection both in Federal University Wukari, Taraba State. The fruits were opened and seeds removed, washed with water and sun-dried before decorticated manually and grounded into powdered form. The powdered seeds were kept in an air-tight container and stored in a refrigerator prior to the analysis. The decorticated sponge gourd and cucumber seeds were analyzed in duplicate for proximate composition of moisture, crude protein, crude fibre, ash, ether extract and nitrogen free extract using

AOAC (2006) methods. The anti-nutritional factors for saponin, Phytate, Oxalate, alkaloids, and tannins were determined using methods described by Anhwange *et al*.(2004).The Amino Acid profile of decorticated seed meals were determined using methods described by Benitez (1989) and AOAC (2006).

RESULTS AND DISCUSSION

The results in Table 1 shows that cucumber moisture content of 4.44%, 34.37% (fat), (33.92% (crude protein) and 7.42% (crude fibre) are higher compared with *L.aegyptica* seed values of 3.75% moisture, 29.38% ash, 32.18% CP and 6.01% CF. *L aegyptica* result is similar to earlier reports by Amoo *et al.* (2008) and Dairo *et al*. (2013) except for ether extract which is above these authors. The analyzed cucumber seed results are in agreement with those reported by Uruah *et al.* (2011) and Niyi *et al.* (2019) but disagreement with lower values reported by Abulude *et al.* (2007).The analyzed results of *C.sativus* and *L.aegyptica* seed meal were higher than those reported for water melon by Fila *et al.* (2013).

Table 1: Proximate composition of decorticated Cucumber and Sponge gourd seed meals (% DM)

Seed meal	Moisture	Protein	Crude Fibre	Ether exyract	Ash	NFE
Cucumber	4.43	33.92	7.42	34.37	4.55	15.31
Sponge gourd	3.75	32.18	6.01	29.38	4.89	23.79

Table 2 shows the anti-nutrients in dehulled cucumber and sponge gourd seed meals. The results revealed that *L. aegyptica* seed has higher values of oxalate (0.08%), alkaloids (2.96%), phytic acid (0.07%) and tannins (24.64%) compared with cucumber seed with values of 0.05% oxalate, 1.38% alkaloids, 0.05% phytic acid and 15.38% tannins. The saponin concentration in cucumber (1.29%) seed was higher compared with L.aegyptica (0.33%) seed meal. The anti-nutrients in *C.sativus* is similar to previous study by Gomathi *et al*. (2016) and Johnson *et al.* (2012) for water melon seeds

Table 2: Anti-nutritional factor of decorticated Cucumber and Sponge gourd seed meals (% Dm)

Seed meal	Oxalate	Saponin	Alkaloids	Phytic acid	Tannins
Cucumber	0.05	1.29	1.38	0.05	15.38
Sponge gourd	0.08	0.33	2.96	0.07	24.64

Table 3 shows the amino acid profile of *L. aegyptica and C. sativus* seed meals. The most concentrated non-essential amino acid in the seed meals was glutamic acid with values of 13.47g/100g for *C. sativus* and 12.57g/100g for *L. aegyptica* while arginine and leucine (7.57 and 6.60 g/100g for *C. sativus* and 12.57 and 6.84 g/100g for *L.aegyptica}* were the most concentrated essential amino acid. Aremu *et al*. (2008) and Oyetayo *et al.* (2012) made a similar observations in *L. cylindrica* seed kernel. The methionine content in the samples of 1.28 to 1.44g/100g is found to be higher than that of soyabean (0.9g/100g) (Akintayo *et al.*, 2002) while the lysine content (3.24 - 3.61g/100g) is higher than that reported by Aremu *et al*.(2008) for *L. cylindrica* seed kernel (2.9g/100g).

Table 3: Essential and non-essential amino acids composition of decorticated Cucumber and Sponge gourd seed meals

S/N	Parameters	DCSM	DSSM
1.	Leucine	6.60	6.89
2.	Lysine	3.61	3.24
3.	Isoleucine	3.21	3.27
4.	Phenylalanine	3.90	4.08
5.	Tryptophan	1.02	0.79
6.	Valine	3.92	3.39
7.	Methionine	1.28	1.44
8.	Histidine	2.17	2.17
9.	Threonine	3.41	3.00
10.	Arginine	7.57	6.54
	Non essential		
1	Proline	3.05	2.264
2	tyrosine	3.92	2.23
3	Alanine	4.32	3.87
4	Glutamic acid	13.47	12.57
5	Glycine	4.23	3.47
6	Serine	3.56	4.11
7	Aspartic acid	8.31	8.00

DCSM = Dehulled cucumber seed meal
DSSM = Dehulled Sponge gourd seed meal

CONCLUSION AND RECOMMENDATIONS

The results obtained from this study have shown that the cucumber and luffa seeds are sources of fat, crude protein, crude fibre and ash contents. The seeds contain a relatively low amount of saponin, alkaloid, phytate and oxalate except for tannin. The seed meals are rich sources of essential and non-essential amino acids .Hence the seeds could be used to encourage the developing countries like Nigeria to shift from cultural practice of sticking to the known food sources for human and livestock and embrace other food materials especially sponge gourd.

REFERENCES

Abitogun, A.S., Ashogbon, A.O. and Borokin, F.B. (2010). Nutritional and Chemical Compositions of Ripe and Unripe *Vitex glandifolia*. *Journal of Research in National Development, **Vol.*8,** 1-5.

Abulude,F.O., Akinjagunla, Y.S., Abe, T., Awanlemhen, B.E. and Afolabi, O.(2007). Proximate Composition, Selected Mineral, Physical Characteristics and *in vitro* Multi-enzyme Digestibility of Cucumber (*Cucumis sativus*) .Fruit from Nigeria. *American Journal of Food Technology,* **Vol.2***: 196-201*

Akintayo, E.T., Adebayo, E.A. and Arogundade, L.A (2002). Chemical composition, physicochemical and functional properties of Akee (*Bilphia sapida*) pulp and seed. *Journ. Food Chemistry*, **Vol:77**: 333–336

Alkhalifa, A. S. L.(1996). Physiological characteristics of fatty acids compound and lipoxygenase activity of crude pumpkin and melon seed oil: *Journal of agriculture and Food Chemistry, **Vol.* **44**: 64-66.

Amoo, I.A., Emenike, A.E. and Akphambang, V.O. E. (2008).Chemical compositon and nutritive significance of *Luffa aegyptica* and *Castenea* sp. Seeds. *Trends Appl. Sci. Res*., **3(4)**: 298-302.

Anhwange, B. A., Ajibola, V. O. and Oniye, S. J. (2004). Chemical studies of seeds of *Moringa Oleifera and Detarium microcarpum* seeds. *J. Biol. Sci,* Asia, **Vol. 4(6)**:711-715

AOAC (Association of Official Analytical Chemists)(2005). Official Method of Analysis of the AOAC (W. Horwitz Editor) Eighteenth Edition. Washington D.C, AOAC.

Aremu, M.O., Olaofe, O., Okiribiti, B.Y. (2008). Chemical Evaluation of the Nutritive value of smooth luffa (*Luffa cylindrica*) seed's kernel. *Electronic Journal of Environmental and Agricultural Food Chemistry* , **Vol.7(10),** 3444 – 3452.

Azeez M.A., Bello, O.S., Adedeji, A.O.(2013). Traditional and medicinal uses of *Luffa cylindrica*: a Review. *Journal of Medicinal Plants Studies*, **Vol. 1(5):**101-111.

Benitez, L. V. (1989). Amino Acid and fatty acid profiles in aquaculture nutrition studies.in S.S. De Silva (ed.). Fish Nutrition Research in Asia. *Proceedings of the Third Asian Fish Nutrition Network Meeting.Asian fish.Society Special Publication.*4, 166 .

Dairo, F A S (2008), "Assessment of luffa gourd seeds *Luffa cylindrica* (Roem) on performance and some haematological indices of rabbit weaners", 9th World Rabbit Congress – June 10-13, 2008 – Verona –Italy, 613-617.

Dairo, F.A.S., Ayodeji, F.O.,Adeyeye, E.I., and Aye, P.A. (2013). Effect of heat on luffa gourd seeds chemical composition and fatty acids of raw seeds. Int. *J. Biol. Chem. Sci*., **7(3)**:1289-1297.

El-Adawy, T. A., Palma E. H., El-bedawy, A. A. and Gafar, A. M. (1999). Prosperities of some citrus seeds. Part 3 Evaluation as a new source of protein and oil: *Nahrang*: **43**, 385-391.

Fila, W.A., Itam, E.H., Johnson, J.T., Odey, M.O. Effiong, E.E., Dasofunjo, K., Ambo, E.E.(2013). Comparative Proximate Compositions of Watermelon *Citrullus Lanatus*, Squash *Cucurbita Pepo'l* and Rambutan *Nephelium Lappaceum. International Journal of Science and Technology* Volume **2 (1)**: 81-88

Gomathi, S. , M. Vijayabaskaran, P., Vaijayanthimala, R., Shanmuga Sundaram, S., Seetaram- Swamy, R. Sambathkumar (2016). Phytochemical characterization of *Cucumis sativus Linn* leave. *European Journal of Pharmaceutical and Medical Research*, **3(4)**: 378-381

Johnson, J.T., Iwang, E.U., Hemen, J.T., Odey, M.O., Efiong, E.E. and Eteng, O.E.(2012). Evaluation of anti-nutrient contents of watermelon *Citrullus lanatus. Annals of Biological Research*, **3 (11)***:5145-5150*

Kubola, J., Siriamornpun, S. and Meeso, N.(2011). Phytochemicals, vitamin C and sugar content of Thai wild fruits. *Food Chem*. **Vol.;126:** 972–981.

Niyi, O.H., Jonathan, A.A. and Ibukun, A.O. (2019). Comparative Assessment of the Proximate, Mineral Composition and Mineral Safety Index of Peel, Pulp and Seeds of Cucumber (*Cucumis sativus*). *Open Journal of Applied Sciences*, **Vol.9**:691-701.

Oboh, I. O. and Aluyor, E.O. (2009). "*Luffa cylindrica* - An emerging cash crop." *African Journal of Agricultural Research*, **4 (8)**: 684–688.

Oyetayo, F.L and Ojo, B. A., (2012). Nutritive value and phytochemical composition of *luffa cylindrica* seed flour. *American Journal of Biochemistry*, **Vol. 2(6)**: 98-103

Teotia, M. S. (1992): Advances in Chemistry and Technology of pumpkins: *Indian Food Packer*, 9-13

Uruah, C.B., Uguru, M, F. and Oyiga, B. C., (2011).Nutritional evaluation of some Nigerian Pumkins(*Cucurbita spp*). *Fruits, Vegetables and Cereal Sciences and Biotechn.. Issue* **2**:64-71.

PROXIMATE COMPOSITION OF PLANT PARTS OF *Pennisetum purpureum* HARVESTED AT SELECTED LOCATIONS IN SOUTHWEST NIGERIA

***Okukenu, O. A., Dele, P. A., Akinyemi, B. T., Jolaosho, A. O., Olajide, A. A. & Oriola, R. A.**

Department of Pasture and Range Management
College of Animal Science and Livestock Production
Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
P.M.B 2240
**E-mail: femi_okukenu@yahoo.co.uk*

ABSTRACT

This study was carried out to evaluate the proximate composition of plant parts of *Pennisetum purpureum* harvested at selected locations in South-west Nigeria. The experiment was laid out in a 6 × 2 factorial design comprising of six (6) locations (Ewekoro, Odeda, Ibarapa, Ido, Oriade and Ejigbo) and two (2) plant parts (stem and leaf) replicated three times. The dry matter (DM) value ranges from 83.83% in *P. pupureum* harvested at Ibarapa to 93.00% in *P. purpureum* harvested at Ejigbo and *P. purpureum* harvested at Ido had the highest (10.71%) crude protein (CP) content with the lowest value (9.68%) observed in *P. purpureum* harvested at Odeda. Meanwhile, *P. purpureum* harvested at Oriade had the highest (7.33%) ether extract (EE) content with the lowest value (5.17%) observed in *P. purpureum* harvested at Ewekoro. The leaf fraction of the harvested *P. purpureum* recorded the highest value (88.16% and 11.74%) for DM and CP content respectively with the lowest value (5.67%) for EE content and the leaf fraction also had the highest value (15.00% and 13.60%) for Ash and NFC content respectively. The leaf fraction of *P. purpureum* harvested at Ejigbo recorded the highest value (94.33%) DM content with the lowest value (81.00%) observed in stem fraction of *P. purpureum* harvested at Ibarapa and the CP content range from 7.83% in stem fraction of *P. purpureum* harvested at Odeda to 12.38% in leaf fraction of *P. purpureum* harvested at Ido. While the leaf fraction of *P. purpureum* harvested at Ewekoro and Ejigbo had the lowest value (4.67%) of EE content with the highest value (8.00%) observed in stem fraction of *P. purpureum* harvested at Ibarapa, Ido and Oriade. It is therefore concluded that there were variations in the nutrient of *P. purpureum* harvested at the selected locations with different plant parts.
(Keywords: natural pasture, *Pennisetum purpureum*, plant parts, location)

INTRODUCTION

The ever-increasing human population and their high demand for animal protein, especially from meat and milk will depend on better utilization of available feed resources by the ruminant livestock for improving household food security and income (Kabi and Bareeba, 2008). Among feed resources, forage crops, especially grasses have shown unique characteristics in different agricultural systems. They can be grown in harsh environments, utilized as functional components in providing environmental services in soil erosion control and greenhouse gas emission mitigation efforts (Beard and Green, 1994) and income generation as basic animal feed (Wright and Turhollow, 2010). Currently, there is increasing demand for ruminant animal products owing to the growing population and improved livelihoods (Dastagiri, 2004). Ruminants rely more essentially on pasture for their nutrient requirement than any other feed resources and inadequate feed supply is a major constraint of livestock production in sub-Saharan African countries (Arigbede *et al.*, 2011). Forage is important to livestock production since it is a major source of ruminant feed and nutrition for sustainable animal protein and ruminant is the largest source of animal protein. Forage crops make up a significant part of the total agricultural land in Africa and provide a critical food supply for the livestock industry. Grasses are the most abundant flowering plants that are useful to man. They are one of the most important sources of nutrients for domesticated ruminants during a large part of the year (Taweel *et al.*, 2005). The nutritive value of forage, as related to ruminants, may be regarded as the product of the intake of the forage and its digestibility, with intake being the more important of the two parameters (Mott, and Moore, 1969).

MATERIALS AND METHODS

The research was carried out at the Laboratory of Pasture and Range Management Department of the Federal University of Agriculture, Abeokuta. The grass was harvested from natural pastures from selected locations across south-west Nigeria. The plant were separated into two (2) parts (stem and

leaf) and oven dried for laboratory analysis. The study was laid out in 6 × 2 factorial design comprising of six (6) locations (Ewekoro, Odeda, Ibarapa, Ido, Oriade and Ejigbo) and two (2) plant parts (stem and leaf) and data collected were subjected to a Two-way analysis of variance and the treatment means were separated using Duncan's Multiple Range Test using SAS (1999) package. The dry matter, crude protein, ether extract and ash contents of the milled grass sample was determined according to procedure of A.O.A.C. (2000) and NDF was determined according to Van Soest *et al,* (1991). Non-fibre carbohydrate was calculated as NFC = 100 - (CP+Ash+EE+NDF)**.**

RESULTS AND DISCUSSION

There was significantly ($p<0.05$) difference on the proximate composition of plant parts of *Pennisetum purpureum* harvested at different location in South-west (Table 1). It is quite evident that there were variations in the proximate composition of the *Pennisetum purpureum* across locations as revealed in the study and these variations could be affected by various factors, in which seasonality and species specific feed resources were known to be the major factors in affecting the nutritive value of native grasses (Subhalakshmi *et al.*, 2011). It was also reported by Kavana *et al.* (2007) that bimodal distribution of rainfall, uneven seasonal growth and availability of pasture had been considered as the major limitations to constant supply of forage for ruminant animals. The dry matter (DM) value ranged from 83.83% in *P. pupureum* harvested at Ibarapa to 93.00% in *P. purpureum* harvested at Ejigbo and the leaf fraction of the harvested *P. purpureum* recorded the highest value of 88.16% for DM content. The increase in the DM value of the leaf proportions as the *Pennisetum purpureum* advance in age conforms to the submission of McDonald *et al*. (1995) who reported that dry matter content increases with advancing maturity which reflects decrease in cell content. *P. purpureum* harvested at Ido had the highest (10.71%) crude protein (CP) content with the lowest value (9.68%) observed in *P. purpureum* harvested at Odeda while the leaf fraction of the harvested *P. purpureum* had the highest value of 11.74% for CP content (Table 1). There was significantly ($p<0.05$) difference on interaction effect of location and plant parts on the proximate composition of harvested *P. purpureum*. The leaf fraction of *P. purpureum* harvested at Ejigbo recorded the highest value (94.33%) DM content with the lowest value (81.00%) observed in stem fraction of *P. purpureum* harvested at Ibarapa and the CP content range from 7.83% in stem fraction of *P. purpureum* harvested at Odeda to 12.38% in leaf fraction of *P. purpureum* harvested at Ido (Table 2). The crude protein content of the *P. purpureum* was considerably influenced by location. There were variations in CP contents of the *P. purpureum* with the different location and this was in comformity with the report of Da Silva *et al*. (2011) in which similar reports was also obtained from previous findings of Teka *et al.* (2012). The variation in the crude protein of *Pennisetum purpureum* might also be attributed to site potential in terms of differences in edaphic factors and temperature condition.

P. purpureum harvested at Oriade had the highest (7.33%) ether extract (EE) content with the lowest value (5.17%) observed in *P. purpureum* harvested at Ewekoro while the leaf fraction had the lowest value (5.67%) for EE content (Table 1). While the leaf fraction of *P. purpureum* harvested at Ewekoro and Ejigbo had the lowest value (4.67%) of EE content with the highest value (8.00%) observed in stem fraction of *P. purpureum* harvested at Ibarapa, Ido and Oriade (Table 2). The ash content range from 13.00% in stem fraction of *P. purpureum* harvested at Odeda to 15.33% in leaf fraction of *P. purpureum* harvested at Ibarapa, Ido , Ejigbo and Oriade. Meanwhile, the leaf fraction of *P. purpureum* harvested at Odeda recorded the highest value (14.47%) of NFC content and stem fraction of *P. purpureum* harvested at Ewekoro had the highest value (63.67%) for NDF with the lowest value (52.33%) observed in leaf fraction of *P. purpureum* harvested at Oriade (Table 2). The higher fibre levels of the grasses in this study might be a demerit in facilitating the colonization of ingesta by rumen microorganisms, which in turn might induce higher fermentation rates, hence digestibility, intake and animal performance might be impaired.

Table 1: Proximate composition (%) of plant parts of *Pennisetum purpureum* harvested at selected locations in south-west

Factors	DM	CP	EE	ASH	NFC	NDF
Locations						
Ewekoro	88.17^{b}	10.31^{a}	5.17^{c}	14.83^{ab}	9.69^{b}	60.00^{a}
Odeda	86.00^{bc}	9.68^{b}	6.83^{ab}	13.33^{b}	14.15^{a}	56.00^{b}
Ibarapa	83.83^{c}	9.77^{b}	6.83^{ab}	14.67^{ab}	13.07^{ab}	55.67^{b}
Ido	85.83^{bc}	10.71^{a}	6.83^{ab}	14.67^{ab}	11.79^{ab}	56.00^{b}
Oriade	87.00^{bc}	10.59^{a}	7.33^{a}	14.67^{ab}	12.41^{ab}	55.00^{b}
Ejigbo	93.00^{a}	10.57^{a}	5.83^{bc}	15.17^{a}	12.10^{ab}	56.33^{b}
SEM	1.20	0.67	0.53	0.49	1.14	1.33
Plant parts						
Leaf	88.16^{a}	11.74^{a}	5.67^{b}	15.00^{a}	13.60^{a}	54.00^{b}
Stem	86.00^{b}	8.81^{b}	7.28^{a}	14.11^{b}	10.80^{b}	59.00^{a}
SEM	0.91	0.14	0.28	0.28	0.62	0.57

$^{a, b, c}$:Means in same column with different superscripts are significantly ($p<0.05$) different.
SEM= Standard Error of Mean, DM= Dry matter, EE= Ether extract, CP = Crude protein, NFC= Non- fibre carbohydrate, NDF= Neutral detergent fibre

Table 2: Interaction effect of locations and plant parts on the proximate composition of *Pennisetum purpureum*

Locations	Plant parts	DM	CP	EE	ASH	NFC	NDF
Ewekoro	Leaf	91.00^{abc}	11.28^{c}	4.67^{c}	15.00^{a}	12.72^{a}	56.33^{bcde}
	Stem	85.33^{de}	9.35^{d}	5.67^{bc}	14.67^{a}	6.65^{b}	63.67^{a}
Odeda	Leaf	86.00^{cd}	11.53^{bc}	6.67^{ab}	13.67^{a}	14.47^{a}	53.67^{def}
	Stem	86.00^{cd}	7.83^{f}	7.00^{ab}	13.00^{a}	13.83^{a}	58.33^{b}
Ibarapa	Leaf	86.67^{cd}	11.06^{c}	5.67^{bc}	15.33^{a}	13.61^{a}	54.33^{cdef}
	Stem	81.00^{e}	8.48^{e}	8.00^{a}	14.00^{a}	12.52^{a}	57.00^{bcd}
Ido	Leaf	86.33^{cd}	12.38^{a}	5.67^{bc}	15.33^{a}	13.62^{a}	53.00^{ef}
	Stem	85.33^{de}	9.03^{de}	8.00^{a}	14.00^{a}	9.97^{ab}	59.00^{b}
Ejigbo	Leaf	94.33^{a}	12.14^{ab}	4.67^{c}	15.33^{a}	13.53^{a}	54.33^{cdef}
	Stem	91.67^{ab}	9.00^{de}	7.00^{ab}	15.00^{a}	10.66^{ab}	58.33^{b}
Oriade	Leaf	87.33^{bcd}	12.03^{ab}	6.67^{ab}	15.33^{a}	13.63^{a}	52.33^{f}
	Stem	86.67^{cd}	9.15^{de}	8.00^{a}	14.00^{a}	11.18^{ab}	57.67^{bc}
SEM		0.67	0.27	0.24	0.21	0.51	0.58

$^{a, b, c\ldots f}$:Means in same column with different superscripts are significantly ($p<0.05$) different

REFERENCES

Arigbede, O. M., Anele, U. Y., SuDekum, K. H., Hummel, J., Oni, A. O., Olanite, J. A. and Isah, A. O. (2011). Effects of species and season on chemical composition and ruminal crude protein and organic matter degradability of some multipurpose tree species by west African dwarf rams. *Journal of Animal Physiology and Animal Nutrition* (96): 250-259.

Beard, J .B. and Green, R. L. (1994). The role of Turf grasses in environmental protection and their benefits to humans. *Journal of Environmental Quality* (23): 1–16.

Dastagiri, M. B. (2004). Demand and supply projections for livestock products in India. National Center Agric. Econ. and Policy . Res. Policy Paper 21.

Kabi, K. and Bareeba, F. B. (2008). Herbage biomass production and nutritive value of mulberry (Morus alba) and Calliandra calothyrsus harvested at different cutting frequencies. *Animal Feed Science and Technology* (140): 178–190.

Teka H. I., Madakadze, C., Angassa, A. and Abubeker, H. (2012). Effect of Seasonal Variation on the Nutritional Quality of Key Herbaceous Species in Semi-arid Areas of Borana, Ethiopia. Department of Plant Production and Soil Science, University of Pretoria, South Africa. *Indian Journal of Animal Nutrtion* 2012.29 (4): 324-332

Wright, L. and Turhollow, A. (2010). Switch grass selection as a ‘‘model’’ bio-energy crop: A history of the process. *Biomass and Bio-energy*. (34): 851–868.

Taweel, H. Z., Tas, B. M., Smit, H. J., Elgersma, A., Dijkstra, J. and Tamminga, S. (2005). Improving the quality of perennial ryegrass (*Lolium perenne* L.) for dairy cows by selecting for fast clearing and/or degradable neutral detergent fiber. *Livestock Production Science* (96): 239-248.

Mott, G. O. and Moore, J. E. (1969) Forage evaluation techniques in perspective. Proceedings of the National Conference on Forage Quality Evaluation and Utilization, Nebraska, Lincoln, U.S.A.

SAS (1999). Statistical Analysis System Institute Inc., SAS/ 24. STAT Programme, Carry, NC: SAS Institute Inc.

A.O.A.C. 2000. Official methods of analysis 15th edition. Association of Official Analytical Chemists, Washington D.C.

Van Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991. Methods for dietary fibre, neutral detergent and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74(10):3583-3597.

Kavana, P. Y., Kizima, J. B. and Masakia, B. J. (2007). Constraints to use of natural pasture for ruminants production along the eastern coast of Tanzania.

Subhalakshmi, B., R. Bhuyan, D.N. Sama, K.K. Sharma and A. Bora. (2011). Effect of variety and stage of harvest on yield, chemical composition and *in vitro* digestibility of hybrid Napier (*Pennisetum purpureum x P. americanum*). *Indian Journal of Animal Nutrition 28: 418-420.*

McDonald, P., Edwards, R. A., Greenhalgh, J. F. and Morgan, C. A. 1995. Animal Nutrition 5th edition. United Kingdom.

Da Silva, D. S., de Andrade, M. V. M., de Andrade, A. P., de Souza Carneiro, M. S. and de Oliveira, J. S. 2011. Bromatologic composition of the herbaceous species of the Northeastern Brazil Caatinga. Review Brasilera De Zootecnia 40: 756-764.

EFFECT OF SUBSTITUTING MAIZE GRAIN WITH COBS TREATED WITH A COMBINATION OF UREA AND WOOD ASH ON SHEEP PERFORMANCE AND RUMEN PARAMETERS

[1]Abdulazeez, A., [2]Tsopito, C.M. and [2]Madibela, O.R.
[1]Federal College of Education (Technical) Gusau, Zamfara State, Nigeria.[2]Botswana University of Agriculture and Natural Resources
Corresponding author:azeezrazaq70@gmail.com, +2348028502373

ABSTRACT
This study was aimed at determining the effect of substituting maize grain with maize cobs treated with 25% urea plus 75% wood ash (WA) on intake, digestibility, nitrogen utilization, rumen NH_3, pH and performance of Tswana breed of sheep. Tswana sheep were fed experimental diet whose maize grain was substituted with graded levels of 25U75WA in the dietary ingredients and the treatments were: 100M = 100% maize grain, 66M34C = 66% maize grain plus 34% treated maize cobs, 34M66C = 34% maize grain plus 66% treated maize cobs and 100C = 100% treated maize cobs in a 4×4 Latin Square Design. Treatment 34M66C had CPI, DMI,OMI and NDFI of 0.1334, 0.9500, 0.8921 and 0.4800 kg/d respectively while the CPD, DMD, OMD and NDFD were 79.57, 68.02, 66.26, and 57.8% respectively. All the treatments had similar rumen NH_3 ranging from 23.55 – 24.00 mg/ml while pH were different and ranged from 6.117 – 6.937. Treatment 100M had the lowest pH. Treatment 100M and 34M66C had ADG of 0.1150 and 0.1417 kg/d respectively however treatment 100M had the lowest FCR of 5.217 compared to 7.059 for 34M66C. It was concluded that treatment 34M66C had better nutrient intake, digestibility and performance compared to diet with 100% maize grain and that the substitution could also reduce cost of feed at the same time supplying minerals present in ash to the fed animals.

Key word: Maize grain, maize cob, urea, wood ash, Tswana sheep

INTRODUCTION

Crop residues such as maize cobs are increasingly becoming popular as livestock feed due to feed shortage occasioned by drought and depletion of the rangelands. Other reasons why crop residues are becoming popular could also be attributed to the high cost of grains as a result of competition between man and livestock. However, crop residues are poor nutritionally and needed to be supplemented with other sources of nutrients. According to Wanapat and Rowlinson (2007), maize cobs can be used as source of energy in ruminant feeds. Maize cobs when used as source of non-forage fibre, increase milk fat concentration and also reduce time of rumination when fed in combination with alfalfa in dairy cattle (Depies and Armentos, 1995). Peyton and Conrad (1982) reported that ground maize cob has been used as energy source for dairy cows in concentrate mixture. Ground maize cobs have also been reported by Wanapat *et al.* (2012) as potential replacement for cassava chips as source of energy in swamp buffalo. This study was aimed at determining the effect of substituting maize grain with maize cobs treated with 25% urea plus 75% WA on intake, digestibility, nitrogen utilization, rumen NH_3, pH and performance of Tswana breed of sheep.

MATERIALS AND METHODS

EXPERIMENTAL INGREDIENTS AND LOCATION OF STUDY

The study was conducted at the Botswana University of Agriculture and Natural Resources, Content Farm located 10 Km north of Gaborone in South Eastern Botswana. Maize cobs were sourced from Molepolole village, 70km from Gaborone and milled (4 mm sieve) at the school farm feed mill in Notwane before mixing with the rest of the ingredients.

IN VIVO STUDY

Four Tswana male sheep sourced from the school farm (18 months old, 32±1 kg) were used in a 4×4 Latin Square Design and housed in metabolism cages suitable for collection of urine and faeces separately. Prior to commencement of the trial, sheep were weighed, vaccinated against

Enterotoxaemia Pasteurella followed by deworming with Ecomectin 14 days later. The trial lasted for forty eight days with 7 days of adaptation and 5 days for collection (12 days/period). Each period was restricted to 12 days due to insufficiency of maize cobs to substitute maize grain as a result of the drought experienced in Botswana during the experimental period.

DATA COLLECTION AND CHEMICAL ANALYSIS

Feed offered and refused were recorded daily throughout the experimental period. Feed were offered twice daily (500g at 8am and 500g at 4pm) while samples of the experimental diets including refusals and faeces (5% samples) were collected daily in the morning before feeding during the 5 days collection period. Samples of concentrate mixture and faeces for each treatment group were then composited and stored at -20°C for later chemical analysis. The samples were divided into two parts, first part for dry matter (DM) analysis, while the second part was kept and pooled for analysis of ash, crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL). Feeds, refusals and faecal DM (DM, ID number 930.15) for all samples were determined by drying in forced air oven at 60° C for 24 hr. Organic matter (OM) (OM, ID number 942.05) and ash were obtained by difference in weight after ignition at 550° C in a muffle furnace (Muffle Furnace Size 3, Gallenkamp, UK). The NDF, ADF and ADL were determined with ANKOM fiber analyzer (Ankom Technology Corporation, Fairport, NY, USA) according to the procedure of Van Soest *et al.* (1991). In the analysis of NDF, sodium sulphite and alpha amylase were also added. Nitrogen was determined by a Kjeldahl method (ID number 955.04) according to AOAC (1999) and CP determined as N*6.25 (ID number 954.01).

Daily collection of urine for each treatment before feeding was acidified with 50% H_2SO_4 to prevent ammonia volatilization, stored and then mixed at the end of the trial. The urine samples were then analyzed for N according to AOAC (1999). Rumen liquor was collected 3 hours post feeding after every period in the morning using a mechanical suction pump. The rumen fluid was then measured for pH using digital pH meter and the fluid sample was then strained through four layers of cheesecloth. Forty five ml of the rumen fluid was kept in a plastic bottle to which 5 ml of 1M H_2SO_4 was added to stop fermentation. About 20 to 30 ml of supernatant was collected and analyzed for NH_3- N according to AOAC (1999).

STATISTICAL ANALYSIS

Data generated from various *in vivo* parameters were analyzed using a 4×4 Latin Square Design with GLM procedure of SAS (2002) and means separated with Duncan's Multiple Range Test (Steel and Torrie, 1984).

RESULTS

Nutrient intake and digestibility of experimental diets (Table 1) are shown in Table 2. Effect of treatments was observed on CPI, DMI, OMI and NDFI. Effect of treatments was observed on crude CPD, DMD, OMD and NDFD. Nitrogen utilization of sheep fed experimental diets is shown in Table 3. Effect of treatments was also observed on NI, FN, UN and NB.

Table 1: Ingredients and chemical composition (g/kg) of experimental diet

Types of treatment					
Ingredients (%)	100M	66M34C	34M66C	100C	
Maize cob	0	15	30	45	
Maize grain	45	30	15	0	
Lucerne	39	36	32.5	29.5	
Wheat bran	10	10	10	10	
Sun Flower Cake	5	8	11.5	14.5	
Salt	0.5	0.5	0.5	0.5	
DCP	0.5	0.5	0.5	0.5	
Chemical composition (g/kg)					SD±
DM	945.0	950.0	950.0	955.0	4.630
ASH	82.01	100.0	107.9	175.4	38.68
OM	918.0	900.0	892.1	824.6	38.68
CP	134.3	131.0	133.5	133.5	3.740
NDF	470.0	470.0	480.0	570.0	54.97
ADF	160.0	220.0	250.0	360.0	78.51
ADL	53.20	63.20	85.20	114.4	28.61
HC	310.0	250.0	230.0	210.0	53.45
NDS	530.0	530.0	520.0	430.0	54.97
ME MJ/kg	18.94	19.19	19.28	17.24	0.938

DM= dry matter, OM=organic matter, CP=crude protein, NDF=neutral detergent fibre, ADF=acid detergent fibre, ADL=acid detergent lignin, HC=hemicellulose, NDS=neutral detergent soluble, ME=metabolizable energy, DCP= Di calcium phosphate. 100M= 100% maize, 66M34C=66% maize 34% treated maize cobs, 34M66C=34% maize

66% treated maize cobs, 100= 100% treated maize cobs.

Table 2: Nutrient intake and digestibility of sheep fed experimental diet

Parameters	Types of treatment					
	100M	66M34C	34M66C	100C	SE	P value
Intake (kg/day)						
CPI	0.0805[c]	0.1309[a]	0.1334[a]	0.0934[b]	0.0060	<0.0001
DMI	0.6685[b]	0.9500[a]	0.9500[a]	0.5670[c]	0.0438	<0.0001
OMI	0.5507[c]	0.9000[a]	0.8921[a]	0.5772[b]	0.0429	<0.0001
NDFI	0.3720[d]	0.5300[a]	0.4800[b]	0.4060[c]	0.0164	<0.0001
Digestibility (%)						
CPD	94.14[a]	81.33[b]	79.57[b]	81.41[b]	1.629	0.0011
DMD	59.12[c]	65.54[b]	68.02[b]	56.23[d]	1.258	<0.0001
OMD	59.79[b]	66.28[a]	67.20[a]	50.58[c]	1.797	0.0003
NDFD	56.82[a]	56.00[a]	57.80[a]	50.12[b]	0.8908	0.0199

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100C= 100% treated maize cobs, CPI= crude protein intake, DMI= dry matter intake, OMI=organic matter intake, NDFI= neutral detergent fibre intake, CPD=crude protein digestibility, DMD= dry matter digestibility, OMI= organic matter digestibility, NDFD= neutral detergent fibre digestibility.

Table 3: Nitrogen utilization of sheep fed experimental diet

Parameters (g/day)	Types of treatment					
	100M	66M34C	34M66C	100C	SE	P value
Nitrogen intake	12.89[c]	20.95[a]	21.35[a]	14.94[b]	0.9614	<0.0001
Fecal nitrogen	1.161[c]	6.490[a]	7.496[a]	4.097[b]	0.6523	<0.0001
Urinary nitrogen	2.120[b]	8.250[a]	9.372[a]	9.768[a]	0.8293	<0.0001
Nitrogen balance	9.609[a]	6.215[b]	4.483[b]	1.081[c]	0.8321	0.0002

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100C= 100% treated maize cobs,

Rumen ammonia and pH of sheep fed experimental diets are shown in Table 4. Effect of treatments was not observed on rumen ammonia while it was observed on rumen pH. Treatment 100M had the lowest pH (6.12) while 100C had the highest (6.94). Treatments 66M34C and 34M66C had similar pH of 6.77 and 6.74 respectively. Performance characteristics of sheep fed experimental diets are shown in table 5. Effect of treatments was observed on FI, FW, WG, ADG and FCR.

Table 4: Rumen ammonia and pH of sheep fed experimental diet

	types of treatment					
Parameters	100M	66M34C	34M66C	100C	SE	P value
Rumen ammonia (mg/ml)	24.00	23.62	23.55	23.75	0.1023	0.5638
Rumen pH	6.120^{c}	6.770^{b}	6.740^{b}	6.940^{a}	0.0824	<0.0001

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100C= 100% treated maize cobs,

Table 5: Performance characteristics of sheep fed experimental diets

	Types of treatment					
Parameters	100M	66M34C	34M66C	100C	SE	P value
FI(kg)	0.6000^{c}	1.0000^{a}	1.0000^{a}	0.7000^{b}	0.0461	<0.0001
IW(kg)	32.07^{bc}	32.40^{b}	33.55^{a}	31.80^{c}	0.4614	<0.0001
FW (kg)	33.45^{c}	34.00^{b}	35.25^{a}	33.00^{c}	0.4802	<0.0001
WG (kg)	1.380^{c}	1.600^{b}	1.700^{a}	1.200^{d}	0.0501	<0.0001
ADG kg/d	0.1150^{c}	0.1333^{b}	0.1417^{a}	0.1000^{d}	0.0042	<0.0001
FCR	5.217^{d}	7.500^{a}	7.059^{b}	7.000^{c}	0.2257	<0.0001

100M= 100% maize, 66M34C=66%maize 34% treated maize cobs, 34M66C=34% maize 66% treated maize cobs, 100C= 100% treated maize cobs, FI= feed intake, IW= Initial weight, FW=Final weight, WG= Weight gain, ADG= Average daily gain, FCR= Feed conversion ratio.

DISCUSSION

Despite the fact that the maize grain-based diet (100M) had low NDF, ADF and ADL, it was characterized by low intake and digestibility. All animals on this treatment had diarrhea and not willing to eat much probably because they initially selected the more palatable grains that were rapidly fermented. The reason for the low intake and digestibility may be attributed to the rapid fermentation of the grain leading to a drop in the rumen pH, hence the inability of the microbes to digest fibre (Nocek and Tamminga, 1991). According to Oba and Allen (2000) when forages that are more fermentable are fed, rumen pH could be lowered leading to low NDF digestibility.

Low intake and digestibility also observed on treatment 100C may be attributed to its high NDF, ADF and ADL compared to the rest of the treatments since more fibrous feed reside longer in the rumen thereby reducing passage rate and hence low intake. Allen and Mertens (1988) reported that NDF digestibility is determined by the fraction of NDF that is potentially digestible, the rate of NDF degradability in the rumen and the rate of passage from the rumen.

The reason why treatments 66M34C and 34M66C lost more nitrogen in faeces and urine may be attributed to their higher intakes of nitrogen compared to treatments 100M and 100C. Van Soest (1994) reported that excess nitrogen derived from microbial nitrogen and proteins that are not part of microbial proteins is normally secreted in milk or lost in faeces and urine of ruminants. Groff and Wu (2005) also reported that when CP in diets is increased there is a general increase in intake and this leads to increased losses of nitrogen into milk, urine and faeces. Even though all the treatment groups had positive nitrogen balance, treatment 100M had the highest because its nitrogen losses to faeces and urine were minimal compared to the rest of the treatments.

The rumen ammonia concentrations in all treatments were similar. The range of NH_3-N concentration was 23.55 to 24.00 mg/100ml. This observation was similar to the figures reported by Hamad *et al*. (2010) who reported values of 22.87 to 23.64 mg/100 ml in lambs fed maize cob-based diet measured 6 hrs post feeding. Khan *et al*. (2006) reported 20.6 to 25.3 mg/100 ml concentration after 6 hours in buffalo bulls fed restricted diets containing urea treated maize cobs ensiled with or without different additives. The result of the rumen pH showed that it ranged from 6.117 to 6.937. Orskov and Ryle (1990) reported that cellulolytic bacteria require pH of 6.2 – 7 while Wanapat and Pimpa (1999) also reported that optimum level of pH in the rumen should be 6.5 to 7.0 which were optimal for microbial growth when animals feed mostly on roughages. The normal rumen pH implied that volatile fatty acids (VFA's) which are by-products of fermentation rapidly diffused through the rumen wall instead of accumulating within the rumen. Accumulation of VFA's could lead to drop in pH because of increased acidic environment hence resulting in decreased DM digestibility. The low pH recorded for the 100% maize grain-based diet might have led to the low intake and digestibility observed as a result of the rapid fermentation of the maize grain in the rumen.

The higher feed intake and digestibility recorded for treatment 34M66C had also translated into higher WG and ADG as compared to the rest of the treatments. However, treatment 100M had lower feed consumption to gain ratio which was as a result of the lower feed intake. Various authors have also reported improvement in intake and digestibility of ruminants fed urea treated maize cobs (Khan *et al*., 2006; Hamad *et al*., 2010; Wanapat *et al*., 2012).

CONCLUSION

It was concluded that maize cobs treated with a combination of urea and wood ash could replace 66% maize grain in sheep diet with added advantage of reducing cost of feed at the same time supplying minerals present in wood ash to the animal.

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REFERENCES

AOAC, (1995). Official Methods of Analysis, 16th ed. Official Methods of Analysis of AOAC International, Gaithersburg, MD, USA.

Allen, M. S., Mertens, D. R., (1988). Evaluating constraints on fiber digestion by rumen microbes *J. Nutr.* 118:216–270.

Depies, K.K. and Armentos, L.E. (1995). Partial replacement of alfalfa fibre with fibre from ground maize cobs or wheat middlings *J. Dairy Sci*.78: 1328-1335.

Groff, E. B. and Wu, Z. (2005). Milk production and nitrogen excretion of dairy cows fed different amounts of protein and varying proportion of alfalfa and corn silage. *J. Dairy Sci.* 88: 3619-3632.

Hamad, M.R., Safaa, N.A., Aiad, A.M., Mohamed, A.S. and Soliman, N.A.M. (2010). Replacement value of urea treated corn with cobs for concentrate feed mixture in pregnant ewes ration *J. Amer. Sci*. 6: 166-178.

Khan, M.A., Iqbal, Z., Sarwar, M., Nisa, M., Khan, M. S., Lee, W.S. and Kim, H.S. (2006). Urea treated maize cobs ensiled with or without additives for buffaloes: Ruminal characteristics, digestibility and nitrogen metabolism *Asian-Aust. J. Anim. Sci*. 5: 705- 712.

Nocek, J. E. and Tamminga, S. (1991). Site of digestion of starch in the gastrointestinal tract of dairy cows and its effect on milk yield and composition. *J. Dairy Sci.* 74:3598-3629.

Orskov, E.R. and Ryle, M. (1990). Energy nutrition in ruminants. Applied Science, Oxford p149.

Osuji, P.O., Nsahlai, I.V. and Khalili, H. (1993). Feed evaluation. ILCA Manual 5 ILCA (international Livestock Centre for Africa), Addis Ababa, Ethiopia.40pp.

Panin, A., and Mahabile, M. (1997). Profitability .and household contribution of small ruminants to small-scale farmers in Botswana. *Small Ruminant Research* 2: 9-15.

Peyton, S.C. and Conrad, H.R. (1982). Maize cobs as energy with urea nitrogen in dairy rations. *J. Dairy Sci.* 65: 1465-1471.

SAS, (2002). Statistical Analysis System. SAS user's guide: Statistics, SAS Inst. Inc., Carry, NC.

Steel, R.G.D. and Torrie, J.H. (1984). Principles and Procedures of Statistics. A Biometrical Approach (2nd Ed). McGraw Hill Book Co. Inc. New York. USA.

Van Soest, P.J., Robertson, H.B. and Lewis, B.A., (1991). Methods of dietary fibre, NDF and non-starch polysaccharides in relation to animal material. *J. Dairy Sci.* 74: 3583-3595.

Van Soest, P. J. (1994). Nutritional Ecology of the Ruminant. 2nd ed. Cornell Univ. Press, Ithaca, NY.

Wanapat, M., Pilajun, R., Kang, S., Satyaningsih, K. and Setyawan, A.R. (2012). Effect of ground maize cobs replacement for cassava chip on feed intake, rumen fermentation and urinary derivatives in swamp buffaloes. *Asian-Aust. J. Anim. Sci*. 8: 1124-1131.

Wanapat, M. and Pimpa, O. (1999). Effect of ruminal NH_3-N levels on ruminal fermentation, purine derivatives, digestibility and rice straw intake in swamp buffaloes. *Asian-Aust. J. Anim. Sci.* 12:904-907.

Wanapat, M. and Rowlinson, P. (2007). Nutrition and feeding of swamp buffalo: feed resources and rumen approach. *Italian J. Anim. Sci*. 6: 67-73.

PHYSICOCHEMICAL CHARACTERISTICS OF GRAIN SORGHUM (*Sorghum bicolor L.*) SILAGE AS INFLUENCED BY VARIETY AND PLANTING DATE

***[1]Munza, B. M., [2]Hassan, M. R., [3]Tanko, R. J., [2]Yashim, S. M., [2]Zakka, T., and [2]Adewumi, A.E.**

[1]Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria
[2]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
[3]National Animal Production Research Institute,Ahmadu Bello University, Zaria, Nigeria
**Corresponding author:bellomunza@gmail.com; Tel: +2347038737250*

ABSTRACT

An experiment was conducted to evaluate the physicochemical characteristics of two grain sorghum varieties as influenced by planting date in Shika-Zaria. A laboratory trial of representative samples of silages using the two varieties (Samsorg-16 and Samsorg-17) and three planting dates (15th June, 30th June and 14th July) in a 2 x 3 factorial arrangement denoted as A, B, C, D, E and F was made in glass jars from chopped forage material harvested at booting stage. The forage was ensiled for 21 days in glass jar. There was no significant (P>0.05) effect of variety on temperature and pH of ensiled grain sorghum (Table 1). The temperature for both varieties was 22.93°C while pH observed ranged between 3.82 and 3.83 for Samsorg-16 and Samsorg-17 varieties, respectively. Variety had effect on dry matter, crude protein, neutral detergent fibre, acid detergent fibre, calcium and phosphorus composition of ensiled grain sorghum. Planting date had significant (P<0.05) effect on all the parameters measured in which silage made from sorghum planted on 15th June recorded higher temperature, dry matter, crude protein, neutral detergent fibre and acid detergent fibre. It is therefore recommended that for good quality silage, Samsorg-17 variety should be planted on 15th June.

Key words: Silage, sorghum, variety, physicochemical and planting date.

INTRODUCTION

The adaptive nature of sorghum, it's potential to produce higher tonnage of green forage and its diverse uses make it a valued tool and one of the best choices for forage growers and dairy farmers demanding high quality feed stocks (Iqbal and Bethune, 2015). Genotype or variety and planting date plays an important role in determining yield and quality of sorghum hence, its silage physicochemical composition (Diawara, 2012). Silage is made to conserve the grass or other herbage with a minimum loss of nutritive value by fermentation of soluble carbohydrates in an anaerobic environment into organic acids, preferably lactic acid, which reduce pH inhibiting normal aerobic bacterial action (Saarisalo *et al*., 2007). Water soluble carbohydrates (WSC) in ensiled crops are a source of energy for bacteria to produce lactic acid and lower pH to <4.2 for good silage quality (McDonald *et al*., 1991). Although excellent silages can be made from sorghums but crude protein (CP) concentrations decrease with increase in stage of maturity (Pholsen and Higgs 2005). Sorghum silage has the potential to bridge the gap between animal feed supply and demand particularly during drier months (Oliver *et al*., 2004). Hence, the experiment was conceived to determine the physicochemical characteristics of two grain sorghum varieties silage as influenced by planting date in Shika, Zaria, Nigeria.

MATERIALS AND METHODS

SILAGE PREPARATION AND SAMPLING

In 2018 growing season at National Animal Production Research Insitute (NAPRI), Shika, five (5) seeds of Samsorg-16 and Samsorg-17 grain sorghum were planted on ridges at 2 cm depth at plant spacing of 15 x 85 cm using the planting dates and later thinned to two (2) plants/ stand after twelve (12) days so as to have a uniform plant population of (13,333 stands/ha). A uniform dose of 120 kg/ha NPK (20:10:10) was applied to sorghum seedlings at 2 and 5 weeks after sowing as first and second doses, respectively. Forage material was harvested at 14 weeks after sowing (booting stage), then chopped to 2 cm with a forage chopper. The chopped forage material was ensiled in glass jars. A laboratory trial of representative samples of silages using the two varieties and three planting dates denoted as A, B, C, D, E and F was made in glass jars. The temperature and pH of the silage was measured with thermometer and pH meter. Proximate and detergent analyses were determined using the method of AOAC, (2005) and van-Soest *et al.* (1991), respectively in the Central Laboratory of NAPRI, Shika, Zaria. While mineral analysis was determined by AOAC (2005) methods using the Atomic Absorption Spectrophotometer.

STATISTICAL ANALYSIS

Data generated were subjected to ANOVA using General Linear Model Procedure of SAS (2005). Significant means will be compared using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

There was no significant ($P>0.05$) effect of variety on temperature and pH of ensiled grain sorghum (Table 1). The temperature for both varieties was 22.93^{o}C while pH observed ranged between 3.82 and 3.83 for Samsorg-16 and Samsorg-17 varieties, respectively. There was significant ($P<0.05$) effect of variety on DM, CP, NDF, ADF, Ca and P composition (Table 1) of ensiled grain sorghum. Dry matter, crude protein and calcium were 4.86%, 34.93% and 25.00% higher in Samsorg-17 than Samsorg-16 sorghum silages, respectively. Neutral detergent fibre, acid detergent fibre and phosphorus were 13.98%, 14.83% and 33.33% higher in Samsorg-16 silage than Samsorg-17 silage, respectively. The variation observed may be attributed to the varietal difference in which the yellow colour of Samsorg-17 sorghum grains could be responsible for the high crude protein. The DM and ADF obtained in this study was higher than the values reported by Kumari *et al*. (2013) for chopped sweet sorghum silage. Significant ($P<0.05$) planting date effect was observed for temperature, pH, DM, CP, NDF and ADF (Table 1) of ensiled grain sorghum. The pH obtained in this study is within 4.2 and below reported by Iqbal and Bethune (2015) that must be attained for a good quality silage. Mineral elements play special roles in the proper functioning of the rumen microorganisms especially those which digest plant cellulose, utilization of energy, protein and metabolism among other functions (McDowell *et al*., 1993). The P content was lower than (0.4-0.9g/day) required for growing goats (Fjell *et al.,* 1991). The Ca concentration was within the daily requirement for goats (0.4-1.1g/ca/day) reported by (Ishiaku *et al.*, 2016). There was significant ($P<0.05$) interaction effect between variety and planting date on parameters measured except pH.

Table 1: Physicochemical composition of ensiled grain sorghum as influenced by variety and planting date and their interaction

	Chemical composition (%)							
	T°C	pH	DM	CP	NDF	ADF	Ca	P
Variety								
Samsorg-16	22.93	3.83	71.70[b]	6.78[b]	62.79[a]	47.34[a]	0.42[b]	0.06[a]
Samsorg-17	22.93	3.82	75.36[a]	10.42[a]	54.01[b]	40.32[b]	0.56[a]	0.04[b]
SEM	0.001	0.06	0.79	0.47	0.50	0.50	0.01	0.01
P-value	0.050	0.983	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Planting date								
15th June	24.00[a]	4.01[b]	74.70[a]	12.94[a]	66.13[a]	51.07[a]	0.50[b]	0.05[b]
30th June	23.00[b]	4.20[a]	73.40[b]	6.62[b]	55.62[b]	47.09[b]	0.44[c]	0.04[c]
14th July	21.80[c]	3.27[c]	74.49[a]	6.25[b]	53.45[c]	33.34[c]	0.53[a]	0.06[a]
SEM	0.01	0.04	0.53	0.31	0.33	0.33	0.01	0.01
P-value	<0.001	<0.001	0.092	<0.001	<0.001	<0.001	<0.001	<0.001
Interaction								
V x P	<0.001	0.230	0.009	<0.001	<0.001	0.015	<0.001	<0.001

[abc]Means with different superscripts within column differed significantly, SEM = standard error of mean, DM = dry matter, CP = crude protein, NDF = neutral detergent fibre, ADF = acid detergent fibre, Ca = calcium, P = phosphorus

CONCLUSION

It can be concluded that silage made from Samsorg-17 sorghum give the highest DM, CP and Ca while higher NDF and ADF were obtained in Samsorg-16 sorghum silage whereas sorghum planted on 15th June recorded the highest DM, CP, NDF and ADF. It is therefore recommended that for good quality silage Samsorg-17 should be planted on 15th June.

REFERENCES

AOAC, (2005). Official Method of Analysis. International, Association of Official Analytical Chemists, 24th edition Washington D.C. USA. Pp 200-210.

Diawara, B. (2012). Effect of planting date on growth, development, and yield of grain Sorghum hybrids. MSc. Thesis. Department of Agronomy, Kansas State University Manhattan, Kansas. Pp 1-75.

Duncan, D.B. (1955). Multiple range and multiple F-test. *Biometrics,* 11: 1-42.

Fjell, D., Blasi, D., and Towne, G. (1991). Nitrate and prussic acid toxicity in forage: Causes, prevention and feeding management, Cooperative Extension Service, Kansas State University, Manhattan, MF-1018, USA. Retrieved 10th July, 2016, from http://www.ksre.ksu.edu/library/crps12 /s115.pdf

Ishiaku, Y.M, Hassan, M.R., Tanko, R.J., Amodu, J.T., Abdu, S.B., Ahmed, S.A., Abubakar, S.A., Lasisi, O.T., Bala A. G., Bello, S. S. and Ibrahim, H. (2016). Effect of plant spacing on yield and quality of columbus grass (*Sorghum almum*) under rain fed condition in Shika, Nigeria. *Journal of Animal Production Research*, *28*(1): 318-328.

Iqbal, M.A. and Bethune, B. (2015). A scoping review on sorghum silage quality enhancement with advanced ensiling operations. *Journal of Advanced Botany and Zoology*, 3(4): 1-6.

Kumari, N.N., Reddy, Y.R., Blümmel1, M., Nagalakshmi, D. and Monica, T. (2013). Effect of feeding sweet sorghum bagasse silage with or without chopping on nutrient utilization in Deccani Sheep. *Animal Nutrition and Feed Technology*, 13: 243-249.McDonald, P., Henderson, A. R. and Heron, S. J. E. (1991). The biochemistry of silage. 2nd Editon. Chalcombe Publications, Marlow, Buckinghamshire, UK.

McDonald, P., Henderson, A. R. and Heron, S. J. E. (1991). The biochemistry of silage. 2nd Editon. Chalcombe Publications, Marlow, Buckinghamshire, UK.

McDowell,L.R.(1996). Feeding minerals to cattle in pasture. *Animal Feed Science Technology*, 60:241.

Oliver, A.L., Grant, R.J., Pedersen, J.F. and Orear. J. (2004). Comparison of brown midrib-6 and-18 forage sorghum with conventional sorghum and corn silage in diets of lactating dairy cows. *Journal of Dairy Science*, 87(3): 637-644.

Pholsen, S. and Higgs, D. E. B. (2005). Effect of main crop cutting age on growth, dry weight yield and fodder quality of main crop and ratoon crop of IS 23585 forage sorghum cultivar. In: Rowlinson, P., Wachirapakorn, C., Pakdee, P. and Wanapat, M. eds. *Proceedings of Conference on Integrating live-stock-crop systems to meet the challenges of globalisation*. AHAT/BSAS International Conference, Khon Kaen, Thailand. Document T137

Saarisalo, E., Skytta, E., Haikara, A., Jalava, T. and Jaakkola, S. 2007. Screening and selection of lactic acid bacteria strains suitable for ensiling grass. *Journal of Applied Microbiology*, 102: 327–336.

SAS. (2005). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.

Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Method for directory Neutral detergent fibre and Non-starch polysaccharides in relation to Animal Nutrition. *Journal of Dairy Science*, 74: 3583-3597.

CARCASS CHARACTERISTIC OF SOME NIGERIAN BREEDS OF SHEEP

[4]Gadda*, B. M., [1]Abdu, M. B. and [1]Salihu, D. Y., [2]Duru, S., [2]Abdu, S. B., [3]Munza fi, S.
[1]Federal College of Animal Health and Production Technology, Vom, Jos, Nigeria
[2]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
[3]Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria
[4]Department of Animal Science, Federal University Dutsin-ma, Katsina State, Nigeria.
**Corresponding author:bellomunza@gmail.com; Tel: +2347038737250*

ABSTRACT
An experiment was conducted to evaluate the effect of breed on carcass characteristics of some Nigerian breeds of sheep. A total of nine (9) mature rams of 12 months of age (25 Kg) managed on the same system were used. The animals were kept for 24 hours where only water was provided to clear the gut content before slaughter. The result indicated that there was significant (P<0.05) effect of breed on carcass characteristics in which Balami breed of sheep had higher value for live weight (39.90 kg), slaughter weight (36.7 kg) and dressed carcass weight (21.0 kg), followed by Uda and Yankasa. Dressing percentage was not significantly (P>0.05) different among breeds. Breed significantly (P<0.05) affected the visceral components in which Balami recorded higher value followed by Uda and Yankasa. The result of prime cut revealed significant (P<0.05) breed effect in which the rack (6.00 kg), rib (2.67 kg), loin (3.10 kg), thigh (3.77 kg), flank (3.19 kg) and breast (2.27 kg) were higher for Balami, followed by Uda and Yankasa. It was concluded that Balami breed of sheep was superior to Uda and Yankasa breeds in terms of carcass characteristics, visceral components and prime cuts. It was therefore recommended that Balami should be used when one is interested in carcass characteristics, visceral components and prime cuts.

Keywords: Breed, carcass and sheep

INTRODUCTION
Sheep contributes about 50% of the total domestically produced meat in Nigeria (Bourn *et al.,* 1994). There are four main breeds of sheep native to Nigeria and these are Balami, Uda, Yankasa and West African Dwarf. Balami and Uda are kept in the semi-arid regions; West African Dwarf sheep in the south and Yankasa throughout the country (Bourn *et al.,* 1994). These four breeds differ considerably in size, coat colour and other characteristics (Adu and Ngere, 1971).

A carcass is made up of various proportions of muscle, bone and fat. The ideal carcass can be described as one that has a minimum amount of bone, a maximum amount of muscle and an optimum amount of fat (Marinova *et al*., 1992; Ameha, 2006). Market requirements differ in size of carcass and level of fatness acceptable. A certain proportion of fat is desirable to reduce drying out of the carcass. On the other hand, too much fat is undesirable. Water makes up 74% of the total muscle weight. The remainder of the muscle is protein, lipid, minerals and some vitamins. Bone provides the rigid support to which the muscles are attached. The hard, calcified cells give bone the strength needed to support the weight of the animal (Marinova *et al*., 1992; Ameha, 2006).

An understanding of carcass characteristics and meat quality traits of these sheep breeds has been over time neglected due to the focus on beef quality, butcher`s expectation and consumer demand for superior quality meat with optimum food value as well as the importance of protein in human diet has however made mutton quality important (Osuhor *et al.,* 2009). Hence, the need to evaluate the carcass characteristics of some Nigerian breeds of sheep.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Animal Products Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria.

Experimental design and management of animals

The experiment was carried out in a Complete Randomized Design using three breeds of sheep (Balami, Uda and Yankasa). A total of nine (9) matured rams of twelve (12) months of age with an average body weight of 25 kg raised on the same diets and the same system of management were used. The animals were sorted according to the three breed (Balami, Uda and Yankasa) groups comprising of three (3) rams per group. The animals were inspected for diseases and disabilities. The animals were fasted for 24 hours without feed but water was made available before slaughtering.

SLAUGHTER AND CARCASS DISSECTION

The animals were slaughtered according to the *Halal* standard procedure by severing the jugular vein and carotid arteries. The hair was removed by flaying as described by Fasae and Adelegan (2011). The internal organs (kidney, liver, heart and spleen) were carefully excise and weighed. The carcass was cut into primal cuts (shoulder, rack, loin, breast shank and flank) and each part was weighed. The dressing percentage was calculated as the ratio of dressed carcass weight to live weight in percentage.

STATISTICAL ANALYSIS

Data generated were subjected to ANOVA using General Linear Model Procedure of SAS (2005). Significant means will be compared using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

Carcass Characteristic of Nigerian Breeds of Sheep

There was significant ($P<0.05$) effect of breed on carcass characteristics of sheep (Table 1). The higher values obtained in Balami breed for live weight, slaughter weight and dressed carcass weight might be attributed to the large body size of Balami over Uda and Yankasa. The dressing percentage obtained in this study was lower than the values reported by Osuhor *et al*. (2009) for Yankasa rams fed dried poultry litter plus maize offal supplement. Carcass weight is the main factor affecting the composition of the carcass and is closely related to age at slaughter. As animals mature, they normally gain weight resulting in a heavier carcass. Much of the weight gain of a mature animal is fat rather than muscle. Thus, at heavier live weight, an animal's carcass will have lower proportions of muscle and bone and a higher proportion of fat.

Table 1: Carcass characteristic of Nigerian breeds of sheep

	Breed			
Component	Balami	Uda	Yankasa	SEM
Live weight (kg)	39.90[a]	30.00[b]	27.00[b]	2.22
Slaughter weight (kg)	36.70[a]	27.60[b]	24.84[b]	4.45
Dressed carcass weight (kg)	21.00[a]	16.00[b]	15.00[b]	1.70
Dressing %	52.60	53.00	55.00	3.00

[abc] means within rows having different superscripts differed significantly (P<0.05), SEM = Standard error of mean

Edible and Non-edible By-products Components of Nigerian Breeds of Sheep

Breed significantly (P<0.05) affected the edible and inedible by-products components (Table 2). The lower values obtained in Yankasa, followed by Uda for the edible and inedible by-product components might be due to the small size of Yankasa followed by Uda compared to the higher values obtained in Balami breed. Some breeds mature earlier than others and the main breed differences may be related to the rate of fat deposition during the later stages of growth (Marinova *et al*., 1992; Ameha, 2006). To achieve a similar level of fatness with breeds of different maturity types, it is necessary to market earlier maturing lambs at lighter weights than later maturing lambs.

Table 2: Edible and non-edible by-products components of Nigerian breeds of sheep

	Breed			
Component (kg)	Balami	Uda	Yankasa	SEM
Head	2.40[a]	2.10[b]	1.85[c]	0.03
Leg	1.3[a]	1.0[b]	0.85[c]	0.01
Heart	0.60[a]	0.25[b]	0.16[c]	0.01
Kidney	0.42[a]	0.27[b]	0.20[c]	0.01
Lung	0.59[a]	0.51[b]	0.47[c]	0.03
Liver	0.83[a]	0.66[b]	0.37[c]	0.01
Spleen	0.11[a]	0.08[b]	0.07[b]	0.01
Testes	1.06[a]	0.98[b]	0.70[c]	0.01
Full gut	4.00[a]	2.70[b]	2.27[c]	0.01
Empty gut content	2.00[a]	1.75[b]	1.70[c]	0.01
Small intestine	0.69[a]	0.62[b]	0.53[c]	0.01
Large intestine	0.36[a]	0.31[b]	0.27[c]	0.01
Blood loss	3.20[a]	2.40[b]	2.26[c]	0.03
Hide and skin	2.80[a]	2.10[b]	1.98[c]	0.03
Pancreas	0.02[a]	0.01[b]	0.01[b]	0.00
Bile duct	0.02[a]	0.01[b]	0.01[b]	0.00

[abc] means within rows having different superscripts differed significantly (P<0.05), SEM = Standard error of mean

Prime Cuts of Nigerian Breeds of Sheep

The results revealed significant (P<0.05) breed effect on the prime cuts (Table 3). The conformation of a carcass refers to its shape. Carcasses that are short in the leg and plump or 'blocky' in appearance are said to have 'good' conformation (Marinova *et al*., 1992; Ameha, 2006). Carcasses with a longer 'leggy' appearance are said to be of 'poor' conformation. Carcasses having good conformation generally contain more fat and less protein than those of poor conformation (Marinova *et al*., 1992; Ameha, 2006). The higher values obtained in Balami over Uda may be due to breed difference. The effect of nutrition on carcass composition is not a simple one as it involves the interactions among

level of intake, the composition of the feed, and nutrient needs of the animal. As more food energy is required to produce a kilogram of fat than a kilogram of muscle, one has to be conscious of the type of market targeted during the feeding operation (Marinova *et al*., 1992; Ameha, 2006).

Table 3: Prime cuts of Nigerian breeds of sheep

Component (kg)	Breed			SEM
	Balami	Uda	Yankasa	
Rack	6.00[a]	5.00[b]	4.70[b]	0.25
Rib	2.67[a]	2.02[b]	2.00[b]	0.14
Loin	3.10[a]	2.53[b]	2.15[b]	0.22
Round/ thigh	3.77[a]	2.47[b]	2.33[b]	0.15
Flank	3.19[a]	2.43[b]	2.37[b]	0.06
Breast	2.27[a]	1.55[b]	1.50[b]	0.06

[abc] means within rows having different superscripts differed significantly (P<0.05), SEM = Standard error of mean

CONCLUSION

It was concluded that Balami breed of sheep was superior to Uda and Yankasa breeds in terms of carcass characteristics, visceral components and prime cuts. It was therefore recommended that Balami should be used for better carcass characteristics, visceral components and prime cuts.

REFERENCES

Adu, I. F. and Ngere, L. O. (1971). The indigenous sheep of Nigeria. *World Review of Animal Production,* (3):51-62.

Ameha, S. (2006). Meat quality of selected Ethiopian goat genotypes under varying nutritional conditions. Ph.D. *Thesis*. University of Pretoria, South Africa.

Bourn, D., Wint, W. B. R and Wooley, E. (1994). Nigerian Livestock Resource Survey. *World Animal Review,* 78(1): 49-58.

Duncan, D.B. (1955). Multiple Range and Multiple F-tests. *Biometric,* 11:1-42.

Fasae, O. A. and Adelegan, M. (2011). Growth and faecal egg count response of village managed goats to wilted and sun-dried cassava foliage. *Journal of Agricultural Science and Environment,* 2315 – 7453.

Marinova, P., Shindarska, Z. and Banskalieva, V. (1992). Deposition and composition of muscular tissue in lambs under different feeding levels and clenbuterol participation. In: *Proceedings of the 38th International Congress of Meat Science and Technology*, Clermot-Ferrand, France, Pp. 89–92.

Osuhor, C. U., Adamu, A. M., Ehoche, O. W. and Lakpini, C. A. M. (2009). Carcass characteristics of Yankasa rams fattened on a diet containing dry layer litter and maize offal diet. *Proceeding of the 34th Annual Conference of Nigerian Society for Animal Production* held at Uyo, Pp. 551-553.

SAS. (2005). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.

YIELD AND PROXIMATE COMPOSITION OF *BRACHIARIA RUZIZIENSIS* FERTILIZED WITH GOAT MANURE AS POTENTIAL DRY SEASON FORAGE FOR RUMINANTS

A. Y. Shuaibu* O. A. Fasae [t], O. O. Adeleye, [t] B. O. Oluwatosin [l] and A. Olugbokiki[+]

** Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria.*

[t] College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Nigeria

[l] Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Nigeria

[+] E3 Farms Limited, Abeokuta, Ogun State.

**Corresponding Author: shuaibuyusuf90@gmail.com, 08038482107*

ABSTRACT

This study was conducted to evaluate the dry matter yield and proximate composition of irrigated Brachiaria ruziziensis as influenced by different rates of goat manure application during the dry season. Five treatments comprising of Brachiaria ruziziensis fertilized with 5, 10, 15, 20 t/ha dry matter (DM) goat manure (GM) and the control were arranged in a randomized complete block design with five replicates. The grass was cut back to 15 cm stubble height at the commencement of the study followed by harvesting of three random quadrat samples of 45-days regrowth for determination of yield and nutrient composition. The dry matter yield ranged from 1.88 to 5.26 t/ha and was highest for plots fertilized with 20 t/ha DM GM and least for control. The crude protein content of B. ruziziensis increased significantly (P < 0.05) with increased manure application rates. Plot fertilized with 20 t/ha DM GM had the highest value (9.28 %) while the control had the least value (7.59%). It can be concluded that goat manure application rate of 20 t/ha DM had the better potential to increase dry matter yield and proximate composition of irrigated B. ruziziensis during the dry season.

Keywords: Goat manure, forage yield, proximate composition, *B. ruzuziensis* and ruminant

INTRODUCTION

Natural grasslands constitute the major feed resources of ruminants, either by grazing or as conserved forages. However in the tropics, the inadequacies of feed and its low nutritive quality during the dry season are major limitation to successful ruminant production (Fasae *et al*., 2019). Most of the animals suffer from seasonal nutritional stress, resulting in weight loss, reproductive inefficiency and even death (Yohanna *et al*., 2015). This seasonal shortage can be mitigated by the use of sown forage of better nutritional value and purposely managed. High quality grass forage like *Brachiaria ruziziensis* have been reported as perennial tropical forage which is easy to establish and respond well to nitrogen fertilization (Skerman and Riveros, 1990). However to maintain the quality and year round production, there is need for water and nutrient to be supplied especially during the dry season to enable continuous production. Thus providing quality forage for ruminant to enhance their growth and provide maximum profit for farmers throughout the year. In Nigeria despite government interventions, inorganic fertilizers still remain expensive, in lieu of this researchers have shifted attention to examine the performance of crops with organic manure which is cheap, readily available, biodegradable and environmentally friendly. Organic manure has been discovered to be rich in nutrients which increase crop growth rate, yield, quality, and the ability to tolerate stressful conditions (Nweke *et al*., 2013). This study was designed to evaluate the effect of different goat manure rate on yield and nutrient composition of irrigated *Brachiaria ruziziensis* as potential dry season forage for ruminants.

MATERIALS AND METHODS

The experiment was conducted at the Kalahari Red goat unit of the Institute of Food Security, Environment Resource and Agricultural Research Farms of the Federal University of Agriculture, Abeokuta, Nigeria, situated in the humid tropics. *B. ruziziensis* was established by planting the seeds using a drill method in June 2015. Prior to manure application, soil samples were randomly collected

from the plots, air−dried, sieved with a 2 mm mesh sieve and analyzed for physical and chemical properties through methods reported by Osayande *et al.* (2015) while goat manure (GM) was also collected from the goat unit of the experimental site for analyses. Necessary manure rates were applied before the commencement of the experiment by making a small farrow about 4−8 cm from the base of the plant then manure applied and farrow closed back and irrigation of the plots to fill capacity started 7 days before the commencement of the experiment at three-day interval. The experiment was laid out in randomized complete block design with five treatments comprised of *B. ruziziensis* fertilized with 5, 10, 15, 20 t/ha dry matter (DM) GM and the unfertilized plot. Each treatment was replicated five times. The plants were undefoliated before the initial cut−back to a stubble height of 15 cm at the start of the experiment in December 2015. Each plot measure 4 m by 4 m with an inter plot space of 0.5 m. Dry matter yield was estimated after 45−day regrowth by throwing a 1.0 × 0.5 m^2 quadrant frame thrice in each plot and the entire sward falling inside it harvested manually using a sickle to stubble height of 15 cm and weighed fresh, sub samples were taken and oven dried at 65^oC till constant weight for determination of dry matter yield. The dry matter, crude protein, ash and ether extract were determined according to AOAC (2005) and data obtained were subjected to analysis of variance using the statistical package SAS (2003) and means were separated using least significant difference (LSD) of the package.

RESULTS AND DISCUSSION

The soil and goat manure composition are shown in Table 1. The composition of goat manure (GM) observed in this study was lower in total nitrogen, organic matter, phosphorus and potassium values reported by Awodun *et al.* (2007) but higher than that reported by Odedina *et al.* (2011). The differences in nutrient content of GM could be related to the nutritional management of goats.

Table 1: Chemical analysis of soil and goat manure sample

Parameters	Soil	Parameters	Goat manure
pH in water	8.15	pH in water	8.07
% Total nitrogen	0.14	Total nitrogen (%)	1.55
% Organic carbon	0.60	Organic carbon (%)	13.07
% Organic matter	1.03	Organic matter (%)	45.41
Av. phosphorus (mg/kg)	16.10	Phosphorus (%)	0.22
K^+ (Cmol/kg)	0.84	Potassium (%)	0.87
Na^+ (Cmol/kg)	0.71	Sodium (%)	0.28
Ca^{2+} (Cmol/kg)	3.13	Calcium (%)	1.27
Mg^{2+} (Cmo/lkg)	1.46	Magnesium (%)	1.36
Exch. acidity ($Cmolkg^{-1}$)	2.70		
% Sand	76.90		
% Clay	17.80		
% Silt	5.30		

Goat manure application rates was found to have significant effect ($P<0.05$) on the dry matter yield of *B. ruziziensis* (Figure 1). The highest DMY of 5.26 t/ha was recorded for treatments fertilized with 20

t/ha DM GM while the least DMY of 1.88 t/ha was recorded for control. The results of this study revealed that DMY of *B. ruziziensis* increased with increased rate of goat manure application. This agrees with the finding of Maleko *et al*. (2015) who observed that dry matter yield of *B. ruziziensis* increased significantly from 9.31 to 13.70 t/ha as cow manure application rate increased from 0 to 15 t/ha DM. This increase in DMY with increased manure application could be attributed to increasing large amount of goat manure added to the soil and slow nutrient release from the manure particularly nitrogen (N) which is known to plays a major role in leaf growth. The DMY in this study was higher than the yield (1.87 t/ha) reported by Panchaban *et al*. (2005) but lower than that reported (21.5 t/ha) by Naveh and Anderson (1967) and (17.6 t/ha per year at 800 kgN/ha per year application) by Skerman and Riveros (1990). The observed variations in yield of *B. ruziziensis* under these studies compared to others might be due to time of data collection, age at cut, season variation, type and rate of fertilizer/manure applied and soil fertility.

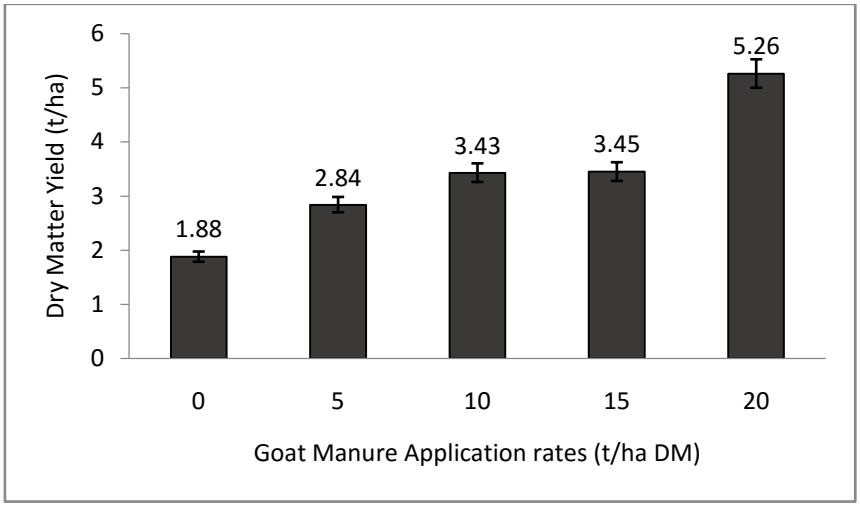


Figure 1: Effect of goat manure application rates on dry matter yield (t/ha) of *B. ruziziensis*

Dry matter (DM) and ash content were not significantly influence by the manure application rates (Table 2). Olanite *et al*. (2014) reported similar DM value for grasses in their experiment. The crude protein (CP) content and ether extract (EE) content were significantly influenced ($P<0.05$) by the manure rates (Table 2). The EE content ranged from 4.49 % in the control to 5.73 % in treatment fertilized with 20 t/ha goat manure. Crude protein content ranged from 7.59 in unfertilized plots to 9.28 % in plots fertilized with 20 t/ha DM goat manure. Also plots fertilized with 10, 15 and 20 t/ha goat manure was observed to be significantly higher than the control. Despite these variations, the forage generally had adequate amount of protein to meet ruminant requirement. The CP contents of *B. ruziziensis* in this experiment were consistently above the critical limit required for maintenance by ruminants. According to Minson (1990), if the CP content of a feed is lower than 7%, animal performance could decline due to low voluntary intake, lower rate of digestibility and negative nitrogen balance. The highest CP values were recorded for *B. ruziziensis* fertilized with 20 t/ha DM goat manure is an indication of a more positive effect of increased goat manure rate on the grass during the experiment. This might be attributed to more organic matter decomposition, and quicker release of nutrients, in the form of nitrogen and phosphorous for plant uptake because of the higher quantity added.

Table 2: Proximate composition (%) of *Brachiaria ruziziensis* using different goat manure application rates

Treatments (t/ha DM)	Dry Matter	Crude Protein	Ether Extract	Ash
Control	37.15	7.59[d]	4.49[ab]	8.37
5	40.86	8.10[cd]	4.65[ab]	8.42
10	39.50	8.17[bc]	3.75[b]	8.51
15	41.84	8.69[b]	5.32[a]	8.77
20	42.70	9.28[a]	5.73[a]	9.33
SEM	0.96	0.17	0.26	0.27

[abcd] Means on the same column having different superscripts were significantly different (P<0.05)

SEM, Standard Error of Mean

CONCLUSION

The study showed that dry matter yield and proximate composition of irrigated *Brachiaria ruziziensis* fertilized with 20 t/ha DM goat manure produced the best quality forage. This could facilitate year-round production of forage and a safer environment with sensible and efficient use of goat manure.

