ANIMAL BREEDING AND GENETICS

ABG 001: Association between egg weight and morphometric traits of duck and goose eggs in southern guinea savanna Region of Nigeria.

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Abstract

The study was carried out to determine the association between egg weight and morphometric traits of duck and goose eggs in southern guinea savanna region of Nigeria. A total number of 960 eggs consisting of 480 eggs of each duck and geese were sourced and used for this study. On weekly bases, 40 eggs of each duck and geese were randomly picked, analyzed and data were collated for 12 weeks. Data were obtained on egg weight (EW), egg length (EL), egg width (EWD), shell weight (SW), shell thickness (ST), yolk weight (YW), yolk height (YH), yolklength (YL), yolk circumference (YC), albumen height (AH) and albumen weight(AW). The association between egg weight and other egg biometrical traits for duck were found to be very highly positive and significant($r = 0.111$ -0.533; $P < 0.001$), EW against EL, EWD, SW and ST for external traits. Duck eggs showed a great similarity in the pattern of phenotypic correlations between component traits of internal egg traits of duck with very high positive association of YW against YH, YL but negatively AW. The association between external and internal traits for duck eggs revealed a very highly positive significant ($P < 0.001$) between EW against YW (0.542), EWD (0.331), SW (0.342) and ST (0.32). Veryhigh positive correlations were found between EW against EL, EWD, SW and ST for external egg traits of geese. EW against YW, YH, YL, YC, AW and AH revealeda very positive correlation for internal egg traits for geese whilethe association between external and internal traits for geese eggs revealed a very highly positive significant correlation.The positive correlations obtained among the egg quality traits for both duck and geese indicated that they can be improved phenotypically through selection.

Keywords – Association, duck eggs, goose eggs, egg morphometric traits, Southern Guinea Savanna

Introduction

Economically, important egg morphometric variables such as weight, size, albumen and yolk contents are quantitative traits that show continuous variability (1). It is also an established fact that weight of an egg is a direct proportion of shell, albumen and yolk that it contains and this varies significantly between breeds or strains of the birds of the bird species (2,3). The external and internal quality of eggs is influenced by a broad range of factors. This is because egg quality criteria includes such diverse and important aspects as safety, nutritional and organoleptic properties or technological properties for cooking, all of which must be controlled from farm to fork.

For the poultry breeder, farmers, food, egg sorting and marketing companies, the main priorities are to deliver a safe product which is accepted by the consumers. Therefore, breeders want hens to deliver a consistent product with well-established characteristics concerning the appearance of the product, the integrity of the shell to avoid contamination of the egg, a particular weight, a specific colour of the eggshell and yolk and good processing properties reflecting the freshness of the egg. Along the whole chain the objective is to avoid any defect in external or internal appearance of the product or any deviation from the expected taste of the product. The external and internal quality traits of eggs of hens as well as the relationship between them have been reported by many authors (4,5,6). Like chicken, ducks are reared for eggs and meat. Duck eggs are relatively larger, weighing about 4.5% of duck's body weight, compared to chicken, whose egg weight is only about 3.3% of the hen's body weight. Moreover, ducks are more prolific than chicken and more adaptable to free-range system of rearing. That is why; they are more popular in many European and Asian countries (7).

The goose is a species with interesting biological characteristics, such as a high juvenile growth rate, a good adaptation to free range and grazing, and a high dietary quality of meat (8). There are little studies reported about the relationship between egg weight and other egg quality traits in the duck and geese eggs. Therefore, the aim of the present study was to evaluate the association that exit between the egg weight and morphometric traits of duck and goose eggs in southern guinea savanna area of Nigeria.

Materials and Methods.

Experimental site.

The study was carried out at the Agricultural Education Laboratory of Emmanuel Alayande College of Education, Oyo. Oyo State. Oyo lies on the longitude 3° $7^{'}$ East of Greenwich meridian and Latitude 7° $5^{'}$ North of the equator. It is about 5 kilometers north-eastward from Ibadan, the capital of Oyo state. The altitude is between 300 and 600 meters above sea level. The mean annual temperature is about 27°C (9) while that of rainfall is 1165mm.

Eggs used

Total number of 960 freshly laid eggs of duck and goose were obtained from some backyard rearers. Forty eggs were obtained from each species weekly for twelve weeks and totaling four hundred and twenty eggs for each species. These fresh eggs are used to evaluate the external and internal egg quality traits.

Collection of Data

The traits that are investigated on weekly bases are; Egg weight (g), Egg length (mm), Egg width (mm), Shell weight (g), Shell thickness (mm), Yolk weight (g), Yolk height (mm), Yolk length (mm), Yolk circumference (mm), Albumen height (mm), and Albumen weight(g) using the procedures of (10,11).