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REFERENCE

AOAC. 2005. Official Methods of Analysis. (18th Edition). Association of Official Analytical Chemists Washington DC, USA.

Awodun, M.A., Omonijo, L.I. and Ojeniyi, S.O. 2007. Effect of goat dung and NPK fertilizer on soil and leaf nutrient content, growth and yield of pepper. International Journal of Soil Science 2 (2): 142-147. http://dx.doi.org/10.3923/ijss.

Fasae, O. A., Abiola, M. M., Fabunmi, T. O., Yusuf, A. O. Aderinboye, R. Y. and Fakoya, E. O. 2019. Yield and nutrient composition of fertilized maize as fodder for ruminant production. Nigerian Journal of Animal Production. 46 (2): 219-227.

Maleko, D.D., Kileo N,J., Abdul-Rahman, Y. and Sangeda A.Z. 2015. Short-term effects of cow manure on above ground growth characteristics of Brachiaria ruziziensis in tropical sub-humid environment, Tanzania. International Journal of Plant & Soil Science 6 (5): 283-293.

Minson, D.J. 1990. Forage in ruminant Nutrition. Academic press Inc. San Diego, C.A. 90-95p

Naveh, Z. and G.D. Anderson. 1967. Promising pasture plants for northeast Tanzania. 4. Legumes, grass and grass/legume mixture. E. Afr. Agric. For. J. 32: 282−304.

Nweke, I.A., Ijearu, S.I. and Igili, D.N. 2013. Effect of different sources of animal manure on the growth and *yield of okra (Abelmuschus esculentus (L.) Moench) in ustoxic dystropept at Enugu, south eastern Nigeria. International Journal of Scientific and Technology Research 2 (3): 135-137.*

Odedina, J.N., Odedina, S.A. and Ojeniyi, S.O. 2011. Effect of types of manure on growth and yield of cassava (Manihot esculenta, Crantz). Researcher 2 (5): 1-8.

Olanite, J.A., Ewetola, I.A., Onifade, O.S., Oni, O.A., Dele, P.A. and Sangodele, O.T. 2014. Comparative residual effects of some animal manure on the nutritive quality of three tropical grasses. International Journal of Science, Environment and Technology 3 (3): 1131 – 1149.

Osayande, P.E., Oviasogie, P.O., Orhue, E.R., Irhemu, P., Maidoh, F.U. and Oseghe, D.O. 2015. Soil nutrient status of the Otegbo fresh water swamp in Delta state of Nigeria. Nigerian J. Agric. Food Environ. 11(2): 1−8.

Panchaban, S., Ta-Oou, M. and Sanunmuang, S. 2005. Effect of organic and inorganic fertilizers on yield and quality of ruzi grass (Brachiaria ruziziensis) grown on saline sandy soils of the Northeast, Thailand. In proceeding: Management of tropical sandy soils for sustainable agriculture. pp383-386.

SAS (Statistical Analysis System). 2003. SAS User's Guide. SAS Institute Inc. Cary, North California, USA.

Skerman, P. J. and Riveros, F. 1990. Tropical grasses. Food and Agriculture Organization of the United Nations; Plant Production and Protection series, Rome, Italy.

Yohanna, B. I., Nyako, H. D., Hyeladi, M.I., Yohanna, A. H., and Mohammed, I. D. 2015. Formulation and nutrient composition of dry season rations for ruminants using crop residues and their rumen degradation characteristics in semi−arid region of Nigeria. Annal. Bio. Res. 6(7): 1−6.

EVALUATION OF SELECTED CEREAL STOVER HAYS FOR NUTRIENT COMPOSITION AND *IN VITRO* GAS PRODUCTION IN WUKARI, NIGERIA

***A.J., Amuda[1], R.T., Binuomote[2] and R.D., Isaac[1]**

'Department of Animal Production and Health, Federal University Wukari, Taraba State. [2]Department of Animal Production and Health, LAUTECH, Ogbomosho, Oyo State.

Corresponding author: A. J. Amuda; E-mail: aademolajoseph@gmail.com; +2348039288427

ABSTRACT

An experiment was conducted to determine the nutrient composition and in vitro gas production from six (6) cereal stovers hays in Teaching and Research Farm of Federal University, Wukari, Taraba State, Nigeria. Fresh stovers of maize, sorghum, pearl millet, finger millet, rice and acha were harvested, chopped and air-dried in late October and early November, 2018. The experimental design was Completely Randomised Design (CRD) and each treatment (each stover) was replicated three times. The in vitro gas production was carried out in laboratory using standard technique. The results showed that DM, CP, CF, NFE, EE, Ash, OM, CHO and fibre fractions (NDF, ADF, ADL), cellulose and hemicellulose of the selected cereal stovers hay were significantly (P < 0.05) different from each other except for ether extract (EE) that was similar across the treatments. Sorghum stover hay (T_3) had the highest DM value of 92.69% while T_1 had the highest CP contents of 11.78% CP. However, T6 had the highest CF value (34.00%) of all the selected cereal stovers. The in vitro *gas production parameters such as CH_4, TGV, FE, OMD, (DMD, SCFA and ME varied significantly (P < 0.05) across the treatments. The TGV was highest (24.67ml) in T_2 (finger millet stover) and least (16.67ml) in T_3 (sorghum stover). The results of this study indicated that T_1 (rice stover hay) had over all best nutrient composition and in vitro gas production assessment*.

Keywords: Cereal stovers, chemical composition, hay, *in vitro* gas production, ruminants

INTRODUCTION

In feeding livestock, the aim is to provide the animals with a balanced ration throughout the year with sufficient nutrients to meet the animal's nutrient requirements for maintenance and production. The major constraint to livestock production is feed both in quality and quantity. In Nigeria, forage and fodder supply during the dry season and drought periods is a very important factor limiting livestock productivity. Shortage of feed resources often imposed major constraints on the development of animal production in the tropics and sub-tropics. Considerable quantities of crop residues are generated every year in most developing countries in the tropics and sub-tropics which are suitable for feeding livestock. An intensive feeding system based on locally available agro-industrial by-products and crop residues is an alternative promising feeding system to rear ruminants economically. Ruminants because of their rumen physiological adaptation can utilise inexpensive agro-industrial by-products and crop residues to meet their feed requirements for maintenance, growth, and production. Agro industrial byproducts and crop residues in the diets of ruminants support growth, lactation and result in the production of human edible food. Although most have low nitrogen content, more fibre as well as low nutrient density, effective processing can raise their nutritive value (Areghore, 1994). Little information is available on the extent to which small holder farmer in Nigeria use crop residues as livestock feed. It is very likely, however, that these resources are under-utilised. Even when they are utilised, farmers may not be able to incorporate them efficiently into their year-round livestock feeding programmes because they lack suitable storage facilities and technical know-how on treatment and processing methods and on formulating feed ration. The selected cereal stovers hay (maize, sorghum, pearl millet, finger millet, rice and acha) are major food crops cultivated in north-east Nigeria. Most of these cereal stovers are left on the field to waste after harvesting the main crops.

Consequently, there is need to examine their potential feed value for ruminant animals' production. Thus, a study was carried out to determine the chemical composition and evaluate nutritive value of selected cereal stover hay using *in vitro* fermentation technique.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The study was carried out at Teaching and Research Farm of the Federal University Wukari Taraba State, North-East Nigeria. Wukari is located on Latitude 7^0 51^1 North and Longitude $9^{tl}47^1$ East. Wukari is situated at elevation 189 metres above the sea level and has a mean annual rainfall of 1300mm. The maximum annual temperature ranges between 30^0C and 39.4^0C while the minimum annual temperature is between 15^0 and 23^0C (Oyatayo *et al*., 2015).

HARVESTING AND HAY MAKING

Freshly harvested green cereal stovers (maize, sorghum, pearl millet, finger millet, rice and acha) were collected from Crop Production Teaching and Research Farm of Federal University Wukari and processed into hay. The harvesting was done in the month of October and November 2018 and the samples were collected in batches. Harvested cereal stovers were chopped with cutlass into 3-5cm size (for easy drying). Thereafter, the chopped materials were air-dried under shed for two weeks on concrete. The chopped cereals stover were constantly turned-over to ensure uniform drying and prevent mouldness and loss of nutrients. The chopped cereal stovers were then weighed and divided into equal portions (1kg) and each of the cereal stover serve as experimental treatment making six treatments. Treatment A = Maize Stover (MS); Treatment B = Sorghum Stover (SS); Treatment C = Pearl Millet Stover (PMS); Treatment D = Finger Millet Stover (FS); E = Rice Stover (RS) and F = Acha Stover (AS). All were replicated three times in a completely randomized design. However, the samples for laboratory analysis were oven dried at 65^oC and milled by 'MG 123' grinder. The samples were ground in the laboratory with hammer mill of 1mm sieve and subjected to chemical analysis for determination of dry matter (DM), organic matter (OM), crude protein (CP), crude fibre and nitrogen free extract as described by AOAC (2002). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were assayed by the method of Van Soest *et al,* (1991). Hemicellulose was calculated as the difference between NDF and ADF and cellulose as the difference between ADL and ADF.

IN VITRO STUDY

The rumen fluid was collected through the suction method by means of the hose from three West African Dwarf (WAD) goats under the same feeding regime. The animals were fed with 40% concentrate feed (40% corn, 10% wheat offal, 10% palm kernel cake, 20% groundnut cake, 5% soybean meal, 10% dried brewers grain, 1% common salt, 3.75% oyster shell and 0.25% fish meal) and 60% Guinea grass. The rumen fluid was collected into a thermos flask that had been pre-warmed to a temperature of 39^0C before morning feeding and taken to the laboratory. It was filtered through a four-layered cheese cloth into a warm flask, flushed with carbon dioxide (CO2) gas, and stirred using an automatic stirrer. Incubation was done as reported by (Menke and Steingass, (1988) using 120ml calibrated syringes in three batch incubation at 39^0C into 200mg sample in the syringe was introduced using 30ml inoculums containing strained rumen liquor and buffer ratio (1: 4 v/v) under continuous flushing with CO2. The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24hr. At post incubation period 4ml of NaOH (10 M) was introduce to estimate methane production as reported by Fievez et al., (2005). The volume of the gas produced at intervals was recorded. Metabolisable energy (ME) was calculated as ME = 2.20 + 0.136 GV + 0.057CP + 0.0029CF (Menke and Steingass, 1988). Organic matter digestibility (OMD) = 14.88 + 0.889 GV + 0.45 CP + 0.651 XA. Short chain fatty acids (SCFA) as 0.0239GV - 0.0601(Getachew et al., (1998) was also obtained, where GV, CP, CF

and XA are total gas volume (ml/200mg DM), crude protein, crude fibre and ash, respectively. Data collected were subjected to Analysis of Variance (ANOVA) using statistical package for social sciences(SPSS) version 23 and significant means were separated by the use of Duncan' Multiple Range Test.

RESULTS AND DISCUSSION

CHEMICAL COMPOSITION OF SELECTED CEREAL STOVERS HAY

Table 1 showed the chemical composition of selected cereal stovers hay (Rice, Finger millet, Sorghum, Maize, Pearl millet and Acha). The T_1 (rice stover hay) ($p<0.05$) was significantly higher both in crude protein (11.78%) and ash content (14.40) while T_4 (Maize stover hay) was significantly $P<0.05$) higher (34.00%) in CF compare to other cereal stover hays. Similarly, T_3 (sorghum stover hay) was significantly ($P<0.05$) higher in DM (92.69%), OM (91.65%) and CHO (80.73%) respectively. The crude protein contents which was the major nutrient of the selected cereal stovers hay ranged (8.90 -11.78%) was higher than the critical value of 7.0% recommended by National Research Council (NRC 1981) and also higher than the minimum CP level of 7% required for optimum rumen function (Van Soest, 1994).

Table 1: Chemical composition (g/100g DM) of selected cereal stovers hay

	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Parameters							
Dry Matter	92.56^{ab}	91.69^{c}	92.69^{a}	92.10^{bc}	92.14^{bc}	91.91^{c}	0.30
Crude Protein	11.78^{a}	11.70^{a}	9.60^{b}	8.90^{b}	9.35^{b}	9.05^{b}	0.92
Crude Fibre	31.62^{a}	32.00^{a}	31.05^{b}	31.55^{b}	31.53^{b}	34.00^{a}	1.67
Nitrogen Free Extract	40.52^{c}	43.55^{b}	48.42^{a}	48.15^{a}	43.71^{bc}	44.95^{ab}	2.33
Ash	14.40^{a}	11.50^{b}	8.35^{c}	10.75^{b}	14.20^{a}	10.80^{b}	0.72
Ether Extract	1.15	1.25	1.20	1.15	1.20	1.20	0.11
Organic Matter	85.60^{b}	76.94^{c}	91.65^{a}	89.25^{b}	85.80^{b}	89.78^{b}	1.06
Carbohydrate	72.81^{c}	75.55^{b}	80.73^{a}	79.20^{a}	75.25^{b}	78.95^{a}	1.31

a,b,c= means on the same row with different superscripts are significantly ($P<0.05$) different.

T_1 = Rice stover, T_2 = Finger millet stover, T_3 = Sorghum stover, T_4 = Maize stover, T_5 = Millet stover,

T_6 = Acha stover, SEM = Standard Error of Mean

FIBRE FRACTION OF SELECTED CEREAL STOVERS HAY

Presented in Table 2 is the fibre fractions (NDF, ADF, NDS, ADL, Cellulose and Hemicellulose) of selected cereal stovers. There were significant ($P<0.05$) differences among treatments, except for ADF which was similar across the treatments. Fibre fractions (NDF, ADF, ADL) and cellulose were significantly ($P<0.05$) higher in T_5 (Pearl millet stover hay) compare to other cereal stovers hay. The fibre fractions, cellulose and hemicellulose of the selected cereal stovers hay are relatively low, therefore ruminants can digest them.

Table 2: Fibre fractions (g/100g DM) of selected cereal stovers hay

	Treatments						
Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
NDF	65.05^{abc}	65.41^{ab}	63.81^{bc}	63.21^{c}	66.52^{a}	66.26^{a}	1.20
ADF	45.32^{b}	45.66^{b}	45.01^{b}	44.16^{b}	47.51^{a}	44.34^{b}	1.11
NDS	0.36^{d}	1.83^{d}	9.83^{a}	8.09^{b}	0.87^{d}	4.0^{c}	1.04
ADL	22.03^{b}	21.49^{b}	21.61^{b}	21.41^{b}	23.05^{a}	21.64^{b}	0.58
Cellulose	23.28^{b}	23.17^{b}	23.40^{b}	22.75^{b}	24.46^{a}	22.71^{b}	0.58
Hemillulose	19.69^{ab}	20.75^{ab}	19.13^{b}	19.05^{b}	19.01^{b}	21.92^{a}	1.63

a,b,c = means on the same row with different superscripts are significantly (P<0.05) different.
T_1 = Rice stover (RS), T_2 = Finger millet stover (FMS), T_3 = Sorghum stover (SS), T_4 = Maize stover (MS), T_5 = Pearl Millet stover (PMS), T_6 = Acha stover (AS), NDF = Neutral Detergent Fibre, ADF = Acid Detergent Fibre, NDS = Neutral Detergent Soluble, ADL = Acid Detergent Fibre, SEM = Standard Error of Mean

In vitro fermentation parameter of selected cereal stovers hay

Table 3 showed the *in vitro* gas fermentation parameter of selected cereal stovers hay. The parameters observed differs significantly (P<0.05) across the treatments. The *in vitro* gas fermentation technique provided a useful basis from which metabolisable energy (ME), organic matter digestibility (OMD), short chain fatty acid (SCFA) and methane (CH_4) production of feeds samples be measured. The values of ME (5.14-6.23) obtained among the treatments were significant. The *in vitro* fermentation technique has been widely used to evaluate the energy value of several classes of feed (Getachew *et al.,* 1998).The OMD is said to be a measure of degradability potentials of the microbes on the substrate in the presence of sufficient ammonia nitrogen (NH_3-N) that has influence on bacteria fermentation. The values (45.54-52.58%) obtained were higher than ranged values (35.45 - 46.0%) reported by Falola *et al.,* (2015) for vetiver grass *(Chrysopogon zizanioides L., Roberty)* and 36.45 - 45.93%) reported by Alasa *et al.,* (2010) for *Panicum maximum* intercropped with two cultivars of *Lablab purpureus.* Similarly, SCFA ranged values (0.36 - 0.53ml) obtained in this study were higher than the ranged values (0.31 - 0.36ml) reported by Alasa *et al.,* (2010) but relatively inclined to range values (0.42 - 0.68ml) reported by Falola *et al.,* (2015). The ranged values of OMD, DMD, ME, SCFA and TGV indicated that the cereal stovers are degradable, digestible and could provide energy to ruminants animals.

Table 3: *In vitro gas* fermentation parameters of selected cereal stovers hay

Parameters	Treatments						
	T_1	T_2	T_3	T_4	T_5	t_6	SEM
TGV (ml)	18.67^{b}	24.67^{a}	16.67^{b}	18.00^{b}	18.67^{b}	17.33^{b}	5.94
CH_4 (%)	13.33^{b}	17.33^{a}	9.33^{c}	10.67^{c}	11.33^{c}	12.00^{b}	5.14
FE (g/GVml)	4.07^{ab}	2.86^{c}	5.62^{a}	3.62^{b}	3.84^{b}	3.59^{b}	2.17
OMD (%)	47.30^{ab}	52.58^{a}	45.54^{b}	49.64^{ab}	47.30^{ab}	46.12^{b}	5.75
DMD (%)	74.67^{a}	69.80^{ab}	66.77^{ab}	69.67^{ab}	70.93^{a}	61.40^{b}	7.60
ME (MJ/Kg DM)	5.42^{ab}	6.23^{a}	5.14^{ab}	5.78^{a}	5.42^{ab}	5.24^{ab}	0.89
SCFA (^ml)	0.39^{b}	0.53^{a}	0.34^{c}	0.45^{ab}	0.39^{b}	0.36^{b}	0.16

a,b,c= means on the same row with different superscripts are significantly (P<0.05) different.
T_1 = Rice stover, T_2 = Finger millet stover, T_3 = Sorghum stover, T_4 = Maize stover, T_5 = Pearl millet

stover, T_6 = Acha stover, TGV =Total Gas Volume, CH_4 = Methane, FE = Fermentation Efficiency, OMD = Organic Matter Digestibility, DMD = Dry Matter Degradability, ME = Metabolisable Energy, SCFA = Short Chain Fatty Acid, SEM = Standard Error of Mean

CONCLUSION

It was concluded from this study that rice stover hay (T_1) was higher in nutrient (crude protein), dry matter and DMD as revealed by chemical composition and *in vitro* gas production compare to other stover hays.

REFERENCES

A.O.A.C. 2002. Official methods of Analysis of the Official Analytical Chemists, 17th Edition (Horwitz, W., ed.), Association of Official Analytical Chemists, Washington D.C.

Alasa, M.C, Akinsola, S.O, and Babayemi, O.J (2010). Chemical composition and in vitro gas production of *Panicum maximum* intercropped with two cultivars of *Lablab purpureums.* Babayemi, O.J., Abu, O. and Ewuola, E.O. (Eds). Proceedings of the35th Nigerian Society for Animal production, 14 - 17th March. 2010; 587-590.

Aregheore, E. M. 1994. Potential of crop residues in Ruminant nutrition during the hot dry season in *Zambia Journal of Agricultural Science* 4; 39-42.

Falola, O.O., Adedeji, O. Y., Saka, A.A. Areegbe, A.O and Adisa, A.F. (2015). *In vitro* Evaluation of 4, 6 and 8 Weeks Re-growths of Vetiver Grass (Chrysopogon zizanioides L. Roberty). Proceedings of 40th Annual Conference of Nigerian society for animal production NAPPRI/Ahmadu Bello University, Zaria 2015. Pp. 464 - 467.

Getachew, G., Blummel, M., Marker, H. P. S. and Becker, K. 1998. *In vitro* gas measuring techniques for assessment of nutritional quality of feeds. A review. *Animal Feed Science Technology,* 72: 261 - 281

Menke, K. H. and Steingass, H. 1988. Estimation of the energetic feed value from chemical analysis and *in vitro* gas production using rumen fluid. *Animal. Research. Development*. 28: 7 - 55.

NRC 1981. Nutrient Requirements for goats. Angora dairy and meat goat in temperate and tropical countries. National Research Council, National Academy of Science Press. Washington, DC., U.S.A.

Oyatayo T. K., Songu A. G., Amos A. G. and Ndabula C (2015). Assessment of heavy metal concentration in hand dug well water from selected land uses in Wukari Town, Wukari, Taraba state Nigeria. *Journal of Geoscience and Environmental protection* (3): 1-10.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. (1991). Methods for dietary fiber-neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science.* 74: 3583 - 3597.

NUTRIENT INTAKE AND DIGESTIBILITY IN WEST AFRICAN DWARF GOATS FED DIETS CONTAINING *VERNONIA AMYGDALINA* (BITTER LEAF) AS PHYTOGENIC ADDITIVE

Adebayo, K.O., Olatomiwa, O.A. Olaleye T.O., Akinbode, R.M. and Onwuka, C. F.I.
Department of Animal Nutrition, Federal University of Agriculture, Abeokuta
adebayoko@funaab.edu.ng/ +2348035366932

ABSTRACT
Twenty-four West African dwarf (WAD) goats were subjected to four dietary treatments containing Vernonia amygdalina (VA) at varying inclusion levels (0, 5, 10 and 15g/ kg DM) to assess its effect on nutrient intake and digestibility. Panicum maximum was fed as a basal diet and concentrate diet as supplement in a ratio of 60:40.The experiment was laid out in a completely randomized design and it lasted for 112 days. Results showed that VA inclusion increased (p<0.05) total dry matter (DM), crude protein (CP), crude fibre (CF) and acid detergent fibre (ADF) intakes. Goats on diets containing VA also had the highest (p<0.05) CF, ADF and acid detergent lignin (ADL) digestibility. It was therefore concluded that for increased nutrient intake and fibre fibre digestibility, VA can be included in the diet of WAD goats up to 15g/kg DM.

INTRODUCTION
Phytogenic feed additives are substances derived from plants; they are also referred to as phytobiotics or botanicals. They include herbs and spices and their extracts which can be added to animal feed to promote growth and improve the health status of the animals. Their usefulness lies in some chemical substances that produce definite physiological actions in the body of the animals (Oko and Agiang 2009). Some of the useful herbs and spices are indigenous to Africa and include ginger (*Zingiber officinale*), garlic (*Allium sativium*), scent leaf (*Ocimum gratissimum*) and bitter leaf (*Vernomnia amygdalina)* (Muhammad et al. 2009). *Vernonia amygdalina* is a valuable medicinal plant that is widespread in West Africa, it is known as bitter leaf due to its characteristic bitter taste and flavor, and can be used as an active anticancer, antibacterial, anti malarial and anti parasitic agent (Udochukwu *et al*., 2015). The bitter leaf plant contains *vernonine, vernodalin* and *venomygdin*. It is known to be endowed with valuable biochemical properties, fixed oil, alkaloids, saponins, tannins and other glycosides (Bonsi *et al*., 1995).It is a unique plant, so unique that every part of it has an economic importance. Its leaves are macerated and used in cooking soup, while the extracts are used as tonic for prevention of certain illness. *Vernonia amygdalina* have been shown to be valuable nutritionally. It contains significant quantities of lipids (Ejoh *et al.* 2007), proteins with essential amino acids (Igile *et al.* 1994). It also contains carbohydrates (Eleyinmi *et al.* 2008) and carotenoids, though not in large quantities (Udensi *et al.* 2002). Also contained in this plant are essential elements such as calcium, iron, protein, potassium, phosphorus, manganese, copper and cobalt (Bonsi *et al.* 1995). The study therefore aims at determining the effect of diets containing bitter leaf on nutrient intake and digestibity in West African dwarf goats.

MATERIALS AND METHODS
The study was carried out at the Animal Nutrition laboratory of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Ogun State is in the rainforest zone of South West Nigeria. The area has an annual mean temperature of 34.7°C, a relative humidity of 82% and an annual mean rainfall of 1,037 mm. It is about 70 m above sea level and lies on latitude 7°5'-7°8'N and longitude 3°11.2'E.

PROCESSING OF TEST MATERIALS AND FORMULATION OF DIETS

The leaves of bitter leaf were harvested, air-dried and ground to pass through 1mm sieve. This was used to formulate four concentrate diets which contain bitter leaf at 0, 5, 10 and 15g/kg DM (Table 1).

The diets; basal and concentrate supplement were offered to the animals at 5% of their body weight in a ratio of 60:40 respectively.

Table 1: Ingredient composition of experimental concentrate diet (%)

Ingredients	T1	T2	T3	T4
Cassava peel	40	40	40	40
Maize cob	20	20	20	20
Dried brewer's grain	20	20	20	20
Wheat offal	17	17	17	17
Bone meal	2	2	2	2
Salt	1	1	1	1
Bitter leaf	-	+	++	+++
Total	100	100	100	100
Determined analysis (%)				
Crude protein	11.88	11.88	11.88	11.88
Crude fibre	13.84	13.84	13.84	13.84

-, +, ++, +++ means 0g, 5g, 10g, and 15g of bitter leaf/kg of concentrate feed..

Experimental animals and management

Twenty- four (24) West African dwarf goats with an average live weight of 6.5 - 9kg were used for the experiment. Pens were cleaned and disinfected with Izal solution prior to the arrival of the animals. The goats were kept in the quarantine section for two weeks for proper prophylactic treatment which consisted of intramuscular application of oxytetracycline LA and vitamin B complex at the dosage of 1 mL/10 kg body weight of the animal. The animals were maintained on *Panicum maximum* grass and concentrate and clean water was supplied *ad libitum.* They were thereafter divided into four treatment groups of five animals each on weight equalization basis and housed in individual pens. The study comprises 14 days of adaptation followed by 12 weeks feeding trial and 2 weeks' nutrient digestibility study. The diets were offered at 8:00am in the morning and 12.00pm in the afternoon. The concentrate diets were offered first and then the basal diet in separate feeding trough. Left over of the feed offered was weighed and recorded every morning to compute feed intake on dry matter basis. Initial weights of the animals were taken on the first day of the experiment and thereafter fortnightly throughout the experiment. The nutrients intake was calculated as follows:

Dry matter intake =% dry matter of feed x daily feed intake

Crude protein intake =% crude protein of feed x daily feed intake etc.

NUTRIENT DIGESTIBILITY STUDY

After 12 weeks feeding trial, four goats from each treatments were transferred into clean metabolic cages for separate collection of faeces and urine. There was a 7-day acclimatization followed by 7 days' collection of faeces. Aliquots of collected faeces were dried in the oven at 65^0 C till constant weight.

CHEMICAL ANALYSES

Oven dried feed and faecal samples were analyzed for their proximate compositions: crude protein, crude fibre, ether extract and ash according to AOAC (2000). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest *et al.* (1991).

STATISTICAL ANALYSIS

All data collected were subjected to one-way analysis of variance in a completely randomized design using version 9.1 of SAS software (SAS, 2001)

RESULTS AND DISCUSSION

Vernonia amygdalina (VA) is rich in crude protein, ether extract and ash (Table 2). The CP and ash content obtained in this study are however lower than the range (17 to 33g/100g DW and 10 to13g/100g DW respectively) reported by Alabi (2005). However, ether extract content falls within the range of 2 to 15g/100gDW reported by same author. Presented in table 3 is the nutrient intake of goats fed experimental diets. *Vernonia amygdalina* inclusion increased ($p<0.05$) total dry matter, CP, CF ADF intakes. This is indicative of better degradability and hence increased intake. According to Olafadehan *et al*. (2017) feed intake is a function of availability, palatability, fibre digestion and digesta flow rate. Fajemisin *et al*. (2010) also reported increased nutrient intake when graded levels of VA leaf meal was included in the diets of West African dwarf ewes. The diets have significant ($p<0.05$) effect on CF, ADF and ADL digestibility (Table 4). Crude fibre, ADF and ADL digestibility were highest in diets containing VA while the least values were obtained in the control diet. This implies that the secondary metabolites in VA did not interfere with the digestion process in the rumen.

Table 2: Chemical composition (%) of Bitter leaf *(Vernonia amygdalina)*

Parameters	Percentage
Dry matter	84.00
Crude protein	14.46
Ether extract	8.31
Ash	4.33
Tannin	1.89
Saponin	2.08
Oxalate	3.91

Table 3: Nutrient intakes of West African dwarf goats fed experimental Diets (g/day)

Parameters	T1 0g	T2 5g	T3 10g	T4 15g	SEM
Dry matter (grass)	107.9^{b}	138.93^{a}	123.39^{ab}	143.65^{a}	5.16
Dry matter(conc.)	94.11	94.18	95.19	96.26	0.52
Total dry matter	202.01^{b}	238.18^{a}	218.58^{ab}	239.91^{a}	5.31
Crude protein (grass)	23.22^{b}	30.11^{a}	26.75^{ab}	31.19^{a}	1.12
Crude protein (Conc.)	13.39	13.41	13.54	13.67	0.07
Total crude protein	36.60^{b}	43.52^{a}	40.28^{ab}	44.83^{a}	1.14
Crude fibre (grass)	17.19^{b}	24.45^{a}	21.26^{ab}	21.60^{ab}	1.04
Crude fibre (conc.)	14.25	14.23	14.41	14.57	0.08
Total crude fibre	31.39^{b}	38.71^{a}	35.66^{ab}	36.17^{ab}	1.05
Ether extract (grass)	11.42	13.78	13.13	13.16	0.46
Ether extract (conc.)	8.31	8.32	8.40	8.50	0.46
Total ether extract	19.73	22.11	21.53	21.85	0.47
Ash (grass)	2.45^{b}	3.18^{a}	3.03^{ab}	3.08^{ab}	0.12
Ash (conc.)	5.95	5.97	6.55	6.62	0.19
Total Ash	8.40	8.97	9.58	9.82	0.27

NDF (grass)	107.18	110.25	182.53	134.78	8.89
NDF (Conc.)	72.09	72.20	72.93	73.74	0.39
Total NDF	179.23	182.42	205.43	208.50	8.85
ADF (grass)	77.79[b]	100.94[a]	96.18[ab]	97.81[ab]	3.75
ADF (conc.)	36.05	36.10	38.06	36.87	0.43
Total ADF	113.78[b]	137.00[a]	134.20[ab]	134.63[ab]	3.79
ADL (grass)	32.69[b]	42.42[a]	40.42[ab]	41.18[ab]	1.58
ADL (conc.)	16.90	16.94	18.59	17.28	0.41
Total ADL	49.58	59.36	59.01	58.39	1.73

Means in the same row with different superscripts are significantly different (P<0.05)

Table 4: Nutrient Digestibility of West African dwarf goats fed Experimental diets (%)

Parameters	Treatment				
	T1	T2	T3	T4	SEM
Dry matter	68.16	72.23	70.49	73.24	1.04
Crude protein	69.28	73.04	72.42	69.71	0.91
Crude fibre	73.93b	80.58a	78.26a	78.67a	0.83
Ether extract	52.94	55.89	56.10	55.59	1.36
Ash	65.33	65.93	66.27	71.06	1.10
NDF	51.46	58.55	57.51	59.02	1.34
ADF	31.56[b]	47.41[a]	49.09[a]	47.89[a]	2.61
ADL	24.38[b]	50.13[a]	35.97[ab]	37.77[ab]	3.59

Means in the same row with different superscripts are significantly different (P<0.05)

CONCLUSION AND RECOMMENDATION

Based on the findings of this work, VA improved nutrient intake and fibre digestibility up to 15g/kg DM. It can therefore be included in the concentrate supplement for West African dwarf goats at 15g/kg DM

REFERENCES

Alabi, D.A., Onibudol, M.Z., Amusa, N.A. 2005. Chemical and nutritional composition of four botanicals with fungitoxic properties. World Journal of Agriculture Science. 1:

A.O.A.C., 2000. Official Methods of Analysis, 17th edition, Association of Official Analytical Chemists. Gaithersburg, MD, USA.

Bonsi, M. L. K., P. O. Osuji, A. K. Tuah, and N. N . Umunna, 1995. "Vernonia amygdalina as a supplement to teff staw (Eragrostis tef) fed to Ethiopian Menz sheep". Agro Forestry System 31(3): 229 – 241.

Ejoh, R. A., Nkonga, D. V., Innocent, G. and Moses, M. C. (2007), Nutritional components of some nonconventional leafy vegetables consumed in Cameroun, Pakistan Journal of Nutrition 6, 712-714.

Eleyinmi AF, Sporns P, Bressler DC (2008). Nutritional composition of Gongronema latifolium and Vernonia amygdalina. Nutrition. Food Scirnce., 38: 99-109.

Fajemisin, A.N., A.A. Fadiyimu and G.A. Alokan, 2010. "Protein and antinutrient intakes and digestibility of West African dwarf ewes fed graded levels of Vernonia amygdalina leaf meal diets". Internationa Journal of Current Research, 2: 57-61

Igile, G. O., Oleszek, W. I., Jurysta, M. R., Burda, S. I., Farifunso, M. E. and Fansanmade, A. A. (1994). Flavonoids from Vernonia amygdalina and their antioxidant activities, Journal of Agricultural and Food Chemistry 42, 2445-2448.

Muhammad Javed, Fazil –Raziq Durrani, Abdul Hafeez, Rifatullah khan and Ijaz Ahmad (2009), "Effects of aqeous extract of plant mixture on carcass quality of broiler chicks". Research Publishing Network (ARPN)

Oko, O.O.K. and E.A. Agiang 2009, "Phytochemical evaluation of 3 extractants of Aspilia africana leaves". Proc. of the International conference on Global food crisis, April 19 -24th, Federal University of Technology, Owerri, Nigeria, 87-90.

Olafadehan, O. A. and G.C. Okoye 2017. "Feed intake and blood profile of red sokoto goats fed urea treated ensiled cowpea husk based diets". J. Anim. Prod. Research, 29(1): 48-56.

SAS 2001. Statistical Analysis Systems, SAS/STAT User's guide, SAS Institute Inc., Cary, North Carolina, U.S.A.

Udensi, E., Ijeh, I. and Ogbonna, U. (2002), Effect of traditional processing on the phytochemical and composition of some local Nigerian leafy vegetables, Journal of Science and Technology 8, 37- 40.

Van Soest P. J., J. B. Robertson and B.A. Lewis 1991. "Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition". Journal of Dairy Science. 74: 3583–3597

EFFECTS OF REPLACING CORN BRAN WITH *Cajanus Cajan* LEAF MEAL IN THE SUPPLEMENT DIET ON THE GROWTH PERFORMANCE OF WEST AFRICAN DWARF RAMS

Adebisi, I.A., Ajibike, A.B., Oladepo, O., Okunlola, O.O., Alalade, J.A., Amusa, H.O. Mustapha, T.B. and Emiola, C.B.

Department of Animal Health and Production Technology, Oyo State College of Agriculture and Technology, P. M. B 10, Igbo-ora, Oyo State, Nigeria

**ademolaibrahim01@yahoo.com; +234-806-073-9507*

ABSTRACT

An experiment was carried out to investigate the growth performance of growing West African Dwarf Rams fed diets containing varying inclusion levels of Cajanuscajan leaf meal (CCLM) and Panicum maximum for 56 days in a feeding trial carried out at the Teaching and Research Farm of Oyo State College of Agriculture and Technology Igbo-ora, Nigeria. A total of sixteen (16) growing WAD rams between 6 - 9 months of age with an average body weight of 9.00 -12.00kg were randomly allocated to 4 treatments with 4 animals per treatment, while 2 animals served as replicate. The experimental diet was fed at 3% body weight of individual animals whileCajanuscajan leaf meal was supplemented in total mixed rations at varied inclusion levels (0%, 5%, 10% and 15%) with Panicum maximum. There were significant (P<0.05) difference in all parameters determined across the dietary treatments. The results revealed that rams fed diet T_2(5% CCLM) recorded the least daily weight gain (8.04g/d) while the highest daily weight gain (15.36g/d) was recorded in diet T_4 that contained 15% inclusion level of CCLM. The weekly weight gain of rams was significantly different across all treatments (P<0.05). The feed conversion ratio (FCR) range between 22.03 – 41.16 and showed significantly different (P<0.05) across all treatments. Hence, rams fed diet T_4 that contained 15% inclusion levels of CCLM in total mixed rations recorded the best feed utilization value of 22.03. It is therefore recommended that supplementation of CCLM in diets of growing rams up to 15% enhance the growth performance of the animals.

Keywords: *Tropical grass, Cajanuscajan leaf meal, WAD rams, Growth performance.*

INTRODUCTION

Forages such as grasses and legumes are the main source of feed for ruminants to meet their nutritional requirements, either for maintenance or production. However, in the tropics, inadequate nutrition is a great challenge contributing to production losses in ruminants (Ibhaze, 2016) due to unavailability of forages throughout the year. This unpleasant situation has necessitated the search for alternative feed resources rich in energy and protein that are readily available and relatively cheap. Several indigenous and exotic browse species have been investigated and evaluated for inclusion in ruminant feeding systems in Nigeria (Fajemisin, 2015). The shortage in feed supply due to high cost and seasonality has caused ruminant livestock farmers to search for alternative feed resources that are inexpensive and readily available and which are not directly required as a component of human dietaries and can economically supplement the feed ingredients in rations without adverse effects on the rumen microbial fermentation and performance of the animals (Okoruwa*et al.,* 2013). Tropical browse plants such as *Cajanuscajan* is multipurpose nitrogen fixing crop that provides the seed as human food and poultry feed, the leaves and young stems as animal fodder for the subsistence farmers (Lorgyer, 2009). *Panicum maximum* also called guinea grass (FAO, 2003) is a highly productive, palatable, persistent and acceptable grass by ruminants. It can be fed to livestock solely or with concentrates or legumes. This study was therefore designed to evaluate the effect of *Cajanuscajan*leaf meal in total mixed rations on the growth performance of West African dwarf growing rams fed *Panicum maximum*.

MATERIALS AND METHODS

EXPERIMENTAL SITE AND ANIMALS

The experiment was carried out at the Sheep and Goat Unit, Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora. Sixteen (16) growing West African Dwarf rams weighing between 9.00-12.00kg and of 6 – 9 months of age were used. The animals were acclimatized for two weeks and treated against ectoparasites and endoparasites prior to the commencement of the experiment.

HARVESTING, PROCESSING AND PREPARATION OF EXPERIMENTAL DIETS

The forages were harvested from pasture demonstration plot of the college farm. *Cajanuscajan* leaves and *Panicum maximum* were cut at a height of 30cm above the ground level at 50% flowering stage to allow for good re-growth. *Cajanuscajan* leaves including twigs and petioles were harvested and air-dried to constant weight at room temperature while retaining their greenish colouration. The forage was then milled to pass through 2mm sieve. The CCLM were stored at room temperature in jute bags until needed for inclusion in the commercial supplement. Four experimental diets were formulated by replacing corn bran with *Cajanuscajan*leaf meal (CCLM).

EXPERIMENTAL LAYOUT, DESIGN AND FEEDING METHOD

The animals were allocated by weight into four treatments of four rams per treatment and two animals as a replicate in a Completely Randomized Design (CRD). The treatments consisted of four total mixed diets containing CCLM at 0, 5, 10 and 15% inclusion levels. The rams were fed on a basal diet of *Panicum maximum* in the morning (0800hr), while the experimental supplements were offered in the afternoon (1500hr). Each group of animals was assigned to an experimental diet and fresh clean water was made available.

DATA COLLECTION AND ANALYSIS

Adjustment period of one week was allowed before data collection commenced. At the beginning of the experiment, the rams were weighed and subsequently on a weekly basis prior to feeding in the morning. The initial live weight was subtracted from the final live weight to determine the weight gained by the animals. Feed offered and reminant (left over) were weighed daily to determine the feed intake of the animals. Both values were used to determine Feed conversion ratio, Dry Matter Intake (DMI), the mean initial body weight and weekly body weightwere calculated. All growth performance data obtained were subjected to one-way analysis of variance (SAS, 1999). Mean value variance showing significant ($P<0.05$) difference were separated using Duncan's multiple range test (Duncan 1955).

Table 1: Gross composition of experimental diets (%)

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
CCLM	0.00	5.00	10.00	15.00
Wheat offal	28.00	28.00	28.00	28.00
Corn bran	52.50	45.00	40..00	35.00
PKC	18.00	18.00	18.00	18.00
Bone meal	2.25	2.25	2.25	2.25
Salt	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
CP	13.50	14.23	14.02	14.42
M.E (MJ/KgDM)	2659.66	2015.96	2011.26	2006.75

CCLM= Cajanuscajan leaf meal, PKC= Palm kernel cake, CP= Crude protein and ME= Metabolizable energy

Table 2: Chemical composition of the experimental diets and *Panicum maximum* (%)

Parameters	T_1	T_2	T_3	T_4	*Panicum maximum*
Dry matter	94.68	94.23	93.05	92.75	89.67
Crude protein	15.27	16.82	17.02	18.10	7.30
Crude fiber	8.75	9.12	9.86	10.16	22.20
Nitrogen free Extract	60.21	58.79	54.67	52.56	66.00
Ether extract	4.32	3.86	4.68	4.91	2.90
Ash	6.13	5.64	6.79	7.02	3.30

Table 3: Performance response of West African Dwarf growing rams fed *Cajanuscajan* leaf meal total mixed rations and *Panicum maximum* basal diet

Parameters	T_1	T_2	T_3	T_4	SEM
Average initial weight (kg)	10.91^{d}	11.46^{b}	11.55^{c}	11.64^{a}	0.14
Average final weight (kg)	11.52^{d}	11.91^{c}	12.12^{b}	12.50^{a}	0.12
Average weight gain (kg)	0.61^{b}	0.45^{d}	0.57^{c}	0.86^{a}	0.07
Daily weight gain (g/day)	10.89^{b}	8.04^{d}	10.18^{c}	15.36^{a}	1.33
Weekly weight gain (g/wk)	87.14^{b}	64.29^{d}	81.43^{c}	122.86^{a}	10.66
Concentrate Intake (g/day)	204.82^{b}	196.24^{c}	185.76^{d}	208.65^{a}	4.40
Panicum max. Intake (g/d)	130.91^{b}	134.68^{a}	127.85^{d}	129.78^{c}	1.25
Total DMI (g/head/d)	335.73^{b}	330.92^{c}	313.61^{d}	338.43^{a}	4.83
Feed Conversion Ratio	30.83^{b}	41.16^{a}	30.81^{c}	22.03^{d}	3.91

$^{a\,b\,c\,d}$*Means on the same row with different superscript are significantly different (P< 0.05*).

RESULTS AND DISCUSSION

The growth performance summary of the experimental rams was shown in Table 3. There were significant differences (P<0.05) among the treatments in all the parameters measured. The mean dry matter intake (DMI) values were between 313.61 – 338.43g/day, and these values were similar, meaning that the presence of the CCLM in the diets did not depress feed intake and that the diets containing the test ingredients were all accepted by the rams. Observed values were comparable with 334.94 – 365.97g/day reported by Sanwo*et al.* (2011) for goats fed melon husk and palm oil slurry at 30% inclusion level, but lower than 525.14 – 546.26g/day reported by (Oloche*et al.*, 2013) for WAD goats fed diets containing graded levels of sweet orange peel meal. There were significant (P<0.05) differences in the mean daily weight gain and the feed conversion ratio which ranged from 8.04 –

15.36g/day and 22.03 – 41.16 respectively. The mean daily weight gain of the rams seemed to be slightly increases from $T_2 – T_4$ as the level of CCLM increased. Differences in the mean daily weights of the animals implies that the treatment diets with CCLM also provided adequate nutrients for the growth of the animals and these diets can be used for fattening of rams. Animals on T_4 diet (15% inclusion) had the highest average daily weight gain (15.36g/day) and the least (22.03) feed conversion ratio followed by the rams fed T_1 diet (0% inclusion) with the value (10.89g/day) of average daily weight gain which could be due to the environmental factors and animal factors which can influence the feed intake in animals, such as age and level of exercise. These values are lower than the range of 35.72 – 64.29g/day reported by Ogunbosoye*et al.* (2016) for West African dwarf goats fed graded levels of shea nut (*Vitellariaparadoxa*) cake based rations. FCR seemed to improve from $T_I – T_4$ as the level of CCLM increased in the diets. This showed that inclusion of test ingredients (CCLM) in the diets of the experimental animals had a positive impact on the feed conversion ratio. Observed values were higher than those values of Sanwo*et al.* (2011) who reported 11.59 – 17.24 for goats fed melon husk and palm oil slurry at 30% inclusion level.

CONCLUSION

From the result of the study,*Cajanuscajan* leaf meal at 15% inclusion level had the best performance for WAD rams, it can be concluded that *Cajanuscajan* leaf meal possesses adequate nutritive value to support good growth of growing West African Dwarf rams, especially during the period of drought and the forage can effectively serve as alternative feed ingredient in West African Dwarf growing rams diet.

RECOMMENDATION

Based on the result of this research, it could be recommended that *Cajanuscajan* leaf meal could be incorporated into the diet of WAD rams with inclusion level of up to 15% without any deleterious effect. Further research should be carried out using *Cajanuscajan* leaf meal at higher levels of inclusion in the diets of sheep and other livestock to substantiate its suitability and utilization by the animals.

REFERENCES

A.O.A.C. (1995).Official Methods of Analysis. 15th Edition. Association of Official Analytical Chemists. Washington, DC. Pp: 68-69.

Duncan, B.D. (1955).Multiple Range Test and Multiple Test Biometrics 1:1- 42.

Fajemisin, A.N. (2015).Chemical composition and in vitro evaluation of the nutrient contents of Panicu maximum-Moringaoleiferadiets. Nigerian Journal of Animal Production 42(2):197-208.

FAO. (2003). http:/www.fao.org/ag/agap/frg/AFRIS/DATA/188.hmt. Assessed on 21st July, 2015.

Ibhaze, G.A. (2016). Reproductive performance of intensively managed primiparous gravid West African Dwarf goats fed pulverized bio-fibre waste-based diets. Nigerian Journal of Animal Production 43(2):133-138.

Lorgyer, M.I., Odoh, O.E., Ikondo, N.D and Okoh, J.J. (2009).Replacement value of Pigeon pea (Cajanuscajan) for maize on performance of broiler finishers. Publication of Faculty of Agriculture, Nasarawa state University, Keffi, 1: 67-74.

Ogunbosoye, D.O., Akinfemi, A and Ajayi, D.A. (2016). Performance and Blood profiles of West African dwarf (WAD) growing bucks fed varying levels of shea nut cake based rations in Nigeria. Cogent Food and Agriculture, 4:1474620https://doi.org/10.1080/23311932.1474620.

Okoruwa, M.I., Adewumi, M.K and Njidda, A.A. 2013. Nutrient utilization and growth performance of West African Dwarf goats fed with elephant grass or different proportions of plantain and mango peels. World J. Agric. Sci. vol1(6): pp194-202.

Oloche, J., Oluremi, O.I.A., and Ayoade, J.A., (2013). Performance of West African Dwarf (WAD) goat fed diets containing graded levels of sweet orange (Citrus sinensis) peels meals. Proceeding of the 18th Annual Conference 8 -12 September, 2013. Abuja, Pp 367-370.

Sanwo, K.A., Iposu, S.O., Oso, A.O., Fanimo, A.O. and Abiola, S.S. 2011. Growth Performance, nutrient intake and digestibility of goats fed melon husk and palm oil slurry at 30% inclusion level, Nigerian Journal of Animal Production, 38(2), 148–154.

SAS/STAT (1999). SAS User's guide: version 9.0. Statistical Analysis System Institute Inc. Cary, NC.

EFFECT OF *Cajanus Cajan* LEAF MEAL IN TOTAL MIXED RATIONS ON THE GROWTH PERFORMANCE OF WEST AFRICAN DWARF RAMS

Adebisi, I.A., Ajibike, A.B., Oladepo, O., Okunlola, O.O., Alalade, J.A., Amusa, H.O. Mustapha, T.B. and Emiola, C.B.

Department of Animal Health and Production Technology, Oyo State College of Agriculture and Technology, P. M. B 10, Igbo-ora, Oyo State, Nigeria

**ademolaibrahim01@yahoo.com; +234-806-073-9507*

ABSTRACT

An experiment was carried out to investigate the growth performance of West African dwarf growing rams fed diets containing varying inclusion levels of Cajanus cajan leaf meal (CCLM) and Panicum maximum for 56 days feeding trial which was carried out at Teaching and Research Farm of Oyo State College of Agriculture and Technology Igbo-ora, Nigeria. A total of sixteen (16) growing WAD rams between 6 - 9 months with an average body weight of 9.00 -12.00kg were randomly allocated to 4 treatments with 4 animals per treatment while 2 animals served as replicate. The experimental diet was fed at 3% body weight of individual animals while Cajanus cajan leaf meal was supplemented in total mixed rations at varied inclusion levels (0%, 5%, 10% and 15%) with Panicum maximum. There were significant ($P<0.05$) difference in all parameters determined across the dietary treatments. The results revealed that rams fed diet T_2 recorded the least daily weight gain (8.04g/d) while the highest daily weight gain (15.36g/d) was recorded in diet T_4 that contained 15% inclusion level of CCLM. The weekly weight gain of rams was significantly different across all treatments ($P<0.05$). The feed conversion ratio (FCR) range between 22.03 – 41.16 showed significantly different across all treatments. Hence, rams fed diet T_4 that contained 15% inclusion levels of CCLM in total mixed rations recorded the best feed utilization value of 22.03. It can be concluded that supplementation of CCLM in diets of growing rams up to 15% enhance the growth performance of the animals.

Keywords: *Tropical grass, Cajanus cajan leaf meal, WAD rams, Growth performance.*

INTRODUCTION

Forages such as grasses and legumes are the main source of feed for ruminants to meet their nutritional requirements, either for maintenance or production. However, in the tropics, inadequate nutrition is a great challenge contributing to production losses in ruminants (Ibhaze, 2016) due to unavailability of forages throughout the year. This unpleasant situation has necessitated the search for alternative feed resources rich in energy and protein that are readily available and relatively cheap. Several indigenous and exotic browse species have been investigated and evaluated for inclusion in ruminant feeding systems in Nigeria (Fajemisin, 2015). The shortage in feed supply due to high cost and seasonality has caused ruminant livestock farmers to search for alternative feed resources that are inexpensive and readily available and which are not directly required as a component of human dietaries and can economically supplement the feed ingredients in rations without adverse effects on the rumen microbial fermentation and performance of the animals (Okoruwa *et al.*, 2013). Tropical browse plants such as *Cajanus cajan* is multipurpose nitrogen fixing crop that provides the seed as human food and poultry feed, the leaves and young stems as animal fodder for the subsistence farmers (Lorgyer, 2009). *Panicum maximum* also called guinea grass (FAO, 2003) is a highly productive, palatable, persistent and acceptable grass by ruminants. It can be fed to livestock solely or with concentrates or legumes. This study was therefore designed to evaluate the effect of *Cajanus cajan* leaf meal in total mixed rations on the growth performance of West African dwarf growing rams fed *Panicum maximum*.

MATERIALS AND METHODS

EXPERIMENTAL SITE AND ANIMALS

The experiment was carried out at the Sheep and Goat Unit, Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora. Sixteen (16) growing West African Dwarf rams weighing between 9.00 - 12.00kg and of 6 – 9 months of age were used. The animals were acclimatized for two weeks and treated against ectoparasites and endoparasites prior to the commencement of the experiment.

HARVESTING, PROCESSING AND PREPARATION OF EXPERIMENTAL DIETS

The forages were harvested from pasture demonstration plot of the college farm. *Cajanus cajan* leaves and *Panicum maximum* were cut at a height of 30cm above the ground level at 50% flowering stage to allow for good re-growth. *Cajanus cajan* leaves including twigs and petioles were harvested and air-dried to constant weight at room temperature while retaining their greenish colouration. The forage was then milled to pass through 2mm sieve. The CCLM were stored at room temperature in jute bags until needed for inclusion in the commercial supplement. Four experimental supplements were formulated by replacing a conventional supplement palm kernel cake (PKC), wheat offal, corn bran, bone meal, sheep premix and salt) with *Cajanus cajan* leaf meal (CCLM).

EXPERIMENTAL LAYOUT, DESIGN AND FEEDING METHOD

The animals were allocated by weight into four treatments of four rams per treatment and two animals as a replicate in a completely randomized design (CRD). The treatments consisted of four total mixed diets containing CCLM at 0, 5, 10 and 15% inclusion levels. The rams were fed on a basal diet of *Panicum maximum* in the morning (0800hr), while the experimental supplements were offered in the afternoon (1500hr). Each group of animals was assigned to an experimental diet and fresh clean water was made available.

DATA COLLECTION AND ANALYSIS

Adjustment period of one week was allowed before data collection commenced. At the beginning of the experiment, the rams were weighed and subsequently on a weekly basis prior to feeding in the morning. The initial live weight was subtracted from the final live weight to determine the weight gained by the animals. Feed offered and reminant (left over) were weighed daily to determine the feed intake of the animals. Both values were used to determine Feed conversion ratio, Dry Matter Intake (DMI), the mean initial body weight and weekly body weight were calculated. All growth performance data obtained were subjected to one-way analysis of variance (SAS 1999) mean value variance showing significant ($P<0.05$) difference were separated using Duncan's multiple range test (Duncan 1955).

Table 1: Gross composition of experimental diets (%)

Ingredients	T_1	T_2	T_3	T_4
CCLM	0.00	5.00	10.00	15.00
Wheat offal	28.00	28.00	28.00	28.00
Corn bran	52.50	45.00	40..00	35.00
PKC	18.00	18.00	18.00	18.00
Bone meal	2.25	2.25	2.25	2.25
Salt	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
CP	13.50	14.23	14.02	14.42
M.E (MJ/KgDM)	2659.66	2015.96	2011.26	2006.75

CCLM= Cajanus cajan leaf meal, PKC= Palm kernel cake, CP= Crude protein and ME= Metabolizable energy

Table 2: Chemical composition of the experimental diets and *Panicum maximum* (%)

Parameters	T_1	T_2	T_3	T_4	*Panicum maximum*
Dry matter	94.68	94.23	93.05	92.75	89.67
Crude protein	15.27	16.82	17.02	18.10	7.30
Crude fiber	8.75	9.12	9.86	10.16	22.20
Nitrogen free Extract	60.21	58.79	54.67	52.56	66.00
Ether extract	4.32	3.86	4.68	4.91	2.90
Ash	6.13	5.64	6.79	7.02	3.30

Table 3: Performance response of West African Dwarf growing rams fed *Cajanus cajan* leaf meal total mixed rations and *Panicum maximum* basal diet

Parameters	T_1	T_2	T_3	T_4	SEM
Average initial weight (kg)	10.91^{d}	11.46^{b}	11.55^{c}	11.64^{a}	0.14
Average final weight (kg)	11.52^{d}	11.91^{c}	12.12^{b}	12.50^{a}	0.12
Average weight gain (kg)	0.61^{b}	0.45^{d}	0.57^{c}	0.86^{a}	0.07
Daily weight gain (g/day)	10.89^{b}	8.04^{d}	10.18^{c}	15.36^{a}	1.33
Weekly weight gain (g/wk)	87.14^{b}	64.29^{d}	81.43^{c}	122.86^{a}	10.66
Concentrate Intake (g/day)	204.82^{b}	196.24^{c}	185.76^{d}	208.65^{a}	4.40
Panicum max. Intake (g/d)	130.91^{b}	134.68^{a}	127.85^{d}	129.78^{c}	1.25
Total DMI (g/head/d)	335.73^{b}	330.92^{c}	313.61^{d}	338.43^{a}	4.83
Feed Conversion Ratio	30.83^{b}	41.16^{a}	30.81^{c}	22.03^{d}	3.91

$^{a\,b\,c\,d}$*Means on the same row with different superscript are significantly different (P< 0.05*).

RESULTS AND DISCUSSION

The growth performance summary of the experimental rams was shown in Table 3. There were significant differences (P<0.05) among the treatments in any of the parameters measured. The mean dry matter intake (DMI) values were between 313.61 – 338.43g/day, and these values were similar, meaning that the presence of the CCLM in the diets did not depress feed intake and that the diets containing the test ingredients were all accepted by the rams. Observed values were comparable with 334.94 – 365.97g/day reported by Sanwo *et al.* (2011) for goats fed melon husk and palm oil slurry at 30% inclusion level, but lower than 525.14 – 546.26g/day reported by (Oloche *et al.*, 2013) for WAD goats fed diets containing graded levels of sweet orange peel meal. There were significant (P<0.05) differences in the mean daily weight gain and the feed conversion ratio which ranged from 8.04 – 15.36g/day and 22.03 – 41.16 respectively. The mean daily weight gain of the rams seemed to be slightly increases from $T_2 – T_4$ as the level of CCLM increased. Differences in the mean daily weights of the animals implies that the treatment diets with CCLM also provided adequate nutrients for the growth of the animals and these diets can be used for fattening of rams. Animals on T_4 diet (15% inclusion) had the highest average daily weight gain (15.36g/day) and the least (22.03) feed conversion ratio. These values are lower than the range of 35.72 – 64.29g/day reported by Ogunbosoye *et al.* (2016) for West African dwarf goats fed graded levels of shea nut (*Vitellaria paradoxa*) cake based rations. FCR seemed to improve from $T_I – T_4$ as the level of CCLM increased in the diets. This showed that inclusion of test ingredients (CCLM) in the diets of the experimental animals had a positive impact on the feed conversion ratio. Observed values were higher than those values of Sanwo *et al.* (2011) who reported 11.59 – 17.24 for goats fed melon husk and palm oil slurry at 30% inclusion level.

CONCLUSION

From the result of the study, it can be concluded that *Cajanus cajan* leaf meal possesses adequate nutritive value to support good growth of West African Dwarf growing rams, especially during the period of drought and the forage can effectively serve as alternative feed ingredient in West African Dwarf growing rams diet.

RECOMMENDATION

Based on the result of this research, it could be recommended that *Cajanus cajan* leaf meal could be incorporated into the diet of WAD rams with inclusion level of up to 15% without any deleterious effect. Further research should be carried out using *Cajanus cajan* leaf meal at higher levels of inclusion in the diets of sheep and other livestock to substantiate its suitability and utilization by the animals.

REFERENCES

A.O.A.C. (1995). Official Methods of Analysis. 15th Edition. Association of Official Analytical Chemists. Washington, DC. Pp: 68-69.

Duncan, B.D. (1955).Multiple Range Test and Multiple Test Biometrics 1:1- 42.

Fajemisin, A.N. (2015).Chemical composition and in vitro evaluation of the nutrient contents of Panicum maximum-Moringa oleifera diets. Nigerian Journal of Animal Production 42(2):197-208.

FAO. (2003). http:/www.fao.org/ag/agap/frg/AFRIS/DATA/188.hmt. Assessed on 21st July, 2015.

Ibhaze, G.A. (2016). Reproductive performance of intensively managed primiparous gravid West African Dwarf goats fed pulverized bio-fibre waste-based diets. Nigerian Journal of Animal Production 43(2):133-138.

Lorgyer, M.I., Odoh, O.E., Ikondo, N.D and Okoh, J.J. (2009).Replacement value of Pigeon pea (Cajanus cajan) for maize on performance of broiler finishers. Publication of Faculty of Agriculture, Nasarawa state University, Keffi, 1: 67-74.

Ogunbosoye, D.O., Akinfemi, A and Ajayi, D.A. (2016). Performance and Blood profiles of West African dwarf (WAD) growing bucks fed varying levels of shea nut cake based rations in Nigeria. Cogent Food and Agriculture,4:1474620https://doi.org/10.1080/23311932.1474620.

Okoruwa, M.I., Adewumi, M.K and Njidda, A.A. 2013. Nutrient utilization and growth performance of West African Dwarf goats fed with elephant grass or different proportions of plantain and mango peels. World J. Agric. Sci. vol 1(6): pp194-202.

Oloche, J., Oluremi, O.I.A., and Ayoade, J.A., (2013). Performance of West African Dwarf (WAD) goat fed diets containing graded levels of sweet orange (Citrus sinensis) peels meals. Proceeding of the 18th Annual Conference 8 -12 September, 2013. Abuja, Pp 367-370.

Sanwo, K.A., Iposu, S.O., Oso, A.O., Fanimo, A.O. and Abiola, S.S. 2011. Growth Performance, nutrient intake and digestibility of goats fed melon husk and palm oil slurry at 30% inclusion level, Nigerian Journal of Animal Production, 38(2), 148–154.

SAS/STAT (1999). SAS User's guide: ver9.0. Statistical Analysis System Institute Inc. Cary, NC.

RUMEN FERMENTATION PARAMETERS AND MICROBIAL PROFILES OF WEST AFRICA DWARF SHEEP FED SUGARCANE TOP TREATED WITH DIFFERENT NITROGEN SOURCES

Akinbode, R. M.*, Isah, O. A., Oni, A. O., Adebayo, K. O. and Omoniyi, L. A.
Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Nigeria
P.M.B. 2240, Abeokuta, Ogun State, Nigeria
**Corresponding author: rmakinbode@yahoo.com*

ABSTRACT
This experiment was carried out to examine the effect of sugarcane top treated with different nitrogen sources on rumen fermentation parameters and microbial profiles of West African dwarf (WAD) sheep. Four different silages were prepared such that sugarcane tops were ensiled alone (control) or with 2% urea (USCT silage), 45% boiler litter (BLSCT silage) and 1% urea plus 22.5% broiler litter (UBLSCT) for 42 days. Each silage treatment contains 2% molasses. Twenty-four female WAD sheep weighing 14.58±1.16kgwere randomly assigned to the four silage treatments in a completely randomised design with six animals per treatment for 84 days. Effect of silages on rumen fermentation parameters and microbial profiles at 4 hours post-feeding were evaluated. Results revealed that the rumen pH was highest in animal fed control silage (6.85) and lowest in those fed BLSCT silage (6.56). Highest ammonia nitrogen, total volatile fatty acid, acetate and propionate concentration were recorded in animals fed BLSCT silage. Total viable bacteria, fungi zoopores, cellulolytic bacteria, and proteolytic bacteria counts were higher ($P < 0.05$) in animals fed BLSCT and UBLSCT followed by animals fed USCT while those fed control silage recorded the lowest counts. It can be concluded that feeding of all treated sugarcane top silages especially BLSCT and UBLSCT resulted in improved rumen ecology in terms of microbial biomass, volatile fatty acids production and ruminal pH compared with the control silage.

Keywords: Sugarcane top, Silage, Sheep, Microbial biomass, Volatile fatty acids,

INTRODUCTION

The most critical constraint hindering livestock productivity in developing countries is irregular and insufficient supply of quality forage (Sarwar *et al*., 2002). In Nigeria, small scale farmers cannot afford the cost of establishing improved pasture, and feeding nutritious supplemental feed such as concentrate to ruminant is expensive. Natural forage crops of good quality are not available all the year round, it is therefore becomes imperative for ruminant nutritionists to investigate more on the use of alternative feedstuffs that are less or not useful to man in order to avoid the problem of feed shortage experienced during the dry season. Ruminant animals have ability to cope with poor quality feeds due to the presence of microorganisms in their rumen which encourage pre-gastric fermentative digestion of feed. Sugarcane top is a crop residues derived after harvesting of the cane and is readily accepted by ruminant either fresh, dried or ensiled (Bhatti and Khan, 1996). Sugarcane top is low in protein, poor in mineral and had low digestibility of nutrients (Patil *et al*., 1999) therefore, there is a need to improve its nutritive value by treating with non-protein nitrogen substances for better utilization by animals since rumen micro-organisms depend on dietary protein for proper growth and optimum activity. Information on the influence of sugarcane top treated with urea and poultry litter on rumen fermentation characteristics and microbial profile of ruminant is limited. The study therefore aimed at determining the effect of sugarcane top treated with urea and poultry litter on the rumen fermentation characteristics and microbial profile of West African dwarf sheep.

MATERIALS AND METHODS

Fresh sugarcane tops were allowed to wilt overnight, chopped into small pieces (about 2-4cm) for ease of loading at ensiling. Four silage treatments were prepared with sugarcane tops ensiled alone (control silage) or with 2% urea (USCT silage), 45% boiler litter (BLSCT silage) and 1% urea plus

22.5% broiler litter (UBLSCT silage). Each silage treatment contained 2% molasses and stored under a shed for a period of 42 days.

Twenty-four female West African dwarf sheep weighing 14.58±1.16kg were randomly allotted to four experimental diets (six animals per treatment) in a completely randomised design. The animals were housed in individual pens and had free access to clean water. Each animal was offered their respective silage on *ad-libitum* basis at 7.00 am in the morning and concentrates feed (at 1.5% body weight) as supplement at 4.00 pm in the evening for a period of 84 days. On the last day of the study, about 60mL of rumen fluid was collected from each animal at 4-hour post-feeding via the oesophagus through the use of suction tube for fermentative and microbial analysis. The fluid was immediately measured for pH and temperature using portable pH meter and was filtered through four layers of cheese cloth, and stored at -20^{0}C pending analyses. Ammonia-nitrogen and volatile fatty acid analyses were analysed (AOAC, 2005; Kayol and Borilek, 1995 respectively). Total direct count of bacteria, protozoa and fungal zoospore was done (Baker and Breech, 1986). Total viable bacteria, cellulolytic, proteolytic and amylolytic bacteria counts were also carried out according to Hungate (1969).

All data collected were subjected to Analysis of Variance (ANOVA) while significant differences among means were compared using Duncan's Multiple Range F-test (SAS, 1999). The mathematical model of the experiment: $Y_{ij} = \mu + T_i + \Sigma_{ij}$, where Y_{ij} = observed value of the dependent variables,μ = Population mean, T_i = Effect of the different silages (treatment effect),Σ_{ij}=Random residual error

RESULTS AND DISCUSSION

The rumen fermentation parameters and microbial profiles of West African dwarf sheep fed sugarcane top silage are presented in Table 2. The rumen pH taken was significantly affected ($P < 0.05$) by the diets with sheep fed control silage having the highest value (6.85) while those fed BLSCT silage recorded the least (6.56). The rumen temperature range across the treatment is compared favourably with 39°C which was necessary for the optimum growth of rumen bacteria (Kamra, 2005). The rumen pH recorded for all treatments fell within the range (6.0-7.0) reported by Aduku (1993) as suitable pH for growth and normal activities of rumen bacteria. Rumen bacteria are very sensitive to pH change and none of the three predominant fibrolytic bacteria can grow at pH less than 6.0 (Shi and Weimer, 1992). Fibre digestion is also reduced when ruminal pH reached values below 6.0 (Wanapat *et al*., 2000). Ruminal ammonia nitrogen concentration recorded was significantly ($p<0.05$) different across the treatments with sheep fed USCT, BLSCT and UBLSCT silages having higher concentration compared to control silage. It means that addition of nitrogen sources (urea and broiler litter) had increased ammonia nitrogen concentration with ammonia being the main nitrogen source for the growth and protein synthesis by ruminal bacteria to achieve maximum fermentation (Hoover, 1986). Nguyen *et al.* (2005) had also stated that rumen ammonia concentration reflected the CP levels in the diets and was associated with higher number of bacteria. Ammonia nitrogen concentrations recorded in sheep fed USCT, BLSCT and UBLSCT silages were within the optimal range of ruminal ammonia nitrogen (15 – 30mg %) (Perdok and Leng, 1990) needed for increasing microbial protein synthesis, feed digestibility and voluntary feed intake.

There were significant variations ($P < 0.05$) in the total volatile fatty acid (TVFAs), acetate, propionate and butyrate concentration across the treatments. Total viable bacteria, cellulolytic and proteolytic bacteria counts also differ statistically ($P < 0.05$). It could be observed from this study that the TVFAs, acetate, propionate and butyrate concentrations increased with addition of nitrogen sources. Results obtained is consistent with the rumen pH data which means that the more acid is being produced, the lower the pH. The highest value obtained for acetic acid in sheep fed BLSCT was higher than the value (66.6 mmol/l) reported by Azizi-Shotorkhoft *et al*. (2012). Variation observed

might be due to differences in the proportion of poultry litter included in the ration. The range of cellulolytic and proteolytic bacteria count observed was similar to the range reported by Chanjula *et al*. (2004).

CONCLUSION

It could be concluded from this study that all treated sugarcane top silages especially BLSCT and UBLSCT improved rumen ecology in terms of microbial biomass production, volatile fatty acids concentration and ruminal pH. Sugarcane tops treated with broiler litter and urea is recommended for feeding ruminants especially during the dry season when forages are scarce and of low nutritive value

Table 1: Chemical composition (g/kg DM) of silages and nutrient intake (g/day) by West African dwarf sheep fed sugarcane top silages

Parameters	Treatments				
	Control silage	USCT silage	BLSCT silage	UBLSCT silage	SEM
Chemical composition (%)					
Dry matter	301.20^{c}	287.57^{c}	400.80^{a}	320.00^{b}	13.37
Crude protein	86.00^{c}	120.00^{b}	133.10^{a}	122.60^{b}	5.44
Ether extract	21.20^{b}	20.00^{b}	35.00^{a}	20.00^{b}	1.96
Ash	75.00^{c}	90.00^{b}	130.00^{a}	95.00^{b}	6.16
Neutral detergent fibre	680.00^{a}	630.00^{bc}	610.00^{c}	650.00^{b}	8.36
Acid detergent fibre	380.00^{a}	362.50^{b}	350.00^{b}	355.00^{b}	3.97
Acid detergent lignin	120.00^{a}	110.00^{ab}	100.00^{b}	105.00^{b}	2.73
Hemicellulose	300.00^{a}	267.50^{b}	260.00^{b}	295.00^{a}	5.28
Cellulose	260.00^{a}	252.50^{ab}	250.00^{b}	250.00^{b}	1.68
*Metabolizable energy (MJ/kg DM)	7.13	7.20	7.30	7.29	0.06
Non-fibre carbohydrate	137.80^{a}	140.00^{a}	91.90^{b}	112.90^{ab}	7.47
Nutrient intake (g/day)					
Dry matter	432.03^{c}	431.82^{c}	543.96^{a}	471.76^{b}	13.86
Crude protein	50.46^{d}	58.72^{c}	76.64^{a}	64.17^{b}	2.87
Neutral detergent fibre	221.10^{c}	209.28^{d}	273.27^{a}	229.49^{b}	7.34

*^{a,b,c,} Means on the same row having different superscripts are significantly different (P < 0.05), SEM – Standard error of mean, USCT – urea treated sugarcane top silage, BLSCT – broiler litter treated sugarcane top silage, UBLSCT – urea plus broiler litter treated sugarcane top silage, *calculated according to De Boever ., (1997)*

Table 2: Rumen fermentation parameters and microbial profiles of West African dwarf goats fed sugarcane top silages

Parameters	Treatments				
	Control silage	USCT silage	BLSCT silage	UBLSCT silage	S.E.M
Temperature (ºC)	37.85	38.83	38.90	38.95	0.26
Ph	6.85[a]	6.69[b]	6.56[c]	6.75[b]	0.04
Ammonia-nitrogen (mg/dL)	8.65[c]	17.13[ab]	18.08[a]	16.38[b]	0.36
Total volatile fatty acids (mM)	73.00[c]	108.00[b]	135.00[a]	118.27[b]	7.12
Acetate (mM)	44.33[c]	66.33[b]	80.00[a]	65.73[b]	3.97
Propionate (mM)	16.27[c]	24.33[b]	33.60[a]	26.00[b]	1.90
Butyrate (mM)	9.73[c]	13.00[b]	18.29[a]	17.83[ab]	1.17
Total viable bacteria ($x10^9$CFU/g rumen content)	5.03[c]	6.93[b]	8.01[a]	7.78[a]	0.33
Bacteria ($x10^9$CFU/g rumen content)	3.55[c]	5.40[b]	6.50[a]	6.15[a]	0.14
Protozoa ($x10^6$CFU/g rumen content)	1.35	1.40	1.64	1.95	0.34
Fungi zoopores ($x10^6$CFU/g rumen content)	1.67	1.75	2.05	2.10	0.27
Cellulolytic bacteria ($x10^7$CFU/g rumen content)	5.75c	7.30[b]	8.75[a]	7.75[ab]	0.41
Amylolytic bacteria ($x10^7$CFU/g rumen content)	4.75	4.00	5.75	6.00	0.45
Proteolytic bacteria ($x10^6$CFU/g rumen content)	3.00[c]	4.00[b]	6.50[a]	5.00[b]	0.44

[a,b,c,] Means on the same row having different superscripts are significantly different (P < 0.05), SEM – Standard error of mean, USCT – urea treated sugarcane top silage, BLSCT – broiler litter treated sugarcane top silage, UBLSCT – urea plus broiler litter treated sugarcane top silage

REFERENCES

Aduku, A. O. 1993. Tropical feedstuffs analysis table. Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria.

AOAC. 2005. Official Methods of Analysis. 15th ed. Association of Official Analytical Chemists, Washington, DC.

Azizi-Shotorkhoft, A., Rouzbehan, Y. and Fazaeli, H. 2012. The influence of the different carbohydrate sources on utilization efficiency of processed broiler litter in sheep. Elsevier Livestock Science, 148: 249-254.

Baker, F. J and Breech, M. R. 1986. Total and viable counts, Miles and Mistra method,medical microbiological techniques, pp 419- 423.

Bhatti, M. B and Khan, S. 1996. Fodder Production in Pakistan. FAO PARC, Islamabad

Chanjula, P., Wanapat, M., Wachirapakorn, C. and Rowlinson, P. 2004. Effect of various levels of cassava hay on rumen ecology and digestibility in swamp buffalo. Asian-Australian Journal of Animal Science, 17(5): 663-669

Hoover, W. H. 1986. Chemical factors involved in ruminal fibre digestion. Jounal of Dairy Science, 69: 2755-2766

Hungate, R. E. 1969. A roll- tube method for cultivation of strict anaerobes. In: Methods in Microbiology, (edited by Norris, J. R and Ribbons, D. W.) New York Academic. 313: 117.

Kamra, D. N. 2005. Rumen microbial ecosystem. Current Science, 89: 124 – 135.

Kayol, L. T. and Borilek, G. O. D. 1995. Spectrophotometric determination of Volatile fatty acids. Analytical Chemistry. 34: 112-117.

Nguyen, T. H. N., Ngu, N. T., Thiet, N., Preston, T. R. and Leng, R. A. 2005. Determination of the optimum level of a soybean oil drench with respect to the rumen ecosystem, feed intake and digestibility in cattle. Proceedings of the 2005 MEKARN-CTU Workshop Seminar, 23-25 May, Cantho, Vietnam.

Patil, N.V., Kharadi, V. B., Desai, P. M and Desai, B. M. 1999. Comparative nutritional value of fresh and sun dried sugarcane tops in buffalo calves. IndianJournalofAnimalNutrition, 16: 259-261.

Perdok, H. B. and Leng, R. A. 1990. Effect of supplementation with protein meal on the growth of cattle given a basal diet of untreated or ammoniated rice straw. Asian-Australian Journal of Animal Science, 3: 269-279.

Sarwar, M, Khan, M. A. Mahr-Un-Nisa, and Iqbal. Z. 2002. Dairy Industry in Pakistan: A Scenario. Int. J. Agric. Bio. 4(3):420-428.

SAS. 1999. User's Guide: Statistics, Version 5 Edition. SAS. Inst. Cary, NC.

Shi, Y. and Weimer, P. J. 1992. Response surface analysis of the effects of pH and dilution rate on ruminococcus flavefaciens FD-1 in cellulose-fed continuous culture. Applied Journal of Environmental Microbiology. 58: 2583-2589.

Wanapat, M., Pimpa, O., Petlum, A. and Wachirapakorn, C. 2000. Participation scheme of smallholder dairy farmers in the NE, Thailand on improving feeding systems. Asian-Australian Journal of Animal Science, 13: 830-836.

PHYSICO-CHEMICAL, PHYTOCHEMICAL AND ANTI-OXIDANT PROPERTIES OF BOTANICAL GALACTOGOGUES USED IN RUMINANT FEEDING

***B.N. Umar and **Y. Garba**
**Department of Animal Science, Bayero University, Kano.*
***Centre for Dryland Agriculture, Bayero University, Kano.*

ABSTRACT
Botanical galactogogues contained in Guiera senegalensis (Guiera), Tamarindus indica (Tamarind), Ficus thonningii (Blume) and Anogeissus leiocarpus (African birch) were evaluated for their physico-chemical, phytochemical and antioxidant properties. The samples were shade dried, ground to powder, stored and analyzed for the above-mentioned properties in the laboratory. The treatments were laid in a completely randomized design replicated thrice. The antioxidant properties were evaluated using the diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging activity and ferric reducing antioxidant power (FRAP). Data collected were analyzed using SAS (2000) and Tukey's test was used to separate means (P<0.05). Physico-chemical analysis of the browse plants showed that there was a significant (P<0.05) difference in their contents of moisture, ash, acid insoluble ash, water insoluble ash, sulphated ash, acid soluble extractive and water soluble extractive. Result further revealed that the extracts of G. senegalensis, T. indica, Ficus thonningii and A. leiocarpus possessed varied degree of free radical scavenging and antioxidant activities in a concentration-dependent manner. The values ranged from (0.220- 0.570) µg/ml for DPPH and (0.4715- 0.7185) µg/ml for FRAP. The extract of G. senegalensis was observed to be the most effective radical scavenger and antioxidant (5.124 µg/ml) and was closely followed by A. leiocarpus extract (1.841 µg/ml). Their high radical scavenging and antioxidant activity can be attributed to their high flavonoid and phenolic contents. It was concluded that G. senegalensis had the highest antioxidant property while F. thonningii had the highest ferric reducing antioxidant property. These findings supported the ethno-veterinary uses of these plants to produce effective intervention for free radical mediated diseases. It is thus reommended that antioxidant profile in milk of ruminants fed botanical galactogogues be further studied.

Keywords: galactogogues, antioxidant, physico-chemical, phytochemical

INTRODUCTION

Galactagogues are substances that boost established lactation, whereas the term galactopoietic is used independently to describe the hormone preparations which enhance milk production in an animal already in lactation (Asimov and Krouze, 1991). Phytochemical screening of plants extracts either with organic or aqueous solvents has revealed the presence of numerous active components including ascorbic acid, domperidone, metoclopramide, saponins, glycosides, essential oils, isoflavones, etc. which contribute to galactopoietic effect (Bharti *et al.,* 2012). Majority of these herbal preparations have however not been scientifically, systematically and thoroughly evaluated, but their traditional use suggests some safety and efficacy. The objectives of the study were to determine the physico-chemical, phytochemical and anti-oxidant properties of *Guiera senegalensis* (sabara), *Tamarindus indica* (tsamiya), *Ficus thonningii* (chediya) and *Anogeissus leiocarpus* (marke).

MATERIALS AND METHODS

The experiment was conducted at the Department of Biochemistry, Faculty of Science, Bayero University Kano, Nigeria.

Samples Collection and Preparation

Leaves of *Anogeissus leiocarpus* was collected at Tsohuwar Zara, *Ficus thonningii* at Tarauni, *Guiera senegalensis* at Dirbindai and *Tamarindus indica* at Magadawa in Kano State, Nigeria.

The leaves were air dried at room temperature and ground separately to powdered form. The extraction method used for dried samples involved adding 150 ml of methanol to 20g of the dried

sample. The mixture was then refluxed in a water bath at 50^0C for 1 hour and was then filtered and placed in fridge (Charalampos *et al*., 2013).

LABORATORY ANALYSIS

The total flavonoids content of each plant extract was assessed by a method employed by Zhishen *et al*., (1999). Each sample (0.5 mL) was mixed with 2 mL of distilled water and subsequently with 0.15 mL of a $NaNO_2$ solution (15%).

The total phenol content (TPC) was measured using Folin-Ciocalteu assay (Kähkönen *et al*., 1999). A volume of 0.2 mL of the extract was introduced into test tubes followed by 0.5 mL Folin-Ciocalteu's reagent (diluted 10 times with water). Antioxidant activity of the extracts was evaluated using Phosphomolybdenum according to the procedure of Prieto *et al*., (1999). Then 0.3 ml of plant extract was combined with 3 ml of reagent solution (0.6 M sulfuric acid, 28 mM sodium phosphate and 4 mM ammonium molybdate).

The antioxidant potential was measured using the stable radical DPPH. The experiments were carried out using Blois method (Blois, 1958).

$$\text{DPPH radical scavenging activity (\%)} = \frac{\text{(Absorbance of control–Absorbance of sample)}}{\text{Absorbance of control}} \times 100$$

A modified method of Benzie and Strain (1996) was used for the determination of total antioxidant activity (FRAP assay). The stock solutions included 300 mM acetate buffer (3.1 g $C_2H_3NaO_2 \cdot 3H_2O$ and 16 ml $C_2H_4O_2$), pH 3.6, 10 mM 2, 4, 6-tripyridyl-s-triazine (TPTZ) solution in 40 mM HCl, and 20 mM $FeCl_3 \cdot 6H_2O$ solution.

The Physicochemical analysis of United States Pharmacopoeia-National Formulary (2003) method was adopted for studying physicochemical properties which include;

Two grams of the powdered plant material was weighed in a tared china-dish and oven dried for 30 minutes at 105°C. The china-dish was put in desiccator to cool. It was then weighed on digital balance and the weight of empty dish was subtracted to get dried material. Two grams of powdered plant material was weighed in a tared china-dish and incinerated in furnace at a temperature of 675 ± 25°C for the duration of 48 hours, until the ash got free from carbon. After getting the desired form of ash, the china-dish content was cooled. At the end, the ash contents were weighed and the percentage of the total ash was calculated with reference to the sample weight.

The total ash contents were boiled in 25 mL dilute HCl for 5 minutes. It was then filtered through an ash less filter paper. The filter paper was then dried and ignited in tared china-dish until the ash got free from carbon and later cooled. The ash contents were weighed and the percentage of acid insoluble ash was calculated.

The total ash contents obtained from 2g of powdered plant material were boiled in 25 mL distilled water for 5 minutes and filtered through an ash less filter paper. The filter paper was then dried and ignited in tared china-dish until the ash got free from carbon and then cooled. The ash contents were weighed and the percentage of water insoluble ash was calculated with reference to weight of the total ash used in the test.

Sulphuric acid was mixed with 2g of the powdered plant material in a tared china-dish to make a paste like material. The china-dish was ignited and it was then cooled in a desiccator. The ash contents were

weighed and the percentage of sulphated ash was calculated with reference to the weight of the dried powdered plant material used in the test.

Five grams of powdered plant material was put in a tared flask. Ethanol 95% (100 mL) was poured on it and then macerated in a closed flask for 24 hours. The contents were filtered and 25 mL filtrate was evaporated to dryness in a china dish and the residue was dried in an oven at 105°C and weighed. The percentage of alcohol soluble extractives was calculated with reference to the weight of the sample. One gram of air-dried sample, coarsely powdered was macerated with 100 mL of distilled water in a closed flask for 24 hours shaking frequently. Solution was then filtered and 25 mL of filtrate was evaporated, further dried at 1000^0C and weighted. The percentage of water soluble extractive was calculated with reference to the air-dried samples (Momin and Kadam, 2012).

PHYTOCHEMICAL ANALYSIS

The powdered plant samples (50 g/250 mL) were extracted with petroleum ether, chloroform, ethyl acetate, methanol and water using Soxhlet apparatus at 55-85 °C for 8-10 hours to remove the polar and non- polar compounds (Elgorashi and Van Staden, 2004). The extracts were air dried and then used. The solvents of the respective extracts were condensed and then stored at 4 °C for further use. A small portion of sample was added to 5mL of 1% aqueous HCl in a beaker. The mixture was then stirred, filtered and the volume was reduced to one quarter using a water bath. Few drops of Dragendorff's reagent was added to the filtrate. An orange-red precipitate results which shows the presence of alkaloids (Sofowara, 1993).

Total phenolic content was estimated using Folin-Ciocalteau reagent by the method of Sidduraju and Becker (2003). Twenty (20µg) of leaf extracts were taken separately and it was made up to 1 mL with distilled water. Then, 500 µL of diluted Folins-phenol reagent (1:1 ratio with water) and 2.5 mL of sodium carbonate Na_2CO_3 (20%) were added. The mixture was shaken and incubated in a dark condition for 40 minutes and the absorbance was measured at 725 nm. A calibration curve of gallic acid was constructed and linearity was obtained in the range of 10-50 µg/mL. The total phenolics content in the plant extracts were expressed as mg of gallic acid equivalent (mg GAE/g extract) by using the standard curve.

The total flavonoids content was estimated using the procedure described by Jia *et al*., (1999). A total of 1 mL of the plant extracts were diluted with 200 µL of distilled water separately followed by the addition of 150 µL of sodium nitrite (5%) solution. It was incubated for 5 minutes and 150 µL of aluminium chloride (10%) solution was added. Then, 2 mL of sodium hydroxide (4%) solution was added and made up to 5 mL with distilled water. The mixture was well shaken and the absorbance was measured at 510 nm. Appearance of a pink color showed the presence of flavonoids content. The total flavonoids content was expressed as rutin equivalent mg RE/g extract on a dry weight basis using the standard curve.

Tannins content was estimated by the method described by Siddhuraj and Manian, (2007). 0.5g of the extracts and 10mL of distilled water was mixed, stirred and filtered. Few drops of 1% ferric chloride solution was added to 2mL of the filtrate. Results showing blue-black, green, blue-green precipitate is positive (Trease and Evens, 2002).

Estimation of total saponins content was determined by the method described by Sofowara (1993). One gram of the plant extract was added with 5mL of distilled water. The mixture was then boiled and filtered. The filtrate and 3mL of distilled water was vigorously shaken for 5 minutes. Results showing persisting frothing on warming is positive.

STATISTICAL ANALYSIS

The experiment was laid in a completely randomized design (CRD) with three replicates in each treatment. Analysis of Variance (ANOVA) of the SAS (2000) package was the tool of analysis and the means were separated using the Tukey test ($p<0.05$).

Table 1: Antioxidant Activity of some Botanical Galactogogues

Treatment	Values(µg/ml)
Guiera senegalensis	5.124[a]
Tamarindus indica	1.530[c]
Ficus thonningii	1.329[d]
Anogeissus leiocarpus	1.841[b]

[a, b, c, d], means in the same row with different superscripts are significantly different (P<0.05)

Table 2: Antioxidant Activity of some galactogogues using the DPPH Method

Treatment (µg/ml) Concentration (mg/ml)	*Guiera senegalensis*	*Tamarindus indica*	*Ficus thonningii*	*Anogeissus leiocarpus*
0.2	0.255	0.365	0.360	0.255
0.4	0.220[b]	0.415[a]	0.400[a]	0.255[b]
0.6	0.230[c]	0.330[b]	0.390[a]	0.255[c]
0.8	0.265[c]	0.420[b]	0.515[a]	0.275[c]
1.0	0.320[b]	0.505[a]	0.570[a]	0.305[b]

[a, b, c], means in the same row with different superscripts are significantly different (P<0.05)

Table 3: Antioxidant Activity of some galactogogues using the Ferric Reducing Antioxidant Power Method

Treatment (µg/ml) Concentration (mg/ml)	*Guiera senegalensis*	*Tamarindus indica*	*Ficus thonningii*	*Anogeissus leiocarpus*
0.2	0.5020	0.4715	0.5420	0.5300
0.4	0.4875[b]	0.5345[ab]	0.6580[a]	0.5480[ab]
0.6	0.4860[d]	0.5740[b]	0.6915[a]	0.5410[c]
0.8	0.4830[c]	0.5705[b]	0.6995[a]	0.5575[b]
1.0	0.4820[c]	0.5940[b]	0.7185[a]	0.5670[b]

[a, b, c, d], means in the same row with different superscripts are significantly different (P<0.05)

Table 4: Physico-chemical characteristics of some Botanical Galactogogues

Variables (%)	Treatment			
	Guiera senegalensis	*Tamarindus indica*	*Ficus thonningii*	*Anogeissus leiocarpus*
Moisture Content	9.85[b]	8.50[c]	11.30[a]	8.15[c]
Ash	12.25[c]	10.85[c]	34.85[a]	23.85[b]
Acid Insoluble Ash	2.55[c]	2.56[c]	6.15[a]	3.55[b]
Water Insoluble Ash	4.55[d]	6.61[c]	11.60[a]	8.57[b]
Sulphated Ash	51.35[a]	32.84[b]	32.60[b]	23.94[c]
Acid Soluble Extractive	11.67[b]	8.77[c]	3.97[d]	13.73[a]
Water Soluble Extractive	2.63[b]	3.93[a]	2.67[b]	4.17[a]

[a, b, c, d], means in the same row with different superscripts are significantly different (P<0.05)

Table 5: Phytochemical Concentration of some Botanical Galactogogues

Variables (%)	Treatment	
	Guiera senegalensis	*Anogeissus leiocarpus*
Tannins	4.55[b]	6.91[a]
Saponins	3.64	3.47
Flavonoids	3.44[a]	2.28[b]
Alkaloids	8.53[b]	27.90[a]
Total phenolics content	159.68[b]	190.18[a]

[a, b], means in the same row with different superscripts are significantly different (P<0.05)

RESULTS AND DISCUSSION

The antioxidant activity of evaluated samples revealed a significant ($P<0.05$) difference. Results obtained ranged from 1.329-5.124(µg/ml) with *Guiera senegalensis* having the most while *Ficus thonningii* had the least. Table 2 presents the antioxidant activity of the botanical galactogogues using the DPPH method at different concentrations. However, *Ficus thonningii* (0.360- 0.570µg/ml) had the highest antioxidant activity while *Guiera senegalensis* (0.255-0.320µg/ml) and *Anogeissus leiocarpus* (0.255-0.305µg/ml) had the least among all the plants samples evaluated. Table 3 presents the antioxidant activity of the samples using the FRAP method at 0.2, 0.4, 0.6, 0.8, and 1mg/ml concentrations. At 0.2mg/ml, the result showed that the antioxidant concentration of the plant samples were the same and ranged from (0.4715-0.5420µg/ml). Result reveals that at 0.4mg/ml, 0.6mg/ml, 0.8mg/ml and 1.0mg/ml concentration, the values ranged from (0.4875-0.6580µg/ml), (0.4860-0.6915µg/ml), (0.4830- 0.6995µg/ml), (0.4820-0.7185µg/ml) respectively with *Ficus thonningii* having the highest while *Guiera senegalensis* had the least. Table 4 presents the result of physico-chemical characteristics of the plant samples evaluated. Moisture content was found to be highest in *Ficus thonningii* (11.30%) and lowest in *Anogeissus leiocarpus* (8.15%). Ash was also found to be highest in *Ficus thonningii* (34.85%) and lowest in *Tamarindus indica* (10.85%). Results of Acid insoluble ash and water insoluble ash revealed that *Ficus thonningii* had the highest (6.15/11.60%) while *Guiera senegalensis* had the least (2.55/4.55%) respectively. Sulphated Ash ranged from (23.94-51.35%) with *Guiera senegalensis* having the highest (51.35%) while *Anogeissus leiocarpus* had the least. Acid Soluble Extractive result showed that *Anogeissus leiocarpus* had the highest (13.73%) while *Ficus thonningii* had the least (3.97%). Water Soluble Extractive was also found highest in *Anogeissus leiocarpus* (4.17%) and lowest in *Guiera senegalensis* (2.63%). Table 5 shows the Phytochemical Concentration of the plant samples. Tannins content was found to be highest in *Anogeissus leiocarpus* (6.91%) and least in *Guiera senegalensis* (4.55%). *Anogeissus leiocarpus* and *Guiera senegalensis* were found to have the same saponin content which ranged from (3.47-3.64%). Result of flavonoids content was found to be highest in *Guiera senegalensis* (3.44%) and lowest in *Anogeissus leiocarpus* (2.28%). Alkaloids content reveals that *Anogeissus leiocarpus* has the highest (27.90%) while *Guiera senegalensis* had the least (8.53%). The Total phenolics content of the botanical galactogogues revealed that *Anogeissus leiocarpus* has the highest phenolics content (190.18%) while *Guiera senegalensis* has the least (159.68%).

CONCLUSION

The radical scavenging ability and antioxidant properties of these plants has been found to be adequate for enhancing milk production in lactating animals. Their high radical scavenging and antioxidant activity can be attributed to their high flavonoid and phenolic contents. Without any reservation, the plants extracts evaluated in the present study possess antioxidant properties which provides effective intervention for free radical mediated diseases that may affect lactation in mammals.

REFERENCES

Asimov, D. and Krouze, H. (1991). Composition and somatic cell count of milk in conventional and agro-ecological farm, Brazil. Livestock Resource and Rural Development, 17, 1734-1740

Benzie, I. F. and Strain, J. J. (1996). The ferric reducing ability of plasma (FRAP) as a measure of "antioxidant power": the FRAP assay. Analytical Biochemistry. 239(1): 70-76.

Bharti, S. K., Sharma, N. K., Gupta, A. K., Murari, K. and Kumar, A. (2012). Pharmacological actions and potential uses of diverse Galactogogues in Cattle. International Journal of Clinical Pharmacology and Therapeutics, 2(1): 24-28.

Blois, M. S. (1958). Antioxidant determination by the use of a stable free radical. Nature. 181: 1199-1200.

Charalampos, P. and Michael, K. (2013). Analysis of naturally occurring phenolic compounds in aromatic plants by RP-HPLC coupled to diode array detector (DAD) and GC-MS after sialylation. Foods.2: 90-00.

Elgorashi, E.E. and Van Staden, J. (2004) Pharmacological screening of six Amaryllidaceae species. Journal of Ethnopharmacology 90: 27-32.

Jia, Z., Tang, M. and Wu, J. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chemistry. 64(4): 555-559.

Kähkönen, M.P., Hopia, A.I., Vuorelka, H.J., Rauha, J.P., Pihlaja, K., Kujala, T.S. and Heinonen, M. (1999). Antioxidant activity of plant extracts containing phenolic compounds. Journal of Agricultural and Food Chemistry. 47: 3954-3962.

Momin, R. and Kadam, V.B. (2012). Determination of ash values of some medicinal plants of Genus sesbania of marathwada region in maharashta. Journal of Drug Discovery and Herbal Research.. 1(4):193-195

Prieto, P., Pineda, M. and Aguilar, M. (1999). Spectrophotometric quantitation of antioxidant capacity through the formation of a Phosphomolybdenum complex.: Specific application to the determination of vitamin E. Analytical Biochemistry. 269: 337-341.

SAS, Statistical Analytical System, 2000.

Siddhuraju, P. and Becker, K. (2003) Antioxidant properties of various solvent extracts of total phenolic constituents from three different agro-climatic origins of drumstick tree (Moringa oleifera Lam.) leaves. Journal of Agricultural Food Chemistry. 51(8): 2144-2155.

Siddhuraju, P. and Manian, S. (2007). The antioxidant activity and free radical scavenging capacity of dietary phenolic extracts from horse gram (Macrotyloma uniflorum) seeds. Journal of Food Chemistry 105(3): 950-958.

Sofowara, A. Medicinal Plants and Traditional Medicine in Africa. 2nd Ed. Sunshine House, Ibadan, Nigeria: Spectrum Books Ltd; 1993. Screening Plants for Bioactive Agents; 134-156.

Trease, G. and Evans, S.M. (2002). Pharmacognosy Tindal. 23. 15th ed. London: Bailer -67.

Zhishen, J., Mengcheng, T. and Jianming, W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Journal of Food Chemistry 64(4):555-559.

EFFECTS OF FEEDING *Panicum maximum* SUPPLEMENTED WITH LEGUME PELLETS ON THE RUMEN FERMENTATION CHARACTERISTICS OF WEST AFRICAN DWARF SHEEP

D. K. Oyaniran[+]*, V. O. A. Ojo[+], O. O. Adelusi[-], S. A. Adeoye[+] and A. O. Ogunsakin[+]

[+]*Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria*

[-]*Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria*

**Corresponding Author Email: oyanirandammy4real@yahoo.com Phone: +2348165082609*

ABSTRACT

The study evaluated the effects of supplementation of legume pellets on the rumen fermentation parameters of West African dwarf (WAD) sheep fed Panicum maximum. Twenty WAD rams with average body weight of 12.43 ± 0.5 kg were allocated to four dietary treatments: sole Panicum maximum, P. maximum supplemented with Lablab purpureus pellets, P. maximum supplemented with Calopogonium mucunoides pellets *and P. maximum supplemented with Mucuna pruriens pellets arranged in a Completely Randomized Design. Panicum maximum was offered to the animals ad libitum and legume pellets were fed at 5 % of their body weight. The feeding trial lasted 12 weeks. Rumen pH, ammonia nitrogen (NH_3-N) and total volatile fatty acid were determined, and analyzed using one-way analysis of variance. At 6 hours post feeding, NH_3-N concentration in rams supplemented with* C. mucunoides *pellets were significantly ($P<0.05$) lower than others. Rams supplemented with L. purpureus pellets had the lowest ($P<0.05$) rumen pH (6.99) at 0 hour and at 6 hours post feeding (6.54). Moreso, supplementing rams with L. purpureus pellets increased the NH_3-N and reduced the rumen pH which can improve the activity of micro-organisms in the rumen. As such, supplementation with forage pellets during dry season, will serve as reliable source of feed for ruminants.*

Keywords: Ammonia, legume pellets, *Panicum maximum*, rumen pH, volatile fatty acids

INTRODUCTION

The forage plants decline rapidly in quantity and quality during dry season (Ajayi, 2007). During this period, the animals are faced with reduced feed intake, loss of weight and this led to their poor performance. To alleviate this problem, it becomes imperative to conserve and process forages during period of abundance for use during the period of scarcity. They can be stored as hay or silage and fed to animals as conserved feed. The rumen which is an essential fermentation vat in ruminants, is capable of preparing end products particularly volatile fatty acids and microbial proteins as major energy and protein for ruminants hosts. It also provides an anaerobic environment, constant temperature and pH to the microorganisms for digestion (Yusuf, *et al* 2008). The products of microbial fermentation, mainly volatile fatty acids (VFA) and microbial protein, are available for absorption in the small intestine while the gases (carbon dioxide and methane) are eructated (Bayat and Shingfield, 2012). Tropical forages are rich in fibre and lignin which reduces the fermentation rate, microbial mass and production of VFA in the rumen of the animals (Ebtehag *et al*., 2016). The fibre contents can be reduced by processing forages into pellets (Oyaniran *et al*., 2018) and this will increase the fermentation rate. Hence, this study investigated the rumen pH, ammonia nitrogen and VFA of West African dwarf sheep fed *Panicum maximum* supplemented with legume pellets.

MATERIALS AND METHODS

The experiment was carried out at the Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria on latitude 7° 13’ 49.46" N and longitude 3° 25’ 11.98" E. *Lablab purpureus*, *Calopogonium mucunoides* and *Mucuna pruriens* leaves were harvested at 12 weeks and dried. The dried legumes were milled and pelletized using a 6 mm die size to produce pelletized legume forages of average length of 40 mm. Cassava flour was used as binder (proportion of 1 kg of cassava flour to 100 kg of the milled sample) with addition of water to moisten. The pellets

were warm and moist, when they came out of the mill. They were then air dried to harden up so as to hold their forms. The experimental diets were Sole *Panicum maximum*, *P. maximum* supplemented with *L. purpureus* pellets, *P. maximum* supplemented with *C. mucunoides* pellets, *P. maximum* supplemented with *M. pruriens* pellets. A total number of twenty (20) West African dwarf (WAD) rams with average body weight of 12.43 ± 0.5 kg were used for the experiment. The animals were weighed and randomized into four treatment groups of five animals per treatment each balancing for body weight. A basal diet

of fresh *Panicum maximum* grass was fed daily to the animals. The grass was harvested at 6 weeks of re-growth, wilted, chopped and offered to the animal's *ad libitum* daily. The legume pellets were fed as supplements to the animals at 5 % of their body weight. At the end of feeding trial, ruminal fluid samples were collected before morning feeding and six hours post feeding using oesophageal tube for the determination of rumen pH, ammonia nitrogen and volatile fatty acids. Sub- samples of the grass and legume pellets were oven dried at 65 ^{o}C to constant weight. Proximate composition were determined according to AOAC (2000). Fibre fractions: neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) were analysed according to the procedure of Van Soest *et al.* (1991). Tannin contents were determined using the Vanillin-HCl method as described by Price and Butler (1977). Saponin contents were determined according to the method of Obdoni and Ochuko (2001). The pH of the rumen fluids were measured immediately after collection with the use of pH meter (Hanna instruments, pH 211, microprocessor pH meter, K012818, Portugal). Thirty (30) ml of rumen fluid was taken and filtered through four layers of cheese cloth for the determination of rumen ammonia nitrogen (Lanyansunya *et al*., 2007) and volatile fatty acids were determined according to the procedure of Siedlecka *et al*. (2008). All data obtained were arranged in a completely randomized design and subjected to one-way analysis of variance (ANOVA). Significant means were separated using Duncan's Multiple Range Test of SAS (2000).

RESULT AND DISCUSSION

Table 1 shows the chemical composition of *P. maximum* and herbaceous forage legume pellets. The crude protein content in this study ranged from 94.5 gkg^{-1} in *P. maximum* to 126.0 g kg^{-1} in *Mucuna puriens* pellets. The crude protein content of the legume pellets was higher than the minimum recommended range of 7.0 - 8.0 % for efficient functioning of rumen microorganisms (Van Soest, 1994). *Calopogonium mucunoides* pellets had the highest (P<0.05) NDF content while *L. purpureus* pellet had the least value. The fibre contents of samples in this study were below 60-65 % suggested as the critical limit above which efficiency of utilization of tropical forages by ruminants would be impaired (Muia, 2000). Tannin content was highest (P<0.05) in *Mucuna pruriens* pellets (0.0042 %) while *C. mucunoides* pellet (0.0018 %) had the lowest (P<0.05) value. Tannin content recorded in this study were lower than 2-5 % sheep and cattle can tolerate (Diagayete and Hugg, 1981). Babayemi *et al*. (2004) reported that higher level of saponin in feed is known to deter the activities of bacteria in the rumen.

Table 1: Chemical composition (g kg^{-1}) of *P. maximum* and herbaceous forage legume pellets

	Treatment					
Parameters (g kg^{-1})	*Panicum maximum*	*Lablab purpureus*	*Calopogonium mucunoides*	*Mucuna pruriens*	SEM	P-value
Dry matter	256.00[d]	855.20[c]	902.07[b]	915.23[a]	1.13	<.0001
Crude protein	94.50[d]	120.80[b]	105.00[c]	126.00[a]	3.79	<.0001
Ether extract	40.00[c]	50.00[b]	50.00[b]	70.00[a]	3.30	<.0001
Ash	120.00[a]	95.00[b]	70.00[c]	70.00[c]	6.26	<.0001
Neutral detergent fibre	560.00[b]	480.00[d]	580.00[a]	500.00[c]	12.43	<.0001
Acid detergent fibre	360.00[a]	240.00[c]	300.00[b]	300.00[b]	12.79	<.0001
Acid detergent lignin	140.00[a]	60.00[d]	100.00[b]	80.00[c]	8.92	<.0001
Tannin (%)	ND	0.0025[b]	0.0018[c]	0.0042[a]	3.51	<.0001
Saponin (%)	ND	5.00[c]	5.50[b]	6.00[a]	0.15	0.0002

[a, b, c] means on the same row with different superscripts are significantly different (P<0.05). ND: Not determined. SEM: Standard error of mean

Table 2 shows the rumen parameters of West African dwarf rams fed *P. maximum* supplemented with herbaceous forage legume pellets. Rams supplement with *M. pruriens* pellets had the highest (P<0.05) rumen pH (6.91) while rams that were supplemented with *L. purpureus* pellets (6.51) had the lowest (P<0.05) rumen pH. The high ruminal pH in rams before feeding could be due to effect of low soluble carbohydrate in the rumen of the animals at that time. However, the rumen pH of the animals was reduced at 6 hours post feeding and this could be as a result of high VFA and rapid fermentation at 6 hours post feeding. Highest ruminal pH in rams fed *M. pruriens* pellet supplemented diet at 6 hours post feeding could be the effect of high tannin content which increases saliva and it serves as buffering capacity in the rumen (Yusuf *et al*., 2017). Volatile fatty acids usually accumulate in the rumen if its rate of production exceeds the clearance rate which may lower the rumen pH and cause the metabolic disturbance (Yusuf *et al*., 2013). Low VFA in the rumen of rams supplemented with *C. mucunoides* pellets, could be attributed to high fibre in the feed. At 6 hours post feeding, the VFA in the animals was higher compared before feeding except for rams supplemented with *M. pruriens* pellet. This could be due to high tannin content in the feed and this in line with the reports of Getachew and Makkar (2002) that lower production of VFAs could be due to the elevated content of tannin. The rumen pH of the rams after feeding fell within the range 6.00-7.00 required for optimal microbial digestion of fibre and protein in the rumen (Firkins, 1996). Low NH_3-N in rams supplemented with *C. mucunoides* pellets could be due to low crude protein content and VFA because metabolism of the ammonia requires a considerable and commensurate amount of energy (Oba and Allen, 2003). The concentration of NH_3-N in the rumen depends on the protein content in the feeds fed to the animals (Ranjah, 1980). The ruminal NH_3-N concentration of the rams were sufficient for maximizing rumen microbial synthesis since it lies within the range of 2 and 5 mg/100ml reported as minimum rumen fluid.

Table 2: Rumen Parameters of West African dwarf rams fed *P. maximum* supplemented with herbaceous forage legume pellets

Parameters %	Dietary treatment				SEM	P-value
	P. Maximum	*Lablab purpureus* + *P. maximum*	*Calopogonium mucunoides* + *P. maximum*	*Mucuna pruriens* + *P. maximum*		
pH						
Before feeding (0 hour)	7.18[b]	6.99[c]	7.36[a]	7.22[b]	0.04	0.0002
Post feeding (6 hours)	6.78[ab]	6.54[b]	6.71[ab]	6.91[a]	0.05	0.0003
Total VFA						
Before feeding (0 hour)	1.21	1.23	1.14	1.40[a]	0.04	0.0569
Post feeding (6 hours)	1.22	1.31	1.16	1.22	0.03	0.0354
Ammonia N						
Before feeding (0 hour)	28.07	34.02	27.56	34.02	1.51	0.2530
Post feeding (6 hours)	36.57[a]	39.12[a]	19.32[b]	34.02[a]	2.60	0.2325

[a, b, c] means on the same row with different superscripts are significantly different (P<0.05), SEM = standard error of means.

CONCLUSIONS

From the results of this study, it can be concluded that rams supplemented *Lablab purpureus* pellets had highest ruminal ammonia nitrogen and the lowest rumen pH. The rumen pH of the rams were reduced at 6 hours post feeding.

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REFERENCES

Ajayi, F. T. (2007). Nutritional evaluation of guinea grass (Panicum maximum cv. Ntchisi) intercropped with some legumes for West African dwarf goats. Ph.D Thesis. University of Ibadan.

AOAC. (2000). Official methods of Analysis, Association of Official Analytical chemists, Washington D.C. 17th edition.

Babayemi, O. J., Demeyer, D. and Fievez, V. (2004). In vitro rumen fermentation of tropical browse seeds in relation to their content of secondary metabolites, J. Anim and Feed Sci, 31-34

Bayat, A. and Shingfield, K. J. (2012). Overview of nutritional strategies to lower enteric methane emissions in ruminants. Maataloustieteen Päivät.

Diagayete, M. and Hugg, W. (1981). Tannin contents of African pasture plants: Effects on analytical data and in vitro digestibility. Animal Research and Development, 15: 79-90.

Ebtehag, I. M., Abou Elenin, Etab R. Abd El-Galil, Etman, K. E. I. and El-Shabrawy, H. M. (2016). Improvement of rumen fermentation and performance of growing lambs by adding natural microbial resources. Asian Journal of Animal Sciences, 10 (3): 202-212.

Firkins, J. L. (1996). Maximizing microbial protein synthesis in the rumen. The Journal of nutrition, 126: 1347-1354.

Getachew, G and Makkar, H. P. S. (2002). Tropical browses: content of phenolic compounds estimation of energenic value and stoichiometrical relationship between short chain fatty acid and in vitro gas production. Journal of Agricultural Science Cambridge, 139: 341 – 352

Lanyansunya, T. P., Wang, H., Kariuki, S., Mukisira, E., Abdulrasak, S., Kibitok, N. and Ondiek, J. (2007). The potential of Commelina benghalensis as forage for ruminants. Animal Feed Science and Technology, 144:185-195

Muia, J. M. K. (2000). Use of Naiper grass to improve small holder milk production in Kenya. Ph.D Thesis. *Wageningen Agricultural University. The Netherlands*

Oba, M. and Allen, M. (2003). Effects of corn grain conservation method on feeding behavior and productivity of lactating dairy cows at two dietary starch concentrations. Journal of Dairy Science, 86, pp. 174-183.

Obdoni, B. and Ochuko, P. (2001). Phytochemical studies and comparative efficacy of the crude extracts of some homostatic plants in Edo and Delta States of Nigeria. Global Journal of Pure and Applied Science, 8: 203–208.

Oyaniran, D.K., Ojo, V.O.A., Aderinboye R.Y., Bakare, B.A. and Olanite, J. A. (2018). Nutritive quality of three pelleted and unpelleted legumes. Livestock Research for Rural Development, 30(4).

Price, M. L and Butler, L. G. (1977). Rapid visual estimation and spectrophotometric determination of tannin content of sorghum grain. Journal of Agriculture and Food Chemistry, 25: 1268–1273.

Ranjah, S. K. (1980). Animal nutrition in the tropics. Second reviewed edition, VIKAS Publishing House Limited. India.

SAS. (2000). Statistical Analysis System. User's Guide: Statistics Version 8.2. SAS Institute, NC, USA.

Siedlecka, E. M., Kumirska, J., Ossowski, T., Glamowski, P., Golebiowski, M., Gajdus, J., Kaczynski., Z. and Stepnowski, P. (2008). Determination of volatile fatty acids in environmental aqueous samples. Polish Journal of Environmental Studies, 17(3):351-356.

Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74, 3583–3597.

Van Soest, P. J. (1994). Nutritional Ecology of the Ruminant. 2nd Edition, Cornell University Press, Ithaca, New York, ISBN-13: 9780801427725, pp 476

Yusuf, K. O., Isah, O. A., Onwuka, C. F. I., Olanite, J. A., Oni, A. O. and Aderinboye, R. Y. (2013). Effects of enzymes additive on nutrient intake digestibility and rumen metabolites of yearling cattle fed grass hay based diet. Nigerian Journal of Animal Science 15: 155 – 167.

Yusuf, A. L., Adeyemi, K. D. and Sazili, A. Q. (2017). Effects of dietary supplementation of leaves and whole plant of Andrographis paniculata on rumen fermentation, fatty acid composition and microbiota in goats. BMC Veterinary Research, 13:349.

EFFECT OF PELLET MILL AND BINDER ON QUALITY AND ACCEPTABILITY OF CASSAVA-GLIRICIDIA PELLETS FED TO ZEBU COWS

[*]Dada O.A. , [+]Olorunnisomo O.A and *Ogunsipe M.H.
[*]*Animal Production Unit, Adeyemi College of Education, Ondo, Nigeria.*
[+]*Department of Animal Science, University of Ibadan, Ibadan. Nigeria.*
Corresponding author: doluwagbemiga@yahoo.com

ABSTRACT
The challenge of inadequate nutrition and inability to meet the energy-protein requirement of cattle especially during the dry season has limited their productivity. In Nigeria, Cassava and Gliricidia are valuable feed resources that can fill the gap in feed supply if adequately harnessed, and this is dependent on methods of processing and preservation. This could be through pelleting of feedstuffs. This study was carried out to assess the effect of pellet mill and binder on quality characteristics of Cassava-Gliricidia pellets and its acceptability by cattle. Two flat die pellet mills (vertical and horizontal designs) at 2 levels of starch inclusion (0 and 5%) were adopted for the pellet feed production. Four Zebu cows were used for the preference assessment in a cafeteria study which lasted for 30min daily and a total period of eight days. The effect of pellet mill and starch level was significant on the assessed quality parameters. The crude protein content of pellets ranged from 17.65 to 19.45%. Physical quality was measured in terms of durability. Pellet Durability Index values show that pellets compressed by vertical design flat die mill with 5% starch are the most durable. Pellet preference considered in terms of intake rate showed that Zebu cows preferred Cassava-Gliricidia pellets compressed by vertical design flat die mill without starch (0%) to other pellets used in this study. It is concluded that cassava root meal and gliricidia leaves possess the potential of solving the problem of limiting feed resources of ruminant animals in Nigeria.

Keywords: *Cassava; Gliricidia; pellet mill; Zebu cows; PDI: Pellet Durability Index*

INTRODUCTION

The trends in livestock production in developing countries as well as in the world show a more rapid growth in production of pig and poultry meat in comparison with that of ruminant (Upton, 2004). The unavailability of sufficient pasture forage during the dry season in tropical and subtropical regions is a major problem in ruminant livestock production (Olorunnisomo, 2011). During this period, grazing ruminants lose weight and in extreme cases some deaths do occur. The feeding of supplemental protein diets is one of the means of minimizing weight loss during this period. Thus a sustainable strategy will entail developing means capable of optimizing the use of our common feed resources such as cassava and gliricidia. In Nigeria, cassava production is well-developed as an organized agricultural crop. It has well-established multiplication and processing techniques for food products and cattle feed. Cassava production in other African countries appears small in comparison to Nigeria's substantial output (FAO, 2004a). Ruminants can be fed on cassava tuberous root, foliage, peel and residue obtained after processing cassava. Also as part of global efforts to improve animal nutrition during the dry period of the year, attention is being shifted to the evaluation of indigenous multi-purpose tree (MPT) species. These indigenous MPT are well distributed and adapted to the hot tropical climate (Anele *et al*., 2006). Among the MPT is Gliricidia which is a browse tree of nutritional importance in ruminant feeding system. One of the means of preserving excess forage to ensure a steady supply of quality feeds for livestock during the dry season is to make the leaf meal into pellets. These pellets can be improved nutritionally by mixing leaf meal with other feed ingredients such as wheat bran, cassava tubers, palm kernel cake, brewers' dry grain, and etc. The voluntary intake of feed is a major determinant of feed quality and is quite well accepted as an indicator of potential animal performance (Coleman and Moore, 2003). Furthermore, the utilization of any feed resource is influenced by the preference and acceptability of the feed, which is related to the animal's behavioral pattern (Mtenga *et al*., 1992; Kalio *et al*., 2006).

MATERIALS AND METHODS

The experiment was conducted at the Dairy Unit of the Teaching and Research Farm (TRF), University of Ibadan, Ibadan, Nigeria (3º45´E, 7º27´N; at 220m above sea level).

FORAGE MATERIALS

Gliricidia leaves were harvested from the existing plantations at the TRF. The leaves were seperated and air dried to a constant moisture level and thereafter bagged. It was then ground into the meal form at the feedmill of the Teaching and Research farm. Cassava roots was purchased from Ikire in Osun state. It was washed and crushed. It was thereafter pressed, dried and finally milled into flour. Other ingredients were purchased from the feedmill.

PELLET MILL

Two different pellet mills were used in pelleting the feed ingredients. Treatments 1 and 2 were pelletised by a flat die pellet mill while treatments 3 and 4 were pelletised on a locally fabricated ring die pellet mill.

PREFERENCE AND ACCEPTABILITY TRIAL

Four Zebu cows were used for the acceptability study. The method used is the cafeteria method of feeding as described by Larbi *et al.* (1993). Large feeders were used to enable the four (4) cattle feed simultaneously in a convenient situation. Each animal had free access to each of the alternative feed resources in the feeding troughs. The order of placement of the test feed in the parlor was randomized every day to avoid adaptation of the animal to a particular diet. The animals were served 2kg each of the treatments and were replicated twice. Feeding was allowed for a period of 30 minutes daily and the trial was carried out for eight days. The feed consumed was determined by deducting the feed refusal from the quantity offered.

PROXIMATE ANALYSIS

Feed sample (Pellets) were analysed for Dry Matter (DM) and Crude Protein (CP) according to AOAC (2005). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to the procedure of Goering and Van Soest (1985).

DURABILITY MEASUREMENT

The durability of the pellets was evaluated by using a durability tester. 100g of each sample was placed in a tumbling box having 60 rpm (revolution per minute) and was allowed to run for 5 minutes. The samples were recovered and the fines were separated from the pellets.

EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS

A 2 x 2 factorial arrangement in a completely randomized design consisting of 2 pellet mills (a flat die pellet mill and a locally fabricated ring die mill) and 2 levels of starch (0 and 5%) of starch inclusion in the diets was adopted for the pellet feed production.

The data collected were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of MINITAB (2002-2003). Significant differences among means were separated using the Duncan's Multiple Range Test (DMRT) of the same software.

RESULTS AND DISCUSSION

Table 1: Proximate Composition (%) of Pellets

	DM	CP	EE	ASH	CF	NFE	NDF	ADF	ADL
T1	85.72	19.45^{a}	0.75^{a}	8.25^{c}	20.55^{d}	39.45^{a}	46.00^{b}	20.50^{b}	11.50^{b}
T2	85.42	18.85^{b}	0.85^{a}	8.35^{c}	21.25^{c}	38.65^{b}	41.50^{c}	17.00^{c}	10.25^{bc}
T3	85.46	18.35^{c}	0.85^{a}	9.75^{a}	21.85^{b}	36.85^{c}	49.50^{a}	27.50^{a}	14.50^{a}
T4	85.53	17.65^{d}	0.75^{a}	9.25^{b}	22.05^{a}	38.45^{b}	45.50^{b}	15.50^{c}	9.25^{c}
SEM	0.13	0.05	0.05	0.05	0.05	0.09	0.66	0.66	0.395

$^{a-d}$ Means in the same row with different superscripts are significantly different ($p < 0.05$)

T1: Pellets compressed by flat die mill + 0% starch; T2: Pellets compressed by flat die mill + 5% binder

T3: Pellets compressed by ring die mill + 0% binder; T4: Pellets compressed ring die mill + 5% binder

The CP content of pellets ranged from 17.65 to 19.45%. All these values are well above 8% suggested by Norton (1994) for effective ruminal function. This is an indication that pellets of this composition can serve as a protein supplements for cattle, especially during the period of drought.

PELLET DURABILITY INDEX

Table 2: Effect of pellet mill and starch on PDI of cassava-gliricidia pellets

Pellet mill	
M1	93.75^{a}
M2	89.25^{b}

$^{a-b}$ Means in the same column with different superscripts are significantly different ($p < 0.05$)

M1: Flat die pellet mill; M2: Locally fabricated ring die pellet mill

Table 3: Effect of Starch Inclusion on Durability Index

Starch level	
0%	90.25^{b}
5%	92.75^{a}

The effect of pellet mill on the PDI value was pronounced with pellets compressed by flat die having lesser fines after agitation compared to pellets from ring die. The difference may be due to the quantity of steam generated by the individual pellet mill. Skoch *et al*. (1981) indicated that steam

conditioning improved pellet durability. The addition of starch binder (5%) made the pellets to be more durable. PDI values for pellets having binder were significantly ($P < 0.05$) higher than pellet without binder. This emphasised the importance of binder in the production of durable pellets. Pellets without binder compressed by flat die mill were more durable than pellets from ring die mill irrespective of binder inclusion. Sonthi and Nitipong (2013) studied the potential of cassava root to serve as pellet fuel and found out that all pellets had little amount of fines. This result agrees with the above assertions and show that pellets of cassava roots are of good durability. In addition, the durability of such pellets can be influenced by pellet mill.

ACCEPTABILITY

Table 4: Effect of pellet mill type and starch on acceptability of cassava-gliricidia pellets by Zebu cows

Pellet mill	
M1	1.17[a]
M2	0.83[b]

[a-b] Means in the same row with different superscripts are significantly different ($p < 0.05$)

M1: Flat die pellet mill; M2: Locally fabricated ring die pellet mill

Table 5: Effect of starch on acceptability of cassava-gliricidia pellets by zebu cows

Starch level	
0%	1.09[a]
5%	0.91[b]

[a-b] Means in the same row with different superscripts are significantly different ($p < 0.05$)

STARCH: CASSAVA STARCH

The Coefficient of Preference is a measure of acceptability of forages by ruminants and is determined as the ratio of individual forage intake to the mean intake of all the forages. The results are presented in Tables 4 & 5. Based on this, the effect of machine was significant on the acceptability of pellets by cattle. Pellets compressed by flat die mill are considered to be acceptable while pellets from the ring die mill are not acceptable. West (1998) reported that a major factor which could enhance intake of forages by cattle is to simply lower the cell wall content. Thus, result of statistical analysis of pellets' chemical quality showed that pellets compressed by flat die mill had comparatively lower NDF content than pellets from ring die mill. This could be one of the reasons that made pellets compressed by flat die mill acceptable to the cattle. The effect of starch binder inclusion in the diet is also noticeable in the preference of cattle for pellets made by either mill. The result revealed that the addition of starch binder (at 5%) to the diet reduced the intake of pellets by the animals. According to Matthews (1983), palatability of a feed is interchangeable with preference for the feed. It is determined by the taste, smell, appearance, temperature and texture of the feed. It could then be argued that the inclusion of pregelatinised starch as binder in the production of pellets has a way of altering those dietary characteristics that stimulates a selective response by the animals.

CONCLUSION AND RECOMMENDATION

It is concluded that pellets made from cassava root meal and gliricidia leaves possess the potential of solving the problem of limiting feed resources in Nigeria. However, the efficiency of pellet mill must be carefully considered for optimum maximization of these resources. It is recommended that binder inclusion in cassava-gliricidia pellets should not exceed 5% of the feed.

REFERENCES

Anele U.Y., Olanite, J.A., Adekunle, I.O., Jolaosho, O.A. and Onifade, O.S. (2006): Seasonal in-vitro gas production parameters of three multipurpose tree species in Abeokuta, Nigeria. Livestock Research for Rural Development, 18(10).

AOAC. (2005). Official Methods of Analysis, 18th edn. Association of Official Analytical Chemists, Washington D.C.

Coleman S. W. and Moore, J. E. (2003). Feed quality and animal performance. Field Crops Res., 84: 17 - 29.

FAO. (2004a). Online Statistical Database. Rome, Italy: Food and Agricultural Organization of the United Nations. www.fao.org

Kalio, G. A., Oji, U. I. and Larbi, A. (2006). Preference and acceptability of indigenous and exotic acid soil-tolerant multipurpose trees and shrubs by West African Dwarf sheep. Agrofor. Syst., 67: 123 - 128.

Larbi A. Osakwe I.I. and Lambourne J. W. (1993): Variation in relative palatability of sheep among Gliricidia sepium provenances. Agrofor. Syst., 22: 221 - 224

Matthews L.R. (1983). General introduction. In: Measurement and scaling of food preferences in dairy cows: concurrent schedules and free access techniques. PhD Thesis, University of Waikato, New Zealand, 236p

Mtenga L. A., Komwilhangilo, D. M. and Kifaro, G. C. (1992). Selectivity in sheep and goats fed Albizia, Gliricidia, Leucaena and Tamarind multipurpose tress. In: S. H. B. Lebbie, B. Rey and E. K. Irungu (Eds); Proc. of the 2nd Biennial Conf. of Afri. Small Rum. Res. Network, AICC, Arusha, Tanzania. 7th-11th December 1992. Pp: 151 - 155.

Norton B.W. (1994). Anti-nutritive and toxic factors in forage tree legumes. In: Gutteridge, R.C. and Shelton, H.M. (eds), Forage tree legumes n tropical grassland society of Australia Inc

Olorunnisomo Olusola (2011). Intake and digestibility of elephant grass ensiled with cassava peels by Red Sokoto goats. *Conference on International Research on Food Security, Natural Resource Management and Rural Development*.

Skoch, E.R., Behnke, K. C., Deyoe C.W. and Binder, S.F. (1981).The effect of steam-conditioning rate on the pelleting process. *Animal Feed Science Technology* 6:83

Sonthi W. and Nitipong S. (2103). Effect of particle size and moisture content on cassava root pellet fuel's qualities follow the acceptance of pellet fuel standard. *Inter. Jour. of Renew. and Sust. Energy*. 2 (2): 74 -79

Upton M., (2004). The role of livestock in economic development and poverty reduction. PPLPI Working paper Nº 10, UN Food and Agricultural Organization (FAO), Roma Italy.

Van Soest P.J. and Robertson J.B. (1985). Analysis of forages and fibrous foods. AS 613 Manual. Department of Animal Science, Cornell University, Ithaca, pp 105 -106

EFFECT OF BREWERS' DRIED GRAIN ON GROWTH AND LACTATION PERFORMANCE OF YANKASA SHEEP IN GUINEA SAVANNAH

Dikko, A. H*, T. Z. Adama*, P. P. Barje and D.N. Tsado***,
**Department of Animal Production, Federal University of Technology, Minna, P.M.B. 65, Niger State, Nigeria*
*** National Animal Production Research Institute (NAPRI), Shika Zaria.*
Corresponding Author: aliyu.dikko@futminna.edu.ng. 07036048131

ABSTRACT
The aim of this experiment was to determine the effect of feeding varying levels of brewers dried grain on feed intake, body weight gain, milk yield and composition of Yankasa ewes. Five treatment diets designated D1, D2, D3, D4 and D5 were formulated with maize component substituted with BDG at 0 %, 10 %, 20 %, 30 % and 40 % respectively. The experimental animals were randomly allotted to the five treatments groups in four replicates, each comprising one lamb per replicate in a completely randomized design. The animals were sourced from Biotechnology Department of the National Animal Production Research Institute (NAPRI), Shika Zaria, with properly recorded dates of birth and weight at birth. The lambs were used for the experiment at twelve week. The animals were intensively managed given the experimental diets in the morning and supplemented with forage (Digitaria smutti) afterward. The oestrus of ewes was synchronized using a synthetic prostaglandin named Estrumate® administer through intramuscular injection to have a uniform gestation and parturition. The parameters measured were feed intake, body weight gain, milk yield and milk composition. One way ANOVA using SAS (2000) statistical package was used for analysis. A non-significant (P>0.05) difference was observed among the treatment groups in respect of feed intake with weight gain having a significant difference. However D5 had a better result (4.75 Kg, 22.08) in respect to weight gain and feed conversion ratio respectively. Milk composition and showed a significant (P<0.05) difference with D5, D4 and D3 (7.39%, 7.25 % and 6.63 % respectively. Milk yield showed a significant (P<0.05) difference at week two among the dietary treatment with treatment two (D2) having the best result ((0.11 Kg). It was concluded and recommended that maize can be replaced with BDG up to 40 %.

INTRODUCTION

BACKGROUND TO THE STUDY

Low protein intake, coupled with rapid human population growth, constitute a major problem facing developing countries. Animal protein consumption is among the most important components of human diet and varies from country to country (Okai *et al*., 2005). Rapid human population and low productivity of livestock has led to low protein intake of animal origin in developing countries like Nigeria (Okai *et al*., 2005). This has resulted to demand of this animal protein to exceed supply. To solve this problem, the need to improve animals and animal products production by putting a lot of effort in the production of highly reproductive animals becomes very paramount (Ani and Adiegwu, 2005). The feeding cost constitutes about 65-75 % total production expenses under intensive animal production system. This scenario is attributed to the struggle for foodstuff by livestock and man for some common and normal feed and foodstuff. This situation is so serious in third world countries such as Nigeria thereby necessitating the sourcing for cheaply available unconventional feedstuff that can meet the growth and reproductive requirements of the animals. In Nigeria, there abound untapped potentials for unconventional feed ingredients which can be utilized to feed sheep and other small ruminants. Among these, is brewers' dried grain (BDG) which is a major by-product of brewing industries. The primary purpose of sheep production is to supply wool, meat and milk. The need to increase the supply of milk and mutton is worrisome as seen in most cities in Nigeria. The high demand for milk and mutton could be as a result of its potential over other milk and meat. Low productivity level of production is due to nutritional constraints characterize Sheep production in Nigeria (Tolera *et al*., 2000). The aim of this work is to evaluate the effect of brewers dried grain on growth and lactation performance on Yankasa sheep in guinea savannah.

MATERIALS AND METHODS

EXPERIMENTAL LOCATION

This experiment was conducted at the Biotechnology department farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika - Zaria. Shika lies between Latitudes 11° and 12° N, and between Longitude 7° and 8°E and is located in the sub-humid zone of the Northern Guinea Savannah at the elevation of 640 meters above sea level. Shika experience an average annual rainfall of 1100mm from May to October. The peak of rainfall is witnessed between July and September record the peak of the rainfall Shika also has an average daily temperature of about 25°C with mean relative humidity of about 75 %. The wet period (rainy season) is preceded by dry season (dry period) that starts November to April, having an average daily temperatures ranging from 14 to 36°C and an average relative humidity of between 20 and 37 % (IAR, Meteorological report, 2009).

DESIGN AND MANAGEMENT OF THE EXPERIMENTAL ANIMALS

The experimental design used for the study was complete randomized design (CRD). Twenty Yankasa ewes aged between 5 and 6 months raised at the Biotechnology department farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Zaria, Shika station were used. The experimental animals were treated with ivomec to control the internal parasites and vaccinated against Pestes des Petite Ruminate (PPR), before allotting them to dietary treatments. The weights of experimental animals were taken on the farm and allowed a 14-day adjustment period and subsequently on a weekly basis. The experimental animals were fed at 1.5 % body weight. The experimental animals were allotted to five dietary treatments, D1 (control 0 % Brewers' Dried grains BDG), D2 (10 % BDG), D3 (20 % BDG), D4 (30 % BDG) and D5 (40 %) with each treatment having four animals and each animal constituting a replicate. The animals were managed intensively. Water and forage were given *ad libitum*. This experiment lasted for 90 days.

FEED COMPOSITION

Five different experimental feeds were compounded for the five treatments which were designated as D1, D2, D3, D4 and D5. Diet1 served as control containing 0 % BDG replacing maize, while D2, D3, D4 and D5 had 10 %, 20 %, 30 % and 40 % respectively of BDG replacing maize. The composition of the experimental diets is presented in table 1

BREEDING PROCEDURE AND OESTRUS SYNCHRONIZATION

Oestrus synchronization was done on all the twenty experimental animals during the feeding trial. This was aimed at having a uniform gestation and parturition period using Estrumate®; a synthetic Prostaglandin $F_{2\alpha}$ analogue (Coopers Animal Health Ltd, Berkhamsted, England) containing 263µg of Cloprostenol Sodium (Vet), equivalent to 250 µg Cloprostenol, and 0.1 % w/v Chlorocresol (BP). Intramuscular injection of 2 ml of the $PGF_{2\alpha}$ was administered to each animal. Following intramuscular injection of experimental animals with $PGF_{2\alpha}$, they were observed for oestrus continuously for 7 days (Voh Jr. 2004). Ninety nine (99 %) percent of the animals that came into oestrus during the first $PGF_{2\alpha}$ treatment were mated using rams of proven performance at the rate of one ram to 10 ewes (1:10) The experimental animals were twice daily (at 0700 and 1800 hours), observed for oestrus visually by trained inseminators. Pregnancy was determined through the use of Ultra sound Technology

Table 1: Composition of Experimental Diets

	Dietary Supplements				
Ingredients (%)	D1	D2	D3	D4	D5
Maize	37.87	34.08	30.30	26.51	22.72
BDG	0	3.79	7.57	11.36	15.15
Maize Offal	18.94	18.94	18.94	18.94	18.94
CSC	39.19	39.19	39.19	39.19	39.19
Bone Meal	2.50	2.50	2.50	2.50	2.50
Salt	1.50	1.50	1.50	1.50	1.50
TOTAL	100	100	100	100	100
Calculated Nutrients (%)					
CP	13.71	23.20	33.29	14.96	15.64
CF	10.07	14.40	18.72	10.99	11.43
ASH	3.11	4.32	6.04	2.90	3.04
EE	3.80	6.54	9.04	2.90	3.04
NFE	69.31	51.62	62.91	67.02	65.64
Calcium	18.28	17.59	16.91	16.03	15.28
Phosphorus	4.16	4.21	4.26	4.14	4.14
Methionine	0.21	0.35	0.50	0.24	0.25
Lysine	0.51	0.85	1.71	0.59	0.62
Energy (kcal/kg/ME)	3516	3624	3619	3757	3355

BDG –Brewers Dried Grains, CSC – Cotton Seed Cake D1 = 0 % BDG, D2 = 10 %, BDG D3 = 20 % BDGD4 = 30 % BDG, D5 = 40 % BDG CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, NFE = Nitrogen Free Extract

COLLECTION OF DATA

FEED INTAKE

Data on intake of feed was taken on daily basis. Feed that was offered to the experimental animals were weighed and unconsumed feed was collected and weighed in the morning of the preceding day. Feed intake was obtained by subtracting the leftover from the amount of feed offered in each treatment.

BODY WEIGHT GAIN

Body weight was taken at the beginning of the experiment *using CAMRY Scale of 150 Kg capacity made in China* Model NS-(100kg-150kg). Body weight gain for each week was determined by differences between the body weight of the present week and the preceding week.

MILK SAMPLES COLLECTION

Milking was done once daily using partial milking method. This was done by separating the lambs from their dams in the night and their weight taken in the morning before they are taken to their dams between the hours of 7-8 am. At noon their weight is taken again. The difference between the weight taken before they are taken to their dams and weight after they stay with their dams represent yield of milk. .

MILK COMPOSITION DETERMINATION

100 ml milk samples were taken weekly from each animal by hand milking and preserved with potassium chromate tablets and were used for the determination of milk protein - using the AOAC (2006) procedures.

Milk Fat content was determined using the Gerber Milk test procedure, while Total solid was calculated using the formular: TS = Lc/4 + (1.22 x % Fat) + 0.72,

Where Lc = lactometer reading. Solid non-Fat was determined by subtracting % fat from Total solids.

Ash content was determined by oven drying the samples at 550°C for 2 days.

DATA ANALYSIS

Data collected were subjected to analysis of variance (ANOVA) using SAS. The separation of means and others are contained in the package.

Growth and Lactation Performance of Yankasa ewes fed varying levels of Brewers Dried Grains diet

Growth performance of Yankasa ewes fed varying levels of BDG diet is presented in Table 2. No significance (P>0.05) difference among the treatments with regard to feed intake, total feed intake and final body weight gain was observed. However a trend was observed, animals fed diet having 10 % BDG (D2) had the highest (28.70) value for final body weight, and animals fed diet having 30 % BDG (D4) had the lowest value (25.00 %). Body weight gain was highest (4.75 Kg) in treatment five where the animals were fed 40 % BDG. Animals fed diet containing 40 % BDG (D5) had the highest value (0.86 Kg) and D4 which contains 30 % BDG had the lowest value (0.75 Kg) for daily feed intake. As for total feed intake, D5 containing 40 % BDG has the highest value (78.49 %) while D4 which contain 30 % BDG had the lowest Value (68.25 %).

Table 2: Growth performance of Yankasa ewe fed graded levels of Brewers Dried Grain from Nigerian Brewery

Parameters (Kg)	D1	D2	D3	D4	D5	SEM	LS
Initial body weight	22.63	21.75	22.88	22.75	21.25	0.788	NS
Final body Weight	27.50	28.70	26.25	25.00	26.00	0.862	NS
Weight Gain (g)	2.87	1.95	2.37	1.25	4.75	0.862	*
Daily Feed Intake	0.83	0.78	0.79	0.75	0.86	0.261	NS
Total Feed Intake	75.08	70.98	71.66	68.25	78.49	2.353	NS

[abc] Means in the same row with the same superscript are significantly not different (P>0.05)SEM = Standard error of mean, NS = Not Significant LS = Level of Significance FCR = Feed Conversion Ratio, D1 = Diet 1 – 0 % BDG D2 = Diet 2 - 10 % BDG D3 = Diet 3 - 20 % BDG D4 = Diet 4 - 30 % BDG D5 = Diet 5 - 40 % BDG

Weekly milk Yield samples from Yankasa ewes fed varying levels of Brewers Dried Grain diet.

Table 4.8 shows the weekly milk yield from Yankasa ewes fed varying levels of BDG from Nigerian brewery Kaduna. There was no significant differences (P>0.05) within the diet groups except in week two where there was significant differences among the diet groups. D2 which contain 10 % BDG had the highest value (0.11 Kg) diet D5 which contain 40 % BDG had the lowest value (0.03 Kg).

Total milk yield was highest (0.40 Kg) in animals fed 10 % BDG (D2) and lowest (0.29 Kg) in D5 which contains 40 % BDG.

Table 3: Weekly Milk yield of Yankasa ewe fed graded levels of Brewers Dried Grain from Nigerian Brewery

Parameters (Kg)	D1	D2	D3	D4	D5	SEM	LS
Wk 1	0.07	0.08	0.08	0.05	0.04	0.014	NS
Wk 2	0.04[b]	0.11[a]	0.03[b]	0.08[ab]	0.03[b]	0.010	*
Wk 3	0.03	0.04	0.03	0.03	0.03	0.003	NS
Wk 4	0.02	0.01	0.02	0.03	0.03	0.003	NS
Wk 5	0.02	0.02	0.02	0.02	0.03	0.001	NS
Wk 6	0.02	0.02	0.02	0.03	0.02	0.002	NS
Wk 7	0.02	0.02	0.02	0.02	0.02	0.001	NS
Wk 8	0.01	0.02	0.02	0.01	0.02	0.001	NS
Wk 9	0.02	0.01	0.01	0.02	0.01	0.001	NS
Wk 10	0.01	0.01	0.01	0.02	0.01	0.001	NS
Wk 11	0.02	0.02	0.02	0.01	0.02	0.001	NS
Wk 12	0.02	0.02	0.01	0.02	0.12	0.001	NS
Wk 13	0.01	0.01	0.02	0.01	0.02	0.001	NS
WK 14	0.02	0.03	0.02	0.01	0.01	0.001	NS
TMYield	0.31	0.40	0.30	0.30	0.29	0.020	NS

[abc] Means in the same row with different superscript are significantly different (P>0.05)

SEM = Standard error of mean NS = Not Significant LS = Level of Significance TMYield = Total Milk Yield D1 = Diet 1 – 0 % BDG D2 = Diet 2 - 10 % BDG D3 = Diet 3 - 20 % BDG D4 = Diet 4 - 30 % BDG D5 = Diet 5 - 40 % BDG

Composition of milk of Yankasa ewes fed varying level of Brewers Dried Grain obtained from Nigerian Brewery

Table 4 shows the composition of milk from Yankasa ewes fed varying levels of brewers dried grains. Milk Protein values of D3, D4 and D5 showed significant difference between D1 and D2. Milk protein is observed to have increased as the level of BDG increases. Total solids decreases from 20 % inclusion level as inclusion level increases. However, D1 and D3 differ significantly from D4 and D5 in total solids Milk fat, moisture and energy values showed no significant difference among the diet groups. Non- fat- solids values of D3 and D1 (control) are significantly different from those of D4 and D5 but are statistically similar to D2. Moisture is significantly higher in D3, D5 and D2 but is statistically similar with other diet groups. Ash values in D2 are significantly lower than other diet groups. Calcium and phosphorus values of animals fed D5 are significantly higher than those fed D1. It is also observed that Calcium and Phosphorus increases in the milk as the inclusion levels of BDG increases in the diet. Sodium values are significantly higher in D2, D3, D4 and D5 over D1 (control). Sodium is seen to have increased in the milk up to 30 % BDG inclusion in the diet. Potassium values of milk from animal fed D4, D3, D1 (control) and D2 were significantly higher than those of D5. The milk protein result shows that as the inclusion levels increases, the milk protein, fat, calcium and phosphorus also increase. This means that there is a correlation between milk protein increase and milk fat, calcium and phosphorus increase. This is supported by the work of Cunningham *et al*. (1996) who reported that milk protein is positively correlated with milk fat. The authors believe that that the behavior of the milk protein is influence by milk fat content.

Also the result agrees with the work of Duncan (1998) who reported that calcium and phosphorus in milk are known to be bounded to casein which is a major component of milk protein. The protein content of the milk increased with an increase in milk fat and decreases as milk fat content declined.

This might probably explain the pattern of behavior of calcium and phosphorus content in milk. The general composition of mineral composition in milk is connected to mineral content of the test ingredient (BDG) used. Pyne (1990) reported that nutrition has a major effect on milk composition.

Table 4 Composition of milk of Yankasa ewes fed varying level of Brewers Dried Grain obtained from Nigerian Brewery

Parameter (%)	DI	D2	D3	D4	D5	SEM	LS
Protein	5.31^{b}	5.84^{b}	6.63^{a}	7.25^{a}	7.39^{a}	0.254	*
Total Solids	17.56^{ab}	18.20^{ab}	19.73^{a}	16.49^{b}	16.24^{b}	0.453	*
Fats	5.87	6.19	6.28	6.63	7.06	0.267	NS
Solid-not-fat	12.41^{a}	11.14^{ab}	13.52^{a}	10.97^{b}	11.14^{b}	0.323	*
Moisture	67.53	83.23	83.38	81.54	83.28	3.110	NS
Ash	2.93^{a}	2.92^{a}	2.92^{a}	2.83^{a}	2.37^{b}	0.056	*
Energy (Kcal/Kg)	4199.15	4263.09	4164.06	4182.50	4166.57	15.232	NS
Calcium (ppm)	6095.50^{b}	6248.80^{ab}	6264.10^{ab}	6517.10^{ab}	6669.10a	77.652	*
Phosphorus (ppm)	2570.00^{c}	2583.80^{c}	3250.40^{b}	3603.40^{ab}	4002.70^{a}	5.273	*
Sodium (ppm)	75.74^{c}	130.92^{ab}	145.31^{a}	153.31^{a}	119.08^{b}	7.177	*
Potassium (ppm)	246.23^{a}	244.41^{a}	249.63^{a}	254.72^{a}	198.44^{b}	4.956	*

^{abc} Means in the same row with different superscript are significantly different (P<0.05)

SEM = Standard error of mean * = Significant level (P<0.05), NS = Not Significant

LS = Level of Significance D1 = Diet 1 – 0 % BDG, D2 = Diet 2 - 10 % BDG, D3 = Diet 3 - 20 % BDG D4 = Diet 4 - 30 % BDG D5 = Diet 5 - 40 % BDG

REFERENCES

AOAC (Association of Official Analytical Chemicals) (2006). Official Method of Analysis of the AOAC (W. Horwitz Editor Eighteen Edition, Washington; D. C., USA.

Ani, A.O. and Adiegwu, L.I. (2005). The feeding value of velvet beans (Mucuna pruriens) to weaner rabbits. Proceedings of 30th Annual Conference of Nigeria Society for Animal Production (NSAP).20th- 24th March, 2005. University of Nigeria, Nsuka, Nigeria. Pp. 186-189.

Cunningham, K.D., Cerava, M.J., Johnson, T.R. & Ludden,P.A., (1996). Influence of Source and amount of dietary protein on milk yield by cows in early lactation. Department of Animal Sciences, Purdue University, West Lafayette, IN47907.

Duncan, J.S. (1998). Secretion of milk protein. Journal of mammary Gland Biology and Neoplasia, 3, 275-286 IAR. (2009). Metereological Statistics- Institute for Agricultural Research, A.B.U, Samaru, Zaria.

Okai, D.B., Abora, P.K.B., Davis, T. & Martin, A. (2005). Nutrient composition, availability, current and potential uses of "Dusa": A cereal by-product obtained from "koko" (porridge) production. Journal of Science and Technology, 25,33-38.

Payne, W. J. A. (1990). An introduction to Animal husbandry in the Tropics. 3rd (ed.). London, New York: Longman. P 120.

SAS (2002). Statistical Analysis System. SAS Institute Inc., Gray N.C., USA. Pp. 967-978.

*Tolera, A., Merkel, R.C., Goestch, A.L., Sahhe, T. & Negesse, T. (2000). Nutritional constraints and future prospects for Sheep production in East Africa. In: R.C. Merkel, G. Abebe and A.L. Goetsh (eds). The opportunities and challenges of enhancing Sheep production in East Africa. Proceedings. of a Conference held at Debub University, Awassa, Ethiopia, Nov. 10-12, Pp. 43-*57.

Voh Jr., A.A., Larbi, A.,Olorunju, S.A.S.,Agyemang, K., Abiola, B.D. & Williams, T.O. (2004). Fertility of N'Dama and Bunaji Cattle to artificial insemination following oestus synchronization with PRID and PGF2α in the humid Zone of Nigeria. Tropical Animal Health and Production. 36, 499-511.

AVAILABILITY OF GRASS FORAGES IN AKINYELE INTERNATIONAL CATTLE MARKET, IBADAN

Fagbenro, R. B., Komolafe, P. L., Analoh, J. C., Babayemi, O. J.
Department of Animal science, University of Ibadan, Nigeria
Corresponding author: lollyb2020@yahoo.com
08068238166

ABSTRACT
The study was carried out at Akinyele international Cattle Market, Ibadan. A period of 15 days was used to monitor the inflow of grass brought to feed cattle by direct observation using checklist. Relevant information on source of grass, types of grass and quantity supplied were gathered. The study revealed that grass was brought from 30 different locations within Oyo state. The location with highest contribution of grass forages supplied was Fiditi (103±68.71) while the lowest is from Sogunro (11.00±0.00) and Oloosa-oko (11.00±0.00) respectively. Five different grass species were brought to feed cattle at the study area with the highest being Pennisetum purpureum (59%) and the least Pennisetum pedicellatum (10%). The largest quantity of grass was brought on Fridays while the smallest was on Tuesdays. The study revealed that there is consistent inflow of different species of grass to the study area from various locations.

INTRODUCTION
In Nigeria, the uneven distribution of rainfall poses serious forage management and animal feeding difficulties during the dry season. Thus, available forage materials can no longer provide the minimum protein and energy requirements to grazing animals (Obioha and Ndukwe, 1976). However, in the rainy season, there is an abundance of grazeable forages. Ruminants suffers a lot from the unavailability of quality feed during the dry season, as there is usually a total absence of succulent and high quality nutrition feed for grazing. Seasonal fluctuation in nutritive values of forages are the constraints to livestock production during the dry season (Abbator *et al.,* 2000).

Akinyele international cattle market presents an interesting situation as it is one of the largest cattle market in South-west Nigeria and at any point in time, up to a thousand cattle are available for sale. The cattle are fed maintenance ration to keep them healthy prior to when they are sold. This ration consists majorly of grass forage as it is the cheapest feed source available. However, due to the amount of cattle units present in the market, the availability of grass forages and the source of these grass forages that cattle traders in Akinyele International cattle market use to meet the maintenance ration requirement of their cattle prior to its sale needs to be assessed.

Therefore, the study was carried out to assess the inflow of grass forage fed to cattle at Akinyele International cattle market, IbadanMaterials and methods

The study was carried out at Akinyele International cattle market, Ibadan for a period of fifteen days from 7am-7pm every day of the week. Direct observation with the aid of checklist and weighing balance was used to obtain relevant data on the source of grasses, type of grasses, quantity of grass offloaded daily. Data obtained were analysed using descriptive statistics with Excel 2016 and SPSS statistical package (version 21).

RESULTS AND DISCUSSION

Presented in Figure 1 is the species of grass forage supplied to Akinyele International Cattle Market. It was observed that four different species of grass were constantly supplied which are *Pennisetum purpureum, Andropogon gayanus, Panicum maximum, Pennisetum pedicellatum, at 59%, 18%, 13% and 10% respectively*. The most frequently supplied specie of grass *is Pennisetum purpureum while the least is Pennisetum pedicellatum.* The high supply of *Pennisetum purpureum* may be due to the fact that it is one of the highest yielding tropical grasses. It is a very versatile species that can be grown under a wide range of conditions and systems: dry or wet conditions. It is a valuable forage and very popular throughout the tropics, notably in cut-and-carry systems (Mannetje, 1992; FAO, 2015). While the least supplied grass forage found in Akinyele international cattle market was *Pennisetum pedicellatum*. The reduced quantity supplied might be that animals in the study area has less preference for the specie of forage. It could also be that available *pennisetum pedicellatum* at that season of the year might be lignified with minimal quantity available for cut and carry. Babayemi *et al.*, (2005) reported that the dry season is characterized by insufficient feed.

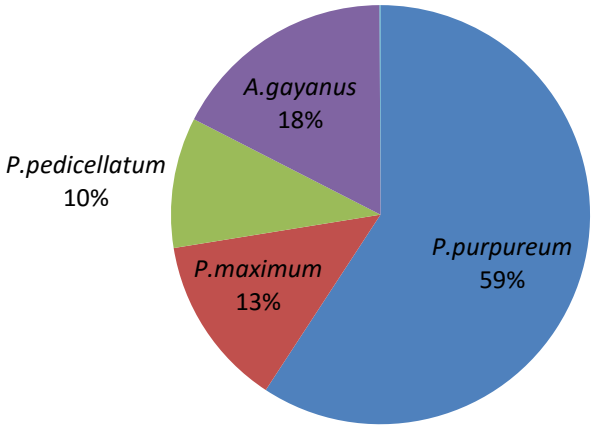


Figure 1: Species of Grass Forage Supplied to Akinyele International Cattle Market

Shown in Figure 1 is the average daily grass of forage supplied to Akinyele International cattle market. The study showed that, grasses are consistently supplied to the study area on a daily basis all through the period of the study. It was observed that the frequency of supply and quantity was highest on Fridays (16 tonnes) and the least on Tuesdays (2.7 tonnes). The quantity of grass inflow at the other days are Wednesday, Sunday, Monday, Saturday and Thursday follows at 15981kg, 12551kg, 9163kg, 3895.3kg, and 3816kg respectively. The highest frequency of supply and quantity on Fridays might be due to the fact that most farmers will want to purchase more grass on Friday as most sellers may not be around during the weekend while the least supply on Tuesday could be as a result of suppliers trying to decongest available grasses in relation to weekend preparation.

According to information gathered on the field, grass sellers source for grass at alternate days. They source today and rest tomorrow. They do this so that grass will not be in abundant

without them being able to sell off. Since the shelf life of cut and carry grass is small before chlorination and depreciation sets in. This is as justified from figure 2 below.

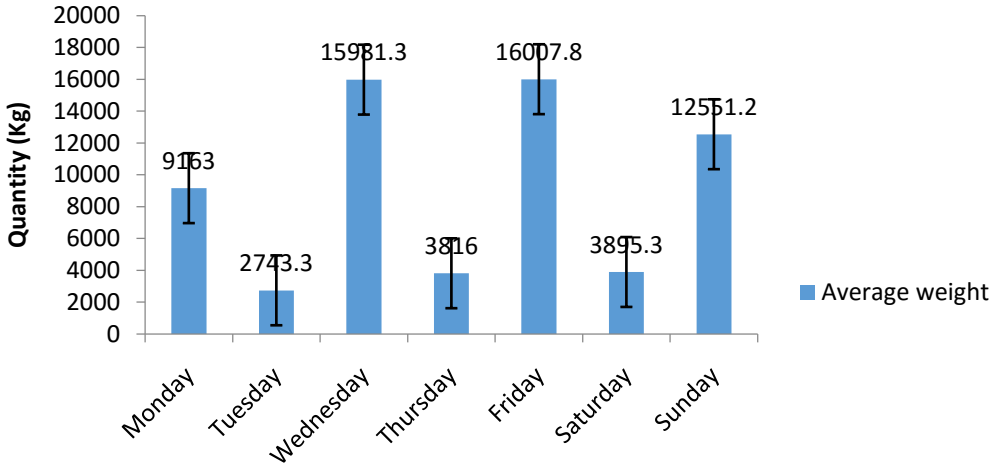


Figure 2: Average Daily Grass Forage Supplied to Akinyele International Cattle Market

Presented in Table 1 are the locations of grass forages supplied to Akinyele International cattle market Ibadan. It was observed that grass species were brought from 30 different locations within Oyo state. The location with the highest frequency of supply was Fiditi (103±68.71) with the lowest from Sogunro (11.00±0.00) and Oloosa-oko (11.00±0.00) respectively. Fiditi had the highest population of all the grass species supplied (*Pennisetum purpureum (698), Panicum maximum (142), Pennisetum pedicellatum (113)*) except for *Andropogon gayanus (215)* which is highest in Ajibode. The highest frequency of grass supplied from Fiditi could be due to the fact that Fiditi is a location at the outschet of Ibadan but relatively closer to the study area. It is an area with a land mass not occupied by buildings when compared with other source within Ibadan thus encouraging the growth of forages. Kallah (2014) reported that rain forest and mangrove swamp encourages very high yielding grass. Exploration of forages by individuals within Ibadan metropolis might be as a result of proximity.

.Table 1: Locations of Grass Forages Supplied to Akinyele International Cattle Market

Source	Grass types				
	P.purpureum	*P.maximum*	*P.pedicellatum*	*A.gayanus*	*Mean* (±SD)
Fiditi	698	142	113	77	103 ± 68.7
Oyo	297	37	13	0	43.4 ± 24.5
Moniya	359	133	71	45	55.3 ± 43.6
Tose	250	23	33	187	41.1 ± 35.7
Aba-odo	32	0	0	0	10.7 ± 2.9
Iroko	81	18	29	42	28.3 ± 13.8
Onikanyinkanyin	53	75	18	38	26.3 ± 20.2
Ajibode	44	19	21	215	29.9 ± 23.5
Odo-oba	33	15	14	35	24.3 ± 21.3

Akinyele	33	9	10	0	10.4 ± 7.3
Ijebu	0	17	0	0	8.5 ± 0.5
Ikereku	11	13	6	6	12.0 ± 4.6
Abrigiji	23	1	44	0	22.7 ± 8.5
Apapa	41	0	0	0	20.5 ± 2.5
Ojoo	66	0	0	5	35.5 ± 4.5
Jobele	65	9	0	0	24.7 ± 11.7
Alabata	61	6	7	41	38.3 ± 17.6
Akinmonrin road	40	0	0	0	40.0 ± 0.0
Matunde	2	7	22	0	15.5 ± 5.5
Oniyanrin	18	0	0	0	18.0 ± 0.0
Toll-gate	5	22	2	0	9.7 ± 2.9
Iware	62	0	18	17	50.0 ± 7.0
Sogunro	5	0	0	6	11.0 ± 0.0
Omilabu	20	0	0	0	20.0 ± 0.0
Alade	45	1	0	0	23.0 ± 12.0
Eluwaje	47	1	0	0	48.0 ± 0.0
Arulogun	38	0	3	20	30.5 ± 13.5
Ologbogbo	17	2	0	0	19.0 ± 0.0
Alausa	49	0	1	0	50.0 ± 0.0
Oloosa-oko	3	8	0	0	11.0 ± 0.0

Source: Field survey

SD: Standard deviation

CONCLUSION

The study showed that grasses are always supplied daily to Akinyele International Cattle Market Ibadan. Four different species of grass were offloaded with *Pennisetum purpureum* most frequently supplied. The quantity of grass supplied was more on Friday. Fiditi was recorded to be the location from which most of the grass species were mostly brought to the study area.