Statistical analysis

Data collected were subjected to one way analysis of variance (ANOVA) using general linear model of (12) with the below model:

$$r = \frac{\sum XY}{(\sum X^2 \sum Y^2)^{1/2}}$$

Where r = correlation coefficient, $\sum XY$, $\sum X^2$ and $\sum Y^2$ = sum of the variables

Results and Discussion

Phenotypic correlations between egg weight and its external components for duck eggs were presented in table 1. Very high positive significant ($P < 0.001$) correlations were found with egg weight and egg length (0.466), egg weight and egg width (0.423), egg weight and shell weight (0.535), egg weight and shell (0.411) and such a relationship was found between shell thickness and shell weight (0.364). Table 2 shows the phenotypic correlation among the internal egg traits of duck. There are very highly positively significantly ($P<0.001$) correlation existed between yolk weight and yolk height (0.290), yolk weight and yolk length (0.458), albumen height and albumen weight (0.385). A very high negative ($P< 0.001$) correlation was found between yolk weight and albumen weight (-0.345) while a highly negatively ($P < 0.01$) relationship exist between yolk weight and albumen height (0.216). Phenotypic correlation between external and internal quality traits of duck eggs was shown in table 3. In this study, as a result of phenotypic correlation determined between the internal and external quality traits of the egg, it was understood that there was an increase in the weight of the egg and an increase in the yolk weight, and there was statistically significant increase in the other traits ($P<0.001$) such as yolk height, yolk length, albumen weight and albumen height. The correlation coefficients in this present study indicate the strength of linear relationship between egg weight and other egg morphometric traits. The association between egg weight and other egg morphometric traits in this current study varied from medium to low, negative to positive and significant at most of the relationship. Thus, such documentation agreed with the literature values of (13) for both naked neck and normally feathered eggs, although there was disparity in the correlation estimates of shell thickness where they reported negative and extremely low coefficients. The present relationship between egg weight and other egg quality traits disagreed with the findings of (14) for eggs from indigenous chickens..

The association between egg weight and external egg quality traits of geese eggs was revealed in table 4. A very highly positively significant ($P < 0.001$) correlation was found between egg weight and egg length (0.640), egg weight and egg width (0.367). The relationship between egg length and egg weight (0.340), egg length and shell weight (0.278) was found to be highly positively significantly ($P< 0.001$) correlated. Regarding the variables related to internal egg quality traits of geese eggs (table 5) exhibited a marked very

high positive (P < 0.001) correlation between the albumen weight and yolk length (0.363), albumen height and albumen weight (0.529). Correlations between albumen height and yolk height (0.218), albumen height and yolk length (0.196) were positively correlated at (P < 0.01) and (P < 0.05) respectively. The relationship revealed by this present study on duck eggs was in line with the reports of (15,16) who noted that all most all external quality traits of the egg were changed at the significant levels depending on the change occurred in the egg weight and results indicated that egg weight influences egg quality traits of Guinea fowl and Muscovy duck with conclusion that positive correlations obtained among the egg quality traits indicated that they can be improved phenotypically through selection.

Phenotypic correlation between external and internal quality traits of goose eggs was presented in table 6. It was revealed that there was an increase in the weight of the egg and an increase in the albumen weight and there was statistically significant increase in the other traits (P < 0.001) such as yolk weight, yolk height, yolk length, and albumen height. Association between the egg weight and internal and external egg traits for geese of negative to positive and very highly significant correlations between traits showed a great similarity in the pattern of phenotypic correlations between component traits of total egg traits. Thus, this result confirmed those found by (17) on Italian geese and (18) on various genetic types of geese. The results on association between the external and internal egg traits of duck eggs were found in conformity with the research findings of (11) who statistically obtained important positive correlation in the eggshell weight and the internal quality traits for Japanese quail.

Table 1: Phenotypic correlation of external quality traits of duck eggs

	EW	EL	EWD	SW	ST
EW	-				
EL	0.466***	-			
EWD	0.423***	0.058	-		
SW	0.535***	0.214	0.124	-	
ST	0.411***	-0.128	0.111	0.364***	-

***P < 0.001 = Very highly significant

EW = egg weight, EL = egg length, EWD = Egg width, SW= Shell weight, ST = Shell thickness

Table 2: Phenotypic correlation of internal quality traits of duck eggs

	YW	YH	YL	YC	AW	AH
YW	-					
YH	0.290***	-				
YL	0.458 ***	-0.227	-			
YC	-0.019	-0.010	0.03	-		
AW	-0.345***	0.122	-0.216	0.015	-	
AH	-0.216**	0.216	0.026	-0.044	0.385 ***	-

***P < 0.001 = Very highly significant, **P <0.01 = highly significant.

YW = yolk weight, YH = yolk height, YL = yolk length, YC = yolk circumference, AW = albumen weight, AL = albumen length

Table 3: Phenotypic correlation between external and internal quality traits of duck eggs

Internal egg Traits	**External quality traits**				
	EW	**EL**	**EWD**	**SW**	**ST**
YW	0.542***	0.074	0.331***	0.342***	0.322***
YH	0.350***	0.092	0.368***	0.102	0.012
YL	0.392***	0.017	0.458***	0.204	0.367***
YC	-0.012	0.053	-0.035	0.009	0.005
AW	0.411***	0.355***	0.094	0.047	0.068
AH	0.166**	0.166	-0.058	0.144	0.294***