REFERENCES

Abbator, F.I, Kibon, A. and Mohammed, I.D. (2000). Nutrient composition and rumen degradation of some feed stuff in semi-arid region of Nigeria. Journals sustain. Agricultural Environment 4 (2): 158-164.

Babayemi O.J, Adewumi M.K, Olorunisomo O.O, (2005). ANS 530 Pasture and range management. Lecture note, Department of animal science, University of Ibadan.

FAO (2015). Grassland Index. A searchable catalogue of grass and forage legumes. FAO, Rome, Italy.

Kallah M. S. (2014). Rangelands in Nigeria: A Partial Resource Appraisal towards Improving LivestockProduction. In: Forage Production and Management in Nigeria, eds.J. O. Gefu and J. T. Amodu, National Animal Production Research. Institute. Ahmadu Bello University, Zaria, Nigeria 2004:1-10.

Mannetje L.'t (1992). Pennisetum purpureum Schumach. Record from Proseabase. Mannetje L.'t and Jones R.M. (Eds). PROSEA (Plant Resources of South-East Asia) Foundation, Bogor, Indonesia

Obioha F.C and Ndukwe. N (1976): Changes in yield and chemical in yield and chemical composition of standing and conserved forage during dry season in East – CentralNigeria. Nigeria Journal of Animal Production 3: 105-116

NUTRIENT INTAKE, NITROGEN METABOLISM AND FEED GAIN RATIO OF WEST AFRICAN DWARF GOATS FED CASSAVA PEEL BASED DIETS SUPPLEMENTED WITH GRADED LEVEL OF *SACCHAROMYCES CEREVISIAE*

***Fajemisin, A. N., Omotoso, O. B., Ajayi, H. J. and Alokan J. A.**
Department of Animal Production and Health, Federal University of Technology, P.M.B 704, Akure, Ondo State, Nigeria
Corresponding email: debofajemisin@yahoo.co.uk; obomotoso@futa.edu.ng

ABSTRACT
*A-90 day study was conducted to evaluate the nutrient intake, nitrogen metabolism and feed gain ratio of West African Dwarf (WAD) goats fed cassava peel based diets supplemented with graded level of saccharomyces cerevisiae. Five concentrate diets were formulated such that yeast (***S. cerevisiae)** *were supplemented at diet A (control), diet B (0.25g), diet C (0.375g), diet D (0.50g) and diet E (0.625g) respectively. Fifteen WAD goats with an average live weight of 8.30±2.5kg were randomly allotted to the five dietary treatments, of three goats per replicate in a completely randomized design experiment. Parameters assessed included; nutrient composition, feed intake, nutrient digestibility, nitrogen utilization and weight gain. Results showed that inclusion of Saccharomyces cerevisiae significantly (P<0.05) influenced the dietary treatments. Dry matter (DM) contents ranged from 77.03±0.86% (Diet B) to 82.56±0.46% (Diet A). Crude protein (CP) content of the diets increased progressively with increased supplementation of Saccharomyces cerevisiae in the diets. Diet E of 0.625g level of S. cerevisiae had the highest CP content of 16.75±1.52%. The DMI was higher in the WAD goats fed the control diet (422.87±10.81) while the CPI was higher in the diet D of 0.5g level of Saccharomyces cerevisiae (78.19±6.95g/day). Highest nitrogen intake (10.70±0.12g/day) and highest nitrogen retained (72.47±2.16%) were obtained in WAD goats fed Diet A (control). However, yeast supplementation caused a better ruminal digestion, improved nitrogen balance and nutrient utilization; and at supplementation level up to 0.625g, no significant improvement was noticed on the weight gain.*

Key words: Ruminant farmers, goats, yeast, weight gain.

INTRODUCTION

Cassava peel is a rich source of energy and fibre in ruminant feeding (Baah *et al*., 1999) and it is readily acceptable by goats especially when fermented or dried to reduce its moisture and primarily hydrocyanic acid (HCN) content. Feeding concentrates to ruminants has proven to enact the activities of the rumen microbes for better feed utilization. To ensure continuous supply of adequate nutrients required by these animals, both in-season and off-season, the efficient use of alternative feed resources has earlier been and persistently be advocated (Adegbola, 2002). Although, most alternative feed materials are highly lignified and of low protein value, thereby limiting their intake and utilization by animals, this could possibly be surmounted by their combinations with feed materials of higher nutritive value as supplement. However, the yeast (***Saccharomyces cerevisiae***) has the potentials to improve the nutritional quality of fibrous feeds through fermentation and thus, enhance feed/nutrient intake by the animal. Thus, this study was conducted to assess the effect of feeding cassava peel-based concentrate diets supplemented with graded levels of ***Saccharomyces cerevisiae***.

MATERIALS AND METHODS

The experiment was conducted at the Ruminant Unit of the Teaching & Research Farm, Federal University of Technology, Akure, Ondo state, Nigeria. The concentrate diet (Table 1) was prepared using floor mixing method, and yeast (***S. cerevisiae)*** were supplemented at graded levels such that; diet A (control), diet B (0.25g), diet C (0.375g), diet D (0.50g) and

diet E (0.625g) respectively. Nutrients composition, nutrient intakes, weekly weight change week were evaluated. Ten percent of feaces collected each day were oven dried at 105^0C. The oven dried feed and feacal samples were milled and stored in air tight to containers until required for analysis. Daily urine samples from each goat was collected in sample bottles containing 10mls of 10% concentrated sulphuric acid to prevent loss of nitrogen and refrigerated until required for analysis. The experiment spanned for 90days. Nitrogen balance by the goats was calculated as the difference between nitrogen intake and nitrogen excreted from feaces and urine while nitrogen retention was computed from nitrogen balance expressed as a percentage of nitrogen intake. The air-dried samples of feed and faeces collected were analysed for proximate composition while the urine samples collected were analysed for nitrogen according to AOAC (2002) procedures while all data collected were subjected to statistical analysis using SAS (2008).

Table 1. Gross composition of experimental diets fed to the WAD goats

Ingredients	Diet 1 (0)	Diet 2 (0.25)	Diet 3 (0.375)	Diet 4 (0.50)	Diet 5 (0.625)
Cassava peel meals	51.00	51.00	51.00	51.00	51.00
Cocoa bean shell	7.00	7.00	7.00	7.00	7.00
Wheat offal	13.00	13.00	13.00	13.00	13.00
Palm kernel cake	22.50	22.50	22.50	22.50	22.50
Molasses	1.50	1.50	1.50	1.50	1.50
Urea	1.00	1.00	1.00	1.00	1.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Salt	1.50	1.50	1.50	1.50	1.50
Vitamin-mineral premix	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Analyzed composition					
Dry matter	82.56 ± 0.55^{a}	77.03 ± 0.86^{b}	80.55 ± 0.44^{b}	82.55 ± 0.40^{a}	80.69 ± 0.46^{ab}
Crude protein	9.58 ± 0.51^{d}	11.33 ± 1.51^{cd}	1308 ± 0.51^{bc}	15.67 ± 1.01^{ab}	16.75 ± 1.52^{a}
Crude fibre	11.32 ± 0.23^{a}	11.22 ± 0.06^{a}	10.66 ± 0.02^{b}	10.62 ± 0.02^{b}	8.75 ± 0.03^{c}
Ether extract	1.87 ± 0.04^{e}	6.02 ± 0.02^{d}	7.12 ± 0.08^{c}	5.03 ± 0.03^{b}	8.58 ± 0.05^{a}
Ash	4.67 ± 0.07^{c}	5.29 ± 0.01^{a}	5.14 ± 0.02^{b}	2.54 ± 0.03^{e}	4.19 ± 0.02^{d}

0g, 0.25g, 0.375g, 0.50g and 0.625g are levels of yeast supplementation in the diets

RESULTS AND DISCUSSION

The results revealed that all parameters observed were significantly ($P<0.05$) influenced by the dietary treatment. The dry matter intake (DMI) ranged from 312.08±39.42g/day (goats fed diet E) to 422.87±10.81g/day (goats fed diet A). This implies that yeast supplementation does not affect the dry matter intake of the animals which was according to Hasunuma ***et al.*** (2016) who discovered that DMI was not affected by yeast supplementation to dairy cattle. Also, Whitley ***et al***. (2009) reported that DMI was not impacted by yeast supplementation due to the limited involvement of yeast with ruminal microbes, which is required for improving ruminal fermentation and increasing intake. This study negates the result of Mutsvangwa *et al*. (1992) and Salama *et al*. (2002) who observed that supplementation of yeast in the diet of bulls and dairy goats improved dry matter intake. The crude protein intake (CPI) increases as the level of yeast supplementation increases (Table 2). This might be attributed to the stabilization of ruminal fermentation and activity (Jouany and Morgavi, 2007). More so, age and status of the goats could also be a factor for increased protein intake. The highest nitrogen intake (10.98g/day) was obtained in animals fed diet B. The nitrogen intake observed in this study was slightly higher than 8.75g/day obtained by Ibhaze and

Fajemisin (2015) for WAD goats fed naturally fermented maize cob-based diets. The result suggests that the diets were able to meet the animals' requirements for nitrogen. This could also be attributed to the protein concentration in the diet as well as the nitrogen intake by the animal. The observed live weight gains by the goats were statistically (P>0.05) similar. This affirm the report of several authors that yeast culture supplementation has no effect on growth but reported an increased digestibility of nutrients (Kawas *et al*., 2007; Titti *et al*., 2008). But all these negates the observation of Haddad and Goussous (2004), who reported improved weight gain after supplementing yeast to finishing sheep diets. However, it is evident that yeast can have beneficial effects on the general performance under some circumstances, but there seems to be a considerable unexplained variability in response this could be due to factors such as basal diet, viable cell numbers, the amount of yeast supplemented, type of forage fed and feeding strategy.

Table 2: Response of WAD goat to the test diets

Parameters	A	B	C	D	E
Nutrients Intake					
Dry matter	422.87 ± 10.81^{a}	338.13 ± 45.38^{ab}	403.88 ± 9.20^{ab}	412.71±28.86^{ab}	312.08 ± 39.42^{b}
Crude protein	48.95 ± 1.21^{b}	49.98 ± 8.02^{b}	65.55 ± 2.20^{ab}	78.19 ± 6.75^{a}	64.19 ± 8.17^{ab}
Crude fibre	57.94 ± 0.53^{a}	49.24 ± 6.62^{a}	53.47 ± 1.67^{a}	53.11 ± 3.74	33.79 ± 4.11^{b}
Ether extract	9.59 ± 0.27^{c}	26.46 ± 3.62^{b}	35.70 ± 0.74^{a}	25.14 ± 1.70^{b}	33.18 ± 4.21^{ab}
Ash	23.93± 0.53^{a}	23.25 ± 3.23^{a}	25.79 ± 0.58^{a}	12.69 ± 0.76^{b}	16.17 ± 1.93^{b}
N_2 utilization					
N_2 intake (g/d)	7.83±0.61	8.00±0.52	10.48±0.12	12.51±1.55	10.27±1.31
Faecal N_2	2.93±0.23	3.57±0.53	4.06±0.35	2.87±0.19	3.03±0.60
Urine N_2	0.02±0.00ab	0.02±0.00a	0.02±0.00ab	0.01±0.00bc	0.01±0.00c
N_2 balance	4.88±0.80de	4.41±0.57d	6.40±1.03c	9.62±0.24a	7.23±0.71b
Growth indices					
Initial weight (kg)	8.33±0.48	8.33±0.59	8.33±0.75	8.33±1.11	8.13±1.57
Final weight (kg)	12.87±0.89	12.63±0.63	13.30±0.42	12.97±1.22	12.20±1.27
Weight gain (kg)	4.53±0.39	4.30±0.32	4.97±0.35	4.63±0.15	4.07±0.76
Daily weight gain (g/day)	50.37±4.37	47.78±3.58	55.18±3.92	51.48±1.61	45.19±8.47
Feed gain ratio	8.52±0.82	7.18±1.24	7.39±0.52	8.05±0.53	7.47±1.97

abc - Means bearing different superscripts along the same row are significantly different (P < 0.05).

CONCLUSION AND RECOMMENDATION

Yeast supplementation caused a better ruminal digestion, improved nitrogen balance and nutrient utilization. However, at supplementation up to 0.625g, no significant improvement was noticed on the weight gain.

REFERENCES

Adegbola, T. A. (2002). Nutrient intake, digestibility and rumen metabolites in bulls fed rice straws with or without supplements. Nigeria Journal of Animal Production.29 (1):40-46.

AOAC. (2002). Association of Official Analytical Chemists. Official methods of analysis, 16th edition, Washington D.C., U.S.A.

Baah, J., Tait, R. M. and Tuah, A. K. (1999). The effect of supplementation with Fiscus leaves on the utilization of cassava peels in sheep. Bioresource Technology, 67: 47-51.

Haddad, S. G. and Goussous, S. N. (2004): Effects of yeast culture supplementation on nutrient intake digestibility and growth performance of Awassi lambs. Animal Feed Science Technology 118, 343-348.

Hasunuma, T., Uyeno, Y., Akiyama, K., Hashimura, S., Yamamoto, H., Yokokawa, H., Yamaguchi, T., Itoh, M., Mizuguchi, H., Sato, S., Hirako, M. and Kishibiki, S. (2016) Consecutive reticular pH monitoring in dairy cows fed diets supplemented with active dry yeast during the transition and mid-lactation periods. Animal Feed Science Technology; 221:215-225

Ibhaze, G.A and Fajemisin, A.N. (2015). Feed intake and nitrogen metabolism by West African dwarf does fed naturally fermented maize cob based diets. World Journal of Animal Science Research, 3(2):1-8.

Jouany, J. P. and Morgavi, D. P. (2007). Use of natural products as alternatives to antibiotic feed additives in ruminant production. Journal of Animal Science, 1: 1443-1466.

Kawas, J. R., García-castillo, R. F., Garza-cazares, R., Fimbres-durazo, E., Olivares-sáenz, G. and Hernández-vidal, C. D. (2007). Effects of sodium bicarbonate and yeast on nutrient intake, digestibility, and ruminal fermentation of light-weight lambs fed finishing diets. Small Ruminant Research. 67, 149-156.

Mutsvangwa, T, Edwards, I. E., Topps, J. H. and Paterson, G. F. M. (1992). The effect of dietary inclusion of yeast culture (yea-Sacc) on patterns of rumen fermentation, food intake and growth of intensively fed bulls. Animal Production, 55: 35 - 40.

Salama, A.A.K., Caja, G., Garin, D., Albanell, E., Such, X. and Casals, R. (2002).Effects of adding a mixture of malate and yeast culture (Saccharomyces cerevisiae) on milk production of Murciano-Granadiana dairy goats. Animal Research, 51: 295 – 303.

SAS. (2008). Statistical Analysis System Institute Inc., SAS/STAT Programme, Carry, NC: SAS Institute Inc.

Titti, H. H., Dmour, R. O. and Abdullah, A.Y. (2008): Growth performance and carcass characteristics of awassi lambs and shami goat kids fed yeast culture in their finishing diet. Animal Feed Science and Technology, 142:33-43.

Whitley N. C., Cazac, D., Rude, B. J., Jackson-O'Brien D. and Parveen, S. (2009). Use of commercial probiotics supplement in meat goat. Journal of Animal Science, 87:723-728.

EFFECT OF FEEDING COMPLETE DIETS CONTAINING RICE STRAW ON CARCASS BY-PRODUCTS AND VISCERAL ORGANS OF FATTENED *YANKASA* RAMS

***Garba S., Isaac S. & Halliru S.**
Department of Agricultural Education,
Federal College of Education (Technical) Bichi,
P.M.B., 3473, Kano State Nigeria
**Corresponding author; E-mail: garbasaleh2@gmail.com*
Phone: +2348131659711

ABSTRACT
The study was conducted to evaluate the carcass by-products and visceral organs of fattened Yankasa rams fed complete diets containing rice straw. Twelve (12) Yankasa sheep (rams) were used for the experiment. The animals were randomly distributed to 4 treatments with 3 animals per treatment, each ram served as a replicate and an adjustment period of a week was allowed for the animals before data collection commenced. The feeding trial lasted for a period of 70 days. A Completely Randomized Design (CRD) was used. Data collected was analyzed using Analysis of Variance (ANOVA). Results of this experiment suggests that nutrients in all diets impacted positively and similarly on carcass characteristics and visceral organs of fattened rams with the utilization of available nutrient to rams fed varying levels of rice straw. In this study, it was observed that 8.75% rice straw increased carcass weight compared with rams fed other diets. The improved carcass weight could be attributed to the effect of the laxative action of rice straw in the gut and fibre content of rice straw which supports increased carcass weight. From the study, it can be concluded that rice straw fed had no adverse effect on the carcass by-products and visceral organs characteristics of fattened rams. Therefore, it is recommended that rice straw up to 26.26 % could be included in the fattened rams' diet.

Key words: yankasa rams, carcass by-products, visceral organs, diets, rice straw.

INTRODUCTION

In Nigeria fattened rams play an important role in socio-cultural activities as they are of great use during cultural, religious and other festivities in Nigeria. Sheep production is one of the best ways of enhancing meat supply and also generates income to small holder farmers. Livestock contributes 6-8% of agricultural gross domestic product in Nigeria with estimates of 41.3 million sheep's population in the country (PTNP, 2017). These estimates highlight the important contribution of livestock to sustainable agricultural development. Sheep and other ruminants are essential to the livelihoods of millions of farmers and critical to human health, global food and nutritional security (FAO, 2016). There are four major breeds of sheep in Nigeria, namely: Uda, Balami, Yankasa and West African Dwarf (WAD). However, ram in Nigeria are use for fattening mostly by small holder farmers both in rural and urban areas especially by women and children as a source of investment, without some basic fattening feeding principles and the utilization of agro-industrial by-products in achieving this objective.

Rice is the second most cultivated cereal worldwide (FAO, 2013). Rice straw, a by-product of the rice grain industry, is a potential alternative feed for ruminants. Rice straw producers have generally considered straw as waste product and as such are either left on the farm or baled at their convenience after harvest. Though, several factors determine how much straw can be used in ration, including; quality of rice straw, nutritional needs of the animal, environmental conditions during feeding such as temperature, rain, snow, mud, as well as the condition of the animal and expected performance. Rice straw remain a potential alternative feed for ruminant that needs to be explore for fattening ram, hence the reason for this study.

MATERIAL AND METHODS

EXPERIMENTAL LOCATION

This study was conducted at the Department of Agricultural Education Teaching and Research Farm, Federal College of Education (Technical) Bichi. The farm is located within the campus of the College at about 40 km North of Kano Metropolis in Bichi Local Government Area of Kano State, Nigeria. Kano is situated in the Sahelian geographic region, South of the Sahara in the North-Western Nigeria, 481 metres (1,578 feet) above sea level within longitude: 8°31′00″ E and latitude: 12°00′00″ N (Wikipedia, 2018; Dateandtime.info, 2018).

EXPERIMENTAL RAMS AND THEIR MANAGEMENT

Twelve (12) Yankasa sheep (rams) were used in this experiment and were purchased from Badume market, Dawakin Tofa local government area of Kano State. The animals were randomly distributed to 4 treatment groups of 3 animals per treatment. Each ram served as a replicate and an adjustment period of a week was allowed for the animals before data collection commenced. The feeding trial lasted for a period of 70 days. Water and salt lick were also offered *ad libitum.* The animals were quarantine in the College Farm, for two weeks, and given prophylactic treatment with Avomec® against *endo* and *exto* parasites and also treated with oxytetracycline HCl (a broad spectrum antibiotic). Prior to the experiment, the animals were managed intensively and group-fed with groundnut haulm and wheat offal.

Table 1: Composition of the Rice straw Meal Based Diets fed to Fattening *Yankasa* Rams

	Experimental Treatments			
Ingredients	A	B	C	D
Rice straw	0	8.75	17.5	26.25
Wheat offal	35	26.25	17.5	8.75
Rice offal	10	15	20	20
Cotton seed cake	10	15	15	15
Groundnut haulms	28	18	18	18
Maize	05	05	05	05
Sorghum stover	10	10	05	05
Salt	1	1	1	1
Bone meal	1	1	1	1
Total	100	100	100	100
Calculated values (%)				
Crude protein	14.66	13.73	12.73	11.52
Crude fibre	18.18	19.02	16.05	17.63

CP = crude protein, CF = crude fiber

Table 2: Proximate Composition of the Rice straw Meal Based Diets fed to fattening Yankasa Rams

Parameters	A	B	C	D
Dry matter	91.37	92.30	92.48	93.46
Crude Protein	14.94	14.38	15.01	12.69
Crude fibre	23.92	29.99	27.65	27.14
Ether extract	6.59	6.80	7.20	6.77
Ash	10.64	8.58	10.21	12.80

STATISTICAL ANALYSIS

In this study the data generated were subjected to Analysis of Variance (ANOVA) using Completely Randomized Design (CRD). The treatment means were separated and compared using standard error of the mean (SEM), and Duncan's Multiple Range Test (DMRT) as contained in SPSS (2013) for window 32, version 24.

RESULTS AND DISCUSSION

As shown in Table 3, the pre-slaughter live weight of rams fed 0% rice straw was significantly ($p<0.05$) higher compared with those fed other diets, while those fed 17. 5% rice straw had the lowest pre-slaughter weight. However, the rams fed 8.75% had the highest carcass weight which was significantly ($p<0.05$) higher compared with those fed the control and 26.25% rice straw was significantly lower. In this study, it was observed that 8.75% rice straw increased carcass weight compared with rams fed other diets. The improved carcass weight could be attributed to the effect of the laxative action of rice straw in the gut and fibre content of rice straw which supports increased carcass weight. The rams fed 17.5% rice straw had significantly ($p<0.05$) higher dressing percentage than those fed 8.75% rice straw, while those fed the control diet (0%) and 26.25% rice straw were significantly ($p>0.05$) similar. Dressing percentage at 17.5% level of inclusion of rice straw was highest compared with rams fed other diets. The percentage ribs and loins of rams fed 8.75% had significant differences ($p<0.05$) which was higher than those fed the control, 17.5% and 26.25% respectively. The results of the present study which showed that rice straw resulted in better ribs and loins. It is known that the ram is known to be especially sensitive to dietary fibre concentration. The rams fed 17.5% rice straw had significantly ($p<0.05$) higher back percent than those fed 8.75% rice straw, while those fed diet the control diet (0%) and 26.25% rice straw were significantly ($p>0.05$) similar. The values for the shoulder of rams fed 17.5% and 26.25% were significantly ($p<0.05$) higher than those fed 8.75% rice straw (diet B), which was higher than those fed the control diet (0%). The neck percent of the rams fed 8.75% rice straw and the control diet (0%) were significantly ($p<0.05$) higher than those fed 17.5% rice straw, which was higher than those fed 26.25%. However, percent thigh were highest with rams fed 17.5% and 26.25% rice straw compared with rams fed the control diet (0%) and 8.75% rice straw which were similar ($p>0.05$).

Table 3: Effect of Feeding Complete Diets Containing Rice Straw on Carcass Characteristics of fattened Yankasa Rams

Parameters	Treatments				
	A	B	C	D	SEM
Pre-slaughter Live weight (Kg)	34.10^{a}	32.20^{b}	27.10^{d}	28.10^{c}	0.08
Carcass Weight (Kg)	13.90^{b}	14.10^{a}	13.30^{c}	11.50^{d}	0.08
Dressing Percentage (%)	40.51^{c}	43.70^{b}	45.57^{a}	40.97^{c}	0.21
Ribs (%)	7.33^{b}	8.07^{a}	7.04^{c}	6.64^{d}	0.08
Loin (%)	3.22^{b}	3.73^{a}	2.96^{c}	2.54^{d}	0.07
Back (%)	3.83^{c}	4.35^{b}	5.93^{a}	3.77^{c}	0.08
Shoulder (%)	8.31^{c}	9.01^{b}	10.00^{a}	9.86^{a}	0.08
Neck (%)	4.99^{ab}	5.28^{a}	4.81^{b}	2.72^{c}	0.14
Thighs (%)	12.32^{b}	12.11^{b}	14.81^{a}	14.72^{a}	0.15

SEM: standard error of mean $^{a.b,\ c}$ Means on the row with different superscripts are significantly ($p<0.05$) different.

Table 4: Effect of Feeding Complete Diets Containing Rice Straw on Visceral organs of fattened Yankasa Rams.

Parameters (%)	Treatments				
	A	B	C	D	SEM
Head	7.36[c]	8.70[a]	7.41[c]	7.64[b]	0.05
Legs	2.00[b]	1.93[c]	2.1[b]	2.49[a]	0.49
Heart	0.35	0.46	0.47	0.37	1.42
Lungs	0.39[b]	0.40[c]	0.28[b]	0.35[a]	0.44
Liver	1.54	1.18	1.54	1.35	0.23
Kidney	1.54	0.60	0.26	0.35	0.02
Spleen	0.27[b]	0.32[a]	0.17[c]	0.18[c]	0.01
Testes	0.90[d]	1.32[a]	1.09[c]	1.17[b]	0.24
Full Gut	23.53[b]	9.94[d]	15.56[c]	24.42[a]	0.05
Empty Gut	2.94[b]	1.82[d]	2.90[c]	3.00[a]	0.08
Skin	5.88[c]	8.70[a]	6.67[b]	5.77[d]	0.02

SEM: standard error of mean [a.b, c] Means on the row with different superscripts are significantly ($p<0.05$) different.

The visceral organs of the carcass of fattened Yankasa ram fed complete diet containing rice straw are presented in Table 4. The values for the heads of rams fed 8.75% rice straw was significantly ($p<0.05$) higher compared with those fed the control diet and those fed 17.5% rice straw, while those fed 26.25% rice straw had the lowest. The values for the legs were ($p<0.05$) higher in rams fed 26.25% rice straw compared with those fed the control diet and those fed 17.5% rice straw, while those fed 8.75% rice straw had the lowest. Hearts of the rams were not significantly ($p>0.05$) affected across the dietary treatments. The values for the lungs were ($p<0.05$) higher in rams fed 26.25% rice straw compared with those fed the control diet and those fed 17.5% rice straw, while those fed 8.75% rice straw had the lowest. The liver and kidney of the rams were not significantly ($p>0.05$) affected across the dietary treatments. Spleen was higher ($p<0.05$) for rams fed 8.75% compared with those fed the control diet, while those fed 17.5% and 26.25% were ($p>0.05$) similar. Lower values for testes was recorded in rams fed the control diet and higher in rams fed 8.75% rice straw. The full gut and empty gut were significantly ($p<0.05$) higher in rams fed 26.25% rice straw than those fed other diets. It is however lowest in rams fed 8.75% rice straw. Skin from the rams fed 8.75% rice straw were higher compared with those fed 17.5% rice straw, which was higher than those fed the control diet, while it is lowest in those fed 26.25% rice straw. The result of the present study is not consistent with those of Nader (1999; 2000) who reported poorer performance of rams when fed rice straw as a complete or only feed.

CONCLUSION

From the present study, it can be concluded that rice straw fed had no adverse effect on the carcass by-products and visceral organs characteristics of fattening rams studied. Therefore, on the basis of the results obtained from this study, it is recommended that rice straw up to 26.26 % could be included in the fattened rams' diet.

REFERENCES

Date and time. info (2018). Location of Kano State Nigeria http://dateandtime.info/citycoordinates.php?id=2335204. Accessed on 18 March 2018

FAO (2016). Food and Agricultural Organization: Reducing enteric methane for improving food security and livelihoods. Rome, www.fao.org

FAO (2013) Food and Agricultural Organization: Faostat, http://faostat.fao.org/site/291/default.aspx.

Nader, G (1999; 2000) In: Nader, G., Drake, D.J., Forero, L. (2019). Feeding Rice Straw to Cattle. Retrieved 16th November, 2019 at 11:03pm from http://anrcatalog.ucdavis.edu

Premium Times News Paper (2017). Premium Times News Paper, Thursday, May11, 2017. www.premiumtimesng.com.

Wikipedia, the free encyclopedia (2018). Location of Kano State Nigeria. https://en.wikipedia.org/wiki/Kano. This page was accessed edited on 18 March 2018, at 13:29.

SPSS (2013). Statistical Package for Social Sciences, Version 24. Window 32, IBM SPSS Statistics, IBM Corporation, North Castle Drive Armonk, NY 10504-1785. U.S.A.

CHALLENGES AND USE OF HYDROPONICS FODDER AS LIVESTOCK FEED--A REVIEW

H.D Nyako[1], M.S Tanimu[1], M.M Yahaya[1], S Abdullahi[2]

1. Department of Animal Science, Modibbo Adama University of Technology, Yola
2. Ministry of Livestock and Nomadic Settlement Adamawa State
Corresponding Author: H.D Nyako, Email:halilunyako@gmail.com, Contact: 080680818736

ABSTRACT:
Hydroponics fodder is a method of growing cereal grains to produce fresh green grass leaves within 6 to 8 days. The leaves are very nutritious and with high crude protein and is very economical feed for all grazing animals including horses, cattle, hogs, sheep, goats, rabbit and zebra. The major challenges of hydroponics fodder production are loses in total dry matter because a lot of studies reported that sprouting resulted in 7 to 47 % loss in dry matter from the original seed. Also high temperature in green house slows down the growth of hydroponics fodder similarly high humidity lead production and the light used to create energy for Biochemical activity in the plant. to the infestation of mold. In managing the production of hydroponics fodder it is recommended to disinfect the planting materials using chlorine solution and also maintain correct moisture, pH and temperature in green house. Lighting is the one the most important aspect of hydroponics fodder

Key words: Hydroponics fodder, challenges, production

INTRODUCTION

Hydroponics is a method of growing plants without soil. Hydroponics fodder systems are usually used to sprout cereal grains such as barley, oats, wheat, sorghum, and corn or legumes such as alfafa, clover or cowpea Al-Karaki and Al-Hashimi, (2012). It is a well-known technique for high fodder yield, year round production and least water consumption. This technology may be especially important in the regions where forage production is limited Fazaeli *et al.* (2012). Sprouting is a simple technique to germinate the seeds for the improvement of their nutritive value. Germination eliminates the effect of phytic acid by the production of phytase enzyme and increases the plant enzyme contents Shipard, (2005). Fresh green grass sprout fodder (6 to 8 day old) is a very nutritious and economical feed for all grazing animals including horses, cattle, hogs, sheep, goats, rabbits, zebras Hydroponics Farming, (2013). From time to time, hydroponics growers may face challenges with their hydroponic systems and fodder. Some challenges can easily be resolved without causing too much stress. The most common issues in hydroponics production usually involve high cost initial startup, mold and control of temperature and humidity.

MAJOR CHALLENGES OF HYDROPONICS, FODDER PRODUCTION

LOSS IN TOTAL DRY MATTER

A number of studies reported that sprouting resulted in 7 to 47 % loss in Dry Matter from the original seed after sprouting for a period of 6 to 7 days of growth, mainly due to respiration during the sprouting process Putnam *et al,* (2013). Seed soaking activates enzymes that convert starch stored in endosperm to a simple sugar, which produces energy and gives off carbon dioxide and water, leading to loss of Dry Matter with a shift from starch in the seed to fiber and pectin in the roots and green shoots.

HUMIDITY AND TEMPERATURE CONTROL CHALLENGE

These are highly sophisticated, fully automated fodder production system with controlled environments and are immune to natural weather variations. The required water, light, temperature, humidity and aeration are fully controlled by sensors. Expose to direct sunlight, strong wind and heavy rain. During the growing period the seed are kept moist by either drip or spray irrigation but are not saturated. The environmental factors for optimum growth of a fodder are; temperature between 19

to 25 ^{o}c humidity between 40 to 80 % (optimum being 60 %) light (2000 lux intensity between 12 to 16 h) El-Deeba *et al*. (2009). The sprouts grow, albeit slowly outside the optimal condition mention above, but at higher temperature humidify mold infestation is one of the biggest challenge that needs to addressing.

MANAGEMENT CHALLENGE ON PRODUCTION OF HYDROPONICS FODDER

The quality of hydroponics fodder is greatly influenced by the management of the hydroponics system. Some of the best practices that must be observed in the hydroponics fodder production are; use of clean planting materials, maintaining the correct moisture, pH and temperature in the green house and disinfecting the trays using chlorine solution Sneath and McIntosh, (2003).

MOLD

There are a number of challenges in producing hydroponics fodder. A common challenge that causes many problems for those with fodder sheds is mold. Given the warm moist environment within a fodder shed mold can easily take hold, ruin the fodder and cause livestock health issues if fed. Thus, active management of mold risk is essential. Moldy sprout have decreased livestock performance in trials and has been known to result in animal deaths. Mold is actively managed within sheds through pretreatment of the seed. Additives to the water are used for pre-soaking the grain to minimize the risk of mold. Shed hygiene is also important and thus considerable attention is paid to ensuring the growing trays are well cleaned following each seed and prior to the sowing of the new seed Al-Karaki and Al-Hashimi, (2012).

PATHOGEN AND DISEASE

Pathogen and disease can spread throughout your hydroponics system. They can be brought in by pest or bought on by environmental conditions keeping your hydroponics house clean, a sterile environment free of pests, and at the proper temperature, you can reduce the chance of pathogen and disease infection your greenhouse. An outbreak of pest or infections in hydroponics grown fodder can be quickly controlled by spraying the crops with appropriate pesticide or fungicide. Fresh and clean water should be used for irrigation as water borne plant disease spread quickly Bakshi *et al*. (2007).Hydroponics fodder heavily infested with *Aspergillusclavatus* should not be fed to dairy/beef cattle. Animals may develop posterior ataxia, knuckling of fetlocks, dragging of hind legs, high stepping in the hind limbs, stiff gait, tremors, progressive paresis, hypersensitivity, recumbences, clonic convulsions, decreased milk yield and possibly death McKenzie *et al*. (2004).

LIGHTING CHALLENGE

Proper lighting is one of the most important aspects of plant environment. Plants use light to create energy, so if they do have the proper light they can create energy needed growth. O'Sullivan (1982) as cited in Morgan *et al*. (1992) reported increased losses of Dry Matter, where no light was provided. The authors found that the rate of decrease of Dry Matter content slowed down after the fourth day in lighted experiments, when leaves began photosynthesizing. Lighting prior to day 3 was of little significance Morgan *et al*. (1992). Results obtained by El-Deeba *et al*. (2009), indicated that root length dose not influence lighting operating hours, however its value was about 6 cm under all treatments of lighting (8, 12, 16, and 24 hours/day).

CONCLUSION

Hydroponics fodder production systems produce large quantities of green, palatable livestock feed. However, the research reviewed in this report shows that there are challenges associated with the production and economic competitiveness of hydroponics fodder relative to alternative feed sources. The costs associated with the establishment and daily operation of a fodder shed, coupled with dry matter yield losses during the sprouting make hydroponic fodder an expensive feed source. There is

an opportunity for some research to be undertaken to examine the performance of livestock on hydroponics fodder and the attributes of the final product.

REFERENCE

Al-Karaki, G.N and Al-Hashimi, M. (2012), Green fodder production and water use efficiency of some forage crops under hydroponic condition. Intern.Schol. Res. Network DOI: 10.5402/2012/924672.

Fazaeli H, Golmohammadi H A, Tabatabayee S N and Asphari-Tabrizi M. (2012). Productivity and nutritive value of barley green fodder yield in hydroponic system. World Applied Sciences Journal 16(4): 531-539.

Shipard, I. (2005). How can i Grow and use Sprouts as Living Food. Stewart Publishing.

Hydroponics Farming (2013) Sprouts: A very nutritious and economical feed for all grazing livestock, especially for the sick and elderly.

Putnam, D.H., Robinson, P.H. and Lin. E. (2013). Does hydroponic forage production make sense? Alfalfa & forage news, News and information from UC Cooperative Extension about alfalfa and forage production. Retrieved 16.09.17.

El-Deeba, M.M., El-Awady, M.N., Hegazi, M.M., Abdel-Azeem, F.A and El-Bourdiny, M.M. (2009) Engineering factors affecting hydroponics grass-fodder production. The 16thAnnual conference of the Misr society of Ag Eng. Agricultural engineering and variables of the present epoch: 1647-1666.

Sneath, R. and F. McIntosh, (2003). On farm review of hydroponic forages production for beef cattle. Meat and Livestock Australia Limited. Pp1-54.

Bakshi, M.P.S, .Wadhwa, M and Harinder P.S Makkar, (2007). Hydroponic Fodder Production: A Critical Assesement. *Broadening Horizons* #48.

McKenzie, R.A., Kelly, M.A., Shivas, R.G., Gibson, J.A., Cook, P.J., Widderick, K and Guilfoyle, A.F. (2004). Aspergillusclavatus tremoregenicn eurotoxicosis in cattle fed sprouted grains. *Australian Veterinary Journal*. 82: 635-638.

O'Sullivan, J. (1982). Possible effects in the culture of barley seedlings compared to barley seeds as fodder. Department of Horticulture, University College, Dublin.

Morgan J, Hunter R.R., and O'Haire R. (1992) Limiting Factors in hydroponic barley grass production. *8th International Congress on Soilless Culture, Hunter's Rest, South Africa.*

IN VITRO FERMENTATION CHARACTERISTICS OF PHYTOGENIC FORTIFIED DIETS FOR RUMINANT ANIMALS

[*1]Ibhaze, G. A,[1] Fajemisin, A.N., [1]Obasuyi, O., [1] Ogunjemite, G.E., [1]Usifo, B., [2]Odufuoye, A.,[2]Aromoye, R.A

[1]Department of Animal Production and Health, Federal University of Technology, Akure, Ondo State, Nigeria.

[2]Department of Animal Science, University of Ibadan, Oyo State, Nigeria

Corresponding author: gaibhaze@futa.edu.ng

Tel. +2348055865289

ABSTRACT

The study was carried out to estimate the chemical composition and in vitro rumen fermentation o ginger fortified diets. The diets consisted of four treatments A; Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + Ginger (0g), B: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + ginger (200g), C: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + ginger (300g), D: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) ginger (400g). A completely randomized design (CRD) was adopted with three replicates per each treatment and samples were incubated for 24hrs. The chemical composition showed that dry matter ranged from 40.86% (diet B) to 54.68% (diet D). There was no significant ($p>0.05$) difference in the crude protein content (13.30 – 14.88%). The crude fibre content of the samples was significantly ($p<0.05$) different and it ranged from 14.67 – 22.15%. The in vitro potential gas production and effective degradability of dry matter (%) values were highest (39.03mL/36.14%) in diet D. The highest proportion of cumulative gas production at 24hr incubation was observed also in diet D. Based on this study, it seems fortifying ruminant feed with ginger could improve nutrient degradability.

Keywords: *Zingiber officinale*, gas production, effective degradability, ruminant, silage

INTRODUCTION

Growth and productivity of ruminants are mostly limited by the quality of feed available to the animals. The nutritive value of ruminant feed is determined by its chemical composition as well as rate and extent of digestion in the rumen (Songsak *et al.,* 2007). Moringa leaves are a valuable source of protein for ruminants. Its protein and organic matter are readily digestible in the rumen and/or in the intestine (Kakengi *et al.,* 2005). Ginger (Phytogenic) is in the family *Zingiberaceae*, it is reported to stimulate the appetite of animal and improve nutrients palatability (Tilgner,1999) and has favorable effects on digestion and absorption of lipids. *In vitro* gas production is a technique used in evaluating feed quality . It involves volumetric measurement of gas production in phosphate and bicarbonate buffered *in vitro* incubations in syringes (Abegunde, *et al.,* 2009). It is a rapid method used for predicting organic matter digestibility, short chain fatty acids and metabolizable energy content of ruminant feeds (Menke and Steingass, 1988). *In vitro* methods have the advantage of being less expensive and less time-consuming and accurate to predict feed intake, digestibility, microbial nitrogen supply, animal performance, short chain fatty acids, carbon dioxide and metabolizable energy of feed for ruminants (Getachew *et al.*,1999; Babayemi and Bamikole, 2006; Akinfemi, *et al.*,2009). Gas production reflect all fermented nutrients, soluble as well as insoluble and fractions that are not fermentable which do not contribute to gas production and from the total gas production, methane, individual volatile fatty acids can be predicted (Fievez *et al.,* 2005). This study was conducted to determine the *in vitro* gas production and effective dry matter degradability of ensiled cassava peel, moringa leaves, palm kernel cake diet fortified with ginger (*Zingiber officinale*) for ruminant feeding.

MATERIALS AND METHODS

The gross composition of the feed samples is shown below;

DietA: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (0g)

DietB: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (200g)

DietC: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (300g)

DietD: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (400g)

FERMENTATION KINETICS

The rate of gas production during 24h incubation was determined according to the procedure of Menke and Steingass (1988). Rumen fluid was collected using a stomach tube into a preheated thermos flask, strained through a sieve cloth and flushed with CO_2. The buffer containinig $NaHCO_3$+Na_2HPO_4+KCl+NaCl+$MgSO_4$.7H2O was used and kept in the incubator for warming prior to being mixed with rumen fluid. The experimental samples (200mg) were incubated in 100-mL calibrated glass syringes at 39^oC with the ruminal fluid and volume of gas production was recorded at 3hourly intervals for 24 hours. All samples were incubated with three syringes containing only rumen fluid -buffer mixture as blank. Gas production from the experimental sample was calculated by subtracting the volume of gas produced from the blank. At post incubation period, 4ml of 10M NaOH was introduced to estimate methane production per sample. Cumulative gas production data was obtained using the method of Ørskov and McDonald (1979). The effective degradability (ED) of dry matter was calculated according to the method of (Umunna *et al* 1995). Metabolizable Energy (ME) and Organic matter digestibility (OMD%) were calculated as ME=2.20+0.136GV+0.057CP+0.0029CF and 14.88+0.88GV+0.45CP+0.651XA respectively(MenkeandSteingass,1998), Short chain fatty acids (SCFA) as 0.0239Gv-0.0601(Getachew *et al,* 1991) was obtained where Gv, CP, CFand XA are total gas volume, crude protein, crude fibre and ash respectively. Data obtained were subjected to one-way analysis of variance, where significant differences occurred, the means were separated using Duncan multiple range F-test of SAS (2012)

RESULTS AND DISCUSSION

Dry matter ranged from 40.86-54.68%, however there was no significant ($p>0.05$) difference in the crude protein content (13.30 – 14.88%). The CP values are above the critical 8% crude protein requirement by ruminants for optimum microbial activities in the rumen (Norton, 2003). The crude fibre content of the samples which ranged from 14.67 – 22.15% suggests that many of the soluble nutrients were not degraded and would be adequate to support rumination. The values were within the requirement of 8-33% crude fibre suggested by Castrillo, (2001). Gas production reflects the degradation of dietary organic matter and more gas production, more degradation of Organic matter (Groot *et al*., 1996). Differences in potential gas production (***a*** + ***b***) and effective degradation of dry matter (ED) among the samples could also be due to the extent of lignification of NDF (Al-Masri, 2017). Lower NDF and lignin concentrations mean greater amounts of soluble cell walls which are available for fermentation (Al-Masri, 2017). Getachew *et al*. (2004) reported a negative relationship between gas production and cell wall content of diet. Samples with ginger produced relatively higher gas production. This corroborates the reports of Kim *et al*. (2012) who reported that ginger extract increased total gas production. Cumulative gas production at 24h as presented in Figure 1 showed significance at 400g of ginger inclusion. The level of SCFA indicates that the samples have potential to make energy available to animals. Although not significantly ($p>0.05$) different, samples with ginger had better organic matter digestibility denoting that ginger could improve digestibility.

Table 1: Chemical composition of ensiled experimental diets

Parameters	A(0g)	B(200g)	C(300g)	D(400g)
Dry Matter (%)	47.35±0.00[b]	40.86±0.00[d]	44.70±0.00[c]	54.68±0.00[a]
Crude protein (%)	13.30±0.70	13.50±14.00	14.59±0.84	14.88±0.88
Crude fibre (%)	14.67±0.82[c]	17.53±0.49[cb]	22.14±1.91[a]	19.10±0.25[ab]
Ether extract (%)	17.17±0.48	19.02±2.55	19.08±0.49	16.42±3.32
Ash (%)	5.29±1.39[b]	5.94±0.37[b]	3.30±2.71[c]	7.27±0.43[a]
NFE (%)	49.57±1.03[a]	40.01±11.56[c]	40.89±0.43[c]	42.32±4.02[b]
NDF (%)	36.64±3.68[b]	22.72±21.52[cd]	23.82±21.52[c]	41.39±4.57[a]
ADF (%)	29.29±0.05[ab]	23.77±4.45[b]	31.82±1.41[ab]	37.89±5.14[a]
ME(kcal/kg)	3396.42	3644.54	3552.26	3656.22

Table 2: *In vitro* gas production and estimated fermentation on Metabolizable energy, Short chain Fatty acids, Organic matter digestibility and Effective degradability of samples incubated for 24hrs

Samples	Parameters							
	A	B	a+b	C	ME	SCFA	OMD	ED
A	3.27±0.05	33.94±2.74	37.21	0.25±0.03[ab]	7.99±0.37	0.75±0.02	57.9±2043	33.09±2.60
B	2.35±0.03	36.72±0.25	38.07	0.25±0.02[ab]	7.75±0.04	0.85±0.07	60.40±0.23	35.73±0.20
C	1.84±0.07	34.95±1.76	36.79	0.32±0.04[a]	8.13±0.02	0.78±0.04	58.82±1.57	34.29±1.166
D	1.86±0.07	37.17±0.12	39. 03	0.20±0.00[b]	8.13±0.02	0.83±0.01	60.80±0.10	36.14±0.10

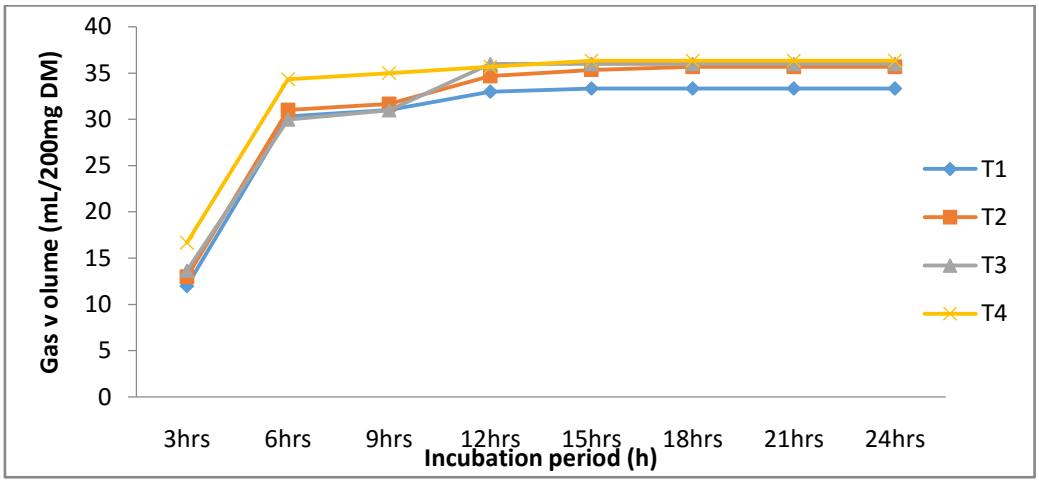


Figure 1:Cummulative gas prodution (*invitro*) of incubated samples at 24hrs

References

Abegunde, T.O., Babayemi O.J, and Akinsoyinu ,A.O., (2009). chemical composition , in vitro digestibility and gas production characteristics of six ficus species based diets with Pannicum maximum in the dry season . Nig. J.Anim . prod. 2009, 36(1):143-152

Akinfemi, A., Adu, O., Adesanya and Aya, V. E. (2009). Use of an invitro Gas Production Technique to Evaluate some Nigerian Feedstuffs. American –Eurasian Journal of Scientific Research 4 (4): 240 -245 2009

Al-Masri, M. R. (2017) ***In vitro*** *rumen fermentation kinetics and nutritional parameters of some native range plants and their relationships to gas production Livestock Research for Rural Development 29 (12)*

Babayemi, O.J. and Bamikole, M.A. (2006) Nutritive value of Tephrosia candida seed in West African Dwarf goats J. Central Eur. Agric., 7: 731-738.

Castrillo .C. (2001). The effect of crude fibre on apparent digestibility and digestible energy content of extruded dog foods. Journal of Animal physiology and Animal nutrition pp 231-236.

Fievez, V. Babayemi, O.J. and Demeyer, D. (2005). Estimation of direct and indirect gas production in syringes: A tool to estimate short chain fatty acid production that requires minimal laboratory facilities. Anim. Feed Sci. Technol., 123 197-210.

Getachew, G, Robinson, P. H., Depeters, E.J and Taylor, S. J.(2004) *Relationships between chemical composition dry matter degradation and in vitro gas production of several ruminant feeds. Animal Feed Science and Technology 111: 51-57.*

Groot, J.C.J, Cone, J.W, Williams, B.A, Debersaques, F.M.A and Lantinga, E.A (1996) *Multiphasic analysis of gas production kinetics for* ***in vitro*** *fermentation of* ***in vitro*** *fermentation of ruminant feeds. Animal Feed Science and Technology 64: 77–89.*

Kakengi, A. M. V.; Shem, M. N.; Sarwatt, S. V., Fujihara, T., 2005. Can Moringa oleifera be used as a protein supplement for ruminants?. Asian Aust. J. Anim. Sci., 18 (1): 42-47.

Kim E, Kim C, Min K, Lee S. (2012) Effects of plant extract on microbial population, methane emission and ruminal fermentation characteristics in in vitro. J Anim Sci. 25:806-811.

Menke, K. H and Steingass, H (1988) *Estimation of the energetic feed value obtained from chemical analysis and gas production using rumen fluid. Animal Research Development 28: 7-55.*

Norton, B.W (2003) *The nutritive value of tree legumes.In:Gutteridge R C and Shelton H M, editors. Forage tree legumes in tropicalagriculture. http://www.fao.org/ag/AGP/AGPC/doc/Publicat/Gutt-shel/x5556e0j.html*

SAS (2012). Statistical Analysis System. SAS Version 9.2 user's guide. Cary, NY: SAS Institute Inc. U.S.A.

Songsak, C., Anut, C. and Piyanate, C. (2007). Chemical Compositions and Nutritional Evaluation of Energy Feeds For Ruminant Using In vitro Gas Production Technique. Pakistan Journal of Nutrition 6 (6): 607-612, 2007

Tilgner, S. (1999). Herbal Medicine from the herbal of the earth. Wise Acres Press Inc. Creswll.OR.P:66-67.

Umunna, N. N, Nsahlai, I. V and Osuiji, O (1995) *Degradability of forage protein supplements and their effects on the kinetics of digestion and passage. Small Ruminant Research 17: 145-152.*

NUTRIENT DIGESTIBILITY AND NITROGEN BALANCE OF WEST AFRICAN DWARF GOATS FED *PLEUROTUS TUBER-REGIUM* DEGRADED CASSAVA ROOT SIEVATE

[*]Jiwuba, P.C., **Ahamefule, F.O., *Onwujiariri, E.B., **Jiwuba, L.C., *Azodo, N.L. **Ikwunze, K. and Nwefuru, M.O.

**Department of Animal Production Technology, Federal College of Agriculture, P.M.B.7008, Ishiagu, Ebonyi State, Nigeria.*

***College of Animal Science and Production, Department of Animal Production and Management, Michael Okpara University of Agriculture, Umudike, Nigeria.*

****Department of Biotechnology, National Root Crops Research Institute, P.M.B, 7006, Umudike, Abia State,Nigeria.*

Corresponding author: jiwubapc@gmail.com

ABSTRACT

An experiment was conducted to evaluate the apparent nutrient digestibility and nitrogen balance of West African dwarf (WAD) goats fed diets containing Pleurotus tuber-regium degraded cassava root sievate (PTR-CRS). Four experiment diets were formulated to contain 0, 20, 40 and 60% of PTR-CRS and designated as T_1, T_2, T_3 and T_4 respectively and fed to the animals in a 4x4 Latin square design pattern. The apparent nutrient digestibility coefficient showed higher ($p < 0.05$) DM, CP and crude fibre digestibility for T_4 compared to other treatments. Nitrogen intake and N balance, differed significantly ($P < 0.05$) with goats on T_4 having the best results. It could therefore be concluded that goats on T_4 had the highest dry matter, crude protein and crude fibre digestibilities. In addition, nitrogen intake and retention was highest at T_4, hence the inclusion of 60% PTR-CRS is recommended for enhanced N utilization and apparent nutrient digestibility by WAD goats.

INTRODUCTION

Cassava root sievate (CRS) is the waste, which results from processing cassava root into fufu, a popular West African food. The sievate is the solid waste produced as a product of cassava root production and made up of 88.60, 2.57 and 13.38% dry matter, crude protein and crude fibre respectively (Jiwuba *et al*., 2018); it constitutes about 25% of the whole plant (Aderemi and Nworgu, 2007). Jiwuba *et al*. (2018) reported 3.79 MJ/kg gross energy value for cassava root sievate meal. They are usually discarded poorly as waste heaps near streams or homes where they are soaked, fermented and processed thereby producing a strong offensive smell and contaminations; hence the need to add value to this agro-waste. The low protein content (Jiwuba *et al*., 2016), high cyanide content (Ubalua and Ezeronye 2008; Morgan and Choct 2016) and high fibre contents are the limiting factor in the utilization of cassava root sievate by goats. Due to high lignin content of cassava root sievate, its utilization is impaired in goat feeding. These have affected the general performance of animals fed such diet; hence the needs to improve the nutritive value of cassava root sievate through biodegradation (use of white rot fungi). The *Pleurotus* species have been shown to be more efficient (Taniguchi *et al*., 2005). The *Pleurotus tuber-regium* have different ability to grow on agro waste and decompose its structural carbohydrate because of the variation in culture behaviour and culturing conditions. Information on cassava root sievate biodegradation in goat feeding is virtually non-existing. The study was therefore designed to determine the apparent nutrient digestibility and nitrogen balance of West African dwarf goats fed diets containing *Pleurotus tuber-regium* degraded cassava root meal.

MATERIALS AND METHODS

The experiment was carried out at the sheep and goat Unit, Federal College of Agriculture Ishiagu, The dried cassava root sievate were sourced from Akawa, Nneato, Umunneochi L.GA. Abia State. The dried cassava root sievate were coarsely milled using a blur mill to reduce its particle size and create a greater surface area for microbial activity. Treatment of cassava root sievate with *Pleurotus tuber regium* was by inoculation of composted cassava root sievate with slides of the *Pleurotus tuber regium* in white perforated bucket were kept on a concrete floor at room temperature covered with polythene sheet and allowed to ferment for 45 days. The Experimental diets designated as T_1, T_2, T_3, T_4 were formulated from non-biodegraded cassava root sievate, biodegraded cassava root sievate, brewers dried grain, palm kernel meal, soybean meal, bone meal, salt and premix. The biodegraded cassava root sievate replaced the non - biodegraded cassava root sievate at, 0, 20, 40 and 60% respectively as shown in Table 1.

Table 1: Composition of the Experimental Diets

	Dietary levels (%)			
Ingredients	T_1 (0%)	T_2 20%)	T_3 (40%)	T_4 (60%)
Non-biodegraded cassava root sievate	60.0	40.0	20.0	0.0
Biodegraded cassava root sievate	0.0	20.0	40.0	60.0
Brewers dried grain	15.0	15.0	15.0	15.0
Palm kernel meal	14.0	14.0	14.0	14.0
Soybean meal	7.0	7.0	7.0	7.0
Bone meal	3.0	3.0	3.0	3.0
Salt	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
Total	100	100	100	100

Four WAD bucks of about 6 – 8 months old were used for this experiment. The animals were subsequently transferred to previously disinfected individual metabolism cages provided with facilities for collecting faeces and urine. They were fed four experimental diets in a 4 x 4 Latin square design. Each animal received the experimental diets consecutively in 4 phases. During phase 1, which lasted for 28 days, each animal received 1.5kg of an assigned experiment diet for 21 days. During this period, each animal had access to free drinking water daily. Total faeces and urine voided by the experimental animals were collected during the last 7 days (22-28). During phases 2 - 4, each animal was offered each of the remaining 3 experimental diets in rotational periods of 28 days each. The last 7 days in each of the feeding periods, was used for total urine and faecal collection. Each animal constituted a replicate while each feeding phase represented an observation. The quantity of each diet offered to the goats during each period ensured about 5% left over. The left overs were collected after 24 hours, weighed and used to determine the voluntary intake. Total faeces were collected in the mornings before feeding and watering during days 22 - 28 of each period. The faeces weighed fresh, dried and bulked for each animal. A sub-sample from each animal was dried in forced draft oven at 100-105^{0}C for 48 hour and used for DM determination. Total urine for each animal was collected daily in the morning before feeding and watering. The urine trapped in a graduated transparent plastic container placed under each cage and to which 15ml of 25% H_2SO_4 was added daily to curtail volatilization of ammonia from the urine. The total volume of urine output per animal was measured and about 10% of the daily outputs was saved in plastic bottles numbered and stored in a deep freezer at 5^{0}C. At the end of each 7 – day collection period, the sample collections were bulked for each animal and sub-samples taken for analysis. The experimental design used was 4 x 4 Latin square experiment. Data obtained were analyzed using analysis of variance (ANOVA) as described by SAS (2008). Significant means were separated using the Duncan Multiple New Range Test.

RESULTS AND DISCUSSION

The apparent nutrient digestibility coefficient of WAD goats fed *Pleurotus tuber regium* degraded cassava root sievate in their diets are presented in Table 2. Dry matter digestibility (DMD), crude protein digestibility (CPD) and crude fibre digestibility CFD) were positively ($p<0.05$) influenced by the experimental diets diets. The DM digestibility of this study ranged between 64.25 and 69.97% and compared well with the range of 63.44 – 71.56% reported by Hamchara *et al*. (2018) for goats fed oil palm fronds treated with *Lentinus sajor-caju* but lower than 82.20 – 88.70 % for WAD goats fed fungal treated rice straw in their diets as reported by Wuanor and Carew (2018). The variations may be attributed to age of the goats and the diets fed to the animals. CP and CF were least digested in T_1 (63.79% and 55.90%) and best digested in T_4 (80.34% and 68.19%), respectively. The highest ($P<0.05$) digestibility coefficient of crude protein obtained in treatment T_4 showed that the dietary protein was better utilized by the animals fed diet T_4 relative to others. This could be attributed to the fact that treatment of lignocellulosic feedstuffs with white rot fungi improves the available amino acid content of the residual biomass. Akinfemi and Ogunwole (2012) noted that fungal treatment of rice straw did not only improved the CP contents but also enhanced digestibility of the diets. Furthermore, Ahemefule (2005) observed that dietary protein enhanced digestibility. The reported CP digestibility coefficient in this study compared with 71.60 -78.80% for WAD goats fed fungal treated rice straw in their diets as reported by Wuanor and Carew (2018). The results of crude fibre digestibility in this study showed that crude protein content of diets were positively correlated with the CPD and CFD. This agreed with earlier reports (Fasae *et al*., 2005) that CFD and CPD decrease with decreasing level of CP in diets. A very important consideration in the utilization of nutrients by animals may be the synchronization of nutrients especially protein and energy. This may explain why the digestibility coefficient of CP and CF increased from treatment $T_1 – T_4$, in the same pattern with DM. The reported CF digestibility coefficient in this study is in agreement with the findings of Wuanor and Carew (2018) for WAD goats fed fungal treated rice straw in their diets.

Table 2: Apparent Nutrient Digestibility Coefficient of African Dwarf Goat fed biodegraded Cassava root sievate in their diets.

	Dietary levels				
Parameter (%)	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	SEM
Dry Matter	64.25[b]	65.35[b]	66.19[b]	69.97[a]	0.71
Crude Protein	63.79[d]	68.00[c]	73.96[b]	80.34[a]	1.66
Crude Fibre	55.90[d]	58.31[c]	64.25[b]	68.19[a]	1.28
Ash	51.96	50.95	51.04	51.48	0.06
Ether Extract	52.87	53.08	53.03	53.54	1.23
Nitrogen fee extract	57.63	55.73	55.63	57.36	0.97

[a-d] means on the same row with different subscript are significantly ($P < 0.05$).

Table 3 shows the nitrogen utilization of WAD goats fed *Pleurotus tuber-regium* degraded cassava root sievate (PTR-CRS) in their diets. The Nitrogen intake (g/day) obtained in this study (12.39-19.62 g/d) followed a particular trend, increasing with increasing levels of PTR-CRS. There was significant ($p<0.05$) difference for Nitrogen intake with T_4 been significantly ($p<0.05$) higher than T_3, T_2 and T_1. The higher N intake observed for the WAD goats in T_4 maybe attributed to the higher CP of the diet. The nitrogen retention increased ($p<0.05$) for WAD goats fed graded levels of *Pleurotus tuber regium* degraded cassava root sievate based diets; indicating that protein supplementation increased nitrogen retention. The high nitrogen balance and nitrogen retention percentage observed in this study, may be attributed to high digestibility of nutrients and low reduction in total N excreted among the *P. tuber regium* degraded CRS diets which resulted to higher utilization of nitrogen from microbial protein, suggesting that the nitrogen was well tolerated and utilized by the WAD goats. The increased Nitrogen retention values among the treatment groups further indicated the potentials of *Pleurotus tuber regium* degraded cassava root sievate to enhance N utilization among the WAD goats.

Table 4: Nitrogen Balance of West African Dwarf Goat fed biodegraded Cassava root sievate in their diets.

Parameters	T_1	T_2	T_3	T_4	SEM
Nitrogen Intake ((g/day)	12.39^{d}	15.63^{c}	17.45^{b}	19.62^{a}	0.69
Urinary Nitrogen(g/day)	1.42	1.23	1.3	1.08	0.08
Faecal Nitrogen (g/day)	3.77	3.72	3.69	3.57	0.08
Total Nitrogen Output(g/day)	5.19	4.95	4.99	4.65	0.12
Nitrogen balance (g/day)	7.22^{d}	10.68^{c}	12.46^{b}	14.97^{a}	0.72
Nitrogen retention (g/d $Wkg^{0.75}$)	4.40^{d}	5.79^{c}	6.49^{b}	7.52^{a}	0.30
Nitrogen utilization (%)	58.16^{c}	66.41^{b}	69.41^{b}	75.09^{a}	1.72

$^{a-d}$ means on the same row with different subscript are significantly ($P < 0.05$).

CONCLUSION

The results revealed that replacement of non-biodegraded cassava root sievate with *Pleurotus tuber-regium* degraded cassava root sievate in West Africa Dwarf (WAD) enhanced crude protein and crude fibre digestibility. The results also showed enhanced nitrogen utilization by the goats fed *Pleurotus tuber-regium* degraded cassava root sievate in their diets. *Pleurotus tuber-regium* degraded cassava root sievate can, therefore be included up to 60% to improve nutrient digestibility and nitrogen utilization in West Africa Dwarf (WAD) goats.

REFERENCES

Aderemi, F.A., and Nworgu F.C. (2007). Nutritional status of cassava peels and root sievate biodegraded with *Aspergillus niger*. American-Eurasian *J. Agric. and Environ. Sci.*2: 308-311.

Ahamefule, F.O. (2005). Evaluation of Pigeon Pea cassava peel based diet for goat production in South-Eastern Nigeria. Ph.D Thesis Michael Okpara University of Agriculture, Umudike, Nigeria.

Akinfemi, A. and Ogunwole, O.A. (2012). Chemical composition and *in vitro* digestibility of rice straw treated with *Pleurotus ostreatus*, *Pleurotus pulmonarius* and *Pleurotus tuber-regium.* S*lovak J. Anim. Sci. 45(1): 14-20.*

Fasae, O. A., Alokan, J. A. and Onibi, G. E. 2005. Feed intake and digestibility in Yankasa sheep fed diets containing varying levels of *Leucaena leucocephala* leaf residue. Nig. J. Anim. Prod. 32 (1): 88-93.

Hamchara, P., Chanjula, P., Cherdthong, A. and Wanapat, M. (2018). Digestibility, ruminal fermentation, and nitrogen balance with various feeding levels of oil palm fronds treated with *Lentinus sajor-caju* in goats. Asian-Australasian Journal of Animal Sciences, 31(10): 1619-1626. DOI: https://doi.org/10.5713/ajas.17.0926

Jiwuba, P.C, Onwujiariri, E.B. and Kadurumba, O.E. (2018). Carcass yield, organ response and cost/benefit evaluation of West African dwarf goats fed yellow root Cassava Peel-Centrosema leaf meal based diets. *Nigerian Journal of Animal Production.* 45(2): 342 – 351.

Jiwuba, P.C., Ezenwaka L.C, Ikwunze K., & Nsidinanya N.O. (2016). Blood profile of West African Dwarf goats fed provitamin A cassava peel-centrosema leaf meal based diets. Analele Stiintifice ale Universitatii,, Alexandru Ioan Cuz", Sectiunea Genetica si Biologie Moleculara TOM XVII, Fascicula 3: 27-134.

Morgan, N.K., and Choct, M. (2016). Cassava: Nutrient composition and nutritive value in poultry diets. *An. Nutr.*2: 253-261.

SAS (2008). Statistical Analysis System. User's guide: statistics. SAS Institute Inc. Cary NC 27513 USA.

Taniguchi, M., Suzuki, H., Watanabe, D., Sakai, K., Hoshino, K. and Tanaka, T. (2005). Evaluation of pre-treatment with *Pleurotus ostreatus* for enzymatic hydrolyses of rice straw. J. BioSci. Bioeng. 100(6): 637-643.

Ubalua, A.O., and Ezeronye, O.U. (2008). Growth Responses and Nutritional Evaluation of Cassava Peel Based Diet on Tilapia (*Oreochromis niloticus*) Fish Fingerlings. *J. Food Technol.*,6: 207-213.

Wuanor, A.A, and Carew, S.N (2018). Nutrient Digestibility, Carcass Yield and Production Economics of West African Dwarf Goats Fed Pleurotus Tuber-Regium Biodegraded Rice Straw and Maize Offal -Brewer Yeast Slurry Mixture. Journal of Animal Husbandry and Dairy Science, 2(1): 13-21.

NUTRITIVE EVALUATION OF SELECTED AGRO-INDUSTRIAL BY-PRODUCTS FOR SMALL RUMINANT PRODUCTION

K. J. Onaleye, A. J. Amuda, R. Elkanah & E. L. Buba
[1] *Department of Animal Production and Health, Federal University, Wukari, Taraba State*
Corresponding author: onaleyekj2000@gmail.com

ABSTRACT
The study was conducted to evaluate the chemical composition and dry matter degradability of four (4) Agro-industrial by-products (Cassava peel, Yam peel, Brewer's waste and Maize offal) from Jalingo, Taraba State using the nylon bag technique. Crude protein content was highest (23.77%) in Brewer's dry grain (BDG) and lowest (4.67%) in Cassava Peel. All the feedstuffs were at least 50% degradable at 48hours incubation period and as such are good feed resources for ruminant stock. Cassava peels had the highest (87.0%) dry matter degradability, followed by Yam peels (86.42%), Maize offal (75.44%) and Brewers dry grain (56.17%). The effective degradability(ED) of 74.3% at 50 hour rumen incubation of Maize offal coupled with its moderate crude protein content (CP) of 13.16% suggests that it is the most nutritive of the tested feedstuffs followed by BDG (55.7% ED ; 23.77% CP), Yam peel (82.4% ED; 7.64% CP) and Cassava peel (81.2% ED; 4.67% CP). The high (>10%) fat content of Maize offal may however place BDG at a better comparative advantage over Maize offal, more so that BDG may provide more bypass protein than the maize offal.

KEYWORDS: By-products, Rumen degradability, Effective degradability, Nylon bag technique, Ruminant

INTRODUCTION
The goal of meeting the growing need for animal protein in the diet of the ever increasing human population in the Sub-Saharan Africa is fraught with poor livestock nutrition. Achieving optimal levels of feeding is one of the most important factors determining profitability in livestock enterprises. This is most problematic during the dry season when forages decline in quantity and quality with consequent fluctuations in the growth rate of the animals (Mbahi *et al.*, 2006). Maize offal, BDG, yam and cassava peels abound in Jalingo, being products from well grown food crops. An adequate appreciation of the value of crop residues and agro-industrial by-products and their use in feeding animals can help reduce pollution, minimize waste-treatment costs, and reduce the cost of feeding in livestock production as well as generate some additional income to crop producers and agro-industrialists (Crickenberger and Carawan, 1996).

FAO (1986) recommended a degradability range of 40 – 50% for a feedstuff to be considered acceptable for feeding ruminant stock. In addition to degradability, the crude protein content of the feedstuff is important as it affects the activities of the microbes in the rumen. Norton (1994) stated that any feed with less than 1.35% nitrogen (8.4% CP) is nitrogen deficient and cannot provide the minimum ammonia levels required to support the activities of the rumen microbes. The bulkiness of most agro-industrial by-products necessitates the need to determine which of them is the most nutritive so as to justify the investment into its procurement and storage for feeding ruminant animals (Onaleye *et al.* 2012).

MATERIAL AND METHODS

PREPARATION OF EXPERIMENTAL SAMPLES

Cassava peel, Yam peel, Maize offal and Brewer's dry grain (BDG) were collected from Jalingo in Taraba State and used for the study. The dry samples were ground through a 2mm sieve and stored in sealed bottles after drying them for 48 hours in the oven at 65°C.

EXPERIMENTAL ANIMALS

Three (3) fistulated male goats of an average weight of 18kg were used for the study. The animals were housed individually on concrete-floored pens and supplied with Groundnut haulms and Maize offal morning and evening. Salt lick and water were given *ad- libitum.*

INCUBATION OF FEED SAMPLES

Three (3) grams of triplicates samples of each feed ingredient per incubation period was weighed into nylon bags of size 7cm x 12.5cm and mesh (pore) size of about 45µm. The bags were made of filter cloth, weighed and numbered for easy identification. Each bag was attached to PVC string with the aid of rubber band. The bags were incubated for 6, 12, 24, 48, and 72 hours in the rumen of the cannulated goats.

After each incubation time, the bags were withdrawn from the animal; washed under running tap with a gentle squeeze between the fingers until the rinse water became clean and clear. They were then drained and oven-dried at 65°C for 48 hours, cooled and weighed to determine the loss in weight due to degradation by rumen microbes. The loss in weight was used to calculate the percent actual dry matter disappearance (ADMD) of the samples. The washing loss (zero time dry matter disappearance) was estimated by soaking three (3) bags of each feed sample in warm (about 37 ^{0}C) water for 30 minutes and following the same procedure as described for incubated samples above.

CHEMICAL ANALYSIS OF SAMPLES

The experimental feedstuffs were chemically analyzed according to standard procedure of AOAC (2000) for DM, Ash, CP, CF and EE. Samples were also analyzed for Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) using the Van Soest *et al.* (1991) method.

FIT CURVE ANALYSIS

The results of the incubation were analyzed using Fit curve macro (Chen, 1995) for Microsoft Excel (NEWAY Excel). Degradation constants were estimated from the non-linear equation: $PD = a + b (1-e^{-ct})$, proposed by Ørskov and McDonald (1979). Where PD = potential degradability of dry matter and crude protein at time t, a = soluble fraction (intercept); b = insoluble but rumen degradable fraction and; c = the rate of degradation of b at time t (6, 12, 24, 48, and 72 hours).

The effective degradability (ED = a + {bc/(c+k)}) of DM was calculated at rumen outflow rates (k) of 0.02, 0.05 and 0.08 /hr according to Ørskov and McDonald (1979): where a, b, and c are as described above and 'k' is the fractional out flow rate from the rumen. Percent actual dry matter degradability values were analyzed in a completely randomized design using the one-way analysis of variance procedures of SAS (1999) and significant means were separated Fisher's LSD

RESUL T AND DISCUSSION

Proximate composition and cell wall content

The Proximate composition and cell wall content of the agro-industrial by-products tested are presented in Table 1. The CP values ranged from 4.67% in Cassava peels to 23.77% in Brewer's dry grain. Maize offal had the highest (12.13%) ether extract (E.E) and the least Ash (5.52%) content. The high (12.13%) E.E in maize offal may result to low feed intake in ruminants as well as low calcium content as seen in the ash content of maize offal compared to other feedstuffs. This is consistent with the findings of Crickenberger and Carawan (1996) who noted that if fat exceeded 10% of the diet dry matter, feed intake and performance may be restricted though the problem can be overcome by adding more calcium to the diet, which invariably increases production cost. Brewer's dry grain had the highest (45.25%) neutral detergent fiber (NDF) followed by Maize bran (32.98%), Cassava peels (22.48%) and Yam peels (15.95%)

The CP content of the Cassava peel obtained in the experiment (4.67%) is close to the 5.33±2.52% reported by Morgan and Choct (2016). The values of the DM and CP of the Brewer's dry grain used in this experiment are also similar to those reported by Arigbede *et al.* (2002). The DM, CP and Ash content observed for Maize offal in this experiment are higher than those reported by Arigbede *et al*. (2002) but with similar NDF value. The differences may be due to harvesting time, location, variety and soil fertility (Heuzé *et al*., 2017). However, their high solubility and high NFE content qualify them as readily available carbohydrates for supplementing maize residues-based livestock feed (Lardy and Andersen, 1999).

Table 1: Proximate composition and cell wall content of the feedstuffs

Sample	DM	CP	ASH	EE	CF	NFE	NDF	ADF	ADL	HC	C
Cassava peel	95.61	4.67	7.62	1.04	6.05	75.78	22.48	10.92	5.89	11.56	5.03
Yam peel	95.31	7.64	7.63	3.50	5.91	70.63	15.95	7.73	4.04	8.22	3.69
BDG	95.20	23.77	6.29	3.28	6.10	55.76	45.25	13.04	0.91	32.21	12.13
Maize offal	95.10	13.16	5.52	12.13	8.64	55.65	32.98	7.90	1.24	25.08	6.66

DM = Dry matter, CP = crude protein, EE = ether extract, CF = crude fibre, NFE = Nitrogen free extract, NDF = Neutral detergent fibre, ADL = Acid detergent fibre, ADL = Acid detergent lignin, BDG = Brewer's dried grain. HC= Hemicelluloses, C= Cellulose, HC = NDF – ADF, C = ADF – ADL

Rumen degradability of feedstuffs

The actual dry matter disappearance (ADMD) by incubation time and the overall means by sample are shown in Table 2. The overall % ADMD ranged from 44.43% in BDG to 76.30% in Yam peels which was significantly ($P < 0.05$) higher than that of BDG. With these degradability values, all the tested feedstuffs may be considered acceptable for ruminant feeding in accordance with the 40 – 50% degradability range recommended by FAO (1986).

Table 2: Actual Dry Matter Disappearance (%ADMD) of incubated feed samples

		Incubation time								
Sample	%DM	0hr	6hr	12hr	24hr	48hr	72hr	Mean	LSD	P value
Cassava Peels	95.61	50.99	65.79	77.13	83.82	87.00	87.67	75.40	18.47	0.0058
Yam peels	95.31	47.66	70.53	79.42	85.78	86.42	88.00	76.30		
BDG	95.20	22.21	28.56	39.03	47.60	56.17	72.99	44.43		
Maize offal	95.13	51.68	57.72	64.37	69.13	75.44	85.00	67.22		

LSD = Least significant Difference

Effective Degradability of feedstuffs

Table 3 shows the Effective Degradability (ED) of feedstuffs at degradability constants a, b, c and rumen fractional outflow rate K = 0.02, K = 0.05 and K= 0.08. The ED values shown are the predicted *in vivo* degradability at mean retention time (MRT) of 50hrs, 20hrs and 12.5hrs respectively (i.e. K = 0.02, 0.05, 0.08). Yam peel and BDG had the highest (77.1%) and lowest (41.0%) ED respectively at k= 0.05 (i.e. 20 hr incubation time). By the 40-50% recommendation of FAO (1986), all the feedstuffs tested are qualified as ruminant feedstuffs on the basis of DM degradability. Yam and Cassava peels with high (> 80%) degradability (at k = 0.05) but low (<8.4%) CP could serve as readily available carbohydrates when ammoniated straw-based diet is fed to ruminants. The high (23.77%) CP content of BDG and its medium (55.7%) ED may imply that a large portion of its nutrients will escape rumen degradation as by-pass nutrients into the intestine goats for digestion and utilization for tissue development (Reddy, 2001).

Table 3: Effective Degradability (ED) (%) of feedstuff at degradability constants a, b, c and fractional outflow rates K = 0.02, 0.05 and 0.08 where ED = a + {bc/(c+k)}

SAMPLE	a	b	c	RSD	Effective Degradability at K =		
					0.02	0.05	0.08
Cassava peels	45.5	41.7	0.114	0.71	81.2	74.8	70.4
Yam peels	51.3	36.0	0.127	0.76	82.4	77.1	73.4
Brewer's waste	26.4	88.3	0.010	4.37	55.7	41.0	36.1
Maize offal	56.1	49.7	0.012	2.37	74.3	65.4	62.4

a = readily soluble fraction, b = insoluble but degradable fraction, c = degradability rate, RSD = regression standard deviation, K = fractional outflow rate

CONCLUSION AND RECOMMENDATION:

All the tested feedstuffs are good feed resources except that cassava peels and yam peels should not be fed solely as they are poor in crude protein. Based on the CP content, rumen degradability and E.E content, BDG is the best feedstuff among the tested samples, followed by Maize offal, Yam peel and Cassava peel. A mixture of BDG and yam or cassava peel meal is recommended for ruminant dry season feeding.

REFERENCES

A.O.A.C. (2000), *Official Methods of Analysis*, 17th edition, Association of Official Analytical Chemists, AOAC Inc. Arlington, Virginia, USA

Arigbede, O.M., Olanite, J.A., Alaba, O., Jolaosho, O.S., Onifade, O. and Egbetayo, M.O.(2002), "Dry Matter and Protein Degradability By West African Dwarf Goats of Some Feed Ingredients Sold in Abeokuta, South West Nigeria" *Proceedings of 7th Annual Conference of Animal Science Association of Nigeria* (ASAN), September 16-19, 2002, University of Abeokuta, Nigeria, pp. 180-183

Banerjee, G. C. (1998). *Animal Husbandry*, 8th edition, New Delhi, Oxford & IBH, pp. 405 and 409

Chen, X.B. (1995). Fit Curve Macros for Microsoft Excel (NEWAY EXCEL). Unpublished note pad.

Crickenberger, R. G. and Carawan, R. E. (1996), "Using Food Processing By-Products for Animal Feed" in: Water Quality and Waste Management", CD-37, North Carolina Cooperative Extension Service

Davies, A. T. and Onwuka, C. F. I. (1993), "Conservation of forage for dry season feeding in the humid zone of Nigeria", *Proceedings of the second African Feed Resources Network (AFRINET) Workshop,* Harare, Zimbabwe, pp. 93-96.

FAO (1986), Food and Agriculture Organization, FAO Production Year Book, 40: 95 and 247

Heuzé V., Tran, G., Edouard N. and Lebas, F. (2017). ***Maize Silage***. Retrieved from *https://www.feedipedia.org/node/13883* May, 2018

Lardy, G. and Andersen, V. (1999), "Alternative Feeds for Ruminants", As-1182, Sept. 1999. North Dakota State University (NDSU) Extension Services

Mbahi, T. F., Kibon, A., Yahaya, M. S. and Gworgwor, Z. A. (2006), "Effects of lablab hay and groundnut haulms supplementation on intake and degradability of Sorghum Stover by Sheep", *Nigerian Journal of Tropical Agriculture,* 8: 136-140

Morgan, N.K. and Choct, M. (2016) Cassava: Nutrient composition and nutritive value in poultry diets, *Animal Nutrition* http://dx.doi.org/10.1016/j.aninu.2016.08.010

Norton, B. W. (1994). "The Nutritive value of tree legumes" In: Getteridge, R.C. & Shelton, P. (Eds.). Forage Tree Legumes in Tropical Agriculture. CAB International.pp178-191 *http://www.fao.org/ag/agP/agpc/doc/Publicat/Gutt-shelx5556e0j.htm*

Onaleye K.J., Kibon, A., Mbahi, T.F., Mufwa, B.J. (2012).Evaluation of Five Crop Residues for Degradability Potentials in Goats at Jalingo, Taraba State. *Journal of Science and Multidisciplinary Research* 4 : 59 – 67

Ørskov, E.R and McDonald, I. (1979) "The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage" *Journal of Agricultural Science,* Cambridge. 92: 499-503.

Reddy, D.V. (2001), *Applied Nutrition*. Oxford and IHB Publishing Co. Pvt. Ltd New Delhi pp 87-89

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. (1991) "Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition" *Journal of Dairy Science* 74:3583-3597

PHYSICAL FEATURES AND CHEMICAL COMPOSITION OF ENSILED MAIZE STOVER AND GROUNDNUT HAULMS FOR SUSTAINABLE RUMINANT PRODUCTION

***Lamidi, A. A., Etela, I., Ukanwoko, A. I., Ingweye, J. N., Ologbose, F. and Oruene, I. A.**

Department of Animal Science, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

**Correspondent Author: akeem.lamidi@uniport.edu.ng 2348055219133 / 08103142367*

ABSTRACT

The study assessed the physical features, proximate composition and fibre fractions of ensiled maize stover and groundnut haulms for sustainable ruminant production. Maize stover and groundnut haulms were collected, wilted for 3 – 4 days, chopped and ensiled in different proportions to make three 3 treatments (T1: 100% maize stover; T2:100 % groundnut haulms; T3:50 % maize stover and 50 % groundnut haulms) and replicated four (4) times in glass Bamma® bottles for 30 days. Physical features and chemical composition of the silage were examined. Results showed that the colour of the silage were cream, greenish brown and light brown for T1, T2 and T3. Texture was smooth for T1, coarse for T2 and slightly coarse for T3. All the silage were moist with pleasant aroma. The pH and temperature value ranges from 3 – 4.5, 30 – 31.5^{o}C, respectively. There were significant differences (P<0.05) in the proximate compositions and fiber fractions of the silage. Treatment 3 T3 had highest (P<0.05) content for the proximate composition and fiber fractions except the hemicellulose which was similar (P>0.05) in T2 and T3. Conclusively, the silage exhibited good physical features, appropriate proximate composition and fibre fractions that justified its potential in solving the challenges of dry season feed scarcity for ruminant production. Treatment 3 (50% maize stover and 50% groundnut haulms) is recommended for farmers based on the proximate composition and fibre fractions.

Key words: Chemical composition, groundnut haulms, maize -stover, ruminant, silage,

INTRODUCTION

In Nigeria, fodder scarcity is considered a major limiting factor to ruminant production. Lamidi *et al*. (2009) reported that available forage for most part of the year is low in crude protein, this leads to marked decreases in voluntary intake and digestibility and causes marked weight loss of animals, and economic return of the venture.

Crop-livestock farming is an integrated agricultural production system in which crop products especially wastes can be used as feed resources for the animals. Also the dung and urine of the animals can be used to improve the soil fertility. Increase in crop production will consequently lead to increase in the production of crop waste which will transform to feed for animal production.

The best way to maximally utilize crop wastes is to convert them to useful materials such as feed resources for animals, especially ruminant animals. Silage production has been used as a means of adding value to different crops waste.

Maize stover is a left over when maize cob has been harvested by the farmers. It can be a waste if left on the farm to dry off, it can also be ploughed back into the soil or destroyed by rodents or insect.

Groundnut haulms is the entire groundnut plant after groundnut were removed after harvesting, it is made up of the leaves, stem and root. It is also crop wastes which were left on the farm. Some were dry when the weather was conducive as hay; where weather is not favorable, it is left on the farm and wasted. Groundnut haulms have a higher crude protein content (11-17%) compared to (2 - 8%) in cereal residues. Addass *et al*. (2011) reported 91% DM, 8.30% ash, 10.90% CP, 31.80 CF and 1.31% EE for groundnut haulms.

This study intends to examine the physical features and chemical composition of ensiled maize stover and groundnut haulms for sustainable ruminant production.

MATERIALS AND METHODS

Experimental site and collection of experimental materials: The experiment was conducted at Forage Science Laboratory, Department of Animal science, University of Port Harcourt, Port Harcourt, Rivers State. Maize stover was collected from the Faculty of Agriculture Demonstration Farm after maize cobs were harvested. Groundnut haulms were gathered after groundnut seeds were harvested and haulms, cleaned of soil from the root. Both crop wastes were allowed to wilt for 2-3 days.

Silage production: The wilted maize stover and groundnut haulms were chopped with forage chopper machine separately and later weighed on percentage bases as: T1(100 % maize stover), T2 (100% groundnut haulms), T3(50 % maize stover+ 50 % groundnut haulms), replicated 4 times in glass bottles to have 12 Bamma® bottles and ensiled for 30 days

Data collection, chemical and data analysis: Physical features were monitored as reported by Lamidi and Akhigbe (2018). Chemical analysis was according to AOAC (2000). The experimental design was a completely randomized design (CRD), in which the experimental treatments were the only source of variability.

The model of analysis is as follows: $Xij = \mu + Ti + \sum ij$

Where Xij = value of observation; μ = population mean; Ti = treatment effect; $\sum ij$ = error term

All data obtained were subjected to the analysis of variance (ANOVA). Means were separated using Least Significant Difference (LSD) SAS (1999) package.

RESULTS AND DISCUSSION

Table 1: Physical features of ensiled maize stover and groundnut haulms

Parameters	Experimental treatments		
	T1	T2	T3
Colour	Cream	Greenish brown	Light brown
Texture	Smooth	Coarse	Slightly coarse
Wetness	Moist	Moist	Moist
Aroma	Mild sweet	Mild sweet	Mild sweet
pH	3.5	3	4.5
Temperature (^{0}c)	32	30	31.5
Mouldiness	No mould	No mould	No mould

T1: 100% maize stover; T2:100 % groundnut haulms; T3:50 % maize stover and 50 % groundnut haulms.

The physical features of ensiled maize stover and groundnut haulms are indicated in Table 1. The colour of the silage were cream, greenish brown and light brown for T1, T2 and T3. Texture was smooth for T1 and coarse for T2 and slightly coarse for T3. All the silage was moist with pleasant aroma. The pH and temperature value ranges from 3 – 4.5, 30 – 31.5^{o}C, respectively.

The colour of the silage was close to the original colour of the grass, which was an indication of good quality silage that was well preserved (Oduguwa *et al*., 2007). The range of pH value (3 – 4.5) recorded in this study was within the value reported (3.81 - 4.90) by Akinbode *et al.* (2017) when sugarcane top was ensiled with broiler litter. Generally, the mild sweet aroma perceived in all the silage is an indication of normal physical characteristics of good silage (Lamidi and Akhigbe, 2018).

Table 2: Proximate composition and fiber fractions of ensiled maize stover and groundnut haulms

Parameters	Experimental treatments				
	T1	T2	T3	SEM	LOS
Dry matter	86.96^b	87.07^b	87.24^a	0.05	**
Crude protein	11.67^c	12.18^b	12.69^a	0.15	**
Ether extract	2.12^c	2.23^b	2.37^a	0.04	**
Crude fibre	13.21^c	13.35^b	13.67^a	0.07	**
Ash	6.56^c	6.78^b	6.89^a	0.05	**
Neutral detergent fibre	47.39^c	49.23^b	51.15^a	0.54	**
Acid detergent fibre	25.67^c	27.12^b	29.05^a	1.35	**
Nitrogen free extract	52.33^b	52.47^b	51.15^a	0.07	**
Acid detergent lignin	8.59^c	8.76^b	9.23^a	1.00	**
Cellulose	17.75^c	18.36^b	19.82^a	0.36	**
Hemicellulose	21.72^b	22.10^a	22.11^a	0.07	**

[a, b, c] Means on the same row with different superscripts differ significantly (P<0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms.

There were significant differences (P<0.05) in all the proximate composition and fiber fractions of the silage across the experimental treatments. The T3 had highest (P<0.05) content for proximate composition and fiber fractions except the hemicellulose which was similar (P>0.05) in T2 and T3.

The CP contents of the silage (11.67 – 12.67%) were above the critical lower limit (7% CP) which forage intake by ruminants and rumen microbial activity could be negatively affected (Norton, 2003). It implies that the silage would provide the adequate nitrogen requirement for the rumen microorganisms to maximally digest the main components of dietary fibre leading to the production of volatile fatty acids (Lamidi and Ogunkunle, 2016) this in turn facilitate microbial protein synthesis (Lamidi and Aina, 2013) and improve the production of meat, milk, skin and hide for man uses. Higher levels of NDF and lignin have been reported to have negative effect on DM intake and digestibility (Bakshi and Wadhwa, 2004). However, the NDF (47.39 – 51.15 %) values observed for the silage were less than 60% which is considered safe for acceptable intakes of forage in ruminants (Meissner *et al*., 1991).

CONCLUSION AND RECOMMENDATION

Conclusively, ensiled maize stover and groundnut haulms had good physical features of a silage. The proximate composition and the fibre fractions further justified its potential T1: 100% maize stover; T2:100 % groundnut haulms; T3:50 % maize stover and 50 % groundnut haulms in solving the problem of dry season feeding for ruminant production. Treatment 3 (50% maize stover and 50% groundnut haulms) is recommended for farmers based on the proximate composition and fiber fractions.

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REFERENCES

Addass, P. A., Nyako, H. D., Agga. D.P., Mohammed, I.D., Midau, A., Fintan, J.S. and. Ja'afar-Furo, M.R. (2011). Nutrients evaluation of some common feed resources for cost effective feeding of ruminants in Mubi, Nigeria. Agriculture and Biology Journal of North America. 2(1): 15-18.

Akinbode, R. M., Isah, O. A., Oni, A. O., Arigbede, O. M., and Ojo, V. O. A. (2017). Nutritional evaluation of sugarcane top ensiled with varying proportion of broiler litter. Livestock Research for Rural Development 29 (1) 2017.

AOAC (Association of Analytical Chemists). (2000). Official Methods of Analysis, 17th ed. Association of Analytical Chemists. Washington, DC.

Bakshi, M. P. S. and Wadhwa, M. (2004). Evaluation of forest leaves of semi-hilly arid region as livestock feed. Asian-Australasian Journal of Animal Science. 95, 93 – 104.

Lamidi, A.A., Aina, A.B.J, Sowande S.O and Jolaosho A.O. (2009). Assessment of Panicum maximum (Jacq), Gliricidia sepium (Jacq) and Gmelina arborea (Roxb) based as all year round feed for West African Dwarf Goat. In: Akinlade et al (Eds) Global Economic Recession and Challenges to Livestock Production in Nigeria. In Proceeding of Animal Science Association of Nigeria (ASAN). Held at the Ladoke Akintola University Technology, Ogbomosho. 14th to 17th September 2009. pp 582 to 584.

Lamidi, A.A., and Aina, A. B. J. (2013). Presowing treatment, agronomic parameters and nutritive potential of Tephrosia bracteolata (Guill. Et Perr.) at four different stages of growth. African Journal of Livestock Extension 11:31-36.

Lamidi, A.A., and Ogunkunle, T. (2016). Nutritional potential of poultry dropping meal as feed resources for ruminant production in Niger Delta. Nigeria. Global Agricultural Science & Technology 1:1-11.

Lamidi, A. A. and Akhigbe, J. (2018). Quality of ensiled guinea grass (Panicum maximum) at varying proportions with sweet potato peels for sustainable ruminant production in Niger Delta, Nigeria. Nigerian Journal of Animal Production. Volume 45(45). 184 – 191.

Meissner, H. H., Koster, H. H, Nieuwoudt, S. H., Coertze, R. J. (1991). Effect of energy supplementation on intake and digestion of early and mid-season rye grass and Panicum/smuts finger hay and in sacco disappearance of various forage species. South African Journal of Animal Science. 21: 33-42.

Norton, B. W. 2003. The nutritive value of trees legumes as dietary supplement for ruminants. In: Forage tree legumes in tropical agriculture. Gutterridge, R. C. and Shetton, H.M. (EDS). PP.171- 191.

Oduguwa, B.O., Jolaosha, A.O. and Ayakoso, M.T. (2007). Effect of ensiling on the physical properties, chemical composition and mineral content of guinea grass and cassava top silage. Uni. of Agric. Abeokuta. Nigerian Journal of Animal Production. 34 (1): 100-106.

SAS. 2002. Statistical Analysis System, Computer Software, SAS/STAT User's Guide Version 9, Statistical Analysis Systems Institute, Cary, North Carolina, 0013402001, USA.

PLANT SECONDARY COMPOUNDS: A VIABLE OPTION FOR MITIGATING ENTERIC METHANE EMISSION IN NIGERIA

Lawal M.

Agricultural Education Department, Federal College of Education Katsina Tel: +2348035927818, E-mail: lawalmohd@yahoo.com

ABSTRACT

This paper highlights the role of ruminants as important contributors to global warming through enteric methane emission with a focus on Africa and Nigeria in particular. It goes on to identify the dearth of research emanating from the country towards developing strategies for mitigating enteric methane emission despite the large ruminant population. The process of methane production by ruminants is briefly described along with the different strategies used for mitigating it. The paper proposes the use of plant secondary compounds as a good potential option of mitigating enteric methane for a country like Nigeria. The need for equipment for measuring enteric methane production in developing any effective strategy was raised. The paper was concluded by calling on scientists and researchers to conduct more research on developing strategies for mitigating enteric methane production; and on government on the need for a policy framework towards achieving this aim.

Keywords: ruminants, methane mitigation, plant secondary compounds, Nigeria.

INTRODUCTION

Ruminant production is very important in Nigeria which has the highest amount of cattle, sheep and goats in Africa with estimates totaling approximately 130 million in 2014 (FAO, 2016). Ruminant animals play numerous economic and social roles in the lives of rural farmers in Nigeria in terms of food, income, security and other festive and ceremonial activities However, ruminant production is said to contribute to the global green house gas emission which contributes to global warming (Moss *et al*., 2000). Ruminant animals produce large amount of methane which is the second most problematic green house gas. Over the years, much effort have been put into mitigating global methane emission but despite that little effort is seen in Africa towards mitigating methane emission. Developing methane mitigation strategies form one of important components of reducing methane emission. In Africa, particularly sub Saharan African very little effort is being put in terms of research towards developing strategies for mitigating enteric methane emission. This is especially true of Nigeria as evidenced by little research literature on the subject matter originating from the country. Nigeria has the highest estimated population of ruminants in Africa and this implies that she may also be the highest enteric methane producer in the continent. With the evident dangers of this on global warming, it becomes necessary for the country take responsible steps in lowering its enteric methane production especially that the country has signed the Paris climate change agreement on lowering methane production in 2017.

METHANE PRODUCTION BY RUMINANTS AND STRATEGIES FOR MITIGATING IT

Ruminant animals are able to utilize forage to obtain their energy requirement but in this natural process, methane is released as a bi-product into the atmosphere as a result of forage degradation in the rumen (Morgavi *et al*., 2011). The rumen is a large fermentation vat which habours millions of various species of bacteria, fungi, protozoa and archaea. Forage ingested by ruminants is broken down by enzymes produced by bacteria, fungi and protozoa into volatile fatty acids (VFAs), carbon dioxide (CO_2) and hydrogen (H_2) (Moss *et al*., 2000). Archaea in turn reduces the CO_2 produced into methane (CH_4) using H_2 in process known as methanogenesis (Morgavi *et al*., 2011). Apart from the negative environmental impact, enteric methane production represents a loss of energy for ruminants estimated up to about 2-12% of GE intake Johnson and Johnson (1995). Various approaches for mitigating

enteric methane production have been described by Hristov *et al*., (2013) to include dietary strategies, breeding, vaccination, and management.

Among the strategies for mitigating enteric methane emissions, dietary manipulation using plant secondary compounds (PSC) is one of the promising options that can be explored in Africa and Nigeria in particular. This is because they are contained in many forages which are widely abundant in the country making it a cheap option and one that can easily be accepted and adopted into the local ruminant production systems. Plant secondary compounds are several chemical compounds produced by plants which are not directly involved in their growth and other vital processes. Some of these compounds like tannins, saponins and essential oils have been found to reduce methane production in ruminants. Many tropical plants used as forage contain high quantities of these compounds thus providing an opportunity for developing dietary strategies for mitigating enteric methane production in the region.

Table 1 Nigerian forages containing PSC with anti methanogenic effect

Acacia tortilis, Moringa olifera, Leucaena lecocephala and *Zizifus mucronata*	Njidda and Nasiru, (2010)
Albezia rhizonse and *Albezia lebeck*	Babayemi *et al*., (2004)
groundnut shell	Akinfemi *et al*., (2012)
Flemingia macrophylla	Asaolu *et al*., (2014)
Syndrella nodiflora	Isah *et al*., (2012)
Essential oils from orange, tangerine, goat weed and African basil	Bamikole, (2015)
Gliricidia sepium and *Brachiaria ruziziensis*	Meale *et al*., (2012)
Acacia nilotica, Guiera senegalensis and *Lannea. acida*	Lawal *et al*., (2017 unpublished)

In developing any strategy for mitigating methane emission, a very important requirement is the ability to measure methane production. Several methods have been developed for measuring and estimating methane production from ruminants. These include:

Lab based in vitro incubation

Open circuit respiration chambers

Ventilated hood

SF6 tracer

Polyethylene tunnel

Open path laser

Greenfeed emission monitoring apparatus

Portable accumulation chambers

These methods have been extensively described by Makkar and Vercoe (2007), Goopy *et al*., (2016) and Hill *et al*., (2016). Lab based in vitro incubation methods like Hohenheim Gas Test, Pressure transducer systems and RUSITEC are relatively cheap, rapid and can be used to screen large amount of plant samples for anti-methanogenic properties. These equipments are available in few very universities in Nigeria. However, the open circuit respiration chambers have the greatest accuracy and are said to be the gold standard for measuring methane production from ruminants. To the best knowledge of the author, no such equipment is available in any of Nigeria's universities or research institutes.

CONCLUSION AND RECOMMENDATIONS

Methane is the second most important green house gas which contributes to global warming. Ruminant animals contribute significantly to global methane emission. Nigeria which has the highest estimated population of ruminants is likely to be the highest emitter of enteric methane in Africa. Very little effort is being done to curb enteric methane emission in the country in terms of developing strategies. More research is needed to develop strategies for cutting enteric methane emission. Plant secondary compounds are a promising option for developing strategies for cutting enteric methane emission in Nigeria. The ability to measure enteric methane emission is very necessary in developing effective strategies for cutting methane emissions. Equipment necessary for measuring enteric methane emission should be provided in universities and research institutes in various regions in the country. This paper is call on fellow scientists and researchers to conduct more researches in this area with a view to developing strategies of cutting enteric methane emission that is appropriate to our local conditions. For this to be successful, government support is needed in terms of developing a policy framework towards curbing enteric methane emission in the country.

REFERENCES

Akinfemi, A., Adua, M.M. and Adu, O.A., (2012). Evaluation of nutritive values of tropical feed sources and by-products using in vitro gas production technique in ruminant animals. *Emirates Journal of Food and Agriculture*, *24*(4), p.348.

Asaolu, V. O., Odeyinka, S. M., Binuomote, R. T., Odedire, J. A. and Babayemi, O. J. (2014). Comparative nutritive evaluation of native Panicum maximum, selected tropical browses and their combinations using in vitro gas production technique. *Agriculture and Biology Journal of North America*. 5(5). pp: 198-208

Babayemi, O.J., Demeyer, D. and Fievez, V., (2004). In vitro rumen fermentation of tropical browse seeds in relation to their content of secondary metabolites. *Journal of Animal and Feed Sciences*, *13*, pp.31-34.

Bamikole, M.A., (2015). Exploring tropical medicinal plants for reducing methane emission from ruminant: the potential of some essential oils from Nigeria. *Forages in Warm Climates*, p.185.

Food and Agriculture Organization of the United Nations (FAO). (2016). FAOSTAT Database. Rome, Italy: FAO. Retrieved April 18, 2016 from http://faostat3.fao.org/download/Q/QA/E

Isah, O.A., Fayemi, P.O., Gazaly, M.B. and Aderinboye, R.Y., (2012). Nutritional characteristics of four browse plants consumed by free-ranging ruminants in Western part of Nigeria. *African Journal of Agricultural Research*, *7*(12), pp.1944-1949.

Johnson, K.A. and Johnson, D.E., 1995. Methane emissions from cattle. *Journal of animal science*, *73*(8), pp.2483-2492.

Meale, S.J., Chaves, A.V., Baah, J. and McAllister, T.A., (2012). Methane production of different forages in in vitro ruminal fermentation. *Asian-Australasian journal of animal sciences*, *25*(1), p.86.

Morgavi, D.P., Eugene, M., Martin, C. and Doreau, M., (2011). Reducing methane emissions in ruminants: is it an achievable goal. *Challenging strategies to promote the sheep and goat sector in the current global context. CIHEAM/CSIC/Universidad de León/FAO Options Méditerranéennes: Série A. Séminaires Méditerranéens, Zaragoza*, pp.65-73.

Moss, A.R., Jouany, J.P. and Newbold, J., (2000). Methane production by ruminants: its contribution to global warming. In *Annales de zootechnie* (Vol. 49, No. 3, pp. 231-253). EDP Sciences.

Njidda, A.A. and Nasiru, A., (2010). In vitro gas production and dry matter digestibility of tannin-containing forages of semi-arid region of north-eastern Nigeria. *Pakistan Journal of Nutrition*, *9*(1), pp.60-66.

Goopy, J. P., Chang, C., & Tomkins, N. (2016). A comparison of methodologies for measuring methane emissions from ruminants. In *Methods for measuring greenhouse gas balances and evaluating mitigation options in smallholder agriculture* (pp. 97-117). Springer, Cham.

Hill, J., McSweeney, C., Wright, A. D. G., Bishop-Hurley, G., & Kalantar-zadeh, K. (2016). Measuring methane production from ruminants. *Trends in biotechnology*, 34(1), 26-35.

Makkar, H. P., & Vercoe, P. E. (Eds.). (2007). *Measuring methane production from ruminants*. Springer Science & Business Media.

Hristov, A.N., Oh, J., Lee, C., Meinen, R., Montes, F., Ott, T., Firkins, J., Rotz, A., Dell, C., Adesogan, A., Yang, W., Tricarico, J., Kebreab, E., Waghorn, G., Dijkstra, J. & Oosting, S. (2013). *Mitigation of greenhouse gas emissions in livestock production – A review of technical options for non-CO2 emissions.* Edited by Pierre J. Gerber, Benjamin Henderson and Harinder P.S. Makkar. FAO Animal Production and Health Paper No. 177. FAO, Rome, Italy.

THE PERFORMANCE OF BALAMI RAMS FED DIFFERENT SUPPLEMENTAL PROTEIN SOURCES AND A BASAL DIET OF SIGNAL GRASS (*Brachiaria decumbens*) HAY

Mohammed, A[1], Umar, A. M.[3] Nyako, H. D.[2] Nuhu, S. H[1]., Yaro, S. S[1]., Oyeniran, J. O[1]. & Ahmad, S[4].

[1]Dept. of Animal Health and Production, Federal Polytechnic, Bauchi, Nigeria, 2Department of Animal production and Range Management, ModibboAdama University of Technology Yola .[3]Dept. of Animal Health and Production, Bilyaminu Usman Polytechnic Hadeja, Jigawa State, Nigeria,[4]Bauchi State Ministry of cullture and Rural Devt.

Corresponding author: amoh881@yahoo.com 08027091937

ABSTRACT

The influence of different supplemental protein sources on the performance of Balami Rams was conducted using twenty (20) experimental Rams. The rams were allocated to four treatments with five animals per treatment as replicates. Supplementary diets A, B, C and D were allocated as one supplement per treatment. The supplementary diet containing Cotton Seed Cake and Maize offal was fed to group A, Group B animals were fed supplementary diet containing Poultry litter and Maize offals. Diets containing Moringa olifera and Maize offals was fed to C treatment and D group was the Control treatment with only maize offal (Table I), while Signal grass (Brachiaria decumbens) as the basal diet, water, and salt blocks were provided ad libitum throughout the feeding trial of ninety (90)days. The result showed that the average daily feed intake shows significant (P<0.05) difference between the treatments with a value of 996.00g//d in treatment C to 888.00 g//d in treatment D (control).The total weight gain(TWG) indicate significant (P<0.05) difference between the treatments .The mean total weight gain of 4.52kg was obtained in treatment C followed by 4.12 and 3.56kg for treatment A and B respectively while treatment D (2.68kg) had the lowest weight gain. The highest average daily weight gain (50.22g/d) was recorded in treatment C (P<0.05), while treatment D (Control) had the least value of 29.78g/d. Feed conversion ratio (FCR) was highest (27.75) in treatment D and lowest in treatment C (19.82) However, supplementing Balami lambs with Moringa olifera mixed with Maize offals performed better than poultry litter and cotton seed

KYE WORDS: Supplement, Basal, Weight gain, Balami

INTRODUCTION

Animal protein consumption in Nigeria and other developing countries has been reported to be comparatively low (Ayorinde and Aromolaran, 1998).Livestock feeding on poor quality native pasture and cereal straws, result in perpetual low productivity (Maigandi *et al*., 2003). Magaji (2004) reported that finding an effective way of utilizing the available feed resources and storage devices of feeds remain the subject of interest to many animal nutritional scientists in order to meet up the nutrients quality and availability at a lower cost. Adegbola (2002) reported that in the dry season, ruminant livestock cannot meet their nutritional requirements on grass alone.

Signal grass (*Brachiaria decumbens*) is one of the tropical grasses with tolerance to low soil fertility, relative freedom from pest and diseases, withstand heavy grazing and remain green long into the dry season (Ndikumana and Leeuw de, 1996), but its potential as feed resource is not well recognized in the ecological zone. ***Brachiaria decumbens*** is the most high-yielding species of the genus Brachiaria. Unlike Congo grass, it has no or very few diseases and can be used as permanent pasture. It is palatable to sheep and goats and withstands heavy grazing. Signal grass can be grazed, it can be fed fresh or to be made into hay. Signal grass is also used as a cover crop and in the control of weeds (AFRIS, 2015). However, ruminant animals cannot survive and produce on this grass alone, therefore supplementation has to be provided.

Therefore, this study is designed to assess the influence of supplemental protein sources on the performance of Balami rams fed *Brachiaria decumbens* as basal diet.

MATERIAL AND METHODS

Composition of Supplementary Diets

Composition of the supplementary diets is shown in Table 1. The diets containing CSC + MO is treatment A. The one containing PL + MO is treatment B that of C treatment is made up of MRL + MO while D served as control with MO only as was the case in Table I. The maize offals (MO) mixed with the other supplemental protein sources served as a booster.

Table 1: Gross Composition of the Supplementary Diets

Ingredients	Treatments			
	A	B	C	D
MO	100	100	100	100
CSC	200	00	00	00
PL	00	200	00	00
MRL	00	00	200	00
Total	300g	300g	300g	100g

MO=Maize offal, CSC= Cottonseed cake, MRL= *Moringa olifera* leaves, PL= Poultry litter

Experimental Design and Treatments

Twenty (20) experimental Rams were balanced for weight and allocated to four treatments with five animals per treatment. Each of the experimental Rams was randomly assigned to a treatment. Complete Randomized Design (CRD) was used for the experiment.

Management of the Experimental Animals

Twenty (20) Balami rams between 7 to 10 months (average of 17.5 kg) of age were used for the experiment. They were procured from Dambam local Livestock market, Dambam, Bauchi State. They were quarantined for fourteen days in which animals were fed groundnut haulms. They were ear tagged and given a prophylactic treatment with a broad spectrum antibiotic, dewormed and vaccinated against *Pest Des Petis Ruminant.* Each of the rams was kept in individual pen of 1 by 2M size for proper record keeping.

The experimental animals were fed with *Brachiaria decumbens* as basal diet, water, and salt blocks were provided *ad libitum* throughout the feeding trial. The feeding trial was conducted for 90 days after the adaptation period. Three hundred grams (300g) of supplements was offered for each experimental animal except those in the control treatment where they were offered 100g between 08.00 and 09.30 am before the basal diet i.e. at least 30 minutes before giving the basal diet. Feed offered and refusals were weighed every day before daily morning feeding.

DATA COLLECTION

The data collected during the feeding trials were supplementary, basal and total daily feed intake and water intake on daily basis. The weight gain for each animal was taken weekly throughout the feeding trials.

Feed intake was calculated by measuring daily offered and refusal of each treatment diet throughout the experiment. Daily feed intake was determined as the difference between the feed offered and the residue for both the supplement and the basal feed for each of the experimental Ram. Feed conversion ratio was determined as a ratio between total feed consumed and the total weight gain.

$$\text{Feed conversion ratio} = \frac{\text{Average daily feed intake}}{\text{Average daily weight gain}} \quad \ldots\ldots 1$$

The animals were weighed individually using weighing scale before the commencement of the experiment and then at weekly intervals between 8: 00 and 9:00 am after overnight fasting. The changes in weight of each of the animals was monitored throughout the period of feeding trial. Average daily weight gain (ADG) was calculated using the following formular as cited by Venkateswarlu *et al.* (2013).

$$\text{ADG} = \frac{\text{Final weight (g) - Initial weight (g)}}{\text{Number of days}} \quad \ldots\ldots 2$$

RESULTS AND DISCUSSION

The supplementary feed intake showed significant ($P<0.05$) difference across the treatments. The control diet (D) recorded the least supplementary feed intake of 92 g/a/d while rams fed diet C recorded the highest mean intake of 275 g/a/d. Treatment A and B had mean daily feed intake of 251 and 242 g/a/d (gram per animal per day) respectively. There was significant ($P<0.05$) difference among the dietary treatments on daily basal feed intake. Animals on diet B had the least value of 698 g/a/ d while animals fed diet D (control) had the highest mean daily basal feed intake of 796 g/a/d followed by treatment A (736 g/a/d) and C (721 g/a/d),. The average Daily feed intake shows significant ($P<0.05$)difference among the treatments. The intake ranged from 888 g/a/d in treatment D (control) as the least value to 996 g/a/d in treatment C as the highest. Treatment A and B recorded the mean values of 987 and 940 g/a/d respectively. This is within the range of 848.50 to 982 g/a/d reported by Muhammad *et al.* (2016) when the authors fattened Uda sheep with Fore-stomach digesta as supplement.

Mean final body weight showed significant ($P<0.05$) difference among the treatments with the least value of 26.28 kg recorded for animals on the control diet (D) and highest mean body weight of 27.96 kg for animals on diet C. Rams on diets A and B had mean values of 27.54 and 27.16 kg weights respectively.

The range tally with 28.75 to 30.38 kg obtained by Muhammad *et al.* (2016) when the authors fattened Uda sheep with Fore-stomach digesta as supplement.

The total weight gain showed no significant ($P>0.05$) difference across the treatments with the rams fed the control diet (D) as the least mean value of 2.68 kg weight gain and the highest mean value of

4.52 kg weight in treatment C followed by A and B with mean total weight gain of 4.12 and 3.56 kg respectively. Mean daily weight gain showed significant (P<0.05) difference across the treatments with the least value of 29.78 g/a/d for rams fed diet D (control) and the highest daily mean weight gain of 50.22 g/a/d for rams fed diet C. Diet A recorded 45.78 g/a/d while rams fed diet B had the mean daily weight gain 39.56 g/a/d. Dry matter intake as percentage body weight had no significant (P>0.05) difference across the treatments with treatment D as the lowest (3.11%) and the highest value of 3.29% recorded for treatment A. Feed conversion ratio (FCR) ranged from 19.82 for treatment C to 27.75 for animals fed diet D (Control).

Table 2: Performance of Fattened Balami Rams fed a Basal Diet of Brachiaria *decumbens* Supplemented with different Protein Sources

Parameters	Treatment				
	A	B	C	D	LSD
D FI (supplementary) (g)	251.00[b]	242.00[b]	275.00[a]	92.00[c]	11.361
DFI (Basal) (g)	736.00 [b]	698.00 [b]	721.00 [b]	796.00 [a]	2.463
Average daily feed intake (g)	987.00[a]	940.00[b]	996[a]	888[c]	2.1o6
Initial body weight (kg)	23.42	23.60	23.44	23.60	1.244
Final body weight (kg)	27.54 [a]	27.16[a]	27.96 [a]	26.28 [b]	0.858
Total weight gain (kg)	4.12[ab]	3.56[ab]	4.52[a]	2.68[b]	1.543
Average daily weight gain (g)	45.78[ab]	39.56[ab]	50.22 [a]	29.78 [b]	17.155
DM%BW	3.29	3.18	3.27	3.11	3.632
Feed conversion ratio	21.56	23.76	19.82	27.89	1.362

Means in the same row with different superscript are significantly different (P<0.05) DFI=Daily feed intake, DM%BW= Dry matter intake as % body weight, LSD= Least significant difference

CONCLUSION

In conclusion, it was observed that Signal grass had better performance when supplemented with *Moringer oleifera* than other supplemental protein sources used in this experiment in terms of feed intake and weight gain.

REFERENCES

Adegbola, T.A. (2002). Nutrient intake, digestibility and rumen metabolites in bulls fed rice straw with or without supplements. *Nigerian Journal of Animal Production,* 29 (1): 40-46.

AFRIS (2015) Animal Feed Resource Information System Feedipedia. *http://www.feedipedia.org/node/489 14/2/2015 4:53* am

Ayorinde, I.A and Aromolaran, A.B. 1998. Economics of rabbit production in Abeokuta south L.G.A. State, Nigeria. *Nigerian Journal of Animal Production, 25: 100-105.*

Magaji,Y.I.(2004). Nutritive value of some browse species used as Ruminant feeds in the northern guinea savanna zone of Bauchi state. Ph.D. Thesis submitted to the Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Maigandi, S.A., Tukur, H.M. and. Daneji, A.I. (2003). Fore-stomach digesta in the diets of growing sheep: II. Haematological Parameters and Blood Urea Nitrogen. *Sokoto Journal of Veterinary Sciences,*5(1): 12-17.

Muhammad, N., Bello M.M.,Maigandi, S.A., Magaji, A.A., Garba, M.G. and Yusuf, A. (2016). Evaluation of Ensiled Fore Stomach Digesta (FSD) with Cowpea Hay on the Performance of Fattening Sheep in Semi-arid Enviroment. *European Journal of Basic and Applied Sciences* Vol. 3 No. 3, 2016 *ISSN 2059-3058*

Ndikumana J. and Leeuw de P.N. (1996) Regional Expertise with *Brachiaria*: Sub Sahara Africa.489611 Pp 247- 257.

Venkateswarlu, M., Ramana R. Y. and Sudhakar, R.M. (2013). Effect of feeding crop residues based complete rations on growth in ram lambs. *International Journal of Science, Environment and Technology*, Vol. 2, No 1, 2013, 15 – 19.

UTILIZATION OF CAMEL'S FOOT (PILIOSTIGMA RETICULATUM) (Hochst.) PODS AMONG RUMINANT FARMERS IN ARUGUNGU LOCAL GOVERNMENT AREA OF KEBBI STATE, NIGERIA

[*]Muftau, M. A., G, Saminu*., B. S, Malami[**] and N, Kadi*

[*]Department of Animal Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, Kebbi State, Nigeria

[**]Department of Animal Science, Faculty of Agriculture, Usmanu Dan Fodio University, Sokoto, Nigeria

E-mail: mamuftau@gmail.com

ABSTRACT

A survey was conducted in Argungu Local Government Area of Kebbi State comprising of 3 villages. A structured questionnaire was administered to 60 farmers within the study area. The data collected was analyzed by using simple statistical tools such as frequency counts and percentages. Majority (48.33%) of the respondents reared cattle, sheep and goats with about 48.33% having the highest flock/herd size of about 21-30 animals. Most (90%) of the farmers offered Kalgo parts as feed to their animals in combination with other ingredients and about 58.33% offered Kalgo parts in dried form to feed their animals with sheep and goats (58.93%) preferring Kalgo parts most. The parts of the Kalgo mostly preferred by ruminants indicated that the pods are mostly (70%) preferred and 21.67% of animals prefers the leaves alone. Kalgo parts is obtained for usage in the dry season as agreed by all (100%) the respondents with about 61.67% covering a distance of 1-2km from their homes/farms before obtaining Kalgo for usage. About 75% and15% obtained the kalgo parts by self and by purchase respectively. The parts are offered as whole as observed in this study, there is no any form of processing such as grinding, pounding and milling done on the leaves/pods before serving it to the animals. All the respondents (100%) in the study area agreed to the fact that Kalgo is naturally occurring plant. The results obtained in this work revealed that Kalgo is an important browse for ruminant production among the farmers.

Key words: Kalgo, utilization, ruminant farmers, Kebbi State

INTRODUCTION

Rural dwellers people generally recognize the trees and shrubs which are well appreciated by ruminants, and their nutritive importance (Thapa *et al.*, 1997; Briggs *et al.*, 1999; Thorne *et al.*, 1999; Komwihangilo *et al.*, 2001; Muftau *et al*., 2019). The role of browse during periods of drought has been recognized and has attracted attention from scientists (Hadja, 2007). Hence, farmers' preference of browse species was related to their availability, palatability and drought resistance.

In a previous survey conducted by Hassan *et al*. (2010), the authors observed that parts of browse species utilized by livestock were leaves, pods twigs and flowers. The pods of *Piliostigma reticulatum* were important feed resources for goats, sheep and cattle during the dry season (Nounhoun *et al*., 2013). Earlier study (Muftau, 2018) indicated that Camel's foot is highly abundant in Kebbi State and as a potential feed resource in the diet of sheep.

It is against the above back ground of the importance of woody shrubs and trees in rangelands that the study was embarked upon to investigate and ascertain the claim made by farmers on the utilization of *Piliostigma reticulatum* which is commonly known as Camel's foot and locally called Kalgo in the northern region of Nigeria as a potential feed resource in Kebbi Sate.

MATERIALS AND METHOD

Study Area

The survey was conducted in Argungu Local Government Area (LGA) of Kebbi State during the dry season period of 2017. Argungu LGA is located between latitudes 12^0 44'N $4^0$31'E/ and longitudes 12.733^0N 4.517^0E. The area has a longer dry season of 8 to 9 months and short rainy season of 4 to 5

months, the vegetation of the area is Sudan type with farming as the major activities of the people residing in this area. The Argungu Local Government also hosts an annual international fishing competition (KARDA, 2014),

Data collection and analysis

A total of 60 structured questionnaires were administered to randomly selected livestock farmers within the Local Government covering 3 out of 6 villages with 20 respondents per village during the dry season of 2017. The respondents were selected by systematic sampling procedure and interviewed. The structured questionnaires captured, flock size; species kept, availability and utilization of Kalgo among others. Statistical tools such as frequency distribution and percentage were used in analyzing the collected data.

RESULTS AND DISCUSSION

All the respondents in this study (Table 1) reared ruminant animals with the majority rearing more than one ruminant species mostly dominated by cattle, sheep and goats (48.33%). This might be attributed to complementary in feeding habits of the species. This finding is in line with the work of Smith (2006) who reported that cattle and sheep grazes lower grasses while goats browse shrubs and trees. Majority of the respondents (48.33%) had a flock/herd size of about 21-30 in numbers. Kalgo plant parts for usage in the study area (Table 1) are obtained mostly (100%) during the dry season (late October to late March). This is in line with the findings of Heuze and Tran (2011) who reported that browse species are particularly available for usage during the cool and hot dry season, which correspond to their fructification period (Yelemou *et al*., 2009) when herbaceous forages are scarce. Ways of obtaining Kalgo pods in this study (Table 2) includes; by self (75%) and by purchase (15%). However some farmers (10%) obtained the pods in both by self and purchasing. This observation is in agreement with the findings of Nounhoun *et al*. (2013) who reported that children and women in the northern Sudanian zone of Burkina Faso are engaged in the collection and storage of the pods of *P. reticulatum* and *F. albida* for sales at local fodder markets. Most of the respondents (61.67%) covered a distance of about 1-2km from their homes/farms before obtaining Kalgo for usage (Table 1). The distance travelled as observed in this study is lower than those reported by Nounhoun *et al*. (2013). All (100%) the respondents in the study areas agreed to the fact that Kalgo is naturally occurring plant which is in line with the reports of (Simbaya, 2000; Akinsoji, 2003; Ugbogu and Akinyemi, 2004; Fayemi *et al*., 2011).

Table 1: Animal species kept and numbers, availability and accessibility of Kalgo plant

Items	n=60 frequency	Percentage (%)
A. Types of Animal kept		
i. Cattle	11	18.33
ii. Sheep	5	8.33
iii. Goat	1	1.67
iv. Sheep and Goat	14	23.33
v. Cattle, Sheep and Goat	27	48.33
B. Numbers of animal kept		
i. bellow 20	18	30.00
ii. 21 – 30	29	48.33
iii. 31 – 40	5	8.33
iv. 41 – 50	7	11.67
v. Above 50	1	1.67
B. In what season is Kalgo obtained for usage?		
i. Dry season	60	100
ii. Rainy season	0	0
C. How is Kalgo plant obtained?		
i. Self	45	75
ii. Purchase	09	15

iii. Both	06	10
D.Distance covered to obtained Kalgo from the farm/home		
i.1-2km	37	61.67
ii. 3-5km	14	23.33
iii. 5km above	9	15
E. Is Kalgo naturally occurred or planted?		
i. Naturally occurring	60	100
ii. Propagated	0	0

Source: field survey, 2017

Different forms of using Kalgo parts (Table 2) for feeding animals in the study area revealed that majority (58.33%) of the farmers preferred the dry form especially the pods. The parts are offered as whole to the animals as observed in this study, there is no any form of processing such as grinding, pounding and milling done on the leaves/pods before serving it to the animals. Most of the farmers (90%) offered Kalgo parts to their animals in combination with other ingredients such as concentrates and supplements. This is in agreement with the work of Crowder and Chheda (1982) who reported that browse plants alone can keep animals in a fair condition but may be inadequate as the sole feed stuff. All the farmers reported an increased use of the parts of kalgo (leaves/pods) by ruminants. Sheep and goats (58.93%) are found to prefer Kalgo (leaves and pods) than cattle (21.43%) in this study (Table 2). This observation was in line with the report of Nouhoun *et al*. (2013); they reported that some browse plants preferred by small ruminants in the sub-sahalian zone were not used by cattle while goats and sheep had nine browse plants preferred in common. All the parts of Kalgo (leaves/pods) are preferred by ruminants but the most (70%) preferred part is the pods as shown in Table2. Nouhoun *et al*. (2013) observed that pods of some browse plants such as *Piliostigma spp* and *F. albida* are especially preferred and used by all ruminant species across the Sahelian zone of Burkina Faso.

The use of Kalgo for animal health apart from feeding as agreed by all (100%) the farmers (Table 2) is in line with the findings of Garba and Muhammad (2008); Awohouedji *et al*. (2013); Nounhoun *et al*. (2013). These authors reported the various uses of browse plants for animal health care ranging from stimulation of milk in cows and goats, and anthelmintic.

Table 2: Kalgo plant usage, preference and method of utilization

Items	n=60 frequency	Percentage (%)
A. In what form is Kalgo fed to animals?		
i. Fresh (pods/leaves)	04	6.67
ii. Dry (pods/leaved)	35	58.33
iii. Wilted (pods/leaves)	21	35
B. How is Kalgo offered to animals?		
i. Kalgo alone	06	10
ii. Kalgo with other ingredients	54	90
C. Part of Kalgo used in feeding animals		
i. Leaves	05	8.33
ii. Pods	42	70
iii. Both	13	21.67
D.Which of the animal species prefers Kalgo most?		
i. Cattle	12	21.43
ii. Sheep	23	41.07
iii. Goats	21	37.50
E. Other usage of Kalgo plant		
i. Animal health	60	100
ii. Others, specify	0	0

Source: field survey, 2017

CONCLUSION AND RECOMMENDATION

Browse plant is an important component in ruminant production especially during the long dry season in the semi-arid environment. The results obtained in this work revealed that Kalgo plant is a permanent browse indigenous to the semi-arid environments. Kalgo is an important browse for ruminant production among the farmers in the study area. Management is however necessary in the production of Camel's foot (Piliostiga reticulatum) in order to improve ruminant production. It is recommended that the pods should be milled and incorporated with other ingredients for effective utilization by animals.

REFERENCES

Awohouedji, D. Y. G., Babatounde, S., Adounkpe, J. G., Houinato, M., Hounzangbe-Adote, S. (2013). Supplementing *Panicum maximum* with two medicinal forages in the diet of Djallonke sheep at Benin national sheep center. *Scientific Journal of Animal Science*. 2 (11) 284-295.

Briggs, J., Badri, M. and Mekki, A. M. (1999). Indigenous knowledges and vegetation use among Bedouins in the eastern desert of Egypt. *Applied Geography 19*, 87-103.

Crowder, L. V. and H. R. Chheda. (1982). Tropical Grassland Husbandry. 5th ed. Longman Pp. 292-294.

Fayemi, P. O., Onwuka, C. F. I., Isah, O. A., Jegede, A. V. Arigbede, O. M., Mucheje, V. (2011). Effects of mimosine and tannin toxicity on rabbits fed processd *Leauceana leucocephala* (Lam) De Wit leaves. *African Journal of Agriculture*. Res., 6 (7): 4081-4085.

Garba, Y and Muhammad, I. R. (2008). Sabara (Guiera senegalensis) as browse and potential milk enhancer in ruminants in the semi- arid, environment. *Research Journal of Animal Science* . 2 (4), 123 -127.

Hadja, O. S. (2007). The importance of some Sahalian Browse species as feed for goats. Doctoral Thesis, Department of Animal nutrition and management. Swidish University of Agricultural Sciences, Uppsala. Pp. 43.

Hassan, A, Ebro A., Kurtu, M and Treydte, A. C. (2010). Livestock feed Resources utilization and management as influenced by altitude in the central High land of Ethiopia. Livestock working paper 27.

Heuze, V. and Tran, G. (2011). Apple-ring Acacia (Faidherbia albidia): Feedipedia Animal feed Resources Information System. Retrieved 12. 04. 2012 from http: // www.trc.zootechhnie.fr/node/357#tables

KARDA. (2014). Kebbi State Agricultural and Rural Development Authority.

Komwihangilo, D. M., Sendalo, D. S. C., Lekule, F. P., Mtenga, L. A. and Temu, V. K. (2001). Farmer's knowledge in the utilisation of indigenous browse species for feeding goats in semi arid central Tanzania. *Livestock Research for Rural development 13*, http://www.cipav.org.co/Irrd/Irrd13/6/komw136.htm.

Muftau, M. A. (2018). Evaluation of yield and feeding value of Camel's foot (*Piliostigma reticulatum*) (Hochst.) pods by using Uda rams in Kebbi State, Nigeria. PhD Thesis, Department of Animal Science, Usmanu DanFodiyo University, Sokoto, Nigeria, 71pp.

Muftau, M. A., B S, Malami., S. A. Maigaindi and H. A Gwandu (2019). Evaluation of Proximate,Fibre Fractions, Mineral Compositions and Phytochemical Screening in Camel's Foot (Piliostigma reticulatum DC) Pods in Kebbi State, Nigeria. *World Journal of Innovative Research* ISSN: 2454-8236, Volume-7, Issue-3, September 2019 Pages 01-04. www.wjir.org.

Nouhoun, Z., Luc, H. D and Eva, S. (2013). Contribution of browse to ruminant nutrition across three agro-ecological zones of Burkina Faso. *Journal of Arid Environments* 95 (2013) 55- 64.

Simbaya, J. (2000). Potential of fodder trees/shrubs legumes as feed resource for dry season supplementation of smallholder ruminant animal. *Development and Field Evaluation of Animal Feed Supplementation Packages*. Proceedings of the final review meeting of the IAEA Technical cooperation Regional AFRA project organized by the joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, 25-29 November, 2000, Cairo, Egypt, pp 69-76.

Smith. A. J, (2006). The tropical agriculturalist: Goats, CTA, Macmillan publishers, Malaysia, pp: 150.

Thapa, B., Walker, D. H. and Sinclair, F .L. (1997). Indigenous knowledge of the feeding value of tree fodder. *Animal Feed Science and Technology 68*, 37-54.

Thorne, P. J., Subba, D. B., Walker, D. H., Thapa, B., Wood, C. D. and Sinclair, F. L. (1999).The basis of indigenous knowledge of tree fodder quality and its implication for improving the use of tree fodder in developing countries. *Animal Feed Science and Technology 81*, 119-131.

Ugbogu, O.A, and Akinyemi, O.D. (2004). Ethno botany and conservation of Ribako district Nature Reserve in Northern Nigeria. *Journal of forestry Research and Management* 2: 60-70

Yelemou, B., Zougmoro, R., Bationo, B. A., Milliogo-Rasolodimby J, and Hien, V. (2009): Phenology and fruit production of *Piliostigma reticulatum* (D.C) Hochst, agro forestry forage specie in the Sahel. *Cameroun Journal of Experimental Biology* 2009 vol. 05 No. 1 10-20.http:www.ajol.info/browse-journals.php.

COMPARATIVE STUDY OF AMINO ACID PROFILE OF UREA PLUS METHIONINE SUPPLEMENTED AND FERMENTED SORGHUM BEER RESIDUE WITH THAT OF OTHER PROTEIN STANDARDS

***Ndams, S.S. and Alli-Balogun, J K**
College of Agriculture and Animal Science, Ahmadu Bello University, Mando Rd. Kaduna. Nigeria
**Corresponding Author's Email and Phone: samuelndams@gmail. com, +234 808 618 3938*

ABSTRACT
Sorghum beer residue (SBR), a by-product of local brewery was purchased dried, supplemented with urea and methionine at concentrations of 1.5: 0.37 %. It was inoculated with rumen liquor of cow and subjected to four days fermentation in a 5ft deep pit. After 4days fermentation, the urea plus methionine supplemented and fermented sorghum beer residue (RSBR) was sundried for 7days on concrete floor and samples taken for the determination of amino acid composition. The amino acid profile of RSBR sample revealed the availability of all essential amino acids except tryptophan (alanine, arginine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine and valine) in the sample. The amino acid profile of RSBR were higher than those of SBR, Groundnut cake (GNC), Soya bean cake (SBC), Food and Agricultural Organization (FAO) and other Animal Feed Standards (AFS). The superiority of essential amino acids in RSBR sample is an indication that it can serve as protein sources in place of conventional plant protein sources.

Keywords: Sorghum beer residue, Urea, Methionine, Fermentation and Amino acid.

INTRODUCTION
In Nigeria today, more than 50% of the country's poultry farms have closed down and another 30% forced to reduce their production capacity because of shortage of feed (Esonu el at., 2001). This feed shortage has been blamed on high cost of the conventional sources of feed ingredients which was rated by Madubuike and Ekenyem, 2006 at 70- 80% of total cost of poultry production. Soya bean and groundnut cakes have been used as protein supplements in poultry diets but their high cost has engineered the need to look for locally available and cheap sources of feed ingredients particularly those that do not attract competition between humans and livestock and for which Pousgha et al ., 2007 suggested traditional Sorghum beer residue. The nutritional qualities of sorghum beer residue (SBR) have been evaluated in the diets of chickens with some success (Demeke,2007 and Pousga et al 2007), it's maximum utilization as a plant protein source have been limited by its high fibre content (Aduku, 1993). The fibre fraction of a feedstuff has the greatest influence on its digestibility. The need to further recycle SBR through the process of fermentation in order to reduce its fibre content, obtain a high protein biomass and interesting amino acid composition becomes eminent. Protein quality is measured by the type of amino acids present. There are twenty different types of amino acids, eleven of which are essential in poultry nutrition because they are notmanufacturedby the animal's body. These include Lysine, Leucine, Isoleucine, Methionine Phenylalanine, Threonine, Tryptophan, valine, Arginine, Histidine and Glycine (Anhwange et al., 2004). Dietary protein with all the essential amino acids in the proportion required by the animal is said to be a high quality protein. In this study, sorghum beer residue was supplemented with urea and methionine and fermented for 4-days and its amino acids composition compared with those of FAO protein standard and Animal Feedstandard.

MATERIALS ANDMETHODS
Sample collection and Inoculumpreparation.

The sorghum beer residue was obtained from the local gin ("Burukutu") producers within Kaduna metropolis, Nigeria. Rumen content of cow was collected fresh just after slaughter at the Sabon-Tasha abattoir, Kaduna. This was then

mixed with water in a 2:1 ratio on a weight by weight (w/w) basis and filtered through a mosquito net of pore size 2.78mm^2 (Ndams *et al.*, 2011). The residue was discarded and the filtrate used as inoculum.

Substrateinoculation

The inoculation of sorghum beer residue prior to fermentation was carried out as described by Ndams *et al*. (2011). SBR was moistened with water at a ratio of 1:5 (w/w). SBR was supplemented with urea and methionine concentrations at a ratio of 1.5: 0.37 % (Fazaeli et al., 2007). The quantities of urea and methionine were first dissolved in the water containing the inoculum before wetting the substrate (SBR).

Substrateinoculation

On quantitative measurement, 2.67kg of methionine and 10.80kg of urea were dissolved in 3600kg of water in which 72.00kg of rumen liquor has been introduced before wetting 720kg (twelve bags of 60 kg each) of SBR. The SBR was inoculated on concrete floor and then turned into a 5ft deep pit lined with polythene materials. It was properly compacted by feet to maintain perfect anaerobic condition. The urea and methionine supplemented SBR was allowed to ferment for 4days. After fermentation, the pit was opened, and the fermented material removed. The fermented product (RSBR) was sundried for 7days on concrete floor and samples taken for determination of amino acidscomposition.

Determination of amino acidscomposition

The determination of amino acids profile in SBR, RSBR and GNC samples were carried out at the Department of Zoology, University of Jos using methods described by Sparkman *et al*. (1958).

RESULTS

The amino acids profile of RSBR sample revealed the availability of all essential amino acids except tryptophan (alanine, arginine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine and valine) in the samples.

Table 1 and figure 1 shows the amino acids profile of SBR, RSBR, GNC and other animal feed protein standards. The amino acids profile of the protein biomass (RSBR) produced after 4days fermentation, except for arginine, glycine and valine which were lower, all other essential amino acid concentrations were higher in RSBR than those of GNC. The amino acid concentrations of RSBR was numerically higher than those of Soya bean and FAO standards (with the exception of lysine which was lower compared to both) as well as that of Animal Feed Standard. Moreover, it had a superior profile in amino acid concentrations when compared to plantproteins.

Table 1: Comparison of the amino acid profile (g/100g protein) of the protein biomass of re-fermented sorghum beer residue with that of other protein standards

Amino acid	SBR	*RSBR	GNC	FAO[a]	SBC [b]	Animal feed standard (AFS)[c]
Alanine	8.66	8.89	2.10	-	-	-
Arginine	4.66	5.18	6.35	-	8.3	-
Cysteine	2.18	2.38	2.1	2.0	1.0	0.74
Glycine	3.17	3.60	7.8	-	4.5	2.43
Histidine	2.40	2.9	2.8	-	3.0	-
Isoleucine	4.18	4.63	2.1	4.20	5.6	2.57
Leucine	13.17	14.31	9.9	4.80	8.2	3.80
Lysine	2.38	3.02	2.1	4.20	6.8	3.20
Methionine	1.93	2.19	0.49	2.20	1.4	0.72
Phenylalanine	5.15	5.48	4.3	2.80	4.9	2.20
Threonine	3.48	4.53	4.3	2.80	4.0	1.97
Tyrosine	4.13	4.44	1.4	-	4.2	-
Serine	4.56	4.99	7.8	-	-	-
Valine	5.27	5.62	10.0	4.20	5.50	2.70

[a]Food and Agricultural Organization

*Urea and methionine treated and fermented sorghum beer residue, GNC= Groundnut cake, SBC = Soy bean cake. Sources: a= Araujo D'Souza (1986), b = Adapted from Park et *al*., 2002 (1991), c = Lo and Morean (1986). RSB = Unfermented sorghum beer residue.

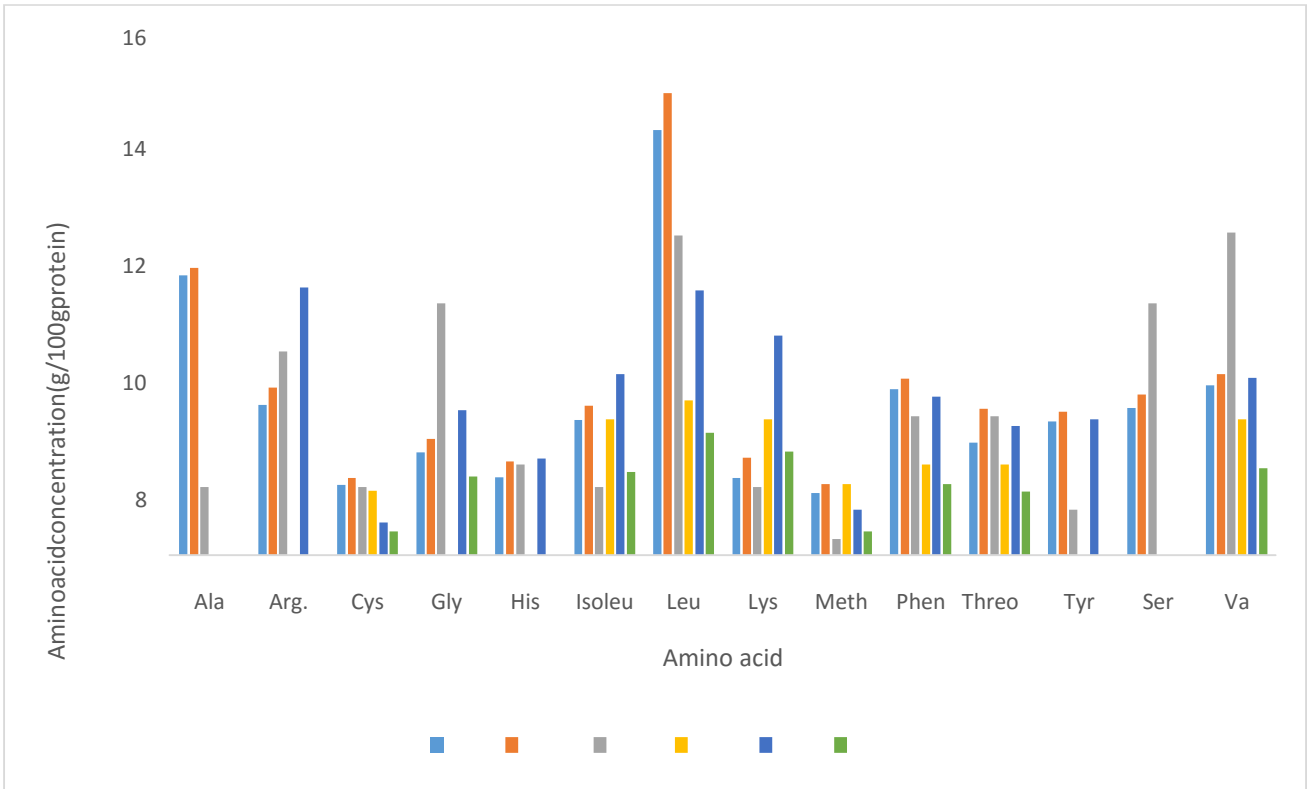


Figure 1: Comparison of the amino acid profile (g/100g protein) of the protein biomass produced (RSBR) with other protein standard

DISCUSSION

The availability of essential amino acids in SBR and RSBR is an indication that RSBR can serve as protein sources in non-ruminant nutrition (McDonald *et al*., 1998). The amino acid content of all the essential amino acids of RSBR samples were numerically higher compared to the unfermented (SBR) sample in this study. This is not inagreement with Spear *et al*., (1978) who observed numerical decrease in essential amino acids in lambs fed tall fescue supplemented with l-methionine Sulphur at 0.05 and 0.15% compared to the control (0%).The amino acid profile of the protein biomass (RSBR) produced in this study, was observed to be higher numerically than those of GNC. It was also superior to the amino acid profile of other plant proteins. The quality of the RSBR protein produced was equal or greater than that of the conventional ingredients in terms of its amino acid profile and the standard set for animal feed. This revealed that RSBR has all the essential amino acids for animal feed. This is in agreement with Ofuya and Obilor (1993) who observed that *Rhizopus* fermented cassava peel feedstuff contained all the essential amino acids that were far more digestible than the control. Also Almeida *et al*. (1995) observed that the protein obtained (34% of the biomass) contained all the essential amino acids for animal feeds when eucalyptus hydrolyzate was fermented using *paecilomycestes variottii*(fungus).

When compared to the FAO and soya bean standards, one can see that the protein standards and the protein biomass produced after 4days fermentation of SBR with urea and methionine supplementation contains all the essential amino acids for animal feeds. Moreover, it has a superior amino acid profile when compared to other plantproteins.

CONCLUSION

In conclusion, the results of this study indicates that 4-days fermentation of sorghum beer residue supplemented with urea and methionine resulted in a protein biomass (RSBR) with superior amino acid profile compared to GNC, Soyabean cake, FAO and Animal Feed Standards and can be used as an alternative to conventional feed ingredients in animalfeed.

RECOMMENDATION

Urea plus methionine treated Sorghum beer residue fermented for four days can be used in place or groundnut cake or soyabean cake as a protein source in monogastric nutrition.

REFERENCES

Aduku, A. O. (1993). Tropical feedstuffs Analysis Table. FacultyofAgriculture, Department of Animal Science, Ahmadu Bello University, Samaru, Zaria, Nigeria. Pp.1-2.

Almeida e Silva, J.S. Ismeal, J.B. Maria, M.M. and Magdala, A.T. (1995). Microbial protein production b*y Paecilomyces variotii* cultivated in eucalyptus hemicellulosic hydrolysate. *Bioresource Technology*. 52:197-200.

Anhwange, B.A, Ajibo, V.O. and Oniye, S.J (2004). Amino acid composition of seeds of Moringa oleifera (Lam), Detarium microcarpum (Guill & Sperr) and Bauhinia monandra (Linn). *ChemClass Journal.* (2): 9-13.

Araujo, A. and D'Souza, J. (1986). Enzymatic saccharification ofpretreated rice straw and biomass production. *Biotechnology and Bioengineering.* 28, 15039.

Demeke, S. (2007). Comparative nutritive value of Atella and industrial brewers grains in chicken starter ration in Ethiopia. *Livestock Research for Rural Development. 19 (1), http://www.cipav.0rg.co/Irrd19/1/deme19008.htm*.

Fazaeli, H., Mashsyekhi, M. R. and Mansouri, H. (2007). Effect of Nitrogen-Sulfur ratio on the digestibility of roughage based diet incubated with rumen liquor of buffalo. *Italian Journal of Animal Science.*6, (2): 450-45.

Lo, S. N. and Moreau, J. R. (1986). Mixed culture microbial protein from waste sulfite pulping liquor II. Its production on pilot plant scale and use in animal feed. *Canadian Journal of Chemical Engineering.* 64,639 – 46.

Madubuike, F. N. and Ekenyem, B.U. (2006). Haematology and serum biochemistry Characteristics of broiler chicks fed varying dietary levels of *ipoemea asarifolia* leaf meal. *International Journal of Poultry Science* 5(1):09-12.

McDonald P., Edwards, R.A., Greenhalg, J.F.D. and Morgan, C.A. (1998). Animal Nutrition(5thed). London Longman GRP. Ltd. Pp.623.

Ndams, S. S., Tegbe, T.S.B., Ogundipe, S.O. and Sheyin, Z. (2011). Determination of the optimum inoculums concentration and fermentation period and their effect on nutrient composition of Brewers dried grains. *Science World Journal 6 (1): 13-19.*

Ofuya, C.O. and Obilor S.N. (1993): The suitability of fermented cassava peel as a poultry feedstu`ff. *Bioresources Technology.* 44:101-104.

Park, H.Y., Kim, H.K., Kim, H.S., Lee, H.S., Shin, I.S. and Whang, K.Y (2002). Effects of the differentSoybean Meal Sources on Layer and Broiler Performance. *Asian-Australian Journal of Animal Science*. 15(2):254-265.

Pousga, S., Boly, H., Lindberg, J.E. and Ogle, B. (2007). Evaluation of Traditional Sorghum Beer Residue, Shea-Nut (*Vitellaria paradoxa)* Cake and Cottonseed (*Gossypium Spp)* Cake for Poultry in Burkina Faso: Availability and Amino Acid Digestibility. *International Journal of Poultry Science* 6(9): 666-672.

Sparkman, D.H., Stein, E.H. and Moore, S. (1958). Anti-nutritive recording apparatus for use in the chromatography of amino acid analytical chemistry.30:1190-1191.

Spear, J. W., Ely, D. G. and Bush, L.P. (1978). Influenced of supplemental sulfur on in vitro and in Vivo MicrobialFermentation of Kentucky 31 Tall Fescue. *Journal of Animal Science.* 47: 552-560.

INVESTIGATION OF GROWTH CONDITIONS ON THE LACCASE ACTIVITY OF *PLEUROTUS OSTREATUS* AND *CERIPORIOPSIS RIVULOSUS* DURING LOW QUALITY FORAGE UPGRADE AS POSSIBLE DRY SEASON FEED

O. J. IDOWU[1], A. S. CHAUDHRY[2] AND J. DOLFING[3]

[1]Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Nigeria, [2]School of Natural and Environmental Science, Newcastle University, Newcastle, United Kingdom, [3]School of Civil Engineering and Geosciences, Newcastle University, Newcastle, United Kingdom.

Corresponding author: idowuoj@funaab.edu.ng

ABSTRACT

This paper investigated the effects of some growth conditions i.e. forage-liquid ratio and fermentation time on the laccase activity of Pleurotus ostreatus (PO) and Ceriporiopsis rivulosus (CR) when used to upgrade selected low quality forages as possible dry season feed for ruminants. PO and CR were cultivated on Brachiaria decumbens (BD), Andropogon gayanus (AG), Triticum aestivum (TA) and Lolium perenne (LP) alongside untreated forages using two forage-liquid ratios (1:3 and 1:5) for each selected solid state fermentation times (14 and 28 days). The laccase activity of CR increased when the forages were in liquid ratio of 1: 5 at higher fermentation time with the exception of BD in ratio 1:3 at 28th day. The laccase activity of PO was increased when the forages were in liquid ratio of 1:3 at higher fermentation with the exception of TA in liquid ratio of 1:5. Generally increased fermentation time did not have much effect on the laccase production of each of the fungi on LP and TA; had minimal effect on AG; and had much effect on BD. It can therefore be concluded that for a higher laccase production to be recorded, CR should be cultivated on LP and TA in ratio 1:5 for shorter time, AG in ratio 1:5 for longer time, and BD in ratio 1:3 for a longer period. PO should be cultivated on AG and BD in ratio 1:3 for longer time, LP in ratio 1:3 for shorter time, and TA in ratio 1:5 for shorter time.

Keywords: Fungi, fermentation time, forages, laccase, ruminant feed

INTRODUCTION

The pre-treatment of low quality forages (LQF) with aerobic fungi (i.e. selective white rot fungi) have been one of the possible ways of upgrading the nutritive value of LQF found during the dry season. Among these white –rot fungi, PO and CR have increased ligninolytic ability to upgrade agro-industrial by-products and crop residues (Niu *et al*., 2018). However, the conditions of growth needed to be favourable for the release of ligninolytic enzymes especially laccase that are involved in the lignin degradation, a constituent that limits the access of other carbohydrates in feed to animals. Among these growth conditions, substrate-liquid ratio and incubation time were selected as they influences the release of enzymes. Substrate-liquid ratio affects the moisture content and optimal moisture content tends to positively influence fungal growth and laccase production by preventing substrate porosity or agglomeration (Patel *et al*., 2009). On the other hand, the incubation time has been identified to affect the rate and extent at which the fungi are capable of exhibiting their enzymatic functions, an essential or basic pre-requisite for fungal improvement of low quality feed (Arora and Sharma, 2009). This current work was carried out to identify the best substrate-liquid ratio and fermentation time that supports the release of laccase enzyme by each of the selected fungi on the selected low quality forages, as a criteria needed in the upgrade of low quality feed.

MATERIALS AND METHODS

A 2 (forage-liquid ratio) x 2 (fermentation time) factorial arrangement was used to obtain the main and interactive effects of the treatment on the laccase production of the fungi when used to inoculate the forages. Five (5g) of each of the forage samples (i.e. BD, AG, TA straw, and LP) used were weighed into 250ml Erlemneyer flasks, rehydrated with two different amounts (15ml and 25ml) of 1% Potato dextrose broth (CR) and 1% malt extract broth (PO) respectively to set the solid/liquid ratio for each of the fermentation time (14 and 28 days) respectively and then autoclaved at 121^0C for 15mins. Each of the Erlenmeyer flasks was then inoculated with three agar plugs (5mm) obtained from plates cultured on Potato dextrose agar at 20^0C (CR) and Malt extract agar at 30^0C (PO) for 10 days respectively and was replicated thrice for each treatment. This growth conditions have been identified in previous experiment. The flasks were thereafter incubated at either 20^0C (CR) or 30^0C (PO) in a dark environment at 95% humidity. Triplicated control flasks containing the substrates and the media but no fungal mycelium were also made available. After each time, 25ml of 10mM sodium acetic buffer solution (pH 5.0) was added to each selected flask for extraction of enzymes. The flasks were then kept in a shaking incubator (200rpm) for 20mins at 20^0C. The contents of each flask were filtered through a dried what-man filter paper no. 1 (150 mm diameter) and the filtrate was centrifuged at 10,000 rpm at 4^0C for 20 min. The supernatant was collected and laccase was determined by monitoring the oxidation of the diammonium salt of ABTS (2, 2' – azino – bis (3 – ethylbenz – thiazoline – 6 – sulfonic acid) as a substrate (Geng *et al*., 2004).

RESULTS AND DISCUSSION

Figure 1 and 2 shows the main effect of forage-liquid ratio at each inoculation time on laccase production by CR and PO respectively on the selected forages after 14th and 28th days of inoculation respectively. The highest laccase activity produced by *C. rivulosus* was at 1:5 ratio with the exception of BD at 28th day. The highest laccase activity produced by *P. ostreatus* for BD, AG and LP was at 1:3 ratio and that of TA was at 1: 5 ratio. The increase in laccase production with increase in inoculation time for CR was not different ($P > 0.05$) for LP; minimal for AG; and maximal for BD and TA. However, that of PO was not different ($P > 0.05$) for LP and TA but was different for AG and BD. The variations recorded in this study can be attributed to the effect of forages and fungi. Forage characteristics and the capacity of the system plays a major role on the fungal activity (Daniel, 2016). Fungi tends to require different optimal moisture content in their substrate before their ligninolytic activity can be exerted. Furthermore, fungi also vary in the incubation time at which they liberate solubles from substrates in preparation for lignocellulose degradation (Sharma and Arora, 2015)

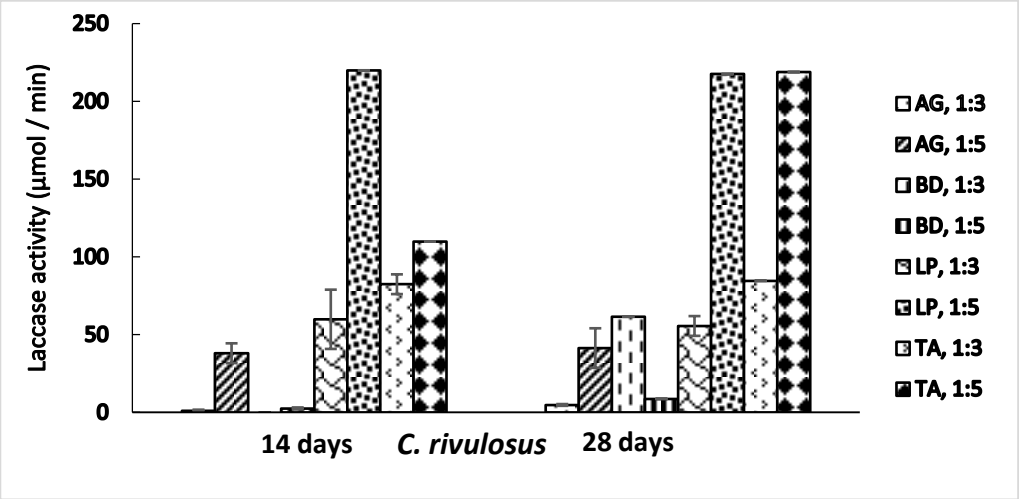


Figure 1.The main effect of substrate-liquid ratio on the laccase activity (µmol / min) of C. rivulosus *after 14th and 28th days of inoculation with the selected forages*

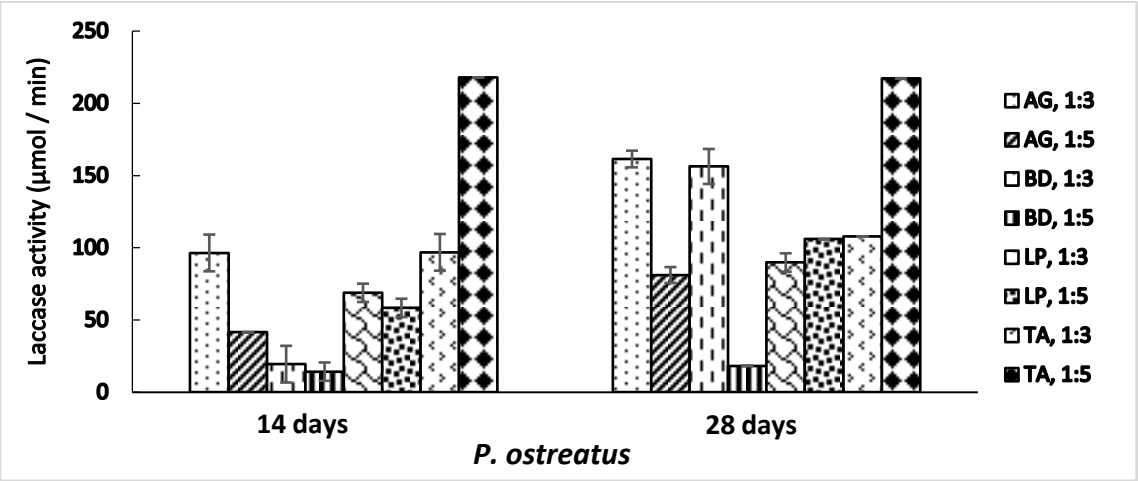


Figure 2.The main effect of forage-liquid ratio on the laccase activity (µmol / min) of P. ostreatus *after 14th and 28th days of inoculation with the selected forages*

Figure 3 shows the laccase activity produced by each of the fungi on the forages at different liquid ratios for 28 days is presented in Figure 3. In general substrate-liquid ratio 1:3 increased the laccase activity in *A. gayanus* and *B. decumbens* than ratio 1:5 and vice versa in *L. perenne* and *T. aestivum*. The forages can be grouped into two groups based on their ability to support laccase activity by the fungi: the low laccase producing group (i.e. BD and A) and the high laccase producing group (i.e. TA and LP). The forages varied in that LP and TA supported a higher production of laccase activity by the fungi by the 14th day of inoculation while for *BD* and AG it was by the 28th day of inoculation. The variations recorded in the forages is an indication that forages used for fungal treatment played a significant role in the liberation of solubles (Bhargav *et al*., 2008). Several factors such as their nutrient composition, degree of crystallinity of structural components especially cellulose, differences in the cell wall composition of C_3 and C_4, forage particle size etc. did have an influence on the ability of the fungi to get the required nutrients needed to initiate their growth and activity (Daniel, 2016).

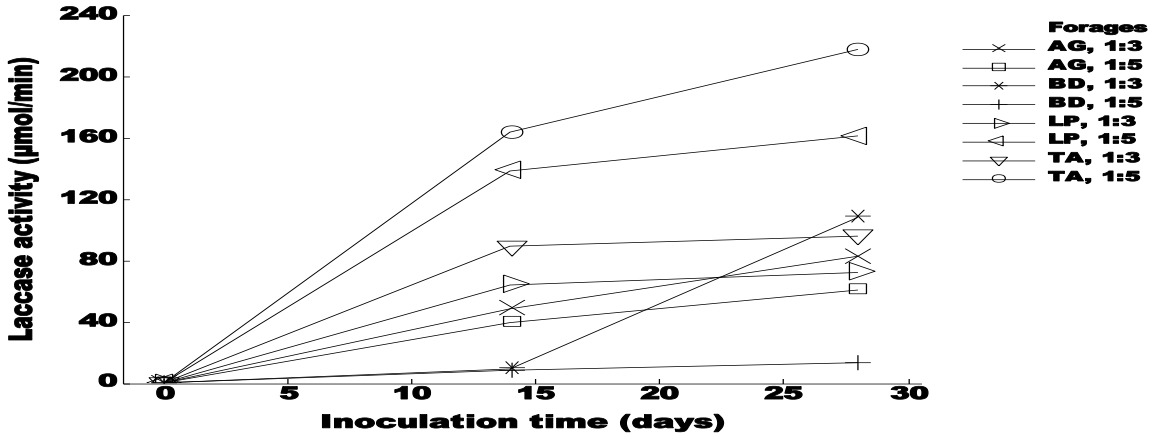


Figure 3 The laccase activity produced by the fungi as influenced by the forages at different sub – liquid ratios for 28 days.

CONCLUSION AND RECOMMENDATION

The fungi varied in their growth conditions requirement as increased laccase production was influenced by substrate-liquid ratio and fermentation time. CR should be cultivated on LP and TA in ratio 1:5 for shorter time, AG in ratio 1:5 for longer time, and BD in ratio 1:3 for a longer period. PO should be cultivated on AG and BD in ratio 1:3 for longer time, LP in ratio 1:3 for shorter time, and TA in ratio 1:5 for shorter time. The shorter fermentation helped in achieving laccase activity by the fungi earlier on LP and TA while longer fermentation time helped in achieving a higher laccase activity by the fungi on BD and AG. Further research in evaluating the effect of these fungi on the chemical composition and degradability potential of the treated forages should be investigated.

REFERENCES

Arora, D.S., & Sharma, R.K. (2009). 'Comparative ligninolytic potential of Phlebia species and their role in improvement of *in vitro* digestibility of wheat straw', *Journal of Animal and Feed Sciences*, 18(1), pp. 151-161.

Bhargav, S., Panda, B.P., Ali, M., & Javed, S. (2008). 'Solid-state fermentation: an overview', *Chemical and Biochemical Engineering Quarterly*, 22(1), pp. 49-70.

Daniel, G. (2016). 'Chapter 8 - Fungal Degradation of Wood Cell Walls A2 - Kim, Yoon Soo', in Funada, R. and Singh, A.P. (eds.) Secondary Xylem Biology. Boston: Academic Press, pp. 131-167.

Geng, X., Li, K., & Xu, F. (2004). "Investigation of hydroxamic acids as laccase-mediators for pulp bleaching." *Applied Microbiology and Biotechnology* 64(4): 493-496.

Niu, D., Zuo, S., Jiang, D., Tian, P., Zheng, M., & Xu, C. (2018). 'Treatment using white rot fungi changed the chemical composition of wheat straw and enhanced digestion by rumen microbiota *in vitro*', *Animal Feed Science and Technology*, 237, pp. 46-54.

Patel, H., Gupte, A., & Gupte, S. (2009). 'Effect of different culture conditions and inducers on production of laccase by a basidiomycete fungal isolate *Pleurotus ostreatus* HP-1 under solid state fermentation', *BioResources*, 4(1), pp. 268-284.

Sharma, R.K., & Arora, D.S. (2015). 'Fungal degradation of lignocellulosic residues: An aspect of improved nutritive quality', *Critical Reviews in Microbiology*, 41(1), pp. 52-60.

INTERACTION EFFECT OF BREEDS OF GOAT AND LEVELS OF TURMERIC POWDER INCLUSION ON MILK YIELD FOR 12 WEEKS POST-KIDDING

Oderinwale O. A.[1&2], Oluwatosin B. O.[2&3], Onagbesan M. O.[2&4], Akinsoyinu A. O.[5], Amosu S. D.[1] & Sanusi G. O.[1]

[1]Department of Animal Production and Health, Federal University of Agriculture Abeokuta (FUNAAB), PMB 2240, Abeokuta, Ogun State, Nigeria

[2]Livestock Science and Sustainable Environment Programme, World Bank Africa Centre of Excellence in Agricultural Development and Sustainable Environment (CEADESE), FUNAAB

[3]Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), FUNAAB

[4]Department of Animal Physiology, FUNAAB

[5]Department of Agriculture and Industrial Technology, Babcock University, Ilisan, Ogun State, Nigeria

Corresponding Address: oderinwale.olatunde@gmail.com ; +2347039432202

ABSTRACT

The study was conducted to evaluate interaction effect of breeds of goat and levels of turmeric powder (TP) inclusion on milk yield for 12 weeks post-kidding. Forty-five lactating Does comprising of 15 Kalahari Red (KR), 15 KalaWAD and 15 West African Dwarf (WAD) were used. The Does were randomly allotted to 3 treatments comprising of 5 Does of same breed per treatment. Three diets, that is concentrate diet (CD) as T0; CD+2g/kg TP as T2; and CD+5g/kg TP as T5 were fed at 5% bodyweight during pregnancy and for 12 weeks of lactation. Data obtained were arranged in a 3x3 factorial layout in a completely randomized design, while ANOVA was done using SAS 9.1. Results obtained revealed that KR fed T0 had the highest significant ($p<0.05$) milk yield (1100.00ml/24hrs) at 1st week of lactation compared to other dietary treatments. KR fed T2 had the overall best performance in terms of milk yield from 2nd to 12th week of lactation except at week 5 where KR fed T0 had the highest significant ($p<0.05$) value of 1160ml/24hrs. Peak value ($p<0.05$) of 1560ml/24hrs was recorded for KR fed T2 at 4th week of lactation, whereas WAD fed T0 had the lowest values for milk yield from weeks 1 to 12 with a peak value of 464.67ml/24hrs at 6th week of lactation. It could be concluded from the results of the study that feeding of concentrate diet with TP especially at the rate of 2g/kg of concentrate to KR Does generally improved the milk yield compared to other breeds of goat used and TP levels.

Keywords: Lactation, Kalahari Red, West African Dwarf, KalaWAD goats, Supplementation

INTRODUCTION

Goats are important for the supply of high quality protein in milk through conversion of feed from non-competitive sources. In developing countries like Nigeria, sheep and goats are often kept in marginal environments with scarce grazing and unfavourable climatic conditions (FAO, 2019). Goats are the third ranking source of milk after cows and buffaloes (Devendra, 1980). Goats are dairy animals of the poor because of the lower capital investment and production costs required, and the animals' rapid generation turnover (and thus earlier milk production compared to other dairy animals), short pregnancies and milk supply in quantities that are suitable for immediate household consumption (FAO, 2019). The efficiency of milk production is dependent on high milk yields. Development of milk production from goats by small farmers in the tropics can complement commercial milk production especially from cows, and it is important for alleviation of undernutrition and malnutrition due to its high nutritional content (FAO, 2010) among the rural dwellers, people with lactose intolerance and other health challenges.

Turmeric (*Curcuma longa*) is believed to have spread from South-East Asia to nearby places like Indonesia, China, Japan and other South Pacific Islands and from there to tropical West and East Africa (Velayudhan *et al.*, 2012). The active ingredients found in turmeric are curcumin, demethoxycurcumin, bisdemethoxycurcumin (Wuthi-Udomler *et al*., 2000) and tetrahydrocurcuminoids (Osawa *et al*., 1995). The curcumin contained in turmeric is believed to have a wide range of biological effects such as anti-inflammatory, antioxidant, anti-tumour, antibacterial, and antiviral activities among others (Prasad *et al*., 2011). Despite the usefulness of turmeric to livestock production, there is no information on its effect on milk yield of goats, thus necessitating conduct of this study

MATERIALS AND METHODS

Preparation of turmeric powder

Fresh turmeric rhizomes were sourced from Oyo State. The rhizomes were sorted, washed, drained and spread in a dry cool to allow drying. Slicing was done afterwards using sharp knives into smaller pieces and thereafter oven dried at 60°C to a constant weight. The dried rhizomes were milled into fine powder using electric blender before its inclusion in the experimental diet and for necessary laboratory analyses.

Animal Management Procedure

A total of 45 matured non-pregnant, and non-lactating Does of at least parity one within age range of 2-2$^{1}/_{2}$ years were sourced from IFSERAR, Federal University of Agriculture Abeokuta, Nigeria. These included 15 Kalahari Red (KR), 15 KalaWAD (KW) and 15 West African Dwarf (WAD) Does. The Does were synchronized after flushing with 1st and 2nd intramuscular injection of Lutalyse® according to the procedure of Heise (2012). Thereafter, mating was done when the synchronized Does came on heat by introducing 6 healthy and proven KR bucks (i.e. 2 bucks per goat breed) into the pens where the Does were housed for at least 5 hours/day for a week. The Does were randomly allotted to 3 treatment groups comprising of 5 Does of same breed per treatment. Flock treatment was carried out prior to mating.

EXPERIMENTAL DIETS

T0: Basal concentrate diet (Control)

T2: Basal concentrate diet + 2g/kg turmeric powder

T5: Basal concentrate diet + 5g/kg turmeric powder

The basal concentrate diet is composed of maize (15kg); wheat offal (42kg); palm kernel cake (30kg); soybean meal (4kg); groundnut cake (3kg); bone meal (3kg); limestone (1.5kg); common salt (1kg); and premix (0.5kg). The dietary treatments were used for flushing of the Does for 2 weeks before the commencement and throughout the experimental period.

FEEDING TRIAL

The pregnant Does were fed individually with experimental concentrate diets for 24 weeks (162 days) until when all the Does kidded. The Does were also fed the diets during lactation phase that lasted for 12 weeks. The diets were administered at 5% body weight throughout the feeding trial. Stall feeding was done using *Brachiaria ruziziensis*. Cool and clean drinkable water was provided for the Does *ad libitum*.

Milk Collection Procedure

Milk was collected from all the Does for 12 weeks starting from a week after kidding by hand milking. Kids were allowed to suckle by themselves before the cisterns are emptied by draining the milk contained in them manually each time milk is collected. The kids are usually separated from the dams for 4hours after which milk produced during the period by individual Does housed in a separate wooden cubicle is collected. At the time of milk yield collection, a neat napkin dipped in warm water is used to clean the udder, followed by slight massaging of the udder with a full palm after which the teats (left and right) on the udder are put in between the thumb and fourth finger; and stripped up-down until the cisterns are empty. Milk collected from each Doe for the 4hrs of separation is measured using a measuring cylinder.

Milk yield (ml/24hrs) = Milk collected per Doe after 4hrs of separation (ml) x 6

Proximate and Fibre Analysis of Concentrate, Turmeric powder and Grass Fed

Samples taken from dietary concentrates, turmeric powder and *Brachiaria ruziziensis* were milled, and kept until when needed for proximate composition (AOAC, 2005) and fibre fractions (Van Soest, 1991).

STATISTICAL ANALYSIS

Data obtained were arranged in a 3x3 factorial layout in a completely randomized design, while ANOVA was done using the procedures of SAS (2004). Significant level was taken at 5% probability, while means was separated using Duncan's multiple range test of the same statistical package.

RESULTS AND DISCUSSION

The proximate and fibre fraction compositions of the basal experimental concentrate diet is presented in Table 1. The crude protein (CP) of the diet (16.49%) was sufficient to meet the need of the Does during pregnancy and lactation according to the report of NRC (2007) which recommends CP ranges of 13-14% and 12-17% for goats during pregnancy and lactation respectively.

Table 1: Proximate and fibre fraction compositions of basal experimental concentrate diet

Parameters (%)	TM-0
Dry Matter	88.19
Crude Protein	16.49
Ether Extract	2.48
Crude Fibre	27.50
Ash	10.98
Nitrogen Free Extract	41.74
Organic Matter	89.02
Neutral Detergent Fibre	62.67
Acid Detergent Fibre	38.00
Acid Detergent Lignin	10.67
Hemicellulose	24.67
Cellulose	27.33
*ME (MJ/kg DM)	12.27

ME= Metabolisable Energy

*Calculated using De Boever *et al.* (1997) equation

The interaction effect of breeds of goat and levels of turmeric powder inclusion on milk yield from 1st week of kidding to 12 weeks post-kidding in Table 2 showed that KR fed T0 had the highest significant ($p<0.05$) milk yield at 1st week of lactation compared to other dietary treatments. This might be due to the fact that it recorded the highest level of oxytocin and reasonable level of prolactin within 24hrs of kidding. KR fed T2 had the overall best performance in terms of milk yield from 2nd to 12th week of lactation except at weeks 2 (KR fed T5); 5 (KR fed T0); and 10 (KR fed T5). Peak value of 1560ml/24hrs was recorded for KR fed T2 at the 4th week of lactation which was the highest significant ($p<0.05$) milk yield obtained for the study. The lowest milk yield (240mls/24hrs) recorded for KR was for those fed T0 at weeks 11 and 12 of the study. KW compared favourably with KR in terms of milk yield, where KW fed T2 had the peak value of 1040ml/24hrs at week 4, whereas lowest value (375ml/24hrs) was recorded for KW fed T0 at the 12th week. WAD fed T0 had the lowest values for milk yield from weeks 1 to 12 with peak value of 790ml/24hrs which was recorded for WAD fed T2 at the 2nd week of lactation. Lowest milk yield of 206.67ml/24hrs was recorded for WAD fed T0 at week 12. The results obtained corroborate that of Mardalena *et al.* (2011) who reported that milk of Etawah dairy goats supplemented with diets containing antioxidant at 0.02%, 0.04% and 0.06% inclusion levels had improved milk yield compared to those without antioxidant supplementation.

ACKNOWLEDGEMENT

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CONCLUSION AND RECOMMENDATION

It could be concluded from the results of the study that feeding of concentrate diet containing turmeric powder especially at the rate of 2g/kg of concentrate to Kalahari Red Does generally improved the milk yield of the goat compared to other breeds of goat used and turmeric powder inclusion levels.

REFERENCES

AOAC 2005. *Official Methods of Analysis* (18th Edition). Association of Official Analytical Chemists, Washington DC, USA.

De Boever J. L., Cottyn B. G., De Brabandar, D. L., Vanacker, J. M. and Boucque, C. V. 1997. Prediction of the feeding value of maize silage by chemical parameters, *in vitro* digestibility and near infra-red spectroscopy (NIRS). *Animal Feed Science and Technology,* 66: 211-222

Devendra C. 1980. Milk Production in Goats Compared to Buffalo and Cattle in Humid Tropics. *Journal of Dairy Science,* 63(10): 1755-1767

Food and Agriculture Organization (FAO) 2010. A dairy goat production handbook for farmers. http://www.fao.org/3/CA3399EN/ca3399en.pdf

Food and Agriculture Organization (FAO) 2019. Gateway to dairy production and products. http://www.fao.org/dairy-production-products/production/dairy-animals/small-ruminants/en/

Heise, A. 2012. Artificial Insemination in Veterinary Science, A Bird's-Eye View of Veterinary Medicine, Dr. Carlos C. Perez-Marin (Ed.), InTech, Available from: http://www.intechopen.com/books/a-bird-s-eye-view-of-veterinary-medicine/artificial-insemination-in-veterinaryscience.

Mardalena, L. Warly, E. Nurdin, W.S.N. Rusmana and Farizal 2011. Milk quality of dairy goat by giving feed supplement as antioxidant source. *Journal of Indonesian Tropical Animal Agriculture,* 36(3): 205-211.

National Research Council (NRC) 2007. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Committee on the Nutrient Requirements of Small Ruminants, National Research Council Report. ISBN: 978-0-309-10213-1.384.

Osawa, T., Y. Sugiyama, M. Inayoshi and S. Kawakisi. 1995. Anti-oxidative activity of tetrahydrocurcuminoids. *Biotech Biochem.* 59: 1609-161.

Prasad, S, Aggarwal, B. B., Benzie, I. F. F., and Wachtel-Galor, S. 2011. Benzie IFF, Wachtel-Galor S, eds. Turmeric, the Golden Spice: From Traditional Medicine to Modern Medicine*; In: Herbal Medicine: Biomolecular and Clinical Aspects;* Chap. 13. 2nd edition. CRC Press, Boca Raton (FL).

S.A.S. 2002. User's Guide. Statistical Analysis Institute Inc. Cary, N.C.

Van Soest P.J., Robertson J.B.. and Lewis B.A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci.,* 74(10): 3583-97

Velayudhan K.C., Dikshit N. and AbdulNizar M. 2012. Ethnobotany of turmeric (*Curcuma longa* L.). *Indian Journal of Traditional Knowledge*, 11(4): 607-614

Wuthi-udomler, M., W. Grisanapan, O. Luanratana and Caichompoo W. 2000. Anti-fungal activities of plant extracts. *South East Asian J. Trop. Med. Public Health,* 31(1): 178-182.

Table 1: Interaction effect of breeds of goat and levels of Turmeric powder inclusion on milk yield from 1st week of kidding to 12 weeks post-kidding

	Kalahari Red			KalaWAD			West African Dwarf		
Weeks	T0	T2	T5	T0	T2	T5	T0	T2	T5	SEM
1 (ml/24hrs)	1100.00^{a}	882.00^{abc}	938.67^{abc}	790.00^{abc}	880.00^{abc}	1000.00^{abc}	373.33^{d}	560.00^{cd}	638.00^{bcd}	52.54
2 (ml/24hrs)	700.00^{bc}	1270.00^{ab}	1386.67^{a}	690.00^{bc}	1140.00^{ab}	950.00^{abc}	400.00^{c}	790.00^{abc}	630.00^{bc}	78.90
3 (ml/24hrs)	1140.00^{ab}	1500.00^{a}	853.33^{ab}	610.00^{b}	980.00^{ab}	560.00^{b}	393.33^{b}	682.50^{b}	525.00^{b}	92.00
4 (ml/24hrs)	1220.00^{ab}	1560.00^{a}	853.33^{bc}	690.00^{bc}	820.00^{bc}	1040.00^{abc}	413.33^{c}	555.00^{bc}	412.75^{c}	90.78
5 (ml/24hrs)	1160.00^{a}	920.00^{ab}	866.67^{abc}	570.00^{bc}	860.00^{abc}	890.00^{abc}	453.33^{c}	530.00^{bc}	465.00^{c}	56.61
6 (ml/24hrs)	620.00^{bcd}	1020.00^{a}	916.67^{ab}	630.00^{bcd}	835.00^{abc}	830.00^{abc}	464.67^{d}	590.00^{bcd}	510.00^{cd}	45.57
7 (ml/24hrs)	480.00^{cd}	923.33^{a}	900.00^{a}	550.00^{bcd}	740.00^{abc}	800.00^{ab}	409.00^{d}	490.00^{cd}	397.50^{d}	45.41
8 (ml/24hrs)	280.00^{c}	1536.67^{a}	890.00^{b}	460.00^{bc}	743.00^{bc}	655.00^{bc}	388.67^{c}	423.25^{bc}	362.50^{c}	80.50
9 (ml/24hrs)	360.00^{b}	773.33^{a}	766.67^{a}	540.00^{ab}	550.00^{ab}	715.00^{a}	320.00^{b}	460.00^{ab}	365.00^{b}	41.92
10 (ml/24hrs)	330.00^{b}	656.67^{a}	726.67^{a}	415.00^{b}	680.00^{a}	650.00^{a}	266.67^{b}	495.00^{ab}	411.50^{b}	35.50
11 (ml/24hrs)	240.00^{d}	720.00^{a}	600.00^{ab}	450.00^{bc}	615.00^{ab}	650.00^{a}	320.00^{d}	392.50^{cd}	372.50^{cd}	32.30
12 (ml/24hrs)	240.00^{de}	701.33^{a}	559.67^{ab}	375.00^{cd}	525.00^{bc}	625.00^{ab}	206.67^{e}	397.25^{cd}	302.25^{de}	33.82

^{abcde} Means on the same row having different superscripts are significantly different ($p<0.05$)

T0 *is without Turmeric*; T2 *is 2g/kg Turmeric Powder Inclusion*; T5 *is 5g/kg Turmeric Powder Inclusion*

SILAGE QUALITY AND GROWTH PERFORMANCE OF WEST AFRICAN DWARF GOATS FED *MORINGA OLEIFERA* LEAVES ENSILED WITH CASSAVA PEELS

Odeyinka, S.M., *Abegunde, T.O., Ofoegbu, M.O. & Apanisile, O.J.
Department of Animal Sciences, Obafemi Awolowo University Ile-Ife, Osun State, 220282, Nigeria
**Corresponding Author e-mail:* tayeabegunde@yahoo.com Tel: +2348032521212

ABSTRACT

Forage scarcity in the dry season is very challenging for ruminant production in the tropics. The utilization of browse species, particularly as silage can bridge this gap. This study assessed the potentials of Moringa oleifera leaves ensiled with varying levels of cassava peels as dry season feed for West African Dwarf (WAD) goats.

Different mixtures of Moringa oleifera leaves and cassava peels were ensiled and designated as follows: T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels, T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels. Chemical composition and silage characteristics were investigated. 25 WAD goats with weights ranging between 4.83-6.90 kg were used in the growth study. Chemical composition of the silage diets showed that it contained 27.79 – 36.26 % dry matter (DM), 7.45 – 22.25 % crude protein (CP), 8.92 – 16.45 % crude fibre (CF), 2.55 – 7.01 % ether extract (EE), 6.10 – 10.08 % ash content, 42.40 - 68.14 % Nitrogen Free Extract (NFE). Appearance, odour and texture of the silage had acceptable physical attributes with pH values ranging from 3.53 – 5.80. Average daily feed intake (ADFI) and Feed conversion ratio (FCR) were not significantly (P<0.05) affected by diets while Average daily weight gain (ADWG) was significantly improved in T3 (40% M. oleifera + 60% cassava peels) than in others.

It was concluded that Moringa oleifera leaves silage with 40% cassava peels as additive elicited the best performance indices in WAD goats fed diets consisting of mixtures of Moringa oleifera leaves and cassava peels ensiled together in graded levels or alone.

Keywords: Feed Intake, Growth, *Moringa oleifera*, Silage, WAD Goats.

INTRODUCTION

Livestock productivity in the tropics has suffered major setback due to inadequate quantity and quality of feeds for animals especially during dry season (Peters, 1998). Tree fodders maintain higher protein and mineral contents during growth than do grasses, which decline rapidly in quality with progress to maturity (Aganga and Tshwenyane, 2003). Due to the deciduous nature and leaves-shattering of some of these tree fodders, silage making which has great potential to solve shortage of feed for small ruminants by preserving excess forage produced during the wet season for use at the dry period could be adopted . Protein content of *Moringa oleifera* leaves is high. They also contain high mineral value and high yield potential (Aregheore, 2002) and can be exploited for feeding animals during the dry season when forage is scarce. Low levels of fermentable carbohydrates in *Moringa oleifera* limit its use as a silage material, hence there is a need to mix with highly fermentable carbohydrate to enhance its silage value. Cassava peels contains readily fermentable carbohydrates and have been used as additive (Olorunnisomo, 2011) in grass silage fed to Red Sokoto goats. Ensiling moringa together with cassava peel presents an opportunity to preserve their nutrients and enhance their feeding value for small ruminants during the dry season. This study was therefore designed to assess the silage quality and growth performance of WAD goats fed *Moringa Oleifera* leaves ensiled with different levels of cassava peels.

MATERIALS AND METHODS

EXPERIMENTAL STATION AND DURATION

The experiment was carried out at the Sheep and Goat Unit, Obafemi Awolowo University (OAU) Teaching and Research Farm, Ile – Ife located approximately between latitude 7^0 31´N and 7^0 33´N; and longitudes 4^0 33´E and 4^0 34´E (Amujoyegbe *et al*., 2008). The experiment lasted Twelve (12) weeks.

SILAGE PRODUCTION AND EXPERIMENTAL DIETS

Moringa oleifera leaves were collected from plots within the Obafemi Awolowo University Teaching and Research Farm, Ile – Ife, Osun State. Fresh cassava peels were also collected from a cassava processing Unit within the OAU Teaching and Research Farm. They were chopped into bits using a forage chopper machine and then included in the silage mixture in levels as designated:

T1= 100% *Moringa oleifera*; T2= 60% *Moringa* + 40% Cassava peels; T3= 40% *Moringa* + 60% Cassava peels; T4= 50% Moringa + 50% Cassava peels; T5= 100% Cassava peels.

Mixture was packed, compacted and sealed in thick polythene bags to create an anaerobic condition for proper fermentation. The silage was ensiled for 21 days after which they were opened.

EXPERIMENTAL ANIMALS AND THEIR MANAGEMENT

Twenty-five growing WAD goats with average weight of 6.02 ± 0.88 kg were randomly assigned to the five experimental diets in a completely randomized design. There were 5 goats per treatment with each animal serving as a replicate. The goats were housed in open sided, well-lighted and adequately ventilated building with slated floor. The house was disinfected before the animals arrived. The animals were vaccinated against *Pestes des Petite Ruminantes*, quarantined and observed for any disease symptom for seven days. The goats were also dewormed and treated against ectoparasites using ivomec ® prior to the commencement of the experiment. Animals were feed at 5% of their body weight. Water was supplied *ad libitum*.

GROWTH PERFORMANCE DETERMINATION

Growth trial lasted twelve weeks. Each animal was weighed using hanging scale and weighing sack before the commencement of the study and subsequently were weighed weekly throughout the experimental period. Parameters measured included; feed refusal, feed intake and weight gain.

Determination of silage quality: After 21 days, the fermentation was terminated by opening the silage bags and silage quality characteristics (colour, aroma and texture) were assessed using the method of Babayemi (2009). Silage pH was determined according to the methods described by Falola *et al*. (2013). Colour assessment was carried out through visual assessment with the aid of a colour chart. Aroma of the silage was assessed by 5 different people. Sub-samples from the treatments and at different depths were taken and mixed together for dry matter determination by oven drying at 65^0C until a constant weight was achieved. The samples were later milled and stored in triplicates in cellophane bags until needed for chemical analysis.

CHEMICAL ANALYSIS:

Crude protein, crude fibre, ether extract and ash of the silages were determined according to the methods of AOAC (1990). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined using the procedure of Van Soest *et al*. (1991).

STATISTICAL ANALYSIS

All data were subjected to a one way analysis of variance (ANOVA) of SAS (1999) in a completely randomized design and treatment means, where significant, were separated using Duncan's Multiple Range Tests of the same package.

RESULTS AND DISCUSSION

The chemical composition of *Moringa oleifera* and cassava peels based silage diets are presented in Table 1. The Dry matter content and Nitrogen Free Extract (NFE) of silage increased as the proportion of the cassava peels in the silage increased while the crude protein, Fibre fraction and Ash reduced. The increased level of NFE and reduced crude protein in the silage mixture with increasing proportion of cassava peels indicate that the addition of cassava peels to Moringa based silage diets improved the energy at the expense of the protein. This is similar to the result obtained by Olorunnisomo and Adesina, (2013) when they assessed the preference of Zebu cows for Moringa leaves ensiled with different levels of cassava peels. The feed mixtures except T5 (sole cassava peels silage) with a CP level of 7.45% met the requirement for protein recommended for ruminants (10-12%) (ARC, 1980). This implies that animals fed high percentage of cassava peels would need protein supplementation to meet their requirement for maintenance and production.

Table 2 shows the silage characteristics of *Moringa oleifera* and cassava peels based silage diets. Appearance, odour and texture of the silage had acceptable physical attributes with pH values ranging from 3.53 – 5.80. Good silage usually preserve well of the original colour of the pasture or any forage (t'Mannetje, 1999). The greenish and dark spots colour of the silages showed that the original colours of the silage constituents were well preserved.

Table 3 shows the growth performance of WAD goats fed *Moringa oleifera* and cassava peels silage diets fed to WAD goats. Average daily feed intake ADFI (g) of diets were not significantly ($P<0.05$) affected by silage diets. Final weight of goats in T2 was significantly higher in T2 than in T5, but similar in T1, T3 and T4.

The Average Daily Gain (ADG) obtained in this study (12.30 -19.05 g/day) is similar to values of 10.60 - 24.60 g/day reported by Okolo *et al*., (2012) for WAD goats fed graded levels of cashew nut shell with some other non-conventional feed stuff. They are also similar to the range of 14.88-21.43 g/day reported by Asaolu *et al*., (2012) for WAD goats offered dried leaves of Moringa, Gliricidia and Leucaena as supplement to a basal diet of cassava peels. Animals fed silage diets consisting of a mixture of 40% Moringa and 60% cassava peels elicited the highest ($P<0.05$) weight gain (19.05) compared to others. Result appears to suggest an associative effect of the combination of Moringa and cassava at this level which gave the best ADG beyond which values were observed to decline. FCR were similar in diets.

Table 1: Proximate composition of *Moringa oleifera* and cassava peels based Silage diets fed to WAD goats

Parameters	T11	T2	T3	TT4	T5
Moisture	6.28	3.71	3.75	4.00	2.38
Dry matter	27.83	30.40	27.79	28.06	36.26
Crude fibre	16.45	12.75	11.94	15.70	8.92
Crude protein	22.25	16.50	12.75	14.38	7.45
Ash	10.08	9.40	7.95	8.66	6.10
Ether Extract	2.55	6.81	6.45	6.64	7.01
NFE	42.40	50.79	57.17	49.62	68.14
Fibre fractions					
NDF	53.17	36.60	45.43	48.69	32.78
ADF	40.04	25.88	30.30	36.55	17.92
LIGNIN	12.02	10.78	11.90	17.82	5.98

T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels;

Table 2: Silage characteristics of *Moringa oleifera* and cassava peels based silage diets.

Parameters	T1	T2	T3	T4	T5
Appearance	Greenish + dark spots	Greenish brown + dark spots	Greenish brown + dark spots	Greenish brown + dark spots	Brown
Odour	Pleasant with faint acidic smell	Pleasant with fruity smell	Pleasant with fruity smell	Pleasant with fruity smell	Pleasant with fruity smell
Texture	Firm and moist	Firm and moist	Firm and moist	Firm and moist	Firm and moist
pH	4.80	3.95	3.82	3.86	3.53
Temp (^{0}C)	29.20	28.60	28.80	28.70	29.30

T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels

T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels.

Table 3: Growth performance of WAD goat fed *Moringa oleifera* based silage diets

Parameter	T1	T2	T3	T4	T5	SEM	P-value
ADFI (g)	138.64	143.05	138.33	138.34	130.86	0.3624	0.520
Initial weight (kg)	6.13	6.90	6.07	6.17	4.83	0.3560	0.533
Final weight (kg)	7.50^{ab}	8.17^{a}	7.67^{ab}	7.23^{ab}	5.87^{b}	0.3397	0.284
TWG (kg)	1.37	1.27	1.60	1.06	1.04	0.108	0.880
ADG (g/day)	16.31^{b}	15.11^{b}	19.05^{a}	12.62^{c}	12.38^{c}	0.0013	0.340
FCR	8.50	9.47	7.26	10.96	10.57	0.3624	0.520

$^{a,b.c.}$; Means within rows with different superscript are significantly different (P<0.05); T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels; ADFI - Average Daily Feed Intake; ADG - Average Daily Gain; TWG - Total weight gain; FCR - Feed Conversion Ratio

CONCLUSION

The study concluded that 40% *Moringa Oleifera* leaves ensiled with 60% cassava peels as additive elicited the best performance indices in WAD goats fed *Moringa oleifera* and cassava peels based silage diets.

REFERENCES

Aganga, A.A. and S.O. Tshwenyane. 2003. Feeding Values and Anti - Nutritive Factors of forage Tree Legumes. *Pakistan. J. Nutr*. 2(3), 170-177.

Amujoyegbe, B.J., Bamire, A.S. and Elemo, K.O. 2008. Agroeconomic analysis of fertilizer effects on maize/cowpea intercrop in Ile-Ife and Abeokuta, Southwestern Nigeria. *Asset Series A, 8 (1): 62-72.*

AOAC, 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, DC., USA., pp: 200-210.

ARC (1980). The nutrient requirement of ruminant livestock. Agricultural Research Council, Uk., ISBN:9780851984599, Pages: 351

Aregheore E.M. (2002). Intake and digestibility of *Moringa oleifera*-batiki grass mixtures for growing goats. *Small Rum. Res*. 46: 23–28

Asaolu, V. O., Binuomote, R., Akinlade, J., Aderinola, O. and Oyelami, O. (2012). Intake and growth performance of West African Dwarf goats fed *Moringa oleifera, Gliricidia sepium* and *Leucaena leucocephala* dried leaves as supplements to cassava peels. *J.Biol.Agric. Health Care*, 2(10): 76-88.

Babayemi, O.J. (2009). Silage quality, dry matter and digestibility by West African Dwarf sheep fed Guinea grass (*Panicum maximum* cv Ntchisi) harvested at 4 and 12 weeks regrowths, *African journal of Biotechnology*, 8(16): 3983.

Falola, O. O., Alasa, M. C. and Babayemi, O. J. 2013. Assessment of Silage Quality and Forage Acceptability ofVetiver Grass *(Chrysopogon zizanioides 1. Roberty)* Ensiled with Cassava Peels by WAD Goats. *Pakistan Journal of Nutrition.* 12 (6): 529-533.

Okolo, F. A., Ocheja, J. O., Lalabe, B. C. and Ejiga, P. A. (2012). Digestibility, performance and bio-economics of growing West African Dwarf goats fed diets containing graded levels of cashew nut shell. *International Journal of Agriculture and Rural Development,* 15 (2): 1000 – 1007

Olorunnisomo O.A and Adesina. (2013). Silage Characteristics, Nutritive Value and Preference of Zebu Cows for Moringa Leaf Ensiled with Different Levels of Cassava Peel. *Agricultural Journal* 8(6):295-2298, 2013, ISSN:1816 9155

Olorunnisomo, O. 2011. Intake and digestibility of elephant grass ensiled with cassava peels by Red Sokoto goats. Conference on International Research on Food Security, Natural Resource Management and Rural Development, Tropentag 2011, University of Bonn, Germany. Oct. 5-7, 2011.

Peters, K.J., (1998). The important of small ruminants in rural development. *Animal resources and development* 28:115 – 125.

SAS. 1999. SAS User's guide: Institute Inc., Cary North Carolina, USA.

`t Mannetje, L. (1999). Introduction to the Conference on Silage Making in the Tropics. In: L.'t Mannetje (Ed.) Proc. FAO e-Conf. on Trop. Silage. FAO Plant Prod. and Protect.Paper 161. 1 Sept. - 15 Dec. 1999. Paper 1.0: 1-3.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*. 74: 3583-3597.

PROXIMATE COMPOSITION OF PLANT PARTS OF *Pennisetum purpureum* HARVESTED AT SELECTED LOCATIONS IN SOUTHWEST NIGERIA

***Okukenu, O. A., Dele, P. A., Akinyemi, B. T., Jolaosho, A. O., Olajide, A. A. and Oriola, R. A.**
Department of Pasture and Range Management
College of Animal Science and Livestock Production
Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
P.M.B 2240
**E-mail: femi_okukenu@yahoo.co.uk*

ABSTRACT

This study was carried out to evaluate the proximate composition of plant parts of Pennisetum purpureum harvested at selected locations in South-west Nigeria. The experiment was laid out in a 6 × 2 factorial design comprising of six (6) locations (Ewekoro, Odeda, Ibarapa, Ido, Oriade and Ejigbo) and two (2) plant parts (stem and leaf) replicated three times. The dry matter (DM) value ranges from 83.83% in P. pupureum harvested at Ibarapa to 93.00% in P. purpureum harvested at Ejigbo and P. purpureum harvested at Ido had the highest (10.71%) crude protein (CP) content with the lowest value (9.68%) observed in P. purpureum harvested at Odeda. Meanwhile, P. purpureum harvested at Oriade had the highest (7.33%) ether extract (EE) content with the lowest value (5.17%) observed in P. purpureum harvested at Ewekoro. The leaf fraction of the harvested P. purpureum recorded the highest value (88.16% and 11.74%) for DM and CP content respectively with the lowest value (5.67%) for EE content and the leaf fraction also had the highest value (15.00% and 13.60%) for Ash and NFC content respectively. The leaf fraction of P. purpureum harvested at Ejigbo recorded the highest value (94.33%) DM content with the lowest value (81.00%) observed in stem fraction of P. purpureum harvested at Ibarapa and the CP content range from 7.83% in stem fraction of P. purpureum harvested at Odeda to 12.38% in leaf fraction of P. purpureum harvested at Ido. While the leaf fraction of P. purpureum harvested at Ewekoro and Ejigbo had the lowest value (4.67%) of EE content with the highest value (8.00%) observed in stem fraction of P. purpureum harvested at Ibarapa, Ido and Oriade. It is therefore concluded that there were variations in the nutrient of P. purpureum harvested at the selected locations with different plant parts.

(Keywords: natural pasture, *Pennisetum purpureum*, plant parts, location)

INTRODUCTION

The ever-increasing human population and their high demand for animal protein, especially from meat and milk will depend on better utilization of available feed resources by the ruminant livestock for improving household food security and income (Kabi and Bareeba, 2008). Among feed resources, forage crops, especially grasses have shown unique characteristics in different agricultural systems. They can be grown in harsh environments, utilized as functional components in providing environmental services in soil erosion control and greenhouse gas emission mitigation efforts (Beard and Green, 1994) and income generation as basic animal feed (Wright and Turhollow, 2010). Currently, there is increasing demand for ruminant animal products owing to the growing population and improved livelihoods (Dastagiri, 2004). Ruminants rely more essentially on pasture for their nutrient requirement than any other feed resources and inadequate feed supply is a major constraint of livestock production in sub-Saharan African countries (Arigbede *et al.,* 2011). Forage is important to livestock production since it is a major source of ruminant feed and nutrition for sustainable animal protein and ruminant is the largest source of animal protein. Forage crops make up a significant part of the total agricultural land in Africa and provide a critical food supply for the livestock industry. Grasses are the most abundant flowering plants that are useful to man. They are

one of the most important sources of nutrients for domesticated ruminants during a large part of the year (Taweel *et al*., 2005). The nutritive value of forage, as related to ruminants, may be regarded as the product of the intake of the forage and its digestibility, with intake being the more important of the two parameters (Mott, and Moore, 1969).

MATERIALS AND METHODS

The research was carried out at the Laboratory of Pasture and Range Management Department of the Federal University of Agriculture, Abeokuta. The grass was harvested from natural pastures from selected locations across south-west Nigeria. The plant were separated into two (2) parts (stem and leaf) and oven dried for laboratory analysis. The study was laid out in 6 × 2 factorial design comprising of six (6) locations (Ewekoro, Odeda, Ibarapa, Ido, Oriade and Ejigbo) and two (2) plant parts (stem and leaf) and data collected were subjected to a Two-way analysis of variance and the treatment means were separated using Duncan's Multiple Range Test using SAS (1999) package. The dry matter, crude protein, ether extract and ash contents of the milled grass sample was determined according to procedure of A.O.A.C. (2000) and NDF was determined according to Van Soest *et al*, (1991). Non-fibre carbohydrate was calculated as NFC = 100 - (CP+Ash+EE+NDF).

RESULTS AND DISCUSSION

There was significantly ($p<0.05$) difference on the proximate composition of plant parts of *Pennisetum purpureum* harvested at different location in South-west (Table 1). It is quite evident that there were variations in the proximate composition of the *Pennisetum purpureum* across locations as revealed in the study and these variations could be affected by various factors, in which seasonality and species specific feed resources were known to be the major factors in affecting the nutritive value of native grasses (Subhalakshmi *et al.*, 2011). It was also reported by Kavana *et al.* (2007) that bimodal distribution of rainfall, uneven seasonal growth and availability of pasture had been considered as the major limitations to constant supply of forage for ruminant animals. The dry matter (DM) value ranged from 83.83% in *P. pupureum* harvested at Ibarapa to 93.00% in *P. purpureum* harvested at Ejigbo and the leaf fraction of the harvested *P. purpureum* recorded the highest value of 88.16% for DM content. The increase in the DM value of the leaf proportions as the *Pennisetum purpureum* advance in age conforms to the submission of McDonald *et al*. (1995) who reported that dry matter content increases with advancing maturity which reflects decrease in cell content. *P. purpureum* harvested at Ido had the highest (10.71%) crude protein (CP) content with the lowest value (9.68%) observed in *P. purpureum* harvested at Odeda while the leaf fraction of the harvested *P. purpureum* had the highest value of 11.74% for CP content (Table 1). There was significantly ($p<0.05$) difference on interaction effect of location and plant parts on the proximate composition of harvested *P. purpureum*. The leaf fraction of *P. purpureum* harvested at Ejigbo recorded the highest value (94.33%) DM content with the lowest value (81.00%) observed in stem fraction of *P. purpureum* harvested at Ibarapa and the CP content range from 7.83% in stem fraction of *P. purpureum* harvested at Odeda to 12.38% in leaf fraction of *P. purpureum* harvested at Ido (Table 2). The crude protein content of the *P. purpureum* was considerably influenced by location. There were variations in CP contents of the *P. purpureum* with the different location and this was in comformity with the report of Da Silva *et al*. (2011) in which similar reports was also obtained from previous findings of Teka *et al*. (2012). The variation in the crude protein of *Pennisetum purpureum* might also be attributed to site potential in terms of differences in edaphic factors and temperature condition.

P. purpureum harvested at Oriade had the highest (7.33%) ether extract (EE) content with the lowest value (5.17%) observed in *P. purpureum* harvested at Ewekoro while the leaf fraction had the lowest value (5.67%) for EE content (Table 1). While the leaf fraction of *P. purpureum* harvested at Ewekoro and Ejigbo had the lowest value (4.67%) of EE content with the highest value (8.00%) observed in stem fraction of *P. purpureum* harvested

at Ibarapa, Ido and Oriade (Table 2). The ash content range from 13.00% in stem fraction of *P. purpureum* harvested at Odeda to 15.33% in leaf fraction of *P. purpureum* harvested at Ibarapa, Ido , Ejigbo and Oriade. Meanwhile, the leaf fraction of *P. purpureum* harvested at Odeda recorded the highest value (14.47%) of NFC content and stem fraction of *P. purpureum* harvested at Ewekoro had the highest value (63.67%) for NDF with the lowest value (52.33%) observed in leaf fraction of *P. purpureum* harvested at Oriade (Table 2). The higher fibre levels of the grasses in this study might be a demerit in facilitating the colonization of ingesta by rumen microorganisms, which in turn might induce higher fermentation rates, hence digestibility, intake and animal performance might be impaired.

Table 1: Proximate composition (%) of plant parts of *Pennisetum purpureum* harvested at selected locations in south-west

Factors	DM	CP	EE	ASH	NFC	NDF
Locations						
Ewekoro	88.17^{b}	10.31^{a}	5.17^{c}	14.83^{ab}	9.69^{b}	60.00^{a}
Odeda	86.00^{bc}	9.68^{b}	6.83^{ab}	13.33^{b}	14.15^{a}	56.00^{b}
Ibarapa	83.83^{c}	9.77^{b}	6.83^{ab}	14.67^{ab}	13.07^{ab}	55.67^{b}
Ido	85.83^{bc}	10.71^{a}	6.83^{ab}	14.67^{ab}	11.79^{ab}	56.00^{b}
Oriade	87.00^{bc}	10.59^{a}	7.33^{a}	14.67^{ab}	12.41^{ab}	55.00^{b}
Ejigbo	93.00^{a}	10.57^{a}	5.83^{bc}	15.17^{a}	12.10^{ab}	56.33^{b}
SEM	1.20	0.67	0.53	0.49	1.14	1.33
Plant parts						
Leaf	88.16^{a}	11.74^{a}	5.67^{b}	15.00^{a}	13.60^{a}	54.00^{b}
Stem	86.00^{b}	8.81^{b}	7.28^{a}	14.11^{b}	10.80^{b}	59.00^{a}
SEM	0.91	0.14	0.28	0.28	0.62	0.57

$^{a, b, c}$:Means in same column with different superscripts are significantly ($p<0.05$) different.
SEM= Standard Error of Mean, DM= Dry matter, EE= Ether extract, CP = Crude protein, NFC= Non- fibre carbohydrate, NDF= Neutral detergent fibre

Table 2: Interaction effect of locations and plant parts on the proximate composition of *Pennisetum purpureum*

Locations	Plant parts	DM	CP	EE	ASH	NFC	NDF
Ewekoro	Leaf	91.00^{abc}	11.28^{c}	4.67^{c}	15.00^{a}	12.72^{a}	56.33^{bcde}
	Stem	85.33^{de}	9.35^{d}	5.67^{bc}	14.67^{a}	6.65^{b}	63.67^{a}
Odeda	Leaf	86.00^{cd}	11.53^{bc}	6.67^{ab}	13.67^{a}	14.47^{a}	53.67^{def}
	Stem	86.00^{cd}	7.83^{f}	7.00^{ab}	13.00^{a}	13.83^{a}	58.33^{b}
Ibarapa	Leaf	86.67^{cd}	11.06^{c}	5.67^{bc}	15.33^{a}	13.61^{a}	54.33^{cdef}
	Stem	81.00^{e}	8.48^{e}	8.00^{a}	14.00^{a}	12.52^{a}	57.00^{bcd}
Ido	Leaf	86.33^{cd}	12.38^{a}	5.67^{bc}	15.33^{a}	13.62^{a}	53.00^{ef}
	Stem	85.33^{de}	9.03^{de}	8.00^{a}	14.00^{a}	9.97^{ab}	59.00^{b}
Ejigbo	Leaf	94.33^{a}	12.14^{ab}	4.67^{c}	15.33^{a}	13.53^{a}	54.33^{cdef}
	Stem	91.67^{ab}	9.00^{de}	7.00^{ab}	15.00^{a}	10.66^{ab}	58.33^{b}
Oriade	Leaf	87.33^{bcd}	12.03^{ab}	6.67^{ab}	15.33^{a}	13.63^{a}	52.33^{f}
	Stem	86.67^{cd}	9.15^{de}	8.00^{a}	14.00^{a}	11.18^{ab}	57.67^{bc}
SEM		0.67	0.27	0.24	0.21	0.51	0.58

$^{a, b, c\ldots f}$:Means in same column with different superscripts are significantly ($p<0.05$) different

REFERENCES

A.O.A.C. 2000. Official methods of analysis 15th edition. Association of Official Analytical Chemists, Washington D.C.

Arigbede, O. M., Anele, U. Y., SuDekum, K. H., Hummel, J., Oni, A. O., Olanite, J. A. and Isah, A. O. (2011). Effects of species and season on chemical composition and ruminal crude protein and organic matter degradability of some multipurpose tree species by west African dwarf rams. Journal of Animal Physiology and Animal Nutrition (96): 250-259.

Beard, J .B. and Green, R. L. (1994). The role of Turf grasses in environmental protection and their benefits to humans. Journal of Environmental Quality (23): 1–16.

Da Silva, D. S., de Andrade, M. V. M., de Andrade, A. P., de Souza Carneiro, M. S. and de Oliveira, J. S. 2011. Bromatologic composition of the herbaceous species of the Northeastern Brazil Caatinga. Review Brasilera De Zootecnia 40: 756-764.

Dastagiri, M. B. (2004). Demand and supply projections for livestock products in India. National Center Agric. Econ. and Policy . Res. Policy Paper 21.

Kabi, K. and Bareeba, F. B. (2008). Herbage biomass production and nutritive value of mulberry (Morus alba) and Calliandra calothyrsus harvested at different cutting frequencies. Animal Feed Science and Technology (140): 178–190.

Kavana, P. Y., Kizima, J. B. and Masakia, B. J. (2007). Constraints to use of natural pasture for ruminants production along the eastern coast of Tanzania.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. and Morgan, C. A. 1995. Animal Nutrition 5th edition. United Kingdom.

Mott, G. O. and Moore, J. E. (1969) Forage evaluation techniques in perspective. Proceedings of the National Conference on Forage Quality Evaluation and Utilization, Nebraska, Lincoln, U.S.A.

SAS (1999). Statistical Analysis System Institute Inc., SAS/ 24. STAT Programme, Carry, NC: SAS Institute Inc.

Subhalakshmi, B., R. Bhuyan, D.N. Sama, K.K. Sharma and A. Bora. (2011). Effect of variety and stage of harvest on yield, chemical composition and *in vitro* digestibility of hybrid Napier (*Pennisetum purpureum x P. americanum*). *Indian Journal of Animal Nutrition 28: 418-420.*

Taweel, H. Z., Tas, B. M., Smit, H. J., Elgersma, A., Dijkstra, J. and Tamminga, S. (2005). Improving the quality of perennial ryegrass (Lolium perenne L.) for dairy cows by selecting for fast clearing and/or degradable neutral detergent fiber. Livestock Production Science (96): 239-248.

Teka H. I., Madakadze, C., Angassa, A. and Abubeker, H. (2012). Effect of Seasonal Variation on the Nutritional Quality of Key Herbaceous Species in Semi-arid Areas of Borana, Ethiopia. Department of Plant Production and Soil Science, University of Pretoria, South Africa. Indian Journal of Animal Nutrtion 2012.29 (4): 324-332

Van Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991. Methods for dietary fibre, neutral detergent and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74(10):3583-3597.

Wright, L. and Turhollow, A. (2010). Switch grass selection as a ‘‘model’’ bio-energy crop: A history of the process. Biomass and Bio-energy. (34): 851–868.

EFFECT OF VARYING LEVELS OF SAWDUST ON SELECTED MACRO MINERALS OF WEST AFRICAN DWARF BUCKS FED Panicum *maximum* AS BASAL DIET

Oladepo, O. Adebisi, I. A., Adams, T. O., Fatola O. S. G. Adesope A. T., Mustapha T. B. & Joseph, O. I.

Department of Animal Health and Production, Oyo State College of Agriculture and Technology Igboora
Corresponding author email: oladepooluwole420@gmail.com

ABSTRACT

Eighteen (18) West Africa Dwarf (WAD) growing buck of six months of age, having weight ranges from (6.5kg-7.5kg) were used in experiment to determine the effect of feeding varying dietary levels of mixed sawdust as a replacement for wheat offal on macro mineral in blood of grower buck. The bucks were randomly allocated to three dietary treatments. The treatments were replicated thrice with two growing bucks per replicate. Three dietary treatments were formulated containing 0%, 25% and 50% of mixed sawdust respectively. Feed and water were served ad-libtum throughout the period of the experiment. The experiment lasted for eight weeks. Data obtained were arranged in a completely randomized design (CRD). The result revealed significant difference (P>0.05) in the values obtained for calcium, phosphorus and magnesium across the treatments. The highest value of calcium was recorded in T2 (6.05) while the lowest value of calcium was observed in T1 (5.18), The lowest value of phosphorus was recorded in T2 (9.00) while highest value was recorded for T1 (10.22). Highest value of magnesium was recorded in T2 (2.13) while lowest value was recorded in T1 (1.98). It could be concluded that 50% replacement level of mixed saw dust could effectively substitute for wheat offal without adverse effect on the health status of growing buck.

Keywords: Macro minerals, Buck goats, Mixed sawdust, Wheat offal, *Panicum maximum*

INTRODUCTION

Since the last century, and especially after the Second World War, there has been a dramatic increase in global production of wastes, indicative of the industrial and scientific revolutions that preceded the war and the unprecedented global levels of economic activities resulting from these revolutions, especially in developed nations (Adetunji, *et al*, 2006). Large quantities of human, agricultural, forestry and industrial wastes that are not being effectively utilized are produced annually in the tropics, thereby constituting environmental and health hazards (Agboola, 1993). In developing countries, it is becoming increasingly difficult to raise ruminant livestock on conventional feed ingredients such as maize, soybean meal, groundnut cake etc. This is as a result of their increased consumption by human beings due to increasing population thereby making it very expensive to incorporate them into ruminant rations (FAO, 1997). Aletor (1986) stated that the most important factors affecting the availability of feed are high cost arising largely from fluctuations in feed supplies, rising prices of feed ingredients, poor quality feeds and inefficiency in production and distribution in the feed industry. The feeding of these animals therefore depends on finding cheaper alternatives or unconventional feedstuffs with little or no competition from human beings (Douthwaite, 2002). Since sawdust is readily available and it can be gotten from neighboring sawmill, this can serve as a source of free ingredient in livestock diet compared to any other livestock nutrition. This experiment aimed at determining the selected macro-Mineral of West African dwarf (WAD) growing buck goats fed varying levels of sawdust as partial replacement for wheat offal using *Pannicum maximum* as basal diet.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm of, Oyo State College of Agriculture and Technology, Igboora, Nigeria. The experimental area lies in savannah forest zone on latitude 7.43°N,,longitude 3.2^0E and maximum average humidity in the study area is 58°/$_0$ .The average minimum temperature is above

21.1^{0}C and maximum average temperature is 32.5^{0}C . The double maximum rainfall is about 214.3mm in June and 165.2mm in September (Sanusi, 2011). Eighteen West African dwarf grower bucks were quarantine for two weeks and used for the study. The goats were randomly allotted to treatment diets comprising of 0%, 25% and 50% saw dust. Each treatment was replicated thrice with two animals per replicate in a completely randomized design. At the end of 8weeks, selected serum macro minerals parameters were carried out by collecting 5ml of blood samples via jugular vein from one animals per replicate, and poured into plain bottles separately. The blood sample were processed and analysed for selected macro minerals parameters such as calcium, phosphorous and magnesium. Data collected were subjected to Analysis of variance using general linear model. Treatment mean were compared with Ducan Multiple Range Test.

Table 1: Gross composition of experimental diet

Ingredients	T1 (0%SD)	T2 (25% SD)	T3 (50% SD)
Corn Bran	60.00	60.00	60.00
PKC	20.00	20.00	20.00
Saw dust	0.00	4.00	8.00
Wheat Offal	16.00	12.00	8.00
Bone Meal	3.25	3.25	3.25
Salt	0.50	0.50	0.50
Grower Premix	0.25	0.25	0.25
Total	100.00	100.00	100.00
C.P (%)	13.46	13.20	12.94
M.E (Kcal/Kg)	2681.45	2734.03	2786.61

RESULTS AND DISCUSSION

Table 2 shows the selected serum macro mineral concentrations of West African Dwarf bucks fed varied proportions of saw dust in concentrate diet with *Panicum maximum*. In the current study, the Ca concentration for T_1, T_2, and T_3 were 5.18mg/dl, 6.05mg/dl and 5.83mg/dl respectively. There were significant ($P<0.05$) difference in the values of Ca concentrations across dietary treatments. The value of Ca obtained in this study were below the values reported by Underwood and Suttle, (1999), healthy sheep can contain from 9 to 12mg/dl of Ca in serum. The value of Ca obtained in this study also contradict with the report of Kaneko (1989) who reported that normal level of serum Ca in healthy lamb ranged from 11.0 to 12.4 mg/dl. The concentration of Ca in all treatment groups were slightly below moderate hyper-calcium level from 12 to 15mg/dl reported by Little dike *et al*. (1976) which causes Calcifications of soft tissues and depress feed intake. The variation in serum Ca concentrations between animals might be associated with endocrine secretions (Underwood and Suttle, 1999). The plasma Ca concentration was greater in the goats fed 25% of saw dust and followed by goats maintained on 50% of saw dust in concentrate diet. The Phosphorus (P) concentration in serum of goats were significantly ($P<0.05$) varied across the treatment groups. The obtained values (9.00 – 10.22mg/dl) in this study were above the normal range of Phosphorous (P) in serum of sheep which ranges from 4 to 8mg/dl reported by Latimer *et al*. (2003). The Mg concentration recorded in T_2 (2.13mg/dl) was higher than other treatments and significantly ($P<0.05$) different across treatment groups. Analysis of Mg minerals in the serum samples from all treatment groups indicated adequate amount of Mg in the serum of the goats. This could be due to higher Mg concentration in the diets. The values of Mg in this current finding were comparable with the critical level which ranged from 1.0 to 2.0mg/dl for sheep reported by McDowell (2003), normal range from 2.0 to 2.7mg/dl reported by Latimer *et al*. (2003) and from 1.0 to 3.0mg/dl reported by (Pulse,1994). However, concentration of Mg in current study is below toxic level (>6ppm), which causes diarrhea in sheep (NRC, 2007). Deficiencies in Mg can cause many problems for livestock, especially those with high nutritional demands such as rapidly growing weaners and

pregnant or lactating ewes (Mayberry *et al.*, 2010). The lower concentrations of Mg recorded for animals fed diet T_1 might be due to the higher potassium concentration in the diet which might affect the absorption of Mg. Magnesium is usually absorbed from the rumen and any excess is excreted via the kidneys (Underwood and Suttle, 1999).

Table 2: The effect of mixed sawdust on macro mineral

	T1	T2	T3	SEM
Calcium(mg/dl)	5.18^{c}	6.05^{a}	5.83^{ab}	0.21
Phosphorus(mg/dl)	10.22^{a}	9.00^{c}	9.64^{b}	0.28
Magnesium(mg/dl)	1.98^{c}	2.13^{a}	2.05^{b}	0.04

^{abc} Means on the same row with different superscript differ ($p<0.05$) significantly

CONCLUSION AND RECOMMENDATION

It is therefore concluded that 50% sawdust supplementation in goat diet does not have deleterious effects on macro mineral elements in blood of goat. However, more research should be carried out by subjecting sawdust to different treatment for better utilization of ruminant animals.

REFERENCES

Adetunji V.O, Oyeyem M. O and Oyebamiji O (2006) The effect of different planes of wheat offal and Soyabean meal on morphological characteristics of WAD bucks spermiogram, vet Arthiv, 76: 159-166

A. Agboola(1993) Soil organic matter and its conservation for increased productivity in Nigeria, *Proceedings of a Conference on Environmental Resources Management in Nigeria,* Port Harcourt, Nigeria, .

Aletor, V.A. (1986). Some agro-industrial by-products used in feeding. A review. World Rev. Anim. Prod. 22.36-41.

Douthwaite, B. (2002). Enabling innovation: A practical guide to understanding and fostering technology change. ZED Books. London & New York.

Kaneko, J.J.(1989). Clinical Biochemistry of Domestic Animals. 4th Edn., Academic Press, New York,California, USA., Pages: 898.

Littledike, E.T., Glazier, D. and Cook, H.M. (1976). Electrocardiographic changes after induced hypercalcemia and hypocalcemia in cattle. *Animal Journal Veterinary Research* 137:383–388.

.Latimer, K.S, Prasse, K.W. and Mahaffey, E.A. (2003).Proteins, lipids, and carbohydrates. In: Latimer K.S, Prasse, K.W, Mahaffey, E.A, editors. Duncan and Prasse's veterinary laboratory medicine: clinical pathology. 4th ed. Ames: Iowa State University Press; p. 162-192.

Mayberry, D, Masters, D. and Vercoe, P. (2010).Mineral metabolism of sheep fed saltbush or a formulated high-salt diet. *Small Ruminant Research* 91:81– 86.

McDowell, L.R. and Valle, G. (2000). Forage evaluation in ruminant nutrition pp. 373, CAB International, Wallingford, UK.

McDowell, L.R. (2003).Minerals in Animal and Human Nutrition.2nd edn. Elsevier Science, Amsterdam. Xvi + 644 pp.

NRC. (2007). Nutrient Requirements of sheep. 7th ed. Natl. Acad. Press, Washington, DC.

Pulse, R. (1994). Mineral Levels in Animal health.DiagnosticData.Sherpa International. Canada.

Ricks, M. (1996). Minerals: Small Ruminant Series. Texas Agricultural Extension Service, Uvalde.

Sanusi,(2011): The double maximum rainfall is about 214.3mm in june and 165.2mm in September

Sisay, T., Vijchulata, P., Chairatanayuth, P. and Swasdiphanich, S. (2007). Effects of natural mineral soils on body weight and liver minerals of black head Somali sheep in Ethiopia. *Kasetsart Journal of Natural Science 41: 288 – 299.*

Suttle, N. F. (1999). Mineral nutrition of livestock.4th ed. CABI International. Cambridge, MA. Underwood, E. J.andSuttle, N. F. (1999). The mineral nutrition of livestock. New YorkCABI Publishing, 624 p.

Underwood, E.J, and N F Shuttle (1999) The mineral nutrition of livestock, CABI Publishing. New York.624p.

BLOOD PARAMETERS OF YANKASA RAMS FED UREA ENSILED CRUSHED CORN COBS SUPPLEMENTED WITH CONCENTRATES

[1]Raymond, J. B., [2]Abubakar, M and [2]Kalla, D. J. U.
[1]Department of Animal Science, Federal University Gashua, Yobe State, Nigeria [2]Department of Animal Production, Abubakar Tafawa Balewa University P. M. B. Bauchi State, Nigeria.
Corresponding author email: babajerimon@yahoo.com
+ 2348035867971, +23407085489822

ABSTRACT
The study was conducted to determine the blood parameters of Yankasa rams fed urea ensiled crushed corn cobs (UECCC) with supplementation. The treatment groups were 1 crushed corn cobs (CCC), 2 urea ensiled corn cobs for seven days (UECCC7), 3 urea ensiled corn cobs for fourteen days (UECCC14) and 4 urea ensiled corn cobs for twenty one days (UECCC21). 20 animals were supplemented with 300g per head per day of concentrate made of maize bran and cotton seed cake. The experiment was conducted in a completely randomized design (CRD). Haematological parameters and Rumen pH were not affected by the dietary treatments, but all values were within the normal range for healthy animals. Rumen metabolites (total volatile fatty acids and rumen ammonia nitrogen) were significant. It was concluded that corn cobs ensiled with urea at 7, 14 and 21 days and supplemented with 300g/day of maize bran and cotton seed cake (1:1) had no adverse effect on the blood composition pH, total volatile fatty acids and rumen ammonia nitrogen of growing Yankasa sheep. Urea ensiled crushed corn cobs is therefore recommended as diet for sheep.

Keyword: Blood, Rumen pH, Rumen metabolites, Corn cobs, urea, *Yankasa* rams

INTRODUCTION
Nigeria is one of the four leading livestock producers in Sub-Sahara (FAO, 2006). The livestock sector plays a significant economic role in most developing countries, and is essential for food security of the rural population. Small ruminant production rarely exist as a sole enterprise but is often a part of an enterprise mix, involving Cattle rearing, Sheep and Goat husbandry, rural poultry, arable farming and vegetable gardening Baah, *et al*., (2012). Pastoralists engage in some farming while crop farmers engage in some livestock production (Osinowo, 1999). Among the major constraints limiting the development of livestock production in many developing countries, inadequacy of animal feed resources is most often the crucial factor. This study was therefore designed to determine the effect of feeding urea ensiled crushed corn cobs with supplementation on blood parameters, rumen ammonia nitrogen, total volatile fatty acids and pH of rumen liquor of growing Yankasa rams.

MATERIALS AND METHODS
EXPERIMENTAL SITE:
The experiment which lasted for ten weeks (70 days), was carried out at the Abubakar Tafawa Balewa University (ATBU) Teaching and Research Farm Bauchi. Bauchi metropolis has an average annual rainfall of 700mm-1300mm lying between lat. $9^0$3 and 12 ^{0} North, long. $8^0$49 and 11East and an altitude of 69^0.2 meters above sea level in the Northern Guinea Savanna ecological zone of Nigeria (Kowal and Knabe, 1972).

Experimental Animals and their Management

Twenty (20) growing Yankasa male Sheep aged 11-15 months with mean live weight of 15.7 kg were purchased from a market in Bauchi suburb and used for the trial. The experimental animals on arrival were examined and quarantined for a period of 14 days, during which they were ear-tagged using numbered plastic tags. The animals were also vaccinated against *PPR* using a tissue cultured rinderpest vaccine. Each animal was housed individually in cross-ventilated pens and allotted to its respected experimental diet. Good clean drinking water and salt lick were provided to the animals *ad libitum.* Initial weights of the animals were recorded before the commencement of the experiment. Weekly weight was taken for the period of the experiment to determine weight changes. Feeds and water were offered and remnant weighed daily to determine voluntary intake.

Experimental Diets Preparation

The experimental feed ingredients were; Crushed Corn Cobs, Cotton Seed Cake, Urea graded fertilizer and Maize Bran. The Corn Cobs of PZE-W composite 5 variety of maize was obtained from a farm in Gubi on the University land. The Corn Cobs were crushed using crushing machine. The Crushed Corn Cobs were ensiled for 7, 14, and 21 days. Four kilograms was dissolved in 100 liters of water to treat 100kg of crushed corn cobs. (Abubakar *et al.,* 2006; Ngele., 2007 and Ngele *et al.,* 2010). The treated Crushed Corn Cobs was ensiled in airtight plastic tanks (200 litres) lined with polyethene. After ensiling, the treated Crushed Corn Cobs were dried under shade for 5 days to allow for the escape of ammonia (Abubakar *et al*., 2006; Ngele., 2007).

Animal Feeding

Supplement of 50 % maize bran + 50 % cotton seed cake mixed, untreated and urea treated corn cobs were fed to the experimental animals.

The experimental animals were fed thus;

Treatment one: 300g of supplement + Untreated Corn Cobs.

Treatment two: 300g of supplement + Urea Treated Corn Cobs at 7 days.

Treatment three: 300g of supplement + Urea Treated Corn Cobs at 14 days.

Treatment four: 300g of supplement D + Urea Treated Corn Cobs at 21 days.

The experimental diet was fed to the animals every morning.

Data Collection

At the 4th week of experiment, 5mls of blood was collected from each animal. The blood samples for hematology were collected in to a well labeled, sterilized vacutainer tube containing ethylene diamine tetra-acetic acid (EDTA).

Rumen liquor/fluids was collected during the 7th week before feeding and 4hrs after feeding using stomach tube and immediately after collection, the pH of the rumen liquor was taken and recorded using AGB-75 laboratory pH meter for total volatile fatty acids determination and rumen ammonia nitrogen (RAN).

RESULTS AND DISCUSSIONS

The effect of dietary treatment on Blood counts of *Yankasa* rams fed Experimental diets.

Table 1 shows the effect (pre and post feeding) of the diets on the blood counts; white blood cells (WBC), red blood cells (RBC), haemoglobin (HGB), packed cell volume (PCV). The WBC, RBC, HGB, PCV, were not significantly different, however, there was decrease in the mean values especially on white blood cells pre and post feeding. The values for the blood counts ranged thus: white blood cells (WBC) 102.52 to 118.24 x 10^3/ul and 33.04 to 97.06 10^3/ul, red blood cells (RBC) 7.89 to 8.7710^3/ul and 7.28 to 7.9710^3/ul, haemoglobin (HGB) 9.32 to11.78 g/dl and 10.22 to 10.70 g/dl, packed cell volume (PCV) 36.32 to 43.18 % and 32.72 to 42.0 g/dl g/dl 4 %. Therefore, the values recorded in this study for blood metabolites (white blood cells, red blood cells, haemoglobin, packed cell volume) were not affected by the dietary treatment. The PCV for sheep falls within the range of 24 to 45 % (Sirois, 1995). This indicates the high nutritive value of the experimental diets. The none significant difference ($P>0.05$) obtained across the treatments in this study could mean that the untreated crushed corn cobs and urea ensiled crushed corn cobs had no negative effects on the performance of the experimental animals and can be said to be safe for feeding Yankasa sheep.

Effect of dietary treatments on ruminal pH, total volatile fatty acids (TVFA) and rumen ammonia (RNA).

Table 2 shows the effect (pre and post feeding) of the diets on rumen liquor pH (RLpH), total volatile fatty acids (TVFA) and rumen ammonia - nitrogen (RNH_3-N).

Rumen pH

Rumen pH Pre- feeding was significantly ($P<0.05$) affected by the dietary treatments. The values for pre-feeding ranged between 6.14 and 6.40. However, there was general decrease in pH post- feeding across the treatments and the values were similar across the treatment (5.36, 5.34, 5.78 and 5.30 for diet 1, 2, 3 and 4 respectively).

This suggests that there was proper digestion of the treatment diets when fed to the animals across the treatments. The pH values recorded before feeding was similar to the findings of Khan *et al.* (2006) who reported 6.5 Mmol/100ml but much lower to the study conducted by Hamad *etal*, (2011) who reported 7.43 Mmol/100ml before feeding, 7.70 Mmol/100ml; 3hours after feeding and 5.30 to 5.78 Mmol/100ml; 4 hours after feeding. Proper digestion usually triggers rumination which results in the production of saliva. The rumen pH recorded falls within range. This an indication of high fermentable diets fed to the animals. This observation agrees with the earlier findings of Adegbola, (2002) and Oddoye *et al.*, (2005).

RUMEN METABOLITES

The total volatile fatty acids (TVFA) post feeding was significant (P<0.05) across the dietary treatments whereas pre feeding was not affected by the dietary treatments; the values were 78.00, 46.00, 81.40 and 53.20, and 42.40, 49.40, 71.40 and 62.40 Mmol/100ml for post and pre feeding respectively. The TVFA in the post feeding increased in treatments 1 and 3 and reduced in treatments 2 and 4. The rumen ammonia nitrogen pre-feeding was not significant across the treatments. However, the post feeding values was statistically significant (P<0.05) across the treatments. The ruminal ammonia nitrogen values recorded after feeding was much lower than the earlier report by Hamad *et al.* (2011) and Khan *et al.* (2006) who reported 13.58 to 16.36 mg/100ml before feeding, 22.87 to 23.64 mg/100ml 3hours after feeding and 29.4 mg/100ml after feeding. The high level of RAN in this current study may be indicating rapid fermentation and degradation of the experimental diets especially for the urea ensiled crushed corn cobs. The levels of volatile fatty acids recorded before feeding and after feeding (78.00, 46.00, 81.40 and 53.20, and 42.40, 49.40, 71.40 and 62.40 Mmol/100ml) were quite high than the earlier report by Hamad *et al.*, (2011) and much lower than the study conducted by Khan *et al.* (2006). Earlier report by Oddoye *et al.*, (2005) suggested that for rumen microbes to operate at a maximum level, the release of nitrogen and fermentable carbohydrate must be synchronized. Khan *et al.* (2006) also noted that, slow release of NH3 and sufficient production of VFA leads to better utilization of the nutrients for rumen microbial growth that resulted in improved digestibility.

CONCLUSION AND RECOMMENDATION

Corn cobs ensiled with urea at 7, 14 and 21 days and supplemented with 300g/day of maize bran and cotton seed cake (1:1) had no adverse effect on the blood composition, pH, total volatile fatty acids and rumen ammonia nitrogen of growing Yankasa sheep. Base on the performance of the animals placed on diet four (4) fed corn cobs ensiled at 21 days and supplemented with 300g/head/day is recommended for growing *Yankasa* Sheep.

Table 1: Blood Metabolites of Yankasa Rams Fed Experimental Diets

Parameters		Diets					
	Periods	UCC	UECC7	UECC14	ECC21	SEM	LS
WBC	BF	108.82	118.24	110.16	102.52	12.08	NS
	4hrs AF	97.06	84.44	33.04	69.00	15.02	NS
RBC	BF	8.63	7.89	8.55	8.77	0.25	NS
	4hrs AF	7.97	7.28	7.75	7.71	0.22	NS
HGB	BF	9.32	10.96	11.78	11.52	0.58	NS
	4hrs AF	10.54	10.22	10.70	10.44	0.24	NS
PCV	BF	36.32	40.78	39.06	43.18	2.33	NS
	4hrs AF	32.72	41.52	38.30	42.04	3.12	NS

= P< 0.05, UCC = Untreated corn cobs, UECC7 = Urea ensiled corn cobs for 7 days, UECC14 = Urea ensiled corn cobs for 14 days, UECC21 = Urea ensiled corn cobs for 21 days, BF = Before feeding, AF = After feeding, SEM = Standard error mean, LS = Level of significance, NS = Non significant ,WBC = White blood cell, RBC = Red blood cell, HGB = Haemoglobin, PCV = Packed cell volume.

Table 2: Rumen pH and metabolites of Yankasa rams fed Experimental diets

		Diets					
Parameters	Period	1	2	3	4	SEM	LS
Rumen Liquor pH	BF	6.40[a]	6.30[ab]	6.14[b]	6.32[ab]	0.04	*
	AF	5.36	5.34	5.78	5.30	0.09	NS
TVFA(Mmol/100ml)	BF	42.40	49.40	71.40	62.40	5.44	NS
	AF	78.00[ab]	46.00[b]	81.40[a]	53.20[ab]	5.86	*
Rumen ammonia RNH3-N(mg/100ml)	BF	64.15	58.50	52.88	47.37	3.80	NS
	AF	43.41[c]	71.01[a]	53.29[b]	65.32[ab]	4.13	*

REFERENCES

Abubakar, M, T. A. Adegbola and Abubakar M. M. (2006). Effects of Varying Levels of Groundnut Houlms and Cowpea Shell on the Performance of Weaner Red Sokoto Goats. *Nigerian Journal of Animal Production*, 32 (2): 274-279.

Abubakar, M., Ngele, M. B. and Umar, A. M. (2006). Effect of supplementing urea treated or Untreated Rice Straw with sundried or Ensiled Poultry Litter on the Performance of Growing *Yankasa* Rams. *Bulletin Animal Health Production Africa* 54: 210-216.

Adegbola, T. A. (2002). Nutrient Intake, digestibility and rumen metabolites in Bulls fed rice Straw with or without Supplements. *Nigerian Journal of Animal Production*, 29 (1): 40-46.

Baah, J., Tuah, A. K., Addah, W. and Tait, R. M. (2012). Small ruminant production

Characteristics in urban households in Ghana. Livestock Research for Rural Development

24 (5): retrieved 15 December, 2019, from http://www.Irrd.cipav.org.co

FAO. (2006). Food and Agricultural organization: Quality bulletin of Statistics. FAO Rome Italy.www.fao.org/statistics/year book. cited by M. Abubakar (2008) in Nutrient Intake, Digestibility, Growth performance and Rumen Studies in Weaner *Yankasa* Sheep Fed Different Nitrogen Sources.

Hamad, M. R., Safaa, A. – E., Aiad, A. M., Mohammed, S. A. and Soliman, N.A.M. (2011).

Replacement Value of Urea Treated Corn with Cobs for Concentrate Feed Mixture in Pregnant Ewes Ratios. *International Journal of Agric and Enviroment* (2) 2307 – 2652.

Khan, M. A., Iqbal1 Z., Sarwar M., Nisa M., Khan M. S., Lee W. S., Lee H. J. and Kim H. S. (2006.). Urea treated corncobs ensiled with or without additives for Buffaloes: Ruminal characteristics, digestibility and nitrogen metabolism *Asian-Aust. J. Anim. Sci.* Vol 19, No. 5 : 705-71.

Kowal, J. M. and Knabe, D. T. (1972). Agroclimatological atlast of the Northern States of Nigeria with explanatory notes. Ahmadu Bello University Press, Zaria, Nigeria. Pp. 128.

Ngele, M. B., Adegbola, T. A., Bogoro, S. E., Abubakar, M. and Kalla, D. J. U. (2009). Rumen degradability and kinetic properties of urea and poultry litter treated rice straw. *Emirate Journal of Food Agriculture.* 21 (1): 32 – 40.

Ngele, M. B. (2007). *Fermentation and Metabolic Trends in Rams Fed Roughages with various Supplements*. Unpublished doctoral dissertation, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Oddoye, E. O., Amaning-Kwarteng, Kotwi, E. K. and Fleischer, J. E. (2005). In Sacco degradability of grass and hay and rumen characteristics in sheep fed urea ammoniated rice straw or untreated supplemented rice straw. *Bulletin of Animal Health and Production for Africa* 53 (2): 113-123.

Osinowo, O. A. (1999), Strategies towards Enhancement of small ruminant Productivity by small scale farmers in the Sahelo – Sudan Savanna areas of Nigeria, In: Orskov, E. R., Adegbola, T. O., Bogoro, S. and Butswat, I. S. R. (eds), Proceedings of International Seminar; *on promoting sustainable small scale livestock production towards reduction of malnutrition and poverty in rural and sub-urban families in Nigeria.* Held in Zaranda Hotel, Bauchi, March, 7th – 11th, 1999, pp 42 – 53.

Sirois, M. (1995). Veterinary Clinical Laboratory Procedures Louis, U.S.A p. 160.

SPSS (2007). Statistical Package for the Social Sciences. Version 16.0 SPSS Inc.

NUTRIENT INTAKE OF WEST AFRICAN DWARF GOATS FED DIETS CONTAINING GRADED LEVELS OF ALKALINE TREATED MALTED SORGHUM SPROUT

SAKA, A. A., ADEKUNJO, R. K., ADEDEJI, O. Y., JINADU, K. B. AND ADEKANBI, O. A

FEDERAL COLLEGE OF ANIMAL HEALTH AND PRODUCTION TECHNOLOGY, P. M. B.5029, MOOR PLANTATION, IBADAN.

ABSTRACT

A twelve week trial was conducted to determine the nutrients intake, digestibility and nitrogen utilization of West African dwarf (WAD) goats fed diets containing graded levels of Alkaline treated malted sorghum sprout (AMSP) using Panicum maximum as the basal diet. A total number of sixteen (16) WAD goats with an average live weight; 5.8 ± 0.6 kg were allotted on weight equalization into four (4) dietary treatments consisting of four goats per treatments in a completely randomized design. Four (4) diets were formulated to contain 0%, 20%, 40% and 60% AMSP. Data was collected on feed intake and nutrient intake was determined. Significant difference (P<0.05) were observed in all the nutrient intake parameters observed except the dry matter intake. Goats fed 40% AMSP recorded the highest total ash intake (27.01%), total acid detergent fibre (11.46%) and total cellulose intake (83.13%) compared with other dietary treatments. It can therefore be concluded that 40% AMSP can be used as potential sources of supplements in ruminants feed most especially during dry season as it enhanced nutrient intake.

Keywords: Nutrient, intake, WAD goats, Alkaline, Malted Sorghum Sprout,

Corresponding author: saka.azeez@gmail.com / 08037929780

INTRODUCTION

Malted sorghum sprout (MSP) is a by-product of sorghum malting simply referred to separated root and shoots left after the malt extractions from the young germinating sorghum seedlings (Aletor *et al*., 1998). It is rich in organic nitrogen (Ikediobi, 1989) and also contains 88.79% dry matter, 26.38% crude protein, 2.35% ether extract, 5.21% ash, 51.06% nitrogen free extract, 49.57% neutral detergent extract, 31.25% acid detergent fibre, 3.92% acid detergent lignin, 18.32% hemicellulose and 27.33% cellulose (Saka *et al*., 2016). The anti-nutritional factors in MSP are tannin and hydrogen cyanide. Van Buren and Robinson (1969) reported that tannin influences the growth of animals in three main ways simply because they have astringent taste which affects palatability; decrease feed intake; form complexes with proteins thereby reducing its digestibility and finally act as an enzyme inactivators. More so, cyanide in MSP caused feed poisoning in animal (Wheeler, 1994). In order to improve the nutritional quality and to provide effective utilization of MSP in ruminant, it is essential that anti-nutritional factors be removed or reduced. Detoxification by alkaline treatments might be a good means of reducing the level of anti-nutritional factors and possibly increase MSP nutritive values. Alkaline treatment is economical because it involves the use of wood ash being regarded as a waste. More so alkaline treatments of high fiber roughages have been investigated extensively, and there are numerous reviews of their effect in increasing feeding value for ruminants (Wanapat *et al.*, 1985). This study is to determine the nutrient intake of West African dwarf (WAD) goats fed diets containing graded levels of Alkaline treated malted sorghum sprout.

MATERIALS AND METHODS

Experimental Site and Duration: The experiment was carried out at the Teaching and Research farm of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan and the acclimatized period and feeding trial lasted for a period of four and twelve weeks respectively.

Experimental animals, diet and design: A total of sixteen WAD goats were obtained from Olorunda village in Ibadan, Oyo state. The animals were confined in well-ventilated individual pens that was cleaned, washed and disinfected with Royal Guard Lysol prior to the arrival of the animals. On arrival, the animals were acclimatized for a period of four weeks during which the goats were given prophylactic treatments; consisting of intra-muscular injection of oxytetracycline LA at 1ml/10kg live body weight and ivomectin at 1ml/25kg live weight. They were also administered vaccine against *Pestes des petit ruminant* (PPR). *Panicum maximum* was fed to the animals during the adjustment period. Fresh, cool, clean water was also made available throughout the experiment. After the adaptation, the animals were balanced on weight equalization into four dietary treatments in a completely randomized design. The dried brown malted sorghum sprout (MSP) was purchased from Life care ventures limited, Sango Otta, Ogun State and it was subjected to alkaline treatment (Fanimo and Akinola, 2006). The alkaline treatment was done by mixing 5kg of raw MSP with 300g of wood ash. The entire mixture was then mixed with 20 litres of water and left in a container for 72 hours (3 days) with frequent stirring. On the 3rd day, the mixture was brought out of the container, the water was allowed to seep out after which it was sundried on the concrete floor. The sundried alkaline treated MSP was then incorporated into the experimental diet at varying levels of 0%, 20%, 40% and 60% to formulate four dietary treatments.

Chemical and Statistical Analysis: The Proximate and fibre fraction analysis of the experimental diets and faecal samples were determined according to the procedure described by AOAC (2001) and Van soest *et al*. (1991) respectively. Data obtained were subjected to one way analysis of variance (ANOVA) using (SAS, 2005). Significant means were separated using the Duncan multiple range test of the same software.

Data Collection/ Feed intake: Feed offered daily per animal were recorded and refusal were weighed and recorded to compute feed intake on daily basis. In short, voluntary intake was estimated as the difference between the feed offered and that consumed. The feed was offered at 5% body weight of the animals. Intakes: Dry Matter Intake ($gday^{-1}$) = Feed intake on wet basis x DM of the feed/ 100

Nutrient Intake ($gday^{-1}$) = Dry Matter Intake ($gday^{-1}$) × Nutrient in feed/ 100

Nutrient in Feed was obtained from the proximate and fibre fractions analysis

Table 1: Chemical Composition of the Experimental Diet

Ingredients	Inclusion Levels of Alkaline Malted Sorghum Sprout			
	T_1 (0%)	T_2 (20%)	T_3 (40%)	T_4 (60%)
Dry matter	87.32	81.63	68.58	60.11
Crude protein	12.41	13.18	10.92	9.07
Ether extract	2.58	0.54	0.90	1.30
Ash	8.61	7.33	16.11	11.56
Nitrogen free extract	50.14	51.32	44.71	29.08
Neutral Detergent Fibre	65.00	75.00	72.00	52.00
Acid Detergent Fibre	18.00	15.00	33.00	26.00
Acid Detergent Lignin	8.00	5.00	5.00	12.00
Hemicellulose	47.00	60.00	39.00	26.00
Cellulose	10.00	10.00	28.00	14.00

RESULTS AND DISCUSSION

Presented in Table 2 is the nutrient intake of West African Dwarf goats fed diet containing graded levels of AMSP. There was significant difference ($p<0.05$) in all the parameters observed except the dry matter intake. The total dry matter intake value observed in this study decreased across the dietary treatment as the AMSP inclusion level increased. A non-significant dry matter intake values observed in this study showed that the alkaline

treatment employed was effective and efficient in reducing the bitterness that could have influenced the intake as it had been established by Morrison (1984) that MSP was somewhat bitter and unpalatable. The result obtained from this study was in agreement with the result of Choi *et al.* (2005) who reported no significant differences in feed intake when Korean black goats consumed diets containing CP ranging from 12 to 18% CP. The concentrate crude protein intake decreased across the dietary treatments as the inclusion levels of AMSP increased. Generally, it is well known that feed intake increases with an increase in dietary CP level (Cheema *et al.,* 1991) but here in this study the DMI was not affected but the concentrate crude protein intake decreased across the dietary treatments. The decrement observed in concentrate crude protein intake of the experimental goats across the dietary treatments could be attributed to the influence of alkaline treatment on MSP in reducing their crude protein content. This observation contradicted the study of Jia *et al.* (1995) who reported an increase in DMI of goats fed higher dietary CP levels. However, this was in line with the observation of Hwangbo *et al.* (2009) who reported that increasing or decreasing CP levels had no significant effect on DMI. Goats fed 40% AMSP recorded the highest concentrate and total ash intake and this could be attributed to the fact that the nutrients were better absorbed. The concentrate NDF intake values obtained was similar in goats fed 0, 20, and 40% AMSP based diet but significantly higher than goats on 60% AMSP based diet group. The concentrate ADL and ADF intake values obtained in this study decreased and increased respectively across the dietary treatment up to those that were fed 40% AMSP based diet. It was evident from the results of this study that the processing method employed to reduce the anti-nutritional factors of MSP was effective and therefore enhanced the nutrient intake.

Conclusion: It was concluded that alkaline treated malted sorghum sprout can be included up to 40% in compounded ration as it enhanced nutrient intake in WAD goats.

REFERENCES

Aletor, V. A., Hamid, I. I., Nieb, E. and Pfeffer, E. (1998). Low-protein amino acids supplemented diets in Broilers. 1. effects on growth performance, relative organ weight and carcass characteristics. In: Proceedings of silver Anniversary Conference Nigerian society of animal production Pp. 153-154.

AOAC. (2001). Official methods of analysis. Association of official Analytical chemists (17th edition). Arlington.

Cheema, A. U., Galyean, M. L., Caton, J. S. and Freeman, A. S. (1991). Influence of protein levels and naloxone on intake, nitrogen metabolism and digestion kinetics in lambs fed oat hay or barley straw. *J. Small Rumin. Res.* 5:35-46.

Choi, S. H., Kim, S. W., Park, B. Y., Sang, B. D., Kim, Y. K., Myung, J. H. and Hur, S. N. (2005). Effects of dietary crude protein level on growth and meat quality of Korean native goats. J. Anim. Sci. Technol. (Kor.) 45:783-788.

Fanimo, A. O. and Akinola, S. O. (2006). Response of broiler Chicken to raw and processed malted sorghum sprout. *World's Poultry Science Journal*. XII European Poultry Conference10-14.

Hwangbo, S., Choi, S. H., Kim, S. W., Son, D. S., Park, H. S., Lee, S. H. and Jo, I. H. (2009). Effects of Crude Protein Levels in Total Mixed Rations on Growth Performance and Meat Quality in Growing Korean Black Goats. *Asian-Aust. J. Anim. Sci.* 22(8): 1133-1139

Ikediobi, C. O. (1989). Industrial utilization of sorghum. A paper presented at the ICRISATWASIP – LAR. Workshop held in Kano. 4 – 6 Dec. 1989. *In Raw Material Research and Development Council (RMRDC) bulletin No. 001, Oct. 1990. Livestock Resources Rural Development*. 17: 95.

Jia, Z. H., Sahlu, T., Femandez, J. M., Hart, S. P. and The, T. H. (1995). Effects of dietary protein level on performance of Angora and Cashmere producing Spanish goats. *J. Small Rumin. Res.* 16:113-119.

Morrison, B. I. (1984). Feed and feeding. A handbook for student and stockman. 22nd Ed Longman Publishing Co. p: 518-519

Saka, A. A., Sowande, O. S., Oni, O. A., Adewumi, O. O., Ogunleke, F. O. and Sodipe, O. G. (2016). Performance Evaluation and Haematological Parameters of West African Dwarf Goats fed diet containing

graded levels of raw and fermented malted sorghum sprout. Nigerian Journal of Animal Science 18(2): 444-457

Van Buren, J. P. and Robinson, W. B. (1969). Formation of complexes between protein and tannic acid. *Journal of Agriculture and Food Chemistry* 17: 772-777

Van Soest, P. J., Robertson, J. B., and Lewis, B.A. (1994). Methods for dietary fibre, neutral detergent fibre and non starch polysaccharides in relation to animal nutrition, *J. Dairy Sci.,* 74:3583-3597.

Wheeler, J. C. (1994). Implications for domestic animals of cyanogenesis in Sorghum forage and hay. *Horticulture* 375:251-259.

Wanapat, M., Sundstol, F. and Garmo, T. H. (1985). A comparison of alkali treatment methods to improve the nutritive value of straw. I. Digestibility and metabolisability. *Animal feed science and Technology* 12: 295-309

SAS. (2005). User's Guide: Statistics, version 9.1. SAS institute Inc. Cary, NC, USA.

Table 2: Nutrient Intake of West African Dwarf goats fed Diet Containing Graded Level of Alkaline Malted Sorghum Sprout

Parameters (g/day)	Inclusion Level of AMSP				
	T_1 (0%)	T_2 (20%)	T_3 (40%)	T_4 (60%)	SEM±
Dry Matter Intake					
Concentrate	145.12	126.07	128.07	107.51	7.42
Forage	159.69	155.06	150.05	164.89	5.65
Total	304.80	281.13	278.12	272.40	10.79
Crude Protein Intake					
Concentrate	18.01^{a}	16.62^{ab}	13.99^{ab}	9.75^{b}	1.23
Forage	12.14	11.78	11.40	12.53	0.43
Total	30.14	28..40	23.02	24.27	1.36
Ether Extract Intake					
Concentrate	3.74^{a}	0.68^{c}	1.15^{bc}	1.40^{b}	0.37
Forage	2.76	2.68	2.59	2.85	0.10
Total	6.51^{a}	3.36^{b}	3.75^{b}	4.25^{b}	0.39
Ash Intake					
Concentrate	12.50^{b}	9.24^{b}	20.63^{a}	12.43^{b}	1.40
Forage	6.79	6.59	6.38	7.01	0.24
Total	19.28^{b}	15.83^{b}	27.01^{a}	19.44^{b}	1.44

NDF Intake					
Concentrate	94.33[a]	94.55[a]	92.21[a]	55.90[b]	6.67
Forage	120.96	117.46	113.66	124.90	4.28
Total	215.29	212.01	205.86	180.81	8.45
ADL Intake					
Concentrate	11.61[a]	6.30[b]	6.40[b]	12.90[a]	0.98
Forage	45.51	44.19	42.76	46.99	1.61
Total	57.12	50.49	49.17	59.89	2.23
ADF Intake					
Concentrate	3.24[b]	2.49[b]	4.62[a]	2.54[b]	0.30
Forage	7.28	7.07	6.84	7.52	0.26
Total	10.52	9.56	11.46	10.05	0.41
Hemicellulose Intake					
Concentrate	68.21[a]	75.64[a]	49.95[ab]	27.95[b]	6.49
Forage	25.07	24.34	23.56	25.89	0.89
Total	93.28[a]	99.99[a]	73.51[ab]	53.84[b]	6.64
Cellulose Intake					
Concentrate	14.51[b]	12.61[b]	35.86[a]	15.05[b]	2.99
Forage	50.30	48.84	47.27	51.94	1.78
Total	64.81[ab]	61.45[b]	83.13[a]	66.99[ab]	3.43

[a,b] Means within the same row with different Superscripts differ significantly (P< 0.05). NDF: Neutral Detergent Fibre, ADL: Acid Detergent Lignin, ADF: Acid Detergent Fibre, AMSP: Alkaline treated Malted Sorghum Sprout.

GOAT PRODUCTION AND DISTRIBUTION PATTERN IN IBADAN/IBARAPA ZONE, OYO STATE, NIGERIA

Sosina A.O.[1], Adeoso O. A.[1]
[1]Department of Animal Science, University of Ibadan, Ibadan, Nigeria
Corresponding Author: dayososina@gmail.com, 08038270701.

ABSTRACT
The availability, population, and distribution of goat at the system level are of great concern to the livestock policymakers. Hence, this study on the mapping of goat production and distribution in Ibadan/Ibarapa zone of Oyo state was undertaken. A three-stage sampling technique with 270 sampling population was used. Six Local Government Areas (LGAs) with a high prevalence of crop-livestock production system, three villages per LGA and fifteen respondents per village were purposively selected. Distribution pattern of goat population (Tropical Livestock Unit, TLU) was appraised with spatial analytical tools following standard methods. The Global Positioning System (GPS) was used to locate the population of farmers and appreciate the spatial distribution of goat production among farmers in the study area. A GIS (Geographic Information System) is a computerized database management system which was used to capture, store, retrieve, manipulate, analyze and display spatial information. Ibarapa East LGA had the highest TLU (37) for Goat when compared with Egbeda, Ido, Ona-ara, Akinyele and Oluyole LGA with TLU of 30, 20, 6, 4 and 2, respectively. The availability of abundant crop residues and feed resources in Ibarapa area coupled with a large expanse of land encouraged goat production activities in Ibarapa East, Egbeda and Ido LGA. In conclusion, using the spatial analytical tool of GIS, various activities of the goat production can be monitored, assessed and designed to meet market intervention.
Keywords: Crop residues, Global positioning system, Goat population and distribution, Ecological zones.

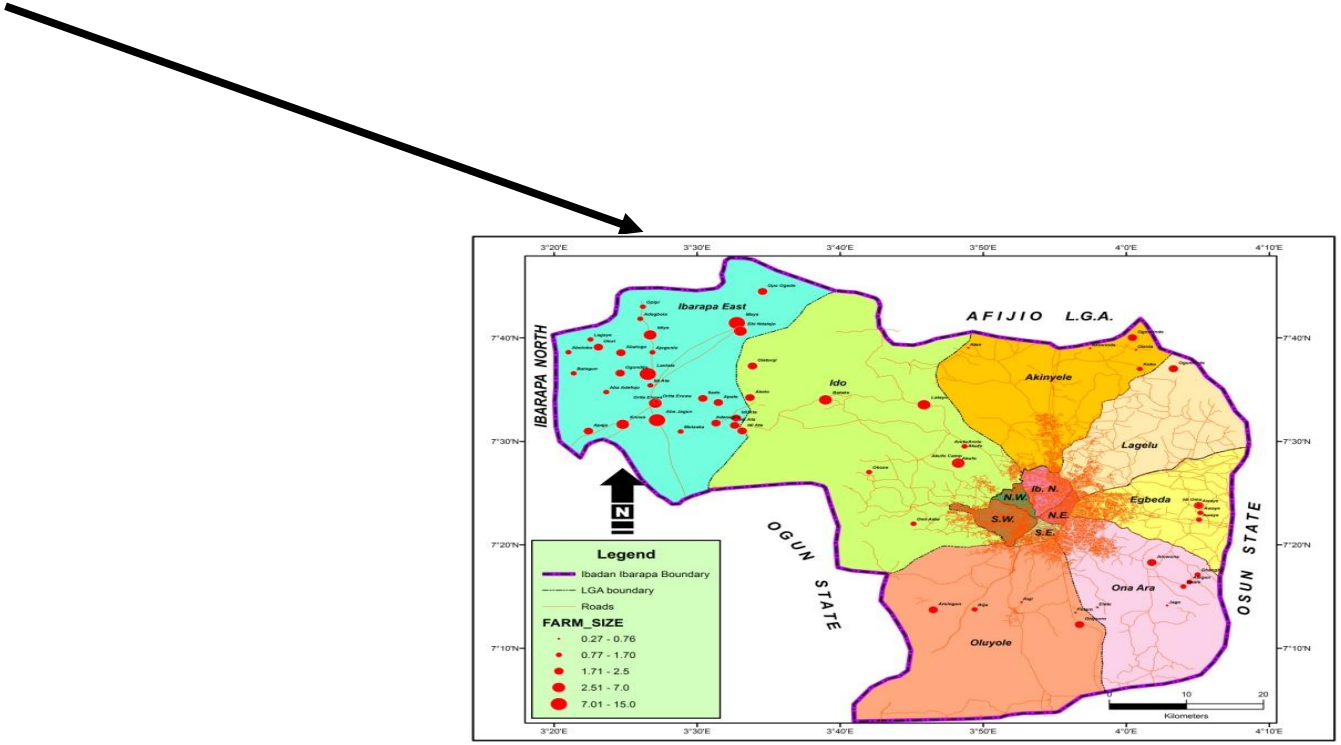
INTRODUCTION

Income from goat production in the derived savannah area of Nigeria is generally low mainly due to inadequate linkage to market. The availability, distribution, and population of goats at the system (village) level are of great concern to the policymakers and livestock planners. The local and uncoordinated market appears to be the only avenue for sales in an area with a high intensity of goat production. However, with the launch and subsequent operation of NigeriaSat 1, the need to exploit the merits of geo-informatics in agriculture in Nigeria is ripe (Nigeria Sat 1 report, 2003). Olatoye and Odularu (2013), Sosina (2017) reported the relevance of geo-information techniques in agricultural development, examine the situation in Nigeria and consequently made a case for the adoption of geo-information techniques, and in particular Precision Farming techniques in Nigeria. There is paucity of information on coordination of production and marketing as well as other actors in the goat production value chain. There is a need to identify the location of the livestock producers with a view to driving agricultural planning and policy implementation. This study therefore assessed goat production and distribution pattern in the Ibadan/Ibarapa zone, Oyo state, Southwest, Nigeria.

MATERIALS AND METHODS

The study was carried out in the Ibadan/ Ibarapa Area of Oyo State of Nigeria (as shown in Figure 1). The area is ethnically heterogeneous with a high concentration of smallholder crop and livestock farmers, considered as the occupational group with a high incidence of poverty. A three-stage-sampling technique was used to elicit information from 270 respondents. Ibadan/Ibarapa Zone of Oyo state was purposively selected for the study. Six cells (LGAs- Akinyele, Egbeda, Ibarapa East, Ido, Oluyole and Ona Ara) were randomly selected for the research, three villages were randomly selected in each cell and fifteen farmers were selected using the snowball selection technique. The data obtained from the Participatory Rural Appraisal were analyzed using descriptive statistics. The GPS of the farmers' location, livestock population and distribution were recorded, taking the longitude and latitude of the locations in question. The recorded GPS data of the study area were transferred into the ARC-GIS. The ARC-GIS software processed the data into location using the ARC-GIS model 10.0 from the GIS unit of the Department of Geography, University of Ibadan.

Fig.1: Map of Ibadan/Ibarapa area study area



The data collected were accompanied by the administration of a structured questionnaire (conducted through an interview session) which was designed to obtain information on socioeconomic characteristics of the farm owners and characteristics of the sampled farms. Data were analyzed using descriptive statistics.

Results

Mapping of Goat Production and Distribution in Ibadan/Ibarapa zone in Fig 1 showed; the GIS mapping of Goat Production of farmers in Ibadan/Ibarapa zone using the GPS location. The GPS was used to locate the population of farmers and appreciate the spatial distribution of goat production among farmers in the study area. The graphical representation shows the Tropical Livestock Unit (TLU) of goat kept by the farmers in the Ibadan/Ibarapa zone. GIS map showed the location of the various farmers' involved in Goat production in the study area. Fig. 2 revealed the Goat production data collected from the Local Government Areas (LGA) Ibarapa East had the highest TLU of 37 for Goat. Ido, Ona-ara, Akinyele, and Oluyole with Goat TLU of 20, 6, 4 and 2 respectively.

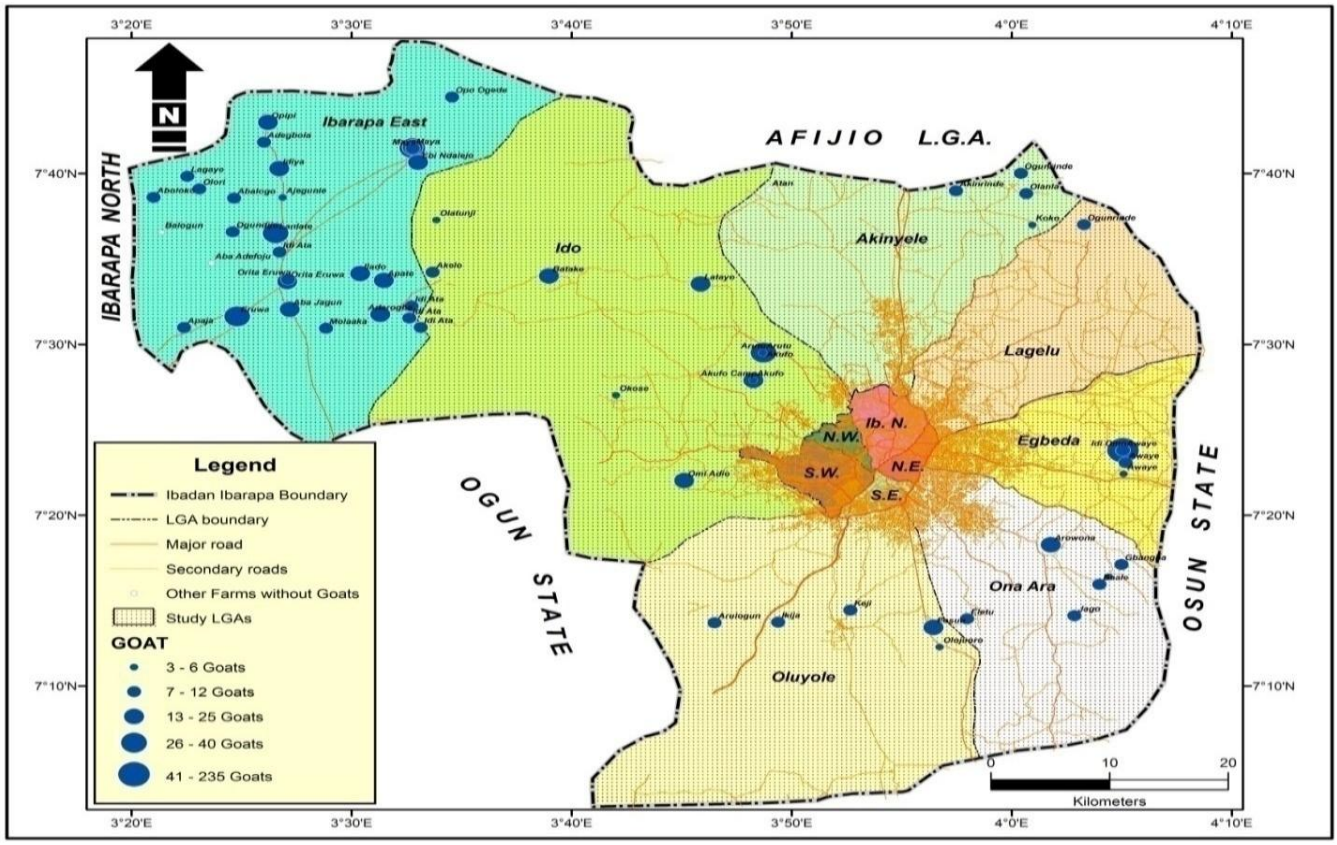


Fig.2: GIS/GPS Mapping of goat production pattern in Ibadan/Ibarapa zone, Southwest, Nigeria

DISCUSSIONS

Goat production and distribution patterns could be due to the availability of abundant crop residues and feed resources in the Ibarapa area coupled with a large expanse of land for goat production activities. These findings agreed with Olafadehan and Adewumi (2011) and Fakoya (2007) that reported similar findings on cattle and goat production among agro-pastoralist in South West, Nigeria. The high populations of goat farmers found in Egbeda and the lower populations in Akinyele, Ona-ara, and Oluyole suggested that the rain-forest ecological zone still favored small ruminant production especially the dominant West African Dwarf (WAD) Goat. The average herd sizes of goat farmers were similar in Akinyele, Oluyole, and Ona-Ara. This was probably due to the urbanization of the area that affected the goat production adversely. The result supported the work of Onwuka ***et al***. (1997) that reported low TLU of goat in the urban area compared with the agrarian communities in

Ogun State. This was against the report of Amole and Ayantunde (2016) that ruminant is produced in the rural areas in Niger state. For commercial goat production and distribution, using the spatial analytical tool of GIS, various activities of the goat production can be monitored, assessed and designed for possible intervention. Spatial analytical using GIS revealed the prevalence of Crop-Livestock farming in the study area. This agreed with the findings of Olugaza ***et al***. (2014); Omodele and Okere, (2014) that reported mapping exercise using the spatial analytical tool of GIS. About the TLU, Ibarapa East is highly favorable for the establishment of commercial goat production compared with other locations in the study area.

RECOMMENDATION

The adoption of information technology (GIS) by farmers in a modern goat production management system that will link production to market in a demand-driven economy is therefore recommended.

Conclusion

In conclusion, the distribution pattern of goat in Ibadan/Ibarapa area of Oyo State showed clearly that Ibarapa East LGA is the most favorable for goat production. This is justifiable because of the abundance of feed materials and large expanse of agricultural land in the area.

Conflict of Interest

Authors declared that there was no conflict of interest.

REFERENCES

Amole T.A. and A.A. Ayantunde (2016). Assessment of Existing and Potential Feed Resources for Improving Livestock Productivity in Niger. *International Journal of Agricultural Research* 11: 40- 55.

Fakoya, E.O. (2007) Utilization of Crop – Livestock Production Systems for Sustainable Agriculture in Oyo State, *Nigeria. Journal Social Science*, 15(1): 31-33 (2007).

NigeriaSat-1 (2003): Images and Operations of Nigeria earth observations satellite: NigeriaSat 1.

Olafadehan O.A. and M. K. Adewumi (2011). Livestock management and production system of agropastoralists in the derived savanna of South-west, Nigeria. *Tropical and Subtropical Agroecosystems*, 12 (2010): 685 – 691.

Olatoye T.A and G.O. Odularu (2013). Applications of remote sensing and geographic information systems technologies in livestock management. A paper presented at the Conference of the International Livestock Research Institute (ILRI), held at Hotel Africana Conference Centre, Kampala, Uganda on September 9-11, 2013.

Olugaza B. O., J.B. Dogba, B. Ogunro, E. A. Odigie, J. Nykoi, J. F. Ojo, O.Taiwo, A.Kamara, C. K. Mulbah, A. J. Fasunla (2014). The rubber plantation environment and Lassa fever epidemics in Liberia, 2008–2012: A spatial regression Spatial and Spatio-temporal Epidemiology.11.pp163- 174.

Omodele T and Okere I. A. (2014). GIS application in poultry production: identification of layers as the major commercial product of the poultry sector in Nigeria. *Livestock Research for Rural Development*, Volume 26, Article 097.

Onwuka C.F.I., P.O. Adetiloye and C.A. Afolami (1997). Use of household wastes and crop residues in small ruminant feeding in Nigeria. *Small Ruminant Research* 24 (1997) 233-237.

Rilwani M. L. and J. O. Gbakeji (2009) Geo-informatics in Agricultural Development: Challenges and Prospects in *Nigeria. Journal Social Science,* 21(1): 49-57 (2009).

Sosina A.O. (2017). Assessment of crop residues as feed resources for crop-livestock production Systems in Ibadan/Ibarapa area of Oyo State, Nigeria. A Ph.D. thesis submitted to the Department of Animal Science, University of Ibadan, Nigeria.

NITROGEN BALANCE IN GROWING RED SOKOTO BUCKS FED SORGHUM HAY WITH OR WITHOUT CONCENTRATE

Umar, A. M[1]., Abubakar, M[2]., Akinade, A. S[3]. Daninna, A. U[4]., & Dahiru, A.M[1].
Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.
Bauchi State College of Agriculture, Yelwa, Bauchi, Nigeria.
FrieslandCampina WAMCO Nigeria Plc, Lagos, Nigeria.
School of Rural Technology and Entrepreneurship Development, Kano State Polytechnic, Kano, Nigeria.

ABSTRACT
Availability of forages for ruminant feeding and the quality of the forage which the animal utilizes continues to be studied. This research was conducted to determine the palatability of Sorghum hay in relation to its nutritive value by evaluating the chemical composition and the nitrogen balance in red Sokoto bucks. Animals were assigned to two dietary treatment groups such that each group consisted of three red Sokoto bucks. Those in treatment 1 (T1) were given sole sorghum hay at 2.5% of their body weight while those on treatment two (T2) were given sorghum hay and concentrates in a ratio of 60:40 (2.5%) of their body weight. The result of the experiment shows that the nitrogen balance of bucks in T2 was significantly ($p < 0.05$) higher than those in T1. In conclusion feeding sole sorghum bicolor hay was not adequate to meet the nutritional requirement of red Sokoto bucks. However, supplementation of sorghum bicolor hay with concentrate at 60:40 ratios increased nitrogen retention.
Keywords: Nitrogen balance, Red Sokoto, Sorghum
Corresponding author: A. M. Umar email: aumustapha@atbu.edu.ng; Mobile: 08033968800

INTRODUCTION
Crop residues are readily available and cheap in the tropics. The abundance of these residues could mean reduction of concentrate cost in the rations since available residues that are nutritious and palatable could be utilized. An important residue that can be found on the sorghum plant is the hay and chaff. Sorghum hay is obtained by cutting and drying Sorghum when it is between the soft-dough stages to avoid wastages (Sutti, 2000). This could encourage the cultivation of forage crops which has not been properly harnessed for the purpose of feeding small ruminants in Nigeria.

MATERIALS AND METHODS
The study was conducted to determine the palatability of Sorghum hay in relation to its nutritive quality by evaluating the chemical composition and the nitrogen balance when it is fed to red Sokoto bucks. The experiment was conducted from October to December 2016 at the experimental unit of the small ruminant research program of the national animal production research institute (NAPRI) Ahmadu Bello University Shika, Zaria. Animals were assigned to two dietary treatment groups such that each group consisted of three Red Sokoto Bucks. Those in treatment 1 (T1) were given sole sorghum hay at 2.5% of their body weight while those in treatment two (T2) were given sorghum hay and concentrates in a ratio of 60:40 at 2.5% of their body weight.

Animals were housed in individual feeding pens (metabolism cages) and fed their treatment diets. They were allowed an adjusted period of 14 days to fine-tune to the feed and metabolism cages. Animals were weighed before the commencement of the experiment and were weighed after the adjustment period prior to commencement of data collection. The bucks' mean body weight was 13.5kg and aged between 12 and 21 months of age. Four days before the experiment commenced, all the animals were de-wormed using albendazole (eagle chemical co LTD). The experiment was of completely randomize design in which the red Sokoto bucks were distributed into two groups of four animals per group. The bucks were weighed and then put into metabolism cages equipped for faecal and urine collection. Fourteen days adjustment period was allowed before faecal and urine collection was done for a period of twenty one days. For each animal, total daily urine output was collected into

plastic bottles containing10ml of 0.05N Sulphuric to prevent ammonia loss from the urine [2]. Total urine collected was measured and 10% of each day's collection was taken, bulked at the end of collection period and stored in a freezer at 0^0C until it was required for nitrogen analysis (Ajayi, 2011).

Total faecal output from each animal was collected and weighed fresh and 20% of each day's collection was taken and dried in the oven for 48 hours at 70^0c and its weight recorded before storing for proximate analysis. Water intake was also collected by using calibrated 9 liters bucket.

2.1 Experimental Diets

Sorghum hay was fed as basal diet supplemented with concentrates consisting of maize offal (MO), wheat offal (WO), cotton seed cake, bone meal and salt. The CP of the concentrate is 13.63%. The chemical composition of the dietary ingredients and concentrates are presented in table 1, while table 2 shows the proximate composition of the experimental diets.

Table 1: Composition of concentrate supplement fed red Sokoto bucks

Ingredients	Percentage %
Maize Offal	40.0
Wheat Offal	31.5
Cotton Seed Cake	25.0
Bone Meal	2.5
Salt	1.0
Total	100
Crude Protein	13.63
Metabolisable Energy (kcal/kg)	2679.0

Table 2: Proximate composition of experimental feed stuffs

Parameters	T1	T2
Dry matter	95.20	93.38
Crude protein	5.36	16.13
Crude fiber	28.66	18.40
Ether extract	2.14	3.19
Ash	2.36	6.56
NFE	61.48	55.72
ADF	29.87	20.06
NDF	52.22	18.70

NFE= Nitrogen free extract, ADF= Acid detergent fibre, NDF= Nuetral detergent fibre.

Feaces were analysed for dry matter (DM), crude fibre (CF), crude protein (CP), ether extract (EA) and ash using an established procedure [(4)]. Nitrogen free extract (NFE) was calculated by difference NFE=100-(CF+CP-EE+ASH). Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined according to the method of Van-Soest *et al*. (1991). Urine was analysed for urinary nitrogen and crude protein using Kjeldahl procedure (AOAC, 2005). Samples of experimental diets, orts and feaces were ashed by charring in muffled furnace at 500^0C for six hours. Organic matter (OM) was obtained as the difference between the dry matter and ash content.

2.2 Statistical analysis

Data collected on nitrogen intake and coefficient of nitrogen balance was analyzed by ANOVA using General Linear Model procedure of SAS (2008). Significant treatment means were separated using Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSION

Table 3: Chemical composition and metabolisable energy of experimental diets fed to growing red Sokoto bucks

	Sorghum Hay Bicolor: Concentrate		
Parameter (%)	100:0 Sorghum hay	Concentrate (NAPRI)	60:40 Sorghum hay + concentrate
Dry matter	95.20	91.11	93.38
Organic matter	92.84	85.22	86.82
Crude protein	5.36	18.94	16.13
Crude fibre	28.66	8.01	18.40
Either extract	2.14	4.60	3.19
Ash	2.36	5.89	6.56
Nitrogen free extract	61.43	62.56	55.72
M. E (Mj/kg)	11.53	11.68	11.56
Acid detergent fibre	29.87	26.12	20.06
Neutral detergent fibre	52.22	48.37	38.67

Table 3 shows the proximate composition of the experimental diets (sorghum bicolor hay/ concentrate) mixture and concentrate supplement. The dry matter (DM) contents of the experimental diets containing sorghum bicolor hay/concentrate mixture at 100:0 and 60:40 ratio are 95.20% and 93.38% respectively. The CP content was 5.36% in 100:0 diet and 16.13% in 60:40 diet. The CF content was 28.66% in 100:0 diet and 18.40% in the 60:40 diet. Ether extract for 100:0 and 60:40 were 2.14% and 3.19% respectively. The ash content was 2.36% in 100:0 diet and 6.56% in 60:40 diet.

The concentrate supplement used for the experiment had a crude protein (CP) content of 18.94%, dry matter (DM) of 91.11%, organic matter (OM) content of 85.22%, crude fibre (CF) of 8.01%. Nitrogen fibre extract (NFE) of 62.56% and metabolisable energy (ME) of 11.68% MJ/kg DM.
The ME content was similar in all treatment with 11.53MJ/kg DM in 100:0 and 11.56MJ/kg DM in 60:40. However, the highest values of 29.87% acid detergent fibre 52.22% neutral detergent fibre and 16.70% lignin were observed in 100:0 diet while low values of 20.06% acid detergent fibre, 38.67% neutral detergent fibre and 8.44% lignin were observed in 60:40 diet.

Table 4: Nitrogen balance of red Sokoto bucks fed Sorghum Hay: Concentrate ratio

	Sorghum Hay Bicolor: Concentrate		
Parameter (g/day)	100:0	60:40	SEM
	Sorghum hay	Sorghum hay + concentrate	
Nitrogen intake	3.03[b]	10.96 [a]	0.21
Feacal nitrogen loss	1.90[b]	2.36[a]	0.20
Urinary nitrogen loss	0.45[b]	1.06[a]	0.20
Total nitrogen output	2.35[b]	3/.42[a]	0.34
Nitrogen absorbed	1.14[b]	8.60[a]	0.20
Nitrogen retained	0.69[b]	7.55[a]	0.33
Nitrogen retained as % intake	23.87[b]	68.76[a]	6.71
Nitrogen absorbed as % intake	38.15 [b]	78.46[a]	4.31

[ab]; means with different superscripts differed significantly ($p<0.05$), SEM = standard error of mean.

Table 4 reveals the nitrogen balance of red Sokoto bucks fed sorghum bicolor hay: concentrate ratio. The result showed that there were significant ($p<0.05$) differences in nitrogen balance parameters across all the treatment. There was an increase ($p<0.05$) in all parameter measured when concentrate was supplemented. There were 72%, 19%, 58%, 31%, 87%, 91%, 65% and 51% increase in nitrogen intake, feacal nitrogen loss, urinary nitrogen loss, total nitrogen output, nitrogen absorbed, nitrogen retained, nitrogen retained as % of intake in red Sokoto bucks fed 60:40 diets when compared with bucks fed 100:0 diet.
The DM content of sorghum bicolor hay concentrate mixture in Table 3 above is was above 91%. This might be due to the fibrous nature of the sorghum forage and cotton seed cake. The value of DM observed was higher than 92.5 and 91.56% reported by Ishiaku (2016) for sole sorghum almum. The CP content of sorghum bicolor hay/concentrate mixture increased with the inclusion of concentrate. The CP range from 5.36-16.13% in sole sorghum bicolor hay and sorghum bicolor hay supplemented with concentrate. The CP values observed in this study for 100:0 were lower than the requirement of 10-12% CP for sheep and goat (Wada *et al*., 2016) but above the requirement of the 60:40 diet. As argued by Munza *et al*. (2017), who stated that the low CP for sole sorghum bicolor hay may be attributed to the stage at harvest of the forage because CP content reduces as the plant advanced in age. The high CP in 60:40 diets might be due to the presence of cotton seed cake.

The CF of the diets, 28.66%, 8.01% and 18.40% were greater than the report of Ishiaku (2016) probably due to varietal difference. The neutral detergent fibre (NDF) was below 60.0% suggested by Munza *et al*. (2017) as critical limit for efficient utilization of roughages. The ME obtained ranged from 11.53-11.56MJ/kg DM. This was lower 12.17MJ/kg, reported by Ishiaku (2016).

Table 4 shows the nitrogen balance of red Sokoto bucks fed sorghum hay: concentrate ratio. The nitrogen balance parameter of Re d Sokoto Bucks fed 60:40 diets were significantly ($p<0.05$) higher than those fed 100:0. This is in line with Hassan *et al.* (2016) who reported that supplementation of protein source improve microbial nitrogen yield and retention with subsequent increase in the performance of growing red Sokoto Bucks.

The higher nitrogen absorbed and retained in Bucks fed (60:40) sorghum bicolor hay/concentrate could be (10.96%/day). Munza *et al.* (2017) stated that superior nitrogen absorbed and retained in Red Sokoto Bucks fed sorghum hay/concentrate mixture as compared to those fed sole sorghum hay might be due to the efficient utilization of nitrogen. Also, higher nitrogen retention (7.55g/day) absorbed in bucks fed 60:40 hay/concentrate mixtures indicated the favorable role of concentrate in post ruminal nitrogen metabolism and utilization compared to 100:0 (0.69g/day).

The nitrogen retention and absorbed as percentage intake were above 68.0%. This was higher than 47.98% reported by Yashim *et al.* (2014), but lower than 95.84% and 74.24% reported by Wada *et al.* (2016) and Ishiaku (2016).

The result of this study revealed that feeding sole sorghum bicolor hay was not adequate to meet the nutritional requirement of red Sokoto bucks. However, supplementation of sorghum bicolor hay with concentrates at 60:40 ratios increased nitrogen retention.

CONCLUSION AND RECOMMENDATION

The result of this study revealed that feeding sole sorghum bicolor hay was not adequate to meet the nutritional requirement of red Sokoto bucks. However, supplementation of sorghum bicolor hay with concentrates at 60:40 ratios increased nitrogen retention.

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REFERENCES

Ajayi, F.T. (2011). Effects of feeding ensiled mixtures of elephant grass (Pennisetum purpureum) with three grain legume plants on digestibility and nitrogen balance of West African Dwarf goats, Livestock Science, Volume 142, Issues 1–3, Pages 80-84. https://doi.org/10.1016/j.livsci.2011.06.020.

AOAC (2005). Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists, Washington DC, Method 935.14 and 992.24.

Chen, Xue & Gomes, M. (1992). Estimation of Microbial Protein Supply to Sheep and Cattle Based on Urinary Excretion of Purine Derivatives – An Overview of Technical Details. Int. Feed Resource Unit. Rowett Res. Inst.

Duncan, D. B. (1955). Multiple range and multiple t-tests. Biometrics, 11:1.42.

Hassan, M.R., Muhammad, I.R., Amodu, S.F., Jokthan, G.E., Abdul, S.B., Adamu, H.Y., Yashim, S.M., Taofik, I., Tamburuwa, M.S. and Musa, A. (2016). Growth Performance of Red Sokoto bucks fed graded levels of lablab (lablab purpureus. L Sweet) hay as supplemented to maize (zea mays) stoverbusal diets. Journal of Animal Production Research, 28(1): 283 – 298.

Ishiaku, Y.M. (2016). Productivity of Columbus grass (sorghum almunintercopped with lablal legumes (lablab purpureus) and their utilization by growth red, Sokoto bucks in Shika, Nigeria. M.Sc. thesis: Department of Animal Science, Ahmadu Bello University Zaria, Nigeria Pp. 83 – 88.

Munza, B. M., Hassan, M. R., Tanko, R. J., Amodu, J. T., Abdu S. B., Ishiaku, Y. M., Salisu, S. G. and Zakka, T. (2017). Effect of seed rate on forage yield and quality of grain sorghum (Sorghum bicolor l. moench) under rainfed in Shika, Nigeria. Journal of Animal Production Research, 29 (1):393-402.

SAS (2008). Statistical Analysis System Users Guide Statistics. SAS Institute Inc., Cary, NC, USA.

Sutti, J.M. (2000). Hay and Straw conservation for small scale farming and postoral conditions. FAO Plant Production and Production series 29, FAO, Rome.

Van Soest, P.J. & Robertson, J.B. & Lewis, B.A.. (1991). Methods for Dietary Fiber, Neutral Detergent Fiber, And Nonstarch Polysaccharides In Relation To Animal Nutrition. Journal of dairy science. 74: 3583-97. 10.3168/jds.S0022-0302(91)78551

Wada, N.I., Njidda, A.A., Olafadehan, O.A. and Bello, B. (2016). Effect of level of Parkia bighobosa in concentrate diets on growth performance, digestibility and nitrogen utilization of yankasa rams. Nigerian Journal for Animal Production, 43(1): 231 – 238.

Yashim, S.M., Jokthan, G.E., Lamidi, O.S., Yukubu, R.L., Hassan, M.R., Ibrahim, T.A. and Audu, S.B. (2014). Performance, nutrient digestibility and Nitrogen balance of growing Yankasa rams fed digitariasimutii hay supplemented with ficussyncomorus leaf meal. Nigeria Journal for Animal Science, 16(1): 85 – 93.

NUTRIENT CHARACTERIZATION OF SOME FOOD PROCESSING WASTE MATERIALS

Wuanor*, A. A. & Ayoade+, J. A.
*Department of Animal Nutrition, Federal University of Agriculture, Makurdi
+Department of Animal Production, Federal University of Agriculture, Makurdi
Corresponding Author: alexwuanor@yahoo.com

ABSTRACT
Thereby achieving the dual aim of feed provision and reduction of materials from refuse heaps. This study was conducted with the objective of investigating the nutrient composition of some food processing waste materials. The materials studied were walnut shells, Thaumatococcus daniellii leaves and Banana leaves. The nutrient composition of the materials showed a profile for dry matter, crude protein, ether extract, crude fibre, ash nitrogen free extracts and metabolizable energy to be 89.62%, 7.00%, 0.36%, 67.10%, 2.27%, 23.27%, 1,273.65 Kcal/kg; 89.22%, 15.51%, 5.45%, 19.57%, 20.46%, 28.43%, 2,334.04 Kcal/kg and 97.21%, 10.62%, 12.65%, 15.82%, 14.21%, 46.70% and 3,490.1 Kcal/kg for walnut shells , Thaumatococcus daniellii leaves and Banana leaves respectively. It was recommended that these materials could be converted to ruminant feedstuff
Key words: Walnut, *Thaumatococcus daniellii*, Banana, Nutrient composition

INTRODUCTION
The quest for conversion of hitherto unusable materials for livestock feeding has formed the basis for unconventional feed development. Processing of food for human consumption generates so much by products, most of which are not useful and end up on refuse heaps contributing to environmental concerns. Walnut shells become a waste material after the nuts are removed and are discarded due to absence of alternative use. Consumption of walnuts has increased due to the purported inherent advantages viz: Provision of plant-based omega-3 fats along with high amounts of copper, manganese, molybdenum, and biotin which may help reduce not only the risk of prostate cancer, but breast cancer as well and contain the amino acid l-arginine, which offers multiple vascular benefits to people with heart disease, or those who have increased risk for heart disease due to multiple cardiac risk factors, contains several unique and powerful antioxidants that are available in only a few commonly eaten foods that may improve sperm quality, weight control, and offer support for brain health and Type 2 diabetes

Leaves of *Thaumatococcus daniellii* (TDL) used in preparing moi moi or Okpa, a breakfast meal are equally discarded after the meal is eaten. Observation have shown that scavenging pigs, goats, sheep and cattle usually struggle over these leaves on refuse heaps, emphasising the need for its nutrient characterization. Banana leaves, used in wrapping food also end up on refuse heaps. The leaves have been investigated for their nutrient composition (Wuanor et al., 2018) and also used in feeding rabbits (Waikyo, 2019). The objective of the study was to conduct a nutrient characterization of these materials as a prelude to possible ruminant feeding.

METHODOLOGY
Cooked walnuts were bought from retailers in Makurdi town over a period of three months, amounting to nine times, and the nuts separated from the shells. The shells were then sun dried and sent for proximate analysis. TDL and Banana leaves (collected from same source, over same period and number of times as the walnut shells) were sourced by buying the food wrapped in them and after removal of the food, the leaves were also sun dried and sent for proximate analysis. Proximate components of the shells and leaves were analyzed using AOAC (2005) procedure while the metabolizable energy was estimated using the formula of Carpenter and Clegg (1956).

RESULTS AND DISCUSSION

Proximate and metabolizable energy compositions of the waste materials are shown in Table 1. In general, all the materials had a high dry matter profile. This is particularly advantageous because nutrients are contained in the dry matter of a material as opposed to moisture. The crude protein ranged from 7.00 to 15.51 and qualifies the materials as ruminant feedstuff since the rumen microbes need a minimum crude protein of 7.0% to carry on their role of breaking down the scabrous feed materials that form the basal diets of ruminants. Particularly, the high crude protein of the TDL is reasoned to be caused also by the proteinous nature of the beans used in preparing pudding cooked in the leaves. The ether extract profile of the materials 0.36 to 12.65 shows that useful fatty acids will be made available for metabolism after the rumen micro organisms would have hydrogenated the fats. The higher ether extract of these banana leaves than that reported by Wuanor et al. (2018) is reasoned to be caused by the palm oil used in preparing the moi moi or Okpa that was cooked in these leaves. In general, the ash, nitrogen extract and metabolizable energy profiles of these materials showed their potential to furnish animals fed with them with minerals and energy.

CONCLUSION AND RECOMMENDATION

It was thus concluded that these materials possess attractive nutrient potentials. It was therefore recommended that the materials should be utilized in feeding ruminant animals.

Table1. Proximate and metabolizable energy compositions of some food processing waste materials

Material	DM	CP	EE	CF	ASH	NFE	Metabolizable Energy Kcal/kg
Walnut shells	89.62	7.00	0.36	67.10	2.27	23.27	1,273.65
Thaumatococcus daniellii leaves	89.22	15.51	5.45	19.57	20.46	28.43	2,334.04
Banana leaves	97.21	10.62	12.65	15.82	14.21	46.7	3,490.1

REFERENCES

AOAC. (2005). Association of Official Analytical Chemists. Official Methods of Analysis (Ed. W. Horowitz) 18th Edition. (2005): 1,018.

Carpenter, K.J and Clegg, K.M. (1956). The metabolizable energy of poultry feeding stuff in relation to their chemical composition. J. Sci., Food and Agric. 7:45-48.

Waikyo, D.V. (2019). Performance of rabbits fed Banana leaves of different growth stages. Unpublished M.Sc. Thesis. Federal University of Agriculture, Makurdi, Nigeria.

Wuanor, A.A., Carew, S.N. and Waikyo, D.V. (2018). Proximate composition and metabolizable energy profiles of Banana leaves of different growth sizes. Innovative Techniques in Agriculture3(1):545-549.

BOTANICAL COMPOSITION AND SEASONAL VARIATION IN NUTRITIONALVAUESOF SOME SAVANNA FORAGES IN NORTH EASTERN NIGERIA

[A]Yahaya, Babawuro [b]Mohammed Baba & [c]Muhammad, Bashar Alhaji

[A]federal University of Kashere, Faculty of Agriculture, Department of Animal Science Gombe State, Nigeria

[B]Bayero University Kano Faculty of Agriculture, Department of Animal Science Kano State Nigeria

[C]Ministry of Agriculture and Animal Production, Gombe State, Poultry Production Unit, (PPU)

Correspondent Author: Phone No: +2347068214403; E-mail: sarkinshanu2005@yahoo.com

ABSTRACT

An experiment was carried out at the Federal College of Education (Technical) Gombegrazing area with the objectives to identify the major forage resources in the area and their chemical composition as affected by seasons in the year 2018. Samples for both dry and wet season were collected using constructed quadrant frame which was randomly thrown on the ground for grasses and legumes species, plants inthe hoop were clipped. Botanical composition, chemical composition were analysed using the procedure described by AOAC (1990). Major grasses identified included Cenchrusciliaris, and Pennisetumpolystachyon.While leguminous and shrubs includeAlysicarpusviginalis, and Cassia singuena. Mean apparent nutrients composition for Neutral Detergent Fibre in dry season were found to increase significantly (P < 0.05) from 39.30% in the wet season to as high as 57.24% in the dry season in cenchrusciliaris. Acid detergent fiber from 24.39 in the wet season to 46.63% in the dry season in Digitariadebilis while lignin from 23.15 to 36.43 in Cenchrusciliarisrespectively. Crude protein and ether extracts were higher during the wet season 14.86% and 7.54% in Arachishypogeaecompared to the dry season. Anti nutitional factors were found to be higher during the wet season. It was concluded that forages such as Digitariadebilis, andCenchruscitiariswhich had over 70% dry matter content in both wet and dry season and lower content of anti-nutritional factorsin both seasons should be conserved during the time of abundance due to its abundance and high nutritional values

Key Words: Botanical Composition, Seasonal Variation, Nutritional Values, Savannah Forages, North Eastern Nigeria

INTRODUCTION

The term forage refers to herbaceous material including grasses, legumes, browse plants trees and fibrous crop by products. In seasonally dry environments, the main limitations to animal production are lack of green feed for at least half of the year coupled with the low nutritive quality of forages during most of the period of active pasture growth (Jones and Wilson, 2018). The low nutritive quality of the forage during the growth period is mainly due to environmental stresses such as high temperature (Goering and Van Soest, 2008).

Nigeria has two broad belts of vegetation types, namely, the forest and savannah types. As obtained in southern coastal areas where humid tropical conditions favour tree growth and some species of grasses which include *Pennisetumspp*, Southern Gamba (*Andropogontectorum)* and Buffel grass (*Cenchrusciliaris*). The savannah zone is commonly used to describe areas within the tropics under grass or grass with scattered trees. The vegetation in this zone includes Northern gamba (*Andropogongayanus)*, Elephant grass (*Pennisetumpurpureum)*, Guinea grass *(Panicummaximum*), Stylo (*Stylosathesgracilis)* and Bermuda grass (*cynodondaclylon*) among others, (Fayemi, A.A, Odu, C.T. and Fagbemi, A. (2012).

The area is excellent for rearing and breeding of ruminants (sheep, goats, cattle, camels, horses and donkeys (Onifade and Agishi, 2017). However over the years feeding constitute the major problem of livestock industry in the country, low nutritive value of pasture and forages affect the quality of milk and meat of farm animals (Provenza, 2013). Therefore, the study determined the major forages in the area and their chemical compositionduring dry and wet season periods. It is hoped that identifying these components of the feeds would improve livestock production and the living standard of pastoralist and the general public.

METHODOLOGY

Samples in wet seasons were collected using a constructed quadrant frame which was randomly thrown on the ground and all the plants inside the hoop were clipped. Similarly, dry season samples were taken from the same position, identified and labelledin separate containersin the laboratory. Proximate analysis according to Association of Official Analytical Chemists (AOAC, 1990) was used to determine the dry matter (DM) contents, the crude protein (CP) crude fibre (CF) ether extract (EE) total ash (TA) and nitrogen free extract (NFE). acid detergent fibre (ADF) neutral detergent fibre (NDF) and lignin were analysed using the procedure of Goering and Van Soest (2008). The data generated were subjected to analyses of variance, using the General Linear Model (GLM) of SPSS (2001). Means were separated using Duncan Multiple Range Test (DMRT) method described by (Humburg 1990).

RESULTS AND DISCUSSION

Major pasture plants in the grazing area during dry season

The effect of seasonal variation on ruminant livestock production is important. During the mid-wet season; forage biomass is higher in quality and quantity, with crude protein values of up to 12.00% in most of the native grasses. Natural grasses and legumes are rich and highly digestible at this period as supported by Provenza, (2013). The severity and duration of low- quality feed during the dry and wet seasonvaries with species within the ecology. However, there are factors that reduce the availability of thesefeed resources such as widespread annual burning of native grasslands, which drastically reduces the amount of forage on offer ((Nyako, 2010; Nuru, 2015). Table 1 shows the major forages or plants identified in the study area.

Table 1: Scientific and common names of some forage species available in F. C. E(Tech) Gombe grazing during the dry season

S/N	Botanical Names	Common names
Grasses		
1	*Andropogongayanus*	Gamba
2	*Cenchrusciliaris*	Karangiya
3	*Digitariadebilis*	Harkiya
4	*Pennisetumpolystachyon*	Kansuwa
Legummes		
5	*Alysicarpusviginalis*	Gadagi
6	*Arachishypogeae*	Harawargyada
7	*Vignaunguiculata*	Harawar Wake
Shurubs		
8	*Cassia singuena*	Rumfu
9	*Guierasengalensis*	Sabara
10	*Poliostigmareticulatum*	Kargo
11	*Ziziphusspinachristi*	Magarya

Chemical composition of forage species during dry seasons

Table 2 indicated the chemical composition of the available forages within the study area. *Digitariadebilis*shows a higher level of DM content of 88.79%, while *Vignaunguiculata*and *Arachishypogeae*indicated a lower level of DM content of 83.54 and 83.62% respectively. Generally,

the forages dry matter content, crude fibre, acid detergent fibre, andneutral detergent fibreweresignificantly different *(P<0.05).*and were higher than the wet season values. This may be connected to the fact that the nutrient content of the forages leached out or are lignified with little or no value as indicated by (Nyako 2010). However, thecrude protein and ether extract were higher during the wet season.

Table 2: Chemical composition of some forage species in F.C.E. (T) Gombe, grazing area during dry season

S/N	Sample Description	%DM	%ASH	%CP	%EE	%CF	%ADF	%NDF
1	*Andropogongayanus*	88.65^{e}	2.37^{a}	8.52^{b}	1.23^{b}	34.67^{d}	44.64^{e}	55.25^{d}
2	*Cenchrusciliaris*	88.28	1.89^{a}	7.98^{a}	0.61^{a}	36.43^{d}	46.51^{e}	57.24^{d}
3	*Digitariadebilis*	88.79^{e}	1.95^{a}	8.28^{a}	0.97^{a}	35.83^{d}	46.63^{e}	57.12^{d}
4	*Pennisetumpolystachyon*	88.56^{e}	1.91^{a}	8.19^{a}	0.72^{a}	35.26^{d}	45.44^{e}	56.51^{d}
5	*Alysicarphusviginanil*	88.84^{e}	4.09^{e}	8.86^{e}	3.25^{d}	20.89^{b}	36.72^{c}	46.83^{b}
6	*Vignaunguiculata*	83.54^{a}	6.87^{b}	7.28^{c}	4.27^{c}	22.72^{c}	38.61^{d}	49.74^{c}
7	*Arachishypogeae*	83.62^{a}	6.97^{b}	8.38^{c}	4.39^{c}	22.63^{c}	38.52^{d}	49.93^{c}
8	*Cassia singuena*	86.17^{c}	1.62^{d}	3.27^{c}	4.73^{c}	18.31^{b}	25.89^{b}	45.61^{b}
9	*Guierasengalensis*	85.52^{b}	2.51^{d}	4.73^{d}	4.21^{c}	19.66^{b}	34.25^{c}	45.44^{b}
10	*Poliostigmareticulatum*	85.22^{b}	1.25^{c}	2.63^{c}	4.13^{c}	19.19^{b}	26.23^{b}	47.41^{b}
11	*Ziziphusspinachristi*	87.26^{d}	2.25^{c}	1.43^{b}	7.22^{d}	10.59^{a}	19.14^{a}	42.98^{a}
	SEM	0.59	1.53	1.01	0.76	2.95	3.12	1.76

$^{a, b, c, d,e}$ *Means with same letters within a column, are not significantly different (P<0.05).*
SEM=standard error of the mean

Table 3: Chemical composition of some forage species in F.C.E. (T) Gombe, grazing area during wet season

S/N	Botanical Name	%DM	%ASH	%CP	%EE	%CF	%ADF	%NDF
1	*Andropogongayanus*	78.25d	12.53d	13.78c	6.05c	7.09d	24.63c	41.7d
2	*Cenchrusciliaris*	80.14b	13.61e	13.78c	4.24a	5.49b	23.13b	39.3c
3	*Digitariadebilis*	79.23b	11.81d	12.43c	5.83b	5.71b	24.39c	43.68d
4	*Pennisetumpolystachyon*	75.86b	10.15c	12.47c	7.33d	5.27b	23.03b	43.21d
5	*Alysicarpusviginalis*	77.21d	8.14b	11.16b	7.17d	6.31c	23.11b	22.13a
6	*Arachishypogeae*	76.13c	10.95c	14.86e	7.54d	4.24a	21.74a	21.24a
7	*Vignaunguiculata*	76.72c	11.16c	12.47c	7.34d	4.83a	19.26a	21.23a
8	*Cassia singuena*	78.13d	14.03e	11.43b	6.03c	4.39a	28.99d	41.15d
9	*Guierasengalensis*	79.01e	9.26b	8.53a	6.64ac	6.43c	25.43c	52.23e
10	*Poliostigmareticulatum*	77.19d	11.68d	13.27c	6.06c	7.15d	23.66b	41.59d
11	*Ziziphusspinachristi*	76.28d	11.89d	17.98e	5.67b	6.94c	46.51e	43.32d
	SEM	0.36	0.66	0.79	0.35	0.35	1.68	1.94
	Significance Level	*	*	*	*	*	*	*

DM=dry matter, ADF=acid detergent fiber, neutral detergent fiber, CP=crude fiber, EE=ether extract, [a, b, c, d,e] Means with same letters within a column, are not significantly different (P<0.05). SEM=standard error of the mean

Table 3 indicated the chemical composition of the available forages within FCE (T) Gombe grazing area during wet season. As shown *Cenchrus ciliaris* indicated higher value of DM content 80.14% while *Pennisetumpolystachyon*and *Arachis hypogeale*indicated a lower level of DM content of 75.86 and 76.13% respectively. Generally the forages dry matter content, crude fibre, acid detergent fibre, neutral detergent fibre were lower than the dry season values and are significantly different *(P<0.05).* More so, crude protein and ether extract show higher percentages during the wet season.

Table 4: Anti-Nutritive factors in the sampled forages (g/100g) in the Gombe grazing area in samples during dry season

		Wet Season			Dry Season		
S/N	Sample Description	Tannins	Saponins	Alkaloid	Tannins	Saponins	Alkaloid
1	*Andropogongayanus*	0.231	0.828	0.002	0.018	0.777	0.0008
2	*Cenchrusciliaris*	0.112	1.061	0.006	0.061	1.01	0.0048
3	*Digitariadebilis*	0.209	1.408	0.002	0.158	1.357	0.0008
4	*Pennisetumpolystachyon*	0.178	0.948	0.001	0.127	0.897	0.0002
5	*Alysicarpusviginalis*	2.72	1.278	0.409	2.669	1.227	0.4078
6	*Arachishypogeae*	0.193	1.3	0.002	0.142	1.249	0.0008
7	*Vignaunguiculata*	0.131	1.248	0.023	0.018	1.197	0.0218
8	*Cassia singuena*	0.195	1.208	0.005	0.144	1.157	0.0038
9	*Guierasengalensis*	0.112	1.408	0.001	0.061	1.357	0.0002
10	*Poliostigmareticulatum*	0.209	1.818	0.002	0.158	1.767	0.0008
11	*Ziziphusspinachristi*	0.175	0.198	0.023	0.124	0.147	0.0218
	Mean	0.406	1.155	0.014	0.355	1.104	0.0042
	Standard Error	0.228	0.141	0.036	0.072	0.021	0.0021

CONCLUSION AND RECOMMENDATION

It is concluded and recommended that forages such as *Digitariadebilis, Cenchruscitiaris*and*Arachis hypogea* which had over 70% dry matter content in both wet and dry season and lower content of anti-nutritional factors in both seasons should be conserved during the time of abundance (wet season) as animal feeds in order to ameliorate feed shortage during dry season periods.

REFERENCES

AOAC.(1990). Official Methods of Analysis.Vol.I (or Vol. II).15th ed.Association of Official Analytical Chemists, Arlington, VA.

Fayemi, A.A, Odu, C.T. and Fagbemi, A. (2012).Nutrient requirement of tropical pasture legumes.Nigerian journal of animal production. 4:311-318

Goering H.K and Van Soest P.J., (2008).A nutritional explanation for body-size pattern of ruminant andnonruminantanimals.National Academy of Science, 25: 641-672.

Humburg M (1990) Statistical Analysis for Decision making 2nd Edition, HarcourtBrace, New York, 1977: 801.

Jones, D.H and Wilson, A. (2018) Nutritive qualityof forages. Retrieved on 20th September 2019 from http://www.i|ri.org/inforserv/webpub/fulldocs/

Nuru, S. (2015) trends in Small Ruminant Production in Nigeria. NAPRI publication: Ahmadu Bello University Zaria, Nigeria.

Nyako H.D (2010) Utilization of local feed resources for improved small ruminants production in Adamawa state. PhD Thesis, Department of Animal Science and Range management FUT-Yola.

Onifade O.S and Agishi, E.C (2017) Use of legumes for livestock production in Nigeria.ABU Samaru Zaria.

Provenza F.D, (2013). Linkingherbivore experience, varied diets, and plant biochemical diversity. Small Ruminant Res., 49, 257-274.

EVALUATION OF THE EFFECTS OF SORREL SEED MEAL SUPPLEMENTED TO GROUNDNUT HAY OF MIXED BREEDS OF GOATS IN SEMI ARID ENVIRONMENT

[1]Z. M. Chana, [2]Hannatu Charles, S. M. Wudiri & Pwadadi P. R.
[1]Department of Animal Science, University of Maiduguri, Borno State.
[2]Departmenat of Aninal Science Federal University Gashua, Yobe State.
*Corresponding Author: Hannatu Charles, *hannycharles99@gmail.com, +234 8133654745.*

ABSTRACT
The study was conducted to evaluate the effects of using sorrel seed meal as a supplement to groundnut hay on nutrient digestibility in mixed breeds of goats and it lasted for 68 days. A total of four (4) bucks were used for the experiment which comprised of an animal per treatment with an average weight of 19.8kg. They were individually weighed and were randomly allocated in metabolic cages. The observed and recorded parameters were; feed intake, weight changes and digestibility. Groundnut hay was used as the basal diet supplemented with SSM at graded levels of 0%, 20%, 40% and 60% for treatment 1, 2, 3, and 4 in a Latin Square Design. The nutrient digestibility was higher in all the animals, The study indicated significant difference (P< 0.05) in total feed intake among the animals. However, there was no significant (P>0.05) difference in live weight changes, hence of animal D tends to have higher value of 650/period with corresponding feed intake of 1012g/DM/day. There was no significant difference (P>0.05) difference in nutrient digestibility among the animals, although the values were all higher which indicates that supplementing goats with SSM result to better nutrient digestibility and a good protein source.
Key words; sorrel seed meal, groundnut hay, nutrient digestibility and goats

INTRODUCTION
Goats have economic potentials due to high fertility, fecundity, prolificacy, early maturity and their adaptability to the humid environment (Fasae, 2011), but the economic benefits obtained from these animals are far below expectation due to low productivity because of poor nutrition. Olorunsomo (2008) reported that available feed resources are low on nutritive values and supplementary concentrates are very expensive. Therefore, there is need to search for non-competitive and low cost alternative feeds for livestock. Hence sorrel seeds can serve as one. Sorrel (*Habiscus sabdariffa*) is a popular plant belonging to the family *malvaceae* and the presumed origin is South East Asia in the region of India to Malaysia. It has long been cultivated in Africa, probably, it was carried by slaves to the new world (Duke, 1999), Sorrel can tolerate little shade and can be grown in green house but it normally grows best in field conditions under full sunlight. It is widely grown in north Eastern and middle belt regions of Nigeria (Akanfa *et al*., 1997). The plant has been found to thrive on a wide range of soil conditions. It can perform satisfactorily on relatively infertile soil but for economic purposes, a soil well supplied with organic materials and essential nutrients is needed (Tindal, .
Literature shows that sorrel seed is comparable to soybeans with regard to the essential amino acid profile. The fat of the seed is a good source of essential fatty acids (arachidonic, linoleic and linolenic acids) which are required to prevent fatty acid deficiency diseases such as skin lesions and low growth rate (Kinsella, 1987). This study was therefore aimed at determining the effect sorrel seed meal for groundnut hay in goat diet.

MATERIAL AND METHODS
This research was carried out at the University of Maiduguri Teaching and Research farm Department of Animal Science, Faculty of Agriculture. Maiduguri is located at latitude of 11.15° north and longitude 30.05° east and at an elevation of 364m above sea level in the North – eastern part of

Nigeria (Alaku, 1983). It is characterized by hot and dry climate and the annual rainfall ranges from 300mm-700mm and falls mostly between June to September. The ambient temperature ranges between30 - 45°C and usually cold during the harmattan period which falls to about 15°C to 19°C and relative humidity ranges from 3 – 43.5% (Alaku, 1983). A total of four (4) mixed breed male goats were used for the study, with an average weight of 19.8kg in a 4×4 Latin Square Design (LSD). Ten (10) days adjustment period were allowed by each animal followed by (7) days collection period, in all the periods. The experiment lasted for 68 days. The animals were weighed and allocated to metabolic cages. The observed and recorded parameters were; feed intake, live weight changes and nutrient digestibility. Two (2) experimental diets were used, groundnut hay as the basal diet supplemented with sorrel seed meal (SSM) at graded levels of 0%, 207%, 40%and 60%. Each of the experimental diets was subjected to proximate analysis, according to the method of AOAC (1988).
The dry matter content of the feeds was determined by taking a weighed quantity of the feed and oven dried at 105°C for 24 hours. This was repeated twice until a constant weight was obtained. The crude protein was determined using kjeldalh method. This method involves digesting the different samples using digesting tablets and concentrated sulphuric acid. The samples were further diluted with distilled water and later distilled using sodium hydroxide (NaoH) and boric acid. The distilled samples were then titrated using 0.1 normal hydrochloric acid. The crude fiber was determined using trichloroacetic acid (TCA) method. The sample were digested with trichloroacetic acid (TCA) to boil and allowed to reflux for about 40 minutes. The digested sample were later rinsed several times with hot water and then with petroleum ether. The Samples were then allowed to oven dry overnight at 105°c before being taken for ashing, during which final weight was obtained. The fat content was determined by using the soxhlet apparatus, 2g of the experimental diets were put into a timble and corked with cotton wool. It was then placed into extraction Chamber. The collection flask contains 50ml of petroleum ether. The apparatus was heated to boil and reflux for two (2) hours. Fat was collected in the flask and cooled then weighed. The ash was determined by direct burning of the samples to ash. Here the samples were subjected to muffle furnance at a temperature of 500-600°C for 3 hours until ash was obtained. The weight of the ash was obtained.
The data generated were subjected to analysis of variance using statistical package (Statistix8.0). Significant differences between the means were compared Least Significant Difference (LSD

Table 1:Proximate Composition of Experimental Diets

Nutrient (%)							
Ingredients	DM	CP	CF	EE	NFE	ASH	ME
Groundnut hay (Basal diet)	97.1	6.26	18.0	2.0	1.05	3.0	430.90
Sorrel seed meal (supplement diet)	97.2	16.19	23.0	4.0	2.59	5.0	1014.98
Total nutrient intake	97.15	22.75	41.0	6.0	3.64	8.0	1456.97

Pauzenga (1985) ME (Kcal/kg) = 37× %CP +81 × %EE +35.5%NFE

Table 2: Feed Intake and Live Weight Changes of Mixed Breed of Goats Supplemented with SSM

	Animals				
Parameters	A	B	C	D	SEM
Basal diet intake (gDM/ani.)	733.45^{b}	731.71^{b}	771.59^{b}	983.13^{a}	53.281*
Supplement intake	29.16^{a}	29.16^{a}	29.16^{a}	29.16^{a}	14.490^{NS}
Total feed intake	762.6^{b}	760.9^{b}	800.8^{b}	1012.3^{a}	58.091*
Live Weight changes	0.575^{a}	0.475^{a}	0.475^{a}	0.650^{a}	0.2331^{NS}

Key: SEM =Standard error of mean. *= Means significantly different. NS = Not significantly different.

Table 3: Nutrient Digestibility of Goats Supplemented with SSM

	Animals				
Nutrient (%)	A	B	C	D	SEM
Dry matter	56.820	56.085	64.977	60.305	5.3197^{NS}
Crude protein	75.915	78.230	79.345	78.628	2.6973^{NS}
Crude fibre	75.785	73.228	79.073	76.283	3.2075^{NS}
Ether extract	92.800	92.683	91.245	93.883	0.9834^{NS}
ASH	66.268	62.268	64.980	62.788	4.4599^{NS}

RESULTS AND DISCUSSION

The proximate composition of the experimental diets is presented in table 1. The crude protein (CP) and ether extract (EE) content of the raw sorrel seed was 16.19% and 4.0% respectively which is lower than the range value of 25.85-27.10% and 5.0% reported by Duwa *et al*., (2012). It's also lower than the range value of 37.4-38.59% and 16% reported by kwari *et al*., (2011) and FAO (1968). The ash value of sorrel was within the range reported by Dashak and Nwanegbo, (2002), John *et al*., (2010) and Duwa *et al*., (2012), But it was above the values reported by FAO (1968). The dry matter (DM) content of groundnut hay was 97.1% which is higher than 91.08% and 94% reported by Siulapwa and Mikoko (2001) and Yahaya *et al.,* (1999) respectively. It has crude protein (CP) of 6.260% which is lower than the value of 10.9% reported by Addass *et al*., (2011). Crude fiber (CF), nitrogen free extract (NFE) and ash values were less compared to the values reported by Smith (1988) and ether extract value of 2.0 was within the range of 1.5 -2.5reported by Smith (1988). The differences could also be due to variety, type of soil and storage conditions.

For feed intake and live weight changes, there were no significant differences ($P>0.05$) among the animals in supplement intake, the values are the same because they all ate the same amount at different periods. There was significant difference ($P<0.05$) among the animals in basal diet intake with animal D having the highest value of 983.13g, it shows that it consumed more of the basal diet

than the other treatments. The total feed intake ranges from762.6-1012.3g which shows that there was a significant difference in T4 having 1012.3g as the highest value. There was no significant (P>0.05) differences among the animals, however, D tends to have higher live weight gain then other animals. The results obtained compares favorably with the report of Reddy (2001).

Table 3 shows the nutrient digestibility of goats supplemented with SSM. It was observed that nutrient digestibility was higher in all the animals. The value for dry matter digestibility ranges from 56.085-64.977 and no significant (P>0.05) differences were observed among the treatments. This result agrees with that reported by Siebert and Hunter (1982). The values of crude protein (CP), crude fiber (CF) and ash ranges from 75.915-79.435, 73.228-79.073 and 62.788-66.268 respectively which shows that there was no significant(P>0.05) differences. The ether extract digestibility values ranged from 91.245-93.883 with animal D having the highest value. This agreed with the report of Olaleru (1995) who stated that proteinous feed increase ether extract digestibility in ruminant because it supplies the rumen microbes with enough nitrogen that will nourish them and multiply their population thereby increasing the host animal digestibility.

REFERENCES

Addass, P.A.,Nyako, H.D.,Midau, A., Fintan, J.S. and Ja,far-Furo, M.R (2011). Nutritrients evaluation ofsome common feed resources for cost effective of ruminants in Mubi, Nigeria. Agriculture and Biology Journal of North America. 2(1):15-18

Akanfa, H.O., Oyeleke, S.B., Yigam, A.A and Lawal, F.F. (1997). Analysis of Sorel drinks. Nigerian Journal of Biochemistry12:77-79.

Alaku, O, and Momppa, S.M. (1983). Body weight and carcass in goats during the adverse period of West African Sahelian dry season. World review Animal Production. 19: 49 -54.

AOAC (1988). Official Method of Analysis. Association of Official Analytical Chemist (AOAC). Arlington Virginia, USA. Pp69-88

Dashank, O.A and Nwanegbo, V. (2002). Chemical composition of the seeds and calyxesof (Habiscus sabdariffa) grown in Jos North Local Government Area of Plateau State.Journal of Natural Sciences. 5:3-34.

Duke, J.A (1999). The quest for tolerant germplasm 1-61:ASA Special Symposium 32., Crop tolerance toSub-optional land condition. American Society of Agronomy, 50:1325.

Duwa, H., T.A Adegbo and B. Saleh,(2012). Effect of feeding graded levels of boiled sorrelseed meal on growth and blood components of cockerels. Research Opinion in Animal and Veterinary Science.2(10)515-520.

FAO (1968). Food composition tables for use in Africa. Food and Agriculture Organisation of the United Nations. Rome, Italy.

Fasae, O.A, (2011). Characteristics of West African Dwarf Goats. A Review. A paper presented at the workshop on intensive Management of "Dairy Goats". Under the DE/PHE Project 577 held at Njala University, Sierra Leone. Pp4.

John, A.B., M.S. Yahaya and Nyameh (2010).effect of sorrel seed supplementation on the performance of Yankasa rams fed brachiaria decumbensas basal diet. Journal of Agriculture and Veterinary Sciences.

Kinsella, J.E. (1987) Sea foods and human health and diseases, Marcel Dekker Inc.New York and Basel.

Kwari, I.D., J,U Igwebuike., I.D. Mohammed and S.S. Diarra, (2011). Arwath hematology and serum chemistry of broiler chickens feed raw or differently processed sorel (Habiscus sabdariffa) Seed meal in semi-arid environment. International Journal of Science and Nature.2(1):22-23.

Olaleru, F. (1995), Effects of source and level of nitrogen on the utilization of sorghum stover by rams. M.Sc. Thesis. Abubakar Yafawa Belewa University Bauchi, Nigeria.

Olorunsomo, O.A. (2008). Sweet potato as a ruminant feed. Performance off sheep fed mixture of forage and root. Nigeria Journal for Animal Production.3(2): 342-351.

Pauzenga, U. 1985. Feeding parent stock. Zotecnica International Pp: 22 -24.

Reddy, D.V. (2001). Applied Nutrition, Oxford and IBM Publishing Company, Pvt Limited. New Delhi, India. Pp122-127.

Siebert, B.D.and Hunter, R.A.(1980). Supplementary feeding of grazing animalism nutritional limit to animal productionfrom pastures. Proceedings of international symposium. St lucia Queen Stand, Australia 1981. Pp 409-426. C.A. BSlough.

Siulapwa, N.J. and S.Mikiko (2001). Status on the feeding value of Agro-Industrial By-products as supplementary animal feeds in Zambia. A review. School of veterinary medicine, Department of Biomedical sciences. University of Zambia P.O. Box 32379. Lusaka, Zambia.

Smith, O.B. (1988). Studies on the feeding value of Agro-industrial by-products. Effect of forage supplementation on the utilization of cocoa pod based diets by ruminants. J Amin. Res., 8(1):114.

Tindal, H.D. (1986). Vegetables in the tropics, Macmillan Edu Ltd Hampshire, Pp:269-288.

Yahaya, M.S., Takahasi., S.Matsauka and A.KIBON (1999).Effect of supplementary feeding of cotton seed cake on feed intake, water consumption and work output of work bulls in Borno state. Nigerian Animal food science and technology. 79:137-143.

EFFECTS OF DIFFERENT INCLUSION LEVELS OF *Albizia labbeck* FLOWER ON NUTRIENT INTAKE, DIGESTIBILITY AND NITROGEN BALANCE IN RED SOKOTO BUCKS FED A COMPLETE DIET

H.Y.Adamu[1],N.O.Ibrahim.[2],S.B.Abdu[1],M.R.Hassan[1],A.lawal[3]. & Abubakar.m[1]
[1]Department of Animal Science , Ahmadu Bello University, Zaria.
[2]Department of Animal Production and Tecch . Coll. Of Agric and Anim. Sc DAC A.B.U Mando kad[2].
[3]Department of Animal Science federal university Gasua[3]
hanwayusuf@gmailo.com
08035865074

ABSTRACT
The work was carried out to study the intake, nutrient digestibility and nitrogen study of Red Sokoto bucks fed grade levels of Albizia labbeck flower meals in a complete diet. 16 Red Sokoto bucks average weight 13.40kg ±2 were randomly assigned into four groups with four bucks per group in a completely randomized design. Involving four dieting treatments T1, T2, T3 and T4 containing 0, 10, 20 and 30% levels of inclusions of Albizia labbeck flower meals. The result of the trial showed that animals fed 30% Albizia labbeck flower meals had highest ($p<0.05$) intake of all the nutrients. The result indicated that the apparent digestibility of Dry Matter (70.96%) and crude Protein (76.58%) was high ($p<0.05$) in animals fed 30% Albizia labbeck flower meals level of inclusion and had the best digestibility of almost all the nutrients. the Nitrogen balance and the Nitrogen retained percent were significantly higher in Bucks fed T_4. It can be concluded that Albizia labbeck flower can be included in the diets of Red Sokoto buck up to 30% without adverse effect on intake and digestibility of nutrients.

Key words: Bucks, A*lbizia labbeck*, Digestibility, Sorghum panicle and Maize offal

INTRODUCTION

The nutrition of goat is the most important factor affecting performance. Poor nutrition results in low rates of production. It is however an accepted fact during dry season of the year, that grassland in the tropics does not supply sufficient nutrients to stock for greater productivity. Moreover, Range is declining due to increase in land use for crop production, overgrazing, urbanization and population increase (Lamidi, 2005).

Tree fodder maintain higher protein and animal contents during growth than do grasse ,which decline rapidly in quality with progress to maturity . Gupta (1980) found inter *alia* that siris leaves had a dry matter digestibility of 68.5%. A subsequent paper concerning with the effect of molasses supplementation on nitrogen retention for small ruminants on a diet of siris leaves appears to be regard to the plant as a standard feed Flowers contain no adverse constituents but pods contain saponins which may limit intake but appear to have no other adverse effect. Protein and neutral detergent fibre contents are as follows: green leaf, 16-23 and 41-35%; fallen leaf, 10 and 49%; fallen flower, 23 and 51%; pods, 19 and 55 %.(Varshney *et al.*, 1971)

. Therefore, the objectives of this study were to evaluate the intake, digestibility and nitrogen balance in Red Sokoto bucks fed with *albizia labbeck* flower meal

MATERIALS AND METHODS

The experiment was conducted at the Department of Animal Science Farm; Ahmadu Bello University Experimental animals were sourced from Tudun Sebu market in Soba Local Government Area. The *Albezia Labbeck* flowers were harvested In GRA Zaria and Main campus, A.B.U., Zaria,

The animals were dewormed and dipped in ascaride solution. The diets consisted of *Albezia Labbeck* flowers, Cotton seed cake, Sorghum panicle, Salt and Bone meal. Included at the levels of 0, 10, 20 and 30% levels of inclusion.

Digestibility and Nitrogen balance studies were carried out using 16 Red Sokoto bucks average weight 13.40kg ±2 were randomly assigned into four groups in a completely randomized design. Last for 21 days in which 14 days were for adaptation, 7 days for Data collection. The diets were offered to the animals daily at 0800hr. 3% of their body weight. Chemical compositions of the feed and faeces samples were analyzed according to AOAC (2001). Data collected during the trials were subjected to one-way ANOVA SAS (1998) .Duncan multiple range tests (DMRT) was used to compare treatment means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition and Feed Intake

Table 1 shows the proximate composition of the *Albizia labbeck* flowers used in the study. The *Albizia labbeck* had crude protein (CP) 21.00% The crude protein (CP) 21.00% obtained in this study was higher than the values For a feed stuff to be regarded as a potential protein source and this finding confirms with various reports that legumes are. It was observed that the flowers had low lipid contents, a necessary factor in preventing rancidity in the flower for a long period of time. The variation in the crude protein level could be attributed to the season and the soil upon which is growing.

Table 2 presents the results of effect of varied levels of nutrient intake in Red Sokoto bucks. T4 had the highest nutrients intake and statistically ($P<0.05$) differed across the treatments. This was likely due to increase in protein and palatability of the diet.. This was similar to the finding reported by Nguyem *et al*. (2008). The dry matter intake increased with concentrate supplementation due to increase in supply of protein and readily available energy to the rumen microbes which speed up digestion and create more space for intake (Njwe and Olubajo,1992). The increase in TDMI in the supplemental group may be due to palatability of concentrate supplemental diets which agrees with finding of Jamie *et al*.(2009).

DIGESTIBILITY AND NITROGEN STUDY

The results of nutrient digestibility of Red Sokoto goats fed diets containing different levels of *Albizia Labbeck* flower meals are presented in Table 3. The result showed that the nutrient digestibility across the treatments differed significantly ($P<0.05$) and were improved ($P<0.05$) in the supplementary group (T3 and T4) and agreed with the report of Adamu (2013). The current result could be attributed to the additional protein source in the supplemental diet that may have increased protein availability to the rumen micro organisms to speed up the digestion process (Jamie et al, 2009). The dry matter digestibility values obtained T3 and T4 (66% to 71%) were indicated as high digestible level though T2 and T1 (50% to 60%) digestibility were still within the range regarded as moderately accepted for average animal production performance (Devendra and McLeory, 1982).

The results of nitrogen utilization of Red Sokoto goats fed diets containing different levels of *Albizia Labbeck* are presented in Table 4. The results showed that nitrogen utilization across the treatments differed significantly ($P< 0.05$). The nitrogen intake increased as the inclusion level of *Albizia Labbeck* increased across the dietary treatments. The nitrogen loss in urine was higher in T4 (30%) this report agreed with the report of Ibeawuchi *et al*. (1993) which says that "Urine nitrogen is a function of nitrogen ingested, the more nitrogen intake, the more nitrogen excreted in the urine. Nitrogen absorbed (g day^{-1}) was higher in T4 (30%)

CONCLUSION

Based on the results of this study, it can be concluded that *Albizia labbeck* flower meals can be included in the diets of Red Sokoto buck up to 30% without adverse effect on intake and digestibility of nutrients.

REFERENCES

Adamu, H.Y, Lamidi, O.S., Ehoche, O.W., Abdu, S.B., Hassan, M.R. and Yashim, S.M (2013) Growth performance of yankasa rams fed varying proportions of Gmelina aborea leaves. Nigerian Journal of Animal Science, Vol. 15: 145-157

AOAC (2001). Association of Official Analytical Chemists 17th Revised edition. In: Official methods of Analyses, Washington DC pp. 210 – 240

Devendra, C. and Burns, M. (1982.) Goat production in the tropics. 2nd edition Commonwealth. Agricultural Bureau, London. Pp 64-73

Duncan,D.B. (1955). Multiple range and multiple F-test Biometrics, 11:1-43

Gupta, B.S. (1981) Studies on the effect of molasses feeding on the nutritive value of siris (Albizia lebbeck) tree leaves. Indian Journal of Nutrition and Diet 18, 144-147

Ibeawuchi JA, Danjuma D, Oguntona T (1993). The value of dried poultry waste as a protein supplement for growing Borno white goats. Discor. Innov. 5(1): 63-68

Jamie, F., Adegbola, A., Jefery, C., Bob, M. and Ann, B. (2009). Warm-Season Legume Haylage or soya bean meal supplementation effects on the performance of lambs. Florida Beef report. htt://www.fao.org/ag/agp/AGPC/doc/gbase/data, pp 153 – 256

Lamidi, O. S. (2005). The Use Of Some Non-Conventional Protein Sources For Fattening Cattle Poultry manure as supplement for cattle grazing the natural pastures, Ph.D Thesis. Dept. Anim. Sci. Ahmadu Bello University. Zaria, Nigeria.

Nguyem, X. B., Van, N. H., Ngoan, L. D., Clare, M. L. and Peter, T. D. (2008). Effects of amount of concentrate supplement on forage intake, diet digestibility and live weight gain in yellow cattle in Vietnam. Asian – Australasian Journal of Animal Sciences, 14: 56 – 65

Njwe, R. M. and Olubajo, F. O. (1992). Evaluation of cassava flour and groundnut cake as concentrate supplement for West African Dwarf goats. Small Ruminants Research in Africa; Proceeding of the first biennial conference of Africa Small Ruminants Research network. ILRAD Nairobi, Kenya, (Ed.) Rey B. Lebbie S. H. and Renolds L., December 10 to 14, 0

Ovimaps(2014) Ovi location map: Ovi earth imagery date6: 14-1

SAS,(1998). Users guide: Statistical Analysis System Procedure. SAS institute, Inc. Carry

Varshney, I.P., Badhwar, G., Khan, A.A. and Shrivastava, A. (1971) Study of saponins and sapogenins of Sesbania grandiflora seeds, Albizia lebbeck pods and Psidium guyava fruits. Indian Journal of Applied Chemistry 34, 214-216.

Table 1: Proximate composition of experimental flower *Albizia labbeck*

Parameters	Percentage
Dry matter	88.07
Organic matter	11.93
Crude protein	21.31
Crude fibre	13.33
ASH	5.36
NFE	47.04
Ether extract	1.03

Table 2: Effects of Albizia *labbeck inclusion* levels on nutrient intake in growing Red Sokoto bucks.

	Albizia labbeck inclusion level (%)				
Parameters(g/d)	TRT1 (0)%	TRT2 (10)%	TRT3 (20)%	TRT4 (30)%	SEM
DM	252.67^{b}	224.34^{c}	245.03^{a}	258.48^{a}	10.49
OM	238.23^{b}	212.28^{c}	232.26^{c}	272.94^{a}	9.92
CP	31.84^{ab}	28.61^{c}	30.75^{b}	33.65^{a}	1.28
CF	52.42^{b}	43.19^{c}	53.27^{b}	64.40^{a}	2.23
EE	10.61^{ab}	8.45^{c}	10.46^{b}	11.24^{a}	0.42
NFE	143.35^{b}	132.01^{b}	137.78^{b}	163.76^{a}	5.98

^{abc} mean values with different superscripts within a row differ significantly ($p<0.05$) SEM = standard error of mean .DM: Dry matter OM: Organic matter CP: Crude protein CF: Crude fibre EE: Ether Extract NFE: Nitrogen free extract.

Table 3: Effects of *Albizia labbeck* flower *inclusion* levels on nutrient digestibility in growing Red Sokoto bucks.

	Albizia labbeck inclusion levels (%)				
Parameters (%)	T1(0)%	T2 (10)%	T3 (20)%	T4 (30)%	SEM
DM	60.74^{c}	51.76^{d}	66.93^{b}	71.96^{a}	1.24
OM	60.06^{c}	51.06^{d}	66.61^{b}	71.54^{a}	1.25
CP	68.69^{c}	64.96^{d}	73.90^{b}	76.68^{a}	0.95
CF	86.42^{c}	83.98^{d}	90.31^{b}	92.42^{a}	0.34
EE	88.02^{c}	84.31^{d}	90.06^{a}	89.90^{b}	0.42
NFE	46.00^{d}	48.57^{c}	54.06^{b}	61.16^{a}	1.28

^{abc} mean values with different superscripts within a row differ significantly ($p<0.05$)

SEM = standard error of mean .DM: Dry matter OM: Organic matter CP: Crude protein CF: Crude fibre EE: Ether Extract NFE: Nitrogen free extract

Table 4: Nitrogen utilization in Red Sokoto Bucks fed different levels of *Albizia labbeck flower*

	inclusion levels of *Albizia labbeck* (%)				
Parameters (g/d)	T1 (0)%	T2 (10)%	T2 (20)%	T3 (30)%	SEM
N Intake	31.84^{ab}	28.61^{c}	30.75^{bc}	33.65^{a}	1.28
N Loss In Faeces	10.16^{a}	8.55^{b}	8.27^{b}	8.59^{b}	0.40
N Loss In Urine	0.65	0.02	0.95	0.73	0.07
Total N Loss	10.81^{a}	9.57^{a}	9.22^{b}	9.32^{b}	0.39
N Absorbed	21.58^{b}	20.06^{b}	22.48^{b}	37.90^{a}	1.42
N Balance	21.02^{b}	19.04^{c}	21.52^{b}	24.32^{a}	0.98
% Nitrogen	67.17^{c}	63.01^{b}	64.29^{b}	71.97^{a}	2.197

^{abc} mean values with different superscripts within a row differ significantly ($p<0.05$).

N = Means Nitrogen SEM = standard error of mean

UTILIZATION OF CATTLE FORE-STOMACH DIGESTA ENSILED WITH AFRICAN LOCUST BEAN PULP AND NON PROTEIN NITROGEN SOURCES BY GROWING UDA RAMS

[1]Inuwa, M., [1]Abubakar, M. M., & [1]Bello, K. M.,
[1]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi,
Corresponding author email: musainuwa211@gmail.com
+ 2340836970701

ABSTRACT
Sixteen growing Uda rams weighing between 20 and 25kg were used to determine the utilization of cattle fore-stomach digesta ensiled with African locust bean pulp (ALBP) and non-protein nitrogen (NPN) sources. The study was conducted in Katagum, Zaki Local Government Area, Bauchi State. The animals were randomly allocated to four dietary treatment groups in a completely randomized design (CRD). The research lasted for eighty four (84) days of feeding and seven (7) days digestibility trials. Data were taken on feed intake and body weight changes. Blood samples were also collected and analyzed for haematological indices. The results showed that feed intake and dry matter intake (%body weight) were significantly (p<0.001) different. The weight gain, ADWG, total feed intake, feed conversion ratio, haemoglobin, park cell volume, red blood cell, white blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration were not significantly different. There was no significant difference in terms of digestibility of DM, CP, CF, EE, and Ash across the treatments. The cost of production showed no significant differences across the treatments means, but treatment A with 40% fore-stomach digesta and 60% African locust bean pulp was recorded the least cost of ₦332.51 and is recommended to farmers for feeding ruminant animals.

Keyword: Rumen Content, African Locust Bean Pulp, Poultry Litter, Non Protein Nitrogen Sources, Growing, Uda Rams

INTRODUCTION
Ruminant animals play active role in converting feedstuffs of no human dietary value to meat and milk. Efforts have been on using such feeds to reduce cost of feeds and subsequently cost of animal production. In recent years, several authors (Garba and Maigandi, 2008; Fawol and Fajemisin, 2011) investigated the use of cheap agro-industrial by-products and waste materials; such as slaughter/abattoir waste and poultry droppings and cassava peels at various levels of inclusions in small ruminant diets to determine their efficiency of utilization in term of growth and production. Also with a view to identifying the most suitable one in terms of nutrition, cost effectiveness and year round availability.

The findings will further buttress the need for the populace in the developing world's to turn to these cheaper sources of protein to combat the problem of malnutrition.

MATERIALS AND METHODS
EXPERIMENTAL SITE
The study was conducted at Katagum, Zaki Local Government Area, Bauchi State.Zaki is a Local Government Area in Bauchi State, Nigeria, and its coordinates are 12º08'N and 10º17'EIt has an area of 1,436km^2 and a population of 191,457 as at 2006 census. The postal code of the area is 752. The predominant ethnic groups in the area are the Hausa with some

Kanuri and Kare-Kare in the east of the area. Zaki Local Government Area has two main seasons, the dry season, which last from October to May/June and the rainy season that last from June/July to September. Zaki Local Government Area as part of the sahel region of Nigeria is blessed with abundant livestock resources because of its climate which is more suitable for livestock production, due to absence of Tse-tse fly on the open grassland. The experiment was conducted between the months of July-October 2019.

EXPERIMENTAL MATERIALS

Rumen contents (RC), Africa locust bean powder, poultry litter, Urea, water mixing bowl, masking tape, marker and weighing scale.

Experimental Animals and their Management

Sixteen (16) growing Uda rams weighing between 20 and 25kg and 6-7 months of age were purchased from Gamawa town of Bauchi State for the experiment. The rams were transported to Zaki Local Government Area. On arrival, the rams were quarantined, dewormed and sprayed against ecto parasites (using permethrin). The experimental rams were allocated to four different dietary treatment groups and water was provided *ad-libitum.* The feeding trial lasted for eighty-four (84) days.

EXPERIMENTAL DESIGN AND FEEDING PROCEDURE

The experimental design used was complete randomized design (CRD). A total of 16 growing Uda rams were used, such that each treatment contained four replicates. Each group of four animals was assigned to one of the experimental diets for 84 days feeding trial. Each ram was fed individually at the rateof 2kg/ram body weight. Apart from the experimental diets (Table 1), each animal was fed the concentrate diet with the formulation shown in Table 2 at the rate of 1kg.

RESULTS AND DISCUSSIONS

CHEMICAL COMPOSITION OF THE EXPERIMENTAL DIETS

Chemical compositions of the experimental diets are present in table 5. Crude protein content was higher in treatment A (16.43%) which was higher than the 6-8% CP recommended by Norton (2003) for growing sheep and goat. Gatenby (2002) indicated 10-12% CP as moderate level for ruminant production.

The higher CP content in this study could be due to the ensiling effect like rapid increase in soluble component of crude protein due to proteolysis and deamination. The DM value (89.61%) obtained in this study was similar with the values of (87.61-87.71%) observed by ochepo *et al*. (2012) in diets containing sugarcane peels. The higher DM value might be attributed to the types of materials used which were all dried. Higher DM suggest a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen.

The crude fibre value (10.11-9.63%) in the present study were lower than the value (31.30-33.60%) obtained by Ahmed *et al*. (2007) when sugarcane baggase was ensiled with chicken manure. This may be as a result of the experimental materials present in the ensiled mass. Ether extract values (8.14 – 6.93%) obtained from this trial was higher than those reported by Tukur and Maigandi (2010). These are authors obtained EE values ranged of (4.3-5.5%) when fattening rams was fed varying levels of fore-stomach digesta (FSD). The higher ether extract (EE) in diets indicate fats content which give rise to high concentration of volatile fatty acid (VFA).

The Ash values 6.52-7,69% in the present study was lower than (12.91-19.54%) reported by Garba *et al*. (2010) when *Guirera Senegalensis* was fed to yankasa rams as complete diets.

GROWTH PERFORMANCE

Growth performance of the experimental animals higher in feed intake is a good indication of proper utilization of the experimental diets (ensiled FSD with ALBP NPN) by the animals, which could also be attributed to the aroma and palatability of the ensiled diets. Initial, final body weight (BW), daily feed intake (DF1) weight gain, average daily weight gain (ADWG), total feed intake, feed conversion ratio and dry matter intake percentage body weight (DMI%BW) of growing uda rams fed graded levels of the experimental diets were shown in table 2.. Statistical analysis revealed that, there was no significant different ($p>0.05$) effects among the experimental diets across the various treatments on the life weight gain and average daily weight gain. The results of voluntary feed intake were varied statistically ($p<0.001$) among the treatments. Treatment D and C had the higher feed intake. Variation in feed intake between treatments could be as a result of better quality of the materials (urea and poultry litter) used to treat fore-stomach digesta (FSD) and African locust bean pulp (ALBP) which might have aided better intake and improved palatability of the diets.

These results are in line reported by Mondal *et al*. (2013) who found that inclusion of Dry rumen contents (DRC) in diets at O, 5 and 10% DRC did not affect final live weight and average daily gain (ADG) in kids and lambs.

Dry matter intake as percentage body weight was significantly different ($p<0.001$) between the treatments. DMI% BW indicates the nutritional quality of the feed with minimal wastage. The DMI% BW generally indicates that the animals on the various diets showed positively DM status by consuming more than (2) percent of their body weight. The values obtained in this study fail within the range of 2.18-3.78% reported by Olorunnisomo (2010) for sheep fed maize and amaranth fodder.

Nutrient Digestibility

The result of nutrient digestibility is present in table 3. The result showed that nutrient in the experimental diets was well utilized. The digestibility of the nutrients obtained in this present study was comparably high. Muhammad *et al*. (2016b) observed similar trend when uda rams were fed graded levels of *Parkia biglobosa* yellow fruit pulp. Wada *et al*. (2014) observed medium digestibility (40-60%).

Generally, the entire nutrients digestibility in this study was higher and the high digestibility could the attributed to the inclusion level of urea and poultry litter in the experimental diets as sourec of protein. This agreed with the report of Garba and Maigandi (2008) that adequate nitrogen in diets enhanced the activities of rumen microbes which eventually improved the overall nutrient digestibility.

The dry matter (DM), Crude fibre (CF), Crude protein (CP) Ether extract (EE), and ASH digestibility in present trial were comparable to the finding of Muhammed *et al*. (2016b) and higher than the report of Wada *et al*. (2014a). DM values in this study ranges from 75.63-83.44% and that of Muhammad *et al*. 2016b) ranged from 77.22-78.02%.

CP values obtained in the present research ranges from 78.74-84.58% which is higher than the values 24.48-32.27% reported by Wada *et al*. (2014a).

CONCLUSIONS AND RECOMMENDATION

The result showed that daily feed intake was significantly higher in treatments C (1.21kg) and D (1.22kg) than in treatment A (1.08kg) and B (1.09kg). Dry matter intake as % BW was significantly higher in treatments C and D than in treatment A (1.08kg) and B (1.09kg). Therefore treatment D was recommended due to the high DFI, weight gain and low in FCR.

Table 1: Chemical Composition of the Experimental Diets and Concentrate Mixture

	Treatments				
	A	B	C	D	Concentrates
Parameters (%)					
Dry matter	89.61	89.11	88.60	89.59	98.10
Crude protein	16.43	15.96	16.11	16.19	14.93
Crude fibre	9.63	10.11	9.72	9.65	28.00
Ether extract	8.14	6.93	7.29	7.39	4.50
Ash	7.69	6.52	6.86	6.93	6.00

Table 2: Performance Characteristics of Uda Rams Fed Experimental Diets

	Treatments					
	A	B	C	D	SEM	LOS
Parameters						
Initial BW(kg)	20.25	20.50	21.75	19.50	0.35	NS
Final BW (kg)	26.50	26.00	28.25	26.75	0.39	NS
DFI (kg)	1.08[b]	1.09[b]	1.21[a]	1.22[a]	0.01	***
Weight gain (kg)	6.25	5.50	6.50	7.25	0.28	NS
ADWG (g/day)	74.40	65.48	77.38	86.31	3.38	NS
TFI(kg)	90.72	91.56	101.64	102.48	4.78	NS
FCR	14.52	16.65	15.64	14.14	0.78	NS
DMI % BW	4.32[b]	4.36[b]	4.84[a]	4.88[a]	0.03	***

TFI = Total Feed IntakeDMI(% BW) = Dry Matter Intake as % Body Weight LOS = Level of significance NS = Not Significant FCR= Feed Conversion Ratio DFI = Daily Feed Intake ***= $p<0.001$ abc, means within the same row with different superscript are significantly different ($p<0.001$).

Table 3: Nutrients Digestibility of Experimental Rams

	Treatment					
	A	B	C	D	SEM	
Parameters (%)						
DM	82.70	82.88	78.14	84.20	0.55	NS
CP	84.58	78.74	83.67	80.45	1.06	NS
CF	82.68	82.54	81.64	76.03	0.93	NS
EE	78.45	79.47	80.78	79.86	0.88	NS
ASH	66.13	64.16	70.65	71.48	1.04	NS

DM = Dry Matter CP = Crude Protein CF = Crude Fibre EE = Ether Extract ASH = Ash

REFERENCE

Ahmed, G. M., Salih, A. B. and Nagwa, E. G. (2007).Improvement of Digestibility of surgarcane baggase by fermentation with chicken manure.Resources Journal of Agriculture and Biological Sciences, 3(2): 115-118.

Fawolu, T. S and Fajemisin, A. N. (2011). Performance and micro-mineral utilization by West African Dwarf rams fed rumen content- poultry droppings mixed based diets. In: A. A. Adeniji, E. A Olatunji and E. S. Gana (eds.J *Value Re-Orientation in Animal Production: A key to National Food Security and Stable Economy.* Proceedings of the 36th Annual Conference of the Nigrian Society for Animal Production (NSAP), 13th -16th march, held at Merit House/Raw Materials Research and Development Council, Abuja. Pp533-535.

Garba, Y., and. Maigandi, S. A. (2008). Nutrient digestibility and utilization by growing lambs fed ensiled fore-stomach digesta (FSD) with poultry litter waste (PLW). In Repositioning Animal Agriculture for the Realization of National Vision 2020. Pp 222-225.

Garba,Y., Mohammed, A. S., Muhammad I. R, and Nasiru, A. (2010). Intake and Nutrientdigestibility by Yankasa rams fed graded levels of *Guira senegalensi as a complete diet.* In: O. J, Babayemi, O. A. Abu and E. O Ewuola (eds) Fast-tracking Animal Agriculture in a Challenged Economy. *Proceedings of the 35th Annual Conference of the Nigerian Society for Animal production* (NSAP) 14th-17th March, held at University Ibadan, Nigeria. Pp514-517.

Gatenby, R.M. (2002). The *Tropical Agricultural series.* In: A. J. Smith (ed). Macmillan Publishers Ltd. Between Town Roads, CTA, Post Bus 380,6700 A.J Wageningen, Netherland. Pp 32-33.

Mondal, S., Haldar, S., Samanta, I., Samanta, G. and Ghosh, T.K. (2013).Exploring nutritive potential of undigested rumen contents as an ingredient in feeding of goats.Anim. Nutr. Feed Technol., 13:79-88.

Mohammed, Y. S., Mustafa MW, Bashir N and Mokhtar AS. 2013. Renewable energy resources for distributed power generation in Nigeria: A review of the potential. Renewable and Sustainable Energy Reviews. Vol 22: 257–268.

Norton, B. W. (2003). The nutritive value of tree legumes *In: Gutteridge, R. C., Shelton, H. M. (eds). Forage Tree Legumes in Tropical Agriculture. Tropical Grassland Society of Australia Inc., Stlucia Queensland. CAB International Pp 192-201.*

Ochepo, C. O., Ochepo, G. O and Ayoade, J. A (2012). The utilization of complete diet containing sugarcane peels by Goats. In *I. I. Bitto, F. G. Kaankuka and S. Attah (Eds) Sustainable Animal Production for National Food Security and poverty Alleviation.* Proceedings of the 37th Annual conference of the Nigerian Society for Animal Production (NSAP), 18th -21st March, held at the collage of Animal Science, University of Agriculture, Makurdi, Nigeria. Pp 507-511.

Olorunnisomo, O. A. (2010). Nutritive Value of Conserved Maize amaranth or Maize amaranth mixture as dry season fodder for growing West African Dwarf Sheep. *Livestock Research for rural development.* 22: 191-194.

Tukur, H. M., & Maigandi, S. A. (2010). Performance of fattening Rams fed varying levels of fore-stomach digesta. *Journal of Agriculture and Environment,*<5(1 and 2), 51-61.

Wada, N. I., Njidda, A. A., Olafadehan, O. A., & Bello, B. (2014). Effect of Graded Levels of *Parkia Biglobosa* in a Concentrate Diet on Growth Performance, Digestibility and Nitrogen Utilization of Yankasa Rams. *Global Journal of Biology), Agriculture and Health Sciences,* 3(4), 65-70.

Muhammad, N.B.M. Miana, K.M, Aljameel, S.A Maigandi and Buhari (2016b). Nutrient intake and Digestibility of uda rams fed Graded levels of parkia bigblobosa Int.J. of Livestock research 6(5): 33-42.

PERFORMANCE OF YANKASA RAMS FED TREATED AND UNTREATED SORGHUM STOVER WITH DIFFERENT SUPPLEMENTS

Mijinyawa A, Abubakar M, Kalla D.J.U. & Yerima .J.
Department of Animal Production, Faculty of Agriculture, Abubakar Tafawa Balewa University (ATBU) Bauchi, Bauchi State, Nigeria.
Correspondent Author: mijinyawaaminu@gmail.com +2348057443388

ABSTRACT
An experiment was conducted to evaluate nutrient intake, digestibility and performance of growing Yankasa rams fed urea treated and untreated sorghum stover with supplementation. Twenty rams were randomly allotted to four dietary treatmentsin complete randomized design. Animals on treatment 1 and 2 were fed untreated sorghum stover while those on 3 and 4 were given treated sorghum stover. Treatment 1 and 3 were supplemented with cotton seed cake (CSC alone) while those on treatment 2 and 4 were supplemented with cotton seed cake and maize bran (CSC+MB 50:50) the experiment lasted for 63 days. The result indicated that urea treatment increased crude protein (CP) content of sorghum stover by 219% and decreased acid detergent fibre 21.57%. Significant (P<0.05) difference were observed in nutrient intake and growth performance. The result of dry matter intake (DMI) was higher in treatment 1 and lowest in 4 with (576.10 g/day and 513.64 g/day respectively). Live weight gain were significantly (P<0.05) affected by the treatments with treatment 3 having the highest value of 78.89g/day and treatment 2 the least 57.46g/day. Animal fed diet 3 utilized their diet much better compared to others. It may therefore be concluded that urea treatment and supplementation of sorghum stover can improve performance. However diet 3 which gave a better average daily gain is recommended for growing Yankasa rams.

Keywords: Sorghum Stover, Cotton Seed Cake, Maize Bran

INTRODUCTION
The utilization of the cheapest and most available feedstuff is a major challenge facing livestock farmers in Nigeria amidst feed crisis (Bogoro, 1997). These cheap feed resources include crop residues, agro-industrial by-products, animal processing wastes, brewery waste and by products, farm animal waste (poultry litters, animal faces) and other forms of fibre, protein and energy by products suitable for ruminant feeding. Crop residues contribute substantially to the supply of nutrients for animals in the tropical and sub- tropical developing countries. According to Fall *et al.* (1987) about 25% of cereal crops are retained in crop residues, making them valuable nutrient sources. The feeding value of crop residues especially cereals such as sorghum and millet has been largely ignored and this has resulted in development of crop varieties and hybrids that produce fewer residues than unimproved varieties and hybrids that produce fewer residues than unimproved varieties (Williams *et al.*, 1997), yet most important feeds for ruminants in small-holder crop-livestock production system of Asia and Africa. Thus, its importance in ruminant nutrition in the long dry season of semi arid areas needs not to be over emphasized despite its limitations. Cereals straws and other crop residues are characterized by low digestibility (< 50 percent), hence low metabolizable energy content (<7.5mj/kgdm), low crude protein content (<60g/kg Dm), low intake (10-20g/kg live weight daily) and low content of available minerals and vitamins (Nicholson, 1984, Doyle *et al.*, 1986). As sole feeds they are therefore, considered too poor,

even to maintain adult ruminant. In the continuous search for ways of enhancing the nutritional status of the crop residues, two methods are commonly employed, viz; supplementation with protein, mineral and energy sources as well as chemical treatment with urea, ammonia, sodium hydroxide, potassium hydroxide and ash (Adebowale, 1987). In Nigeria, protein consumption is below 67g recommended by the World Health Organization (WHO) (Akintola *et al.,* 1999). There is therefore, the need to increase the protein intake to a level which compares to that of the developed nations (Okereke *et al.,* 2005), sheep population in Nigeria which is estimated to be 33.9million (FAO, 2008) and which are primarily kept for meat production can bridge the supply-demand of animal protein gap in Nigeria. However, effective and efficient sheep production cannot be enhanced with the use of conventional feedstuffs such as maize, soybean cake and fish meal as supplements to low quality feeds due to their exorbitant cost, erratic supply (Akinmutimi, 2004) and the competition with humans and monogastric animals (Ajayi *et al.,* 2008; Ukpabi and Abdu, 2009). It is in this light that non conventional energy and protein materials of farm and agro-industrial wastes were being exploited for livestock production in Nigeria (Ndubueze *et al.,* 2006; Okonwo *et al.,* 2008). Such feed resources should be cheap, have high nutritive value, non-toxic, readily available, have low or no demand by both humans and other livestock species and without industrial usage (Egbo *et al.,* 2001; Amaefelu , 2002; Ndubueze *et al.,* 2006).

MATERIALS AND METHODS

LOCATION OF THE EXPERIMENTAL SITE

The experiment was carried out at the Ruminant Animal Research Farm of Animal Production Department, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi.

Experimental animals and their management

Twenty Yankasa rams with average weights 15 kg of ranged 14-16 kg and aged 8 – 10 months were used for the experiment. The rams were sourced from Durun and Mararaban Liman Katagum Markets in Bauchi Local Government area of Bauchi state. The animals were housed in individual pens. The houses are with corrugated iron roof and a concrete floor with large windows to enhance ventilation. The Saw dusts/wood shavings were used as bedding materials to protect the animals from dampness and cold. Before the beginning of the experiment, the animals were treated against ector and endo parasites using ivormectin injection and albendazole bolus and also injected intra-muscularly with *oxytetracycline* long acting broad spectrum antibiotic as a precautionary measure against bacterial infections. The animals were allotted to four dietary treatments of five animals each. Each individual animal was kept separately in its on pen. The animals were kept for a period of two weeks to enable them adapt to confinement. During the adaptation period, the experimental diets were offered to the animals at adlibitum. Feed offered and feed refused were recorded for each animals in each group daily while animal weights were taken on a weekly basis, using a hanging scale/spring balance. Average daily feed intake and average daily weight gains were recorded over the 9 weeks experimental period. The diets use as follows: Treatment one (T1) untreated milled sorghum Stover (UMSS) supplemented with 300g cotton seed cake alone, treatment 2 untreated milled sorghum stover (UMSS) with 300g cotton seed cake and maize bran (50:50). Treatment 3 urea treated milled sorghum stover supplemented with cotton seed cake alone,

while those on treatment 4 were fed urea treated milled sorghum stover supplemented with cotton seed cake and maize bran 50:50. All supplements were fed at 300g per head per day. The supplements were fed twice a day, half of each time; in the morning (09:00 hrs.) and evening (16:00 hrs.)

UREA TREATMENT OF SORGHUM STOVER

One thousand kilogram of milled sorghum Stover was treated with 5% urea solution in batches. Five (5) kilograms of urea was dissolved in 100 litres of water was sprinkled to 100 kg of milled sorghum Stover. The milled sorghum stover was mixed thoroughly and compressed before inserted into an air tight polyethene bag. The sample was done in a polyethene bags of dimension 112 cm by 76 cm and ensiled for three weeks. After this period, the ensiled material was opened and air dried under shade for 3 days. Continuous raking was carried out for uniform drying and to minimize the risk of mould.

EXPERIMENTAL DESIGN

The experimental design was completely randomized design with four treatments of five animals per treatment.

CHEMICAL ANALYSIS

All the diets and faeces were analyzed for chemical composition. Each sample was milled to pass through a 1.0mm screen using a telator cyclotee 1093. The milled samples were used for proximate analysis to determine Nitrogen (N) for use in crude protein determination (N x 6.25), crude fibre (CF), ether extract (EE) and ash according to AOAC (1999). Neutral Detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to procedures outlined by Van Soest *et al.* (1991).

DATA ANALYSIS

Data were analyzed using statistical package for social sciences (SPSS) where there is significant difference in analysis of variance (ANOVA) means were separated using least significant difference (LSD) (version: 21, 2006).

RESULTS AND DISCUSSION

Presented in Table 1 is the chemical composition of the experimental diet, the increase in the Crude Protein (CP) content of sorghum stover is in agreement with findings of Yulistiani *et al.*(2003) which found an increase in CP content of urea treated rice straw to be 2.7 times CP and also slightly higher compared to previous experiment reported by Prasad *et al.* (1998) were 2.34 was recorded for urea treated straw kept in bale and 2.433 kept in stack. However, the increase in nitrogen content in the experiment currently reported was higher compared to the result reported by Ahmed *et al.* (2002). This difference could be due to method of ensiling, the variety of the straws, urea treatment level as well as the nitrogen content of the straw. Yulistiani*et al.* (2000) reported that rice straw with low nitrogen content could benefit more from urea treatment to improve nutritive value especially nitrogen content. Urea treatment decreased slightly cell wall component previous study reported by Yulistiani *et al.* (2000) show that effect of urea treatment on cell wall component was not consistent. Daily feed intake of the urea treated sorghum stover was similar across the treatment which is not in agreement with some findings; Ngele *et al.* (2009) and Getahun (2014). This may be attributed to treatment rendered to the basal diet which reduced the particle size of the straw thereby given a better chance for the animals to consume relatively the same amount across the treatments. The average daily weight gain was significantly ($P < 0.05$) affected by the

treatment. The ADG recorded in this study was higher in treatment 3 (78.93 g/day) while treatment 2 with the lowest (57.46 g/day) were lower to those reported (61.70-82.54 g/day) by Aime *et al.* (1999) when determined the effect of urea treatment on digestibility and utilization of sorghum stover.

Conclusion

Based on the results obtained in this study, urea treatment increased the crude protein content of sorghum stover and decreased the acid detergent fibre. It can be concluded that treated sorghum stover with cotton seed cake supplement fed to Yankasa rams gave a better result comparable to those fed untreated sorghum stover with supplements in terms of digestibility and ADG.

Table 1: Chemical composition of untreated and urea treated sorghum stover and supplements.

Parameters (%)	TSS	USS	CSC	MB + CSC
Dry matter	88.23	90.20	93.6	91.27
Organic matter	79.60	83.53	87.8	84.22
Crude protein	18.63	5.83	30.39	25.59
Neutral detergent fibre	43.24	49.39	48.59	48.76
Acid detergent fibre	34.73	42.21	39.17	37.53
Hemicelluloses	8.51	7.18	9.42	11.23
Ether extract	0.72	0.83	6.20	2.32
Ash	8.53	6.61	5.8	7.05

TSS = Treated Sorghum Stover, USS = Untreated Sorghum Stover, CSC = Cotton Seed Cake, MB + CSC Maize Brand and Cotton Seed Cake.

Table 2: Nutrient intake of Yankasa Rams fed untreated and urea treated sorghum stover with supplements

	Treatments					
Parameters	T1	T2	T3	T4	SEM	LS
Average daily supplement intake (g)	300	300	300	300	0.00	NS
Average daily basal feed intake (g)	327.38	314.83	314.58	271.82	12.05	NS
Average daily feed intake (g)	627.38	614.83	614.58	571.82	12.05	NS
Dry matter intake (g/day)	576.10^{a}	557.79^{b}	558.35^{b}	513.64^{c}	5.28	*
Organic Matter Intake (g/day).	566.86^{a}	515.63^{b}	543.81^{c}	469.03^{d}	8.36	*
Crude Protein Intake (g/day)	110.26^{c}	95.12^{d}	149.78^{a}	127.41^{b}	4.66	*
Neutral Detergent Intake (g/day)	307.46^{a}	301.77^{b}	281.79^{c}	263.81^{d}	3.96	*
Acid Detergent Intake (g/day)	255.70^{a}	245.48^{b}	226.76^{c}	206.99^{d}	4.27	*

T1- untreated sorghum stover + cotton seed cake alone, T2- untreated sorghum stover + cotton seed cake and maize brand (50:50), T3-urea treated sorghum stover + cotton seed cake alone, T4-urea treated sorghum stover + cotton seed cake and maize brand (50:50), NDF- Neutral detergent fibre intake, ADFI- Acid detergent fibre intake, * = Significant difference ($P<0.05$), NS = No Significant difference, SEM = Standard Error Mean, LS = Level of Significance. ^{a,b,c} means with different superscript along the same row are significantly different.

Table 3: Growth Performance of animals fed the experimental diets

	Treatments					
Parameters	T1	T2	T3	T4	SEM	LS
Initial weight (kg)	15.40	14.50	15.40	15.00	0.19	NS
Final weight (kg)	19.52^{c}	18.12^{d}	20.37^{a}	19.75^{b}	0.19	*
Total weight gain (kg)	4.12^{c}	3.62^{d}	4.97^{a}	4.75^{b}	0.12	*
Daily weight gain (g)	65.39^{c}	57.46^{d}	78.89^{a}	75.39^{b}	1.93	*
Dry matter intake (g/day)	576.10^{a}	557.79^{b}	558.35^{b}	513.64^{c}	5.28	*
Feed conversion ratio (FCR)	8.81^{c}	9.71^{d}	7.08^{b}	6.81^{a}	0.27	*

T1- untreated sorghum stover + cotton seed cake alone, T2- untreated sorghum stover + cotton seed cake and maize brand (50:50), T3-urea treated sorghum stover + cotton seed cake alone, T4-urea treated sorghum stover + cotton seed cake and maize brand (50:50), ADG= Average daily gain FCR=Feed conversion ratio, DMI= Dry matter intake,* = Significant difference ($P<0.05$), NS = No Significant difference, SEM = Standard Error Mean, LS = Level of Significance. ^{a,b,c} means with different superscript along the same row are significantly different.

REFERENCES

Adebawale, E.A (1987). Treating maize stover with organic waste ash. Effect of source and concentration of Alkali on nutrient utilization and performing in West African Dwarf Sheep. Journal of Animal Production Research, 7: (2) 123 – 135.

Ahmed, A., M. J. Khan, M. Shahjalal and Islam K. M. S. (2002). Effects of feeding urea and soybean meal - treated rice straw on digestibility of feed nutrients and growth performance of Bull calves. Asian-Aust. J. Anim. Sci. 15(4):522-527.

Aime, J.N., Suchet, L.L., Sandra, S., Charles, L.O. and Arthur, S. (1999). Effect of urea treatment on digestibility and utilization of sorghum straws. Biotechnology, agronomic, society environment. 3: 78 – 85.

Ajayi, H.I., Olomu, J.M. and Oyedeji, J.O (2008). Potentials of African pear (Dacryodes edulis) as a feedstuff for animals. Proceedings of the 13th Annual Science Association of Nigeria, September, 15 – 19, 2008, Zaria, Nigeria.

Akinmutimi, A.H. (2004). Evaluation of sword bean Canavalia gladiate as an alternative feed resource for broiler chickens. Ph.D. Thesis, Michael Okpara University of Agriculture Umudike, Nigeria.

Akintola, E.O., Kehinde, A.S., Abu, O.A. and Tewe, O.O. (1999). Performance and economy of production of growing pigs fed whole cassava plant based diets in the tropics. Animal Production Investment. 2: 181 – 186.

Egbo, M.L., Doma, U.D. and A.B. Lacdaks, (2001). Management in Bauchi metropolis. Proceedings of the 26th Annual Conference on Nigerian Society for Animal Production (NSAP), March 18-21, 2001, ABU Zaria, Nigeria, Pp: 160 – 162.

Fall, S., H. Guerin, C. Sall and N.D. Mbaye, 1987. Cereal straws in the feeding system of ruminant in Senegal. Pp 173-188. In: Said A.N. and Dzowela B.H (eds.), 1989. Overcoming constraints to efficient utilization of agrcultural by-Products as animal feed. Proceedings of the fourth animal workshop held on October 20-27, 1987 at the institute of animal research, Mankon station, Bamenda, Cameron.

Getahun Kebede, 2014. Effects of wheat straw urea treatment and leucaena leucocephala foliage ay supplementation on intake, digestibility, nitrogen balnce and growth of lambs. International Journal of Livestock Production, 6 (4): 88-96

Ndubueze, A.I., Ukachukwu, S.N. Ahamefule, F.O. and Ibeawuchi, J.A. (2006). Milk yield and composition of grazing white Fulani cows fed poultry waste-cassava peel based diets. Pakistan Journal Nutrition., 5: 436 – 440.

Ngele, M.B. Kalla, D.J.U, Abubakar, M. Dass, U.D. and Amba, A.A (2009). Enchancing crop residues for livestock feeding in the tropics

Nicholson J W G. 1984. Digestibility, nutritive value and feed intake. In: F Sunstol and E Owens (eds), Straw and other fibrous byproducts as feeds. Elsevier Science Publishers, Amsterdam. The Netherlands. pp. 340–372.

Okereke, C.O., Ukaechukwu, S.N. and Okoye, F.C., (2005). Effects of dietary inclusion of composite cassava meal on egg production characteristics of laying hens. M.Sc. Thesis, Michael Okpara University of Agriculture, Umudike, Nigeria.

Prasad, J. (2010). Goat, sheep and pig production and management. 4th edition. Kalyani publishers India Pp. 204 – 230.

SPSS (2006). Statistical package for Social Science: version: 21

Williams, T. O., Fermandez-Revera, S. and Kelley,T.G.(1997). The influence of Socio-Economic Factors on the Availability and Utilization of Crop Residues as Animal Feeds In: Sustainable Mixed Crop/Livestock Farming Systems, (CAB International, Wallingford), 25-39.

Yulistiani, D. Gallagher, J.R. and Van Barneveld R.(2000). Nutritive value improvement of rice straw varieties for ruminants as determined by chemical composition and in vitro organic matter digestibility JITU 5:23-31

REPLACEMENT OF PALM KERNEL CAKE WITH KENAF GRAIN MEAL IN CASSAVA PEEL DIET ON PERFORMANCE OF WEST AFRICAN DWARF SHEEP

Omotoso, S.O.,[1*] Ajayi, F.T.,[1] Kenneth-Obosi, O.[2] and Oladele-Bukola, M.O.[1]

[1]Institute of Agricultural Research and Training, Moor Plantation, Ibadan

[2]National Institute of Horticultural Research and Training, Idi-Ishin, Ibadan

**E-mail:tobsum2006@gmail.com, +2348060838357*

ABSTRACT

This study was conducted to evaluate the effect of replacing Palm kernel cake (PKC) with Kenaf grain meal (KGM) in cassava peel-based diet on performance of WestAfrican Dwarf sheep. Sixteen female West African Dwarf sheep with the average live weight of 9.71± 0.05 kg were randomly allotted to four dietary treatments in a complete randomised design with four animals per treatment. The results showed that dry matter (88.80-88.95%) and ether extract (2.84-3.14%) contents were relatively similar.The crude protein contents were highest (16.22%) in diet 3 and lowest (14.73%) in diet 1 while the crude fibrecontent was highest in diet 1 (23.38%) and lowest in diet 2 (17.85%). The performance of the sheep differed ($p<0.05$) across the treatments. Total feed intake (662.82 g/day), weight gain (30.95 g/day) and feed conversion ratio (21.42) were best in sheep fed diet 4 (25% KGM inclusion) compared to other treatments. However, total feed intake(g/kg$W^{0.75}$) was highest ($p<0.05$) in sheep fed diet 1 (25% PKC inclusion) but lowest in sheep fed diet 2 (10% PKC and 15% KGM inclusions). In conclusion, the significant ($p<0.05$) performance of sheep fed with diet 4 (25% KGM inclusion) revealed the possibility of total replacement of PKC with KGM in cassava peel ration without negative impact on the growth of West African Dwarf sheep.

*Keywords:*Cassava peel, kenaf grain, palm kernel cake, performance, sheep

INTRODUCTION

The perennial challenge of feed scarcity and limiting Nitrogen (N) content of tropical grasses in the tropics especially in the dry season triggered several kinds of research on the exploration of crop residues and agro-industrial by-products in ruminants feeding systems. Cassava peel has been successfully used as a suitable source of energy supplement to foliage or poor quality feed but its low crude protein content requires that it should be supplemented with a dietary protein source, preferably of plant origin to make a complete feed suitable for ruminants. Similarly, palm kernel cake is a medium quality energy source, high in fibre and crude protein contents moderately (Carvalho *et al*., 2005) enough to meet the requirements of most ruminants. Though Chanjula *et al*. (2011) had reported that palm kernel cake has no effect on voluntary feed intake for ruminants at high levels, but Wan Mohammed *et al*. (1987) reported that long-term feeding of PKC could lead to copper toxicity in sheep. Often, forage legumes have been the cheapest source of protein widely accepted in ruminant feeding systems in the course of solving the limiting N content of tropical grass species. However, a promising and non-conventional protein, energy and fibre sources for ruminants that have not received adequate attention is the kenaf plant (*Hibiscus cannabinus*). Kenaf is a well-known industrial and commercial fibre crop around the world (Welber *et al.*, 2002). Even though Kenaf seed is reported as a suitable supplementary source of protein in livestock feed (Nyam *et al.*, 2009), very scanty information is available about the utilization of the grain as feed for ruminants. The high content of fibre and edible oil (LeMahieu *et al*., 2003) of kenaf seed also suggests its usefulness as a source of energy for livestock. Though kenaf plant is increasingly gaining wider acceptance by the small and large scale crop farmers for propagation as raw materials for jute and fibre industries in Nigeria, but tons of the seeds produced for subsequent propagation rapidly loss viability and get wasted because of poor storage conditions, inadequate or high cost of storage facilities which is beyond the reach of the rural poor producers. Hence, the seeds are discarded by setting it on a flame. To prevent the wastage of the non-viable Kenaf seeds and intensify efforts at promoting kenaf grain

production for wider use in the livestock industry, this study was designed to explore the potential of kenaf grain in small ruminant feeding strategy.Considering the similar dietary nutritional (protein and energy) potentials of palm kernel cake and kenaf seeds, it was hypothesized that Kenaf grain meal could replace palm kernel cake and also supplement cassava peel-based diet to promote voluntary feed intake for improved growth performance by West African Dwarf(WAD) sheep.

MATERIALS AND METHODS

The experiment was carried out at the sheep and goat unit of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan. Animals selected from the herd for the experiment were given prophylactic treatments against ecto and endo-parasites and adjusted to their treatments diets over a 2-week preliminary period, followed by 84-day feeding trial. Sixteen WAD female sheep with the average live weight of 9.71± 0.05 kg were randomly allotted to individual pens and to one of four treatment diets in a complete randomized design with four animals per treatment.

FEED PROCESSING, FEEDING AND GROWTH TRIALS

Feed ingredients were sourced from animal feedstuff vendors, while dried kenaf grain was collected from the Kenaf and Jute Fibre Programme of the Institute of Agriculture Research and Training, Ibadan. Fresh Guinea grass (*Panicum maximum*) was harvested from an established pasture of the Research Institute and allowed to wilt under room temperature before feeding. Kenaf grain and dried cassava peel were crushed with attrition and hammer mills, respectively into small particle size (1.5-2.5 mm) to allow for proper mixing with other ingredients. Thereafter, the crushed feedstuffs were separately weighed and mixed according to the proportion of each dietary treatment as enumerated in Table 1. Experimental diets (Table 1) were offered separately to individual animals at 3% body weight at 08:00 h. Wilted Guinea grass was offered to all the sheep at 2% body weights at 16:00 h. Provision was made for a daily feed allowance of 10% above the previous week's consumption. Clean water was served *ad libitum*.The initial body weighs of the animals were taken and recorded before the commencement of the experiment. Daily feed intake was determined by subtracting feed refused from feed offered over a 24-h period, while live weight changes were measured once each week before feeding in the morning throughout the 105 days experimental trial excluding 2 weeks of the adaptation period.

CHEMICAL AND STATISTICAL ANALYSIS

Dried samples of the experimental diets and guinea grass were analyzed for Crude protein (N×6.25), Dry matter, ether extract, ash, and crude fibre contents as described (AOAC, 2000). Data obtained were subjected to analysis of variance and Duncan's Multiple Range Tests was used to detect significant differences among means at $p< 0.05$.

Table 5: Ingredient composition (g/100g DM) of the experimental diets

Ingredients (kg)	Diet 1	Diet 2	Diet 3	Diet 4
Dried cassava peel	55.0	55.0	55.0	55.0
Palm kernel cake	25.0	10.0	5.0	-----
Kenaf Grain	-----	15.0	20.0	25.0
Corn bran	15.0	15.0	15.0	15.0
Soya bean meal	2.5	2.5	2.5	2.5
Di-calcium phosphate	1.0	1.0	1.0	1.0
Limestone	0.75	0.75	0.75	0.75
Premix	0.25	0.25	0.25	0.25
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

RESULTS AND DISCUSSION

Table 2 shows the proximate composition of the experimental diets, guinea grass and major test ingredients. The value of dry matter (88.80-88.95%) for the experimental diets was relatively similar. The crude protein (14.73-16.22%) content for all the diets was above the minimum requirement recommended for sheep (Gatemby, 2002). The highest CP value of diet 3 (16.22%) could be due to the combined effect of the test ingredients (palm kernel cake and kenaf grain meal) CP contents. The ash content ranged from 7.15-7.48%. The ether extract values of diets 3 and 4, 1 and 2 were respectively similar, which is an indication that ether extract values (2.84-3.14%) of the experimental diets were not above the dietary fat (5-6%) that could inhibit microbial activity and reduce nutrient digestibility (Kucuk *et al*., 2003) in ruminants. The range of crude fibre was above the minimum level of 17% recommended for ruminants (NRC, 2001). The highest value of crude fibre in diet 1 (23.38%) compared to diets 2 to 4 respectively, with varying proportion of PKC and KGM could have resulted from the inclusion of palm kernel cake, which has been reported to contain a high amount of lignin due to contamination of nutshells (Mok, 2013). The high CP, crude fibre and low ether extract values of the experimental diets reveal the nutritive value of palm kernel cake and kenaf grain meal to supplement cassava peel and ability to promote ruminal microbial activity to improve the digestibility of feed.

Table 2: Proximate composition (g/100g DM) of experimental diets, Kenaf grain meal and Guinea grass

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	KGM	PKC	Guinea grass
Dry matter	88.81	88.80	88.87	88.95	93.23	93.80	88.76
Crude protein	14.73	14.93	16.22	15.73	21.44	18.44	8.60
Ether extract	2.84	2.95	3.08	3.14	3.48	6.82	2.85
Ash	7.48	7.33	7.15	7.27	5.40	5.21	9.04
Crude fibre	23.38	17.85	19.19	18.77	11.27	15.36	32.33
NFE	51.59	56.95	54.37	55.09	58.41	54.17	47.18

NFE= Nitrogen Free extract; KGM= Kenaf grain meal; PKC= Palm kernel cake

The feed intake and growth performance of WAD sheep fed cassava peel concentrate with varying inclusions of palm kernel cake and kenaf grain meal differed significantly ($p<0.05$) across the treatments (Table 3). Total feed intake ranged from 538.96-662.82 g/day, being highest in sheep fed diet 4 (25% KGM inclusion) but lowest in sheep fed diet 1 (25% PKC inclusion). However, total feed intake in metabolic body (g/kg$W^{0.75}$) weight was highest (93.41 .g/kg$W^{0.75}$) in sheep fed diet 1 and lowest (79.74 g/kg$W^{0.75}$) in sheep fed diet 2. The significantly higher total feed intake observed for all the sheep fed diets containing KGM is an indication that the experimental feed was well accepted, which corroborates the findings of Sgwane *et al*. (2008) that kenaf seed increased dry matter intake of sheep fed low-quality hay. This also suggests that the nitrogen content of kenaf seed was sufficient to improve ruminal microbial activities for feed degradability and consequently increased intake. The highest weight gain (30.95 g/day) and efficiency of feed conversion were observed for sheep fed diet 4 (25% KGM inclusion) compared to other treatments (16.07-21.43 g/day) groups. Even though the

high crude protein in KGM and moderate protein in PKC are highly degradable and soluble in the rumen (Carvalho *et al*., 2005), cassava peel which is a source of highly fermentable carbohydrate in ruminant ration could have protected the nitrogen of KGM-PKC from total degradation in the rumen for subsequent absorption in the abomasum and small intestine as documented (Kardaya *et al*., 2009). Therefore, the significantly higher weight gain of sheep fed diet 3 and 4, respectively compared with sheep fed diet 2 (15% KGM +10% PKC) affirms that between 20-25% of KGM could successfully replace PKC in cassava peel ration for sheep. Hence, the variations in performance observed across the treatments further elucidate the potential of KGM to replace PKC as supplementary protein and energy sources for small ruminant feeding.

Table 3: Performance of West African dwarf (WAD) sheep fed cassava peel with varying inclusions of palm kernel cake and kenaf grain meal

Parameters	T1	T2	T3	T4	SEM
Feed intake (g/day)					
Cassava peel-kenaf grain concentrate	280.71^{d}	295.15^{c}	313.63^{b}	344.27^{a}	7.16
Guinea grass	258.25^{d}	315.06^{c}	320.37^{a}	318.55^{b}	7.82
Total feed intake (g/day)	538.96^{d}	610.21^{c}	634.00^{b}	662.82^{a}	13.82
Total feed intake (g/kg$W^{0.75}$)	93.41^{a}	79.74^{d}	80.46^{c}	82.34^{b}	1.67
Weight gain (g/day)					
Initial body weight (kg)	9.48	9.62	9.86	9.88	0.05
Final body weight (kg)	11.20^{c}	10.97^{d}	11.66^{b}	12.48^{a}	0.18
Weight gain (g/day)	20.48^{c}	16.07^{d}	21.43^{b}	30.95^{a}	1.64
Feed conversion ratio	26.32^{c}	38.01^{a}	29.59^{b}	21.42^{d}	1.81

^{abcd}= Means with the same superscripts in the same row are significantly different ($p<0.05$)

CONCLUSION

The highest total feed intake (662.82 g/day), daily live weight gain (30.95 g/day) and better feed conversion ratio (21.42) observed for sheep fed with diet 4 (25% KGM inclusion) revealed the possibility of total replacement of PKC with KGM in cassava peel ration without negative impact on growth performance of West African Dwarf sheep. It is therefore concluded that kenaf grain meal could replace PKC and supplement cassava peel which is a low nitrogen crop residue diet often utilised in small ruminant feeding systems.

REFERENCES

Association of Official Analytical Chemists (AOAC). (2000). Official methods of analysis.17th ed. Arlington, VA, USA.

Carvalho, L.P.F., Melo, D.S.P., Pereira, C.R.M., Rodrigues, M.A.M., Cabrita, A.R.J. and Fonseca, A.J.M. (2005). Chemical composition, *in vitro* digestibility, N degradability and enzymatic intestinal digestibility of five protein supplements.*Animal Feed Science Technology*, 119: 171-178.

Chanjula, P.Y., Siriwanthananukul and Lawpetchara. (2011). Effect of rubber seed kernel and palm kernel cake in combination on nutrient utilization, rumen fermentation characteristics, and microbial populations in goats fed *Brachiaria humidicola* hay-based diets. *Asian-Australian Journal of Animal Science*. 24:73-81.

Gatenby, R. M. (2002). Sheep. The Tropical Agricultural Series. McMillan publishers. Pp. 408-515.

Kardaya, D., Wiryawan, K.G, Parakassi, A. and Winugroho, H.M. (2009). In vitro slow-release urea characteristics under different molasses levels contained in rice straw-based diets. *Indonesian Journal of Animal Veterinary Science*, 14: 177-191.

Kucuk, O., Hess, B.W., Ludden, P.S. and Rule, D.C. (2003). Effects of increasing dietary forage in limited-fed ewes fed a 6% fat diet. *Sheep and Goat Research Journal*, 18:25-33.

LeMahieu, P. J., Oplinger, E. S. and Putnam, D. H. (2003). Kenaf. Alternative Field Crops Manual.

Mok, C.H., Lee, J.H. and Kim, B.G. (2013). Effects of exogenous phytase and betamannanase on ileal and total tract digestibility of energy and nutrient in palm kernel expeller-containing diets fed to growing pigs. *Animal Feed Science Technology*, 186:209–213.

NRC (2001). Nutrient Requirements of Dairy Cattle.7th ed. National Academy Press, Washington, D.C.

Nyam, K. L., Tan, C. P., Lai, O. M., Long, K. and Che Man, Y. B. (2009). Physicochemical properties and bioactive compounds of selected seed oils. *LWT–Food Science and Technology*, 42: 1396–1403.

Sgwane, T. S., Teleni, E. and Gardiner, C. P. (2008). Kenaf seeds (*Hibiscus cannabinus* L.) as a protein supplement to sheep. Australian Rangeland Society.15th biennial Conference Proceedings, 'A climate of Change in the Rangeland'.pp 1-4.

Wan Mohamed, W.E., Hutagulung, R.I. and Chen, C.P. (1987). Feed availability, utilisation and constraints in plantation-based livestock production system. Proceedings 10th Annual Conference Malaysian Society Animal Production, pp. 81-100.

Webber, C. L., Bhardwaj, H. L. and Bledsoe, V. K. (2002). Kenaf production: Fibre, feed and seed. Trends in New Crops and New Uses. (Eds J. Janick and A. Whipkey), ASHS Press, Alexandria, VA, pp. 327-329.

PROFITABILITY OF FEEDING SUN-DRIED POULTRY DROPPING BASED DIETS AS SUPPLEMENT FOR GOATS CONSUMING FINGER MILLET STRAW

Abdulwaheed Adeyemi Bello[*] Balakrishna Gunaji Desai,[+] and Janarda Shamroa Dhekale,[+]

[*]*Department of Animal Health and Production Technology, College of Agriculture, Mokwa, P.M.B 109, Niger State, Nigeria.*

[+]*Department of Animal Husbandry and Dairy Science, College of Agriculture, Dr. B.S.K.K.V, Dapoli, Pin: 415 712 Dist. Ratnagiri, Maharashtra, India.*

[+]*Department of Agricultural Economics, College of Agriculture, Dr. B.S.K.K.V, Dapoli, Pin: 415 712 Dist. Ratnagiri, Maharashtra, India.*

Corresponding author's: email: aabello2003@yahoo.co.uk

Abstract

The profitability of feeding dried poultry droppings based diet as a supplement in goat production enterprise was analyzed in the present study. The data generated in the study was analyzed using gross margin analysis and profitability ratio. The result of the budgetary analysis showed that the highest total cost of **Rs** 855.9/goat was incurred, the highest total revenue of **Rs** 1254.3/goat, highest gross margin of **Rs** 773.24/goat and highest net farm income of **Rs** 713.24/goat were observed for the supplemented treatment groups (T2- T5). The profitability ratio gave the best benefit-cost ratio of 4.62, a rate of return of 3.62, a gross ratio of 0.22 and an expense structure ratio of 0.12. This suggests that feeding of dried poultry droppings based diet to goats is a profitable enterprise. This present study, therefore, recommends the supplementation of sun-dried poultry dropping based diet at 80 % inclusion level for maximum profitability

Keywords: Economics; goats; sun-dried poultry dropping based diet

1. Introduction

Least cost feeding of livestock is immensely essential for the best productivity. Under productivity of livestock is attributed to the insufficient and exorbitant high costs of feeds (Beigh *et. al*, 2017). Therefore, to reduce feed costs and to increase production the need for proper use of comparatively low cost agricultural and industrial by-products is principally essential for profitable livestock production enterprise (Sontakke *et. al.*2014)

Thus non-conventional feeds can in part fulfill the feed needs, reduce rivalry for food between humans and animals, minimize feed cost, and add to self-sufficiency in nutrients from domestically and readily accessible feed sources (Bello, 2016; Bello and Tsado, 2014; Sontakke *et. al.*2014; Mubi *et al.*, 2008; Aro and Tewe, 2007; Onimisi and Omage, 2006; Ndubueze *et al.*, 2006; Saleh *et al.*, 2002; Belewu and Adeneye, 1996; Zinn *et al.*, 1996; Ibeawuchi *et al.*, 1993). Sun-dried poultry droppings readily come to mind as one of such non-conventional feed resources. This study was therefore designed to find out how profitable is it to feed sun-dried poultry dropping based diet as supplement to Konkan Kanyal goats consuming finger millet straw.

2. Result and discussions

Cost and Return of Feeding Sun-dried Poultry Dropping based diet as Supplement for Goats:

Table 1 reveals the estimate of cost and returns analysis obtained from feeding sun-dried poultry dropping based diet as supplement for goats using average cost (Fixed and variable cost) and average body weight gain by each of the treatment groups. The average chevon price/kg was lowest (Rs.857.5) in control treatment group (T1) and was highest (Rs.1130.5) in supplemented treatment group (T5) followed closely by (T4) (Rs.1067.5); total revenue was highest in T5 (Rs.1254.30), keenly followed by T4 (Rs.1185.95) and was lowest in T1 (Rs.958.38). The Net farm income in T1 was (-Rs.102.48) but was highest in T5 (Rs.713.24) followed closely by T4 (Rs.652.45) respectively. Gross margin result followed a similar trend as was observed for total revenue and Net farm income in which highest values were recorded for supplemented treatment group T5 (Rs.773.24), followed closely by T4 (Rs.712.45) and least in T1 (Rs.162.48). This present study revealed that feeding dried poultry droppings based diet as a supplement to goats was profitable and it is in agreement with the earlier findings of (Bello, 2016; Jokthan *et al.,* 2013, Anigbogu and Nwagbara, 2013 Fawola and Fajemisin 2011.). The authors reported that the inclusion of poultry litter in the diet of ruminants reduces feed costs and by extension increases farmer's income, therefore, it is a profitable business.

Profitability and Viability Estimate of Feeding Sun-dried Poultry Dropping based diet as Supplement for Goats:

Table 2 reveals the profitability and viability estimate of feeding sun-dried poultry dropping based diet as supplement for goats in the present study. The Benefit-cost ratio ranged from (0.94) in T1 to (4.62) in T5. From the result of this present study supplemented treatment group (T2-T5) has the best benefit-cost ratio (1.60; 1.91; 4.26 and 4.62) and this implies that supplementation of sun-dried poultry dropping based diet in the diet of goat is profitable according to rule of thumb of project evaluation which states that any business with benefit-cost ratio higher than one means is profitable, equals to one means break-even, while less than one indicates loss (Olagunju *et al.,* 2007). The gross ratio ranged from 1.06, in T1 to 0.22 in T5. This implies that in T1, for every Rs.1.00 returns to goat feeding, Rs.1.06 are being spent while for T5 for every Rs.1.00 returns to goat feeding 22 Paisa is being spent. The rate of returns ranged from -0.06% in T1 to 3.62% in T5. This shows that for every Rs. 1.00 invested into goat feeding in T1 -0.06 Paisa was lost by the farmer and in T5 for every Rs.1.00 invested into goat feeding Rs. 3.62 was gained by the farmer. The expense structure ratio ranged from 0.08 in T1 to 0.12 in T5. The best value was observed in supplemented treatment groups (0.12) which implies that about 12 % of the total cost of production is made up of fixed cost component and this makes goat farming a valuable venture because an increase in production with variable cost also leads to increase in total revenue while the fixed cost remained constant.

Table: 1 Cost and Return of Feeding Sun-dried Poultry Dropping based diet as Supplement to Goats:

S.N.	Treatment	T_1	T_2	T_3	T_4	T_5
1	Initial average body weight of goats (kg)	12.45	13.85	13.93	13.38	14.00
2	Average body weight gain (kg/ goats)	2.45	2.58	2.67	3.05	3.23
3	Average total feed consumed (kg/ goats)	55.43	55.58	59.57	58.72	60.01
4	Initial live weight cost (Rs)	4357.5	4847.5	4875.5	4683	4900
5	Final live weight cost (Rs)	5215	5750.5	5810	5750.5	6030.5
Variable cost						
6	Total cost of feed (Rs)	667.9	326.9	350.5	345.5	353.06
7	Average material cost (Rs)	105	105	105	105	105
8	Depreciation cost of material (10%)	10.5	10.5	10.5	10.5	10.5
9	Misc. Expenditure (drug, water and labour, etc.)	12.5	12.5	12.5	12.5	12.5
10	Total variable cost	795.9	454.9	478.5	473.5	481.06
Fixed cost						
11	Cost of house rent	60.00	60.00	60.00	60.00	60.00
12	Total cost	855.9	514.9	538.5	533.5	541.06
Sales returns						
13	Average chevon price (350Rs/kg)	857.5	903	934.5	1067.5	1130.5
14	Average total manure obtained (kg/ goats)	40.35	48.48	42.05	47.38	49.52
15	Total price of manure (2.5 Rs / kg)	100.88	121.2	105.13	118.45	123.8
16	Total returns (Rs)	958.38	1024.2	1039.63	1185.95	1254.3
17	Net profit/goat (Rs)	102.48	509.3	501.13	652.45	713.24
18	Gross margin	162.48	569.3	561.13	712.45	773.24
Rupees-Dollar= Rs.66.23 **$** 1.00						

T1: had 0% sun-dried poultry dropping based diet (SDPDBD) inclusion; T2: 20% SDPDBD; T3: 40% SDPDBD; T4: 60% SDPDB and T5: 80% SDPDBD.

Table: 2. Profitability ratios

Treatment	Benefit cost ratio	Expense structure ratio	Gross ratio	Rate of return
	Value	Value	Value	Value
T_1	0.94	0.08	1.06	-0.06
T_2	1.60	0.13	0.62	0.60
T_3	1.91	0.13	0.52	0.91
T_4	4.26	0.13	0.23	3.26
T_5	4.62	0.12	0.22	3.62

T1: had 0% sun-dried poultry dropping based diet (SDPDBD) inclusion; T2: 20% SDPDBD; T3: 40% SDPDBD; T4: 60% SDPDBD and T5: 80% SDPDBD.

3. Conclusion

This present study showed that goats fed diets with sun-dried poultry droppings incorporated had better weight gain, total revenue, and net farm income, thus it is a profitable venture. Therefore based on the result of this present study, it is recommended that goats supplemented with sun-dried poultry dropping based diet up 80 % inclusion level has the best net profit.

4. References

Anigbogu, N.M., and Nwagbara, N.N. N. (2013). Performance of West African Dwarf goat Fed maize offal diets supplemented with dry poultry excreta. *Revue d elevageet de med. vet. des pays tropic*,**66**, 51-56.

Aro, S.O. and Tewe O.O (2007). Performance and Carcass yields of barrows fed dried poultry waste as a replacement for palm Kernel cake. *African J. Biotechnol.***6,** 487-492.

Belewu, M.A. and Adeneye J.A. (1996) .The effects of Broiler litter as a protein sources in the performance of Bunaji (White Fulani) bull Calves. *Nigeria J. Anim. Prod.***23**, 66-71.

Bello, A. A. (2016). Economics of Feeding sun-dried poultry dropping based diets on growing rams consuming sorghum stover. *Iranian J. Appl Anim. Sci*. **6**, 595-598

Bello, A.A. and Tsado, .D.N. (2014) Effects of supplementing sorghum (sorghum bicolor L. moench) stover with dried poultry dropping based diet on the performance of growing Yankasa ram. *IOSR J. Agric. Vet. Sci.***7,** 34-39

Beigh, Y .A, Ganai, A.M and Ahmad, H.A (2017). Prospects of complete feed system in ruminant feeding: A review. *Veterinary world*,**10,** 424-437.

Fawola, T.S. and Fajemisin, A.N.(2011). Performance and micro minerals utilization by West African Dwarf ram fed rumen content-poultry droppings mixed diet. In: Proc. 36th Annual Conf. Nig. Soc. Anim. Prod. University of Abuja, Nigeria, 13-1, March 2011, **36,**533-535

Ibeawuchi, J.A. Danjuma, D. and Ogutona, .T. (1993).The value of dried poultry waste as protein supplement for growing Borno White goats.*Discor.Innov* **5**, 63 -68.

Jokthan, G.E; Muhammad, S.A. and Osuhur, C.U. (2013) Effect of cotton seed cake replacement with broiler litter on performance of Yankasa rams fed maize husk basal diets. *FUTA J. Res. Sci.***1,** 147-155.

Mubi, A.A., Kibon A. and Mohammed, I.D. (2008). Utilization of Alkali Treated Sorghum Stover supplemented with poultry litter for growing Heifers in the North East Region of Nigeria.*Asian J. Anim. Vet. Adv.***3**, 183-186.

Ndubueze, A.I. Uka, chukwu, S.N. Ahamefule, F.O. and Ibeawuchi, J.A. (2006). Milk yield and composition of grazing white Fulani cows fed poultry waste cassava peel based Diets. *Pakistan J. Nutr*.**5**, 436-440.

Olagunju, F.I; Adesiyan, I.O. and Ezekiel, A.A. (2007) Economic viability of cat fish production in Oyo state, Nigeria. *J. Human Ecol.***2**1, 121-124.

Onimisi, P.A .and Omage, J.J. (2006).Evaluation of poultry litter as feedstuff for growing rabbits.*Livestock Res. Rur. Dev.***18**, 11

Saleh, H.M., Elwan, K.M., El-fouly, H.A., Ibrahim, I.I., Salam, A.M. and El-Ashry, M.A. (2002).The use of poultry waste as a Dietary Supplement for Ruminants. In: Development and field Evaluation of animal feed supplementation packages. *Proc.final review meeting of an IAEA Technical Co-operation Regional AFRA Project organized by the joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and held in Cairo, Egypt.* 25-29 November, 2000.

Sontakke, U., Kale, V., Bose, B and Kumar, M (2014). Non-conventional feeds and agro-industrial by-product: Their scope and future demand for livestock production culled from https://en.engormix.com/feed- machinery/articles/non-conventional-feeds-agro-t36183.htm on 6/9/2019

Zinn, R.A., Baraja, S.R., Montario, M. and Shen, Y.C. (1996). Protein and Energy value of dehydrated poultry excreta in diets for feedlot cattle.*J. Anim. Sci*.**74,** 2331-2335.