***P < 0.001 = Very highly significant, **P <0.01
EW = egg weight, EL = egg length, EWD = Egg width, SW= Shell weight, ST = Shell thickness, YW = yolk weight, YH = yolk height, YL = yolk length, YC = yolk circumference, AW = albumen weight, AL = albumen length

Table 4: Phenotypic correlation of external quality traits of goose eggs

	EW	EL	EWD	SW	ST
EW	-				
EL	0.640***	-			
EWD	0.367***	0.340***	-		
SW	0.173	0.278***	0.082	-	
ST	0.130*	-0.067	0.027	0.174	-

***P < 0.001 = Very highly significant, *P < 0.05 = significant
EW = egg weight, EL = egg length, EWD = Egg width, SW= Shell weight, ST = Shell thickness

Table 5: Phenotypic correlation of internal quality traits of goose eggs

	YW	YH	YL	YC	AW	AH
YW	-					
YH	0.219	-				
YL	0.172	0.150	-			
YC	-0.106	0.024	0.040	-		
AW	-0.028	0.073	0.363***	-0.009	-	
AH	-0.148	0.218**	0.196*	0.143	0.529***	-

***P < 0.001 = Very highly significant, **P <0.01= highly significant, *P < 0.05 = significant
YW = yolk weight, YH = yolk height, YL = yolk length, YC = yolk circumference, AW = albumen weight, AL = albumen length

Table 6: Phenotypic correlation between external and internal quality traits of goose eggs

Internal egg Traits	**External quality traits**				
	EW	**EL**	**EWD**	**SW**	**ST**
YW	0.412***	0.356**	0.268***	-0.22**	0.088
YH	0.317***	0.199***	0.392***	0.223***	0.357***
YL	0.411***	0.340***	0.143	-0.041	-0.141
YC	-0.058	-0.039	-0.171	0.074	0.064
AW	0.667***	0.402***	0.261***	0.118	-0.102
AH	0.287**	0.097	0.029	0.243***	-0.204**

***P < 0.001 = Very highly significant, **P <0.01 = highly significant
EW = egg weight, EL = egg length, EWD = Egg width, SW= Shell weight, ST = Shell thickness, YW = yolk weight, YH = yolk height, YL = yolk length, YC = yolk circumference, AW = albumen weight, AL = albumen length

Conclusion

The association determined among the external and internal egg quality traits indicate that the parameters can be improved through selection. Poultry researchers will study on egg quality traits as well as the activities of the breeders who deal with the duck and geese eggs breeding and improvement.

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ABG 002: Effect of data distribution on logistic model using bayesian analytical approach

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Abstract
It's an established fact that sample size has a significant effect on sample distribution. It is often observed that small sample size (student t-distribution) result in non-normal distribution. This study compared the predictive response of Logistics growth models based on Bayesian approach with normal distribution and student t-distribution. Body weight data of 417 offspring from Naked Neck (NN) – 197, Giriraja (GR) – 105), and FUNAAB Alpha chicken (BA) – 115 were subjected to the procedure of WinBUGS package to run the Markov Chain Monte Carlo (MCMC) simulation for Bayesian with normal distribution and student t-distribution on Logistic growth model. Deviance Information Criteria (DIC) was used to determine the best data distribution. The study revealed that the growth model parameters obtained from the Logistic model was higher in normally distributed data compared to the student t-distribution with respect to asymptotic weight, age and weight at inflection point which are the important traits to farmers. However, performances of growth traits are better in the student t-distribution. Likewise the prediction of best fit for the Logistic model was found in student t-distributed data. Furthermore, GR chicken performed better followed by the FUNAAB Alpha chicken and then the indigenous Naked neck. The study concludes that student t-distribution is better used with Logistic model based on Bayesian approach.

Keywords: normal distribution, student t-distribution, Bayesian, Logistic model, Giriraja, FUNAAB Alpha, Naked neck.

Introduction

Over the last two decades there has been a revolution in which Bayesian robust statistical inference have become a highly popular and effective tool for the applied statistician. Bayesian methods reduce statistical inference to problems in probability theory, thereby minimizing the need for completely new concept (1). It takes into account of both the prior knowledge about the parameter and the observed data. It also evaluates the fit of the model to the data and implication of the resulting posterior distribution and sensitivity of the conclusions to the assumptions (2). The logistic model is one of the simplest of the S-shaped growth curves. This is because of the ease of computation premise on the few parameters involved in the function. Logistic model have been applied to poultry production for the study of growth performance through their simplification and characterization. The growth curve reflects the whole or part of the animal growth process (3). Exploration of growth and developmental curves derived from growth data can dynamically help us understand and predict the growth and development of animals (4).

In probability theory, the normal (or Gaussian) distribution is a very common continuous probability distribution. The value of the normal distribution is practically zero when the value of an event lies more than a few standard deviations away from the mean. Therefore, it may not be an appropriate data distribution model when one expects a significant fraction of outliers that lies many standard deviations away from the mean. In those cases, a more student t-distribution should be assumed and the appropriate robust statistical inference methods applied. Student's t-distribution (or simply the t-distribution) is any member of a family of continuous probability distributions that arises when estimating the mean of a normally distributed population

in situations where the sample size is small and population standard deviation is unknown. Student t-distributions describe samples drawn from a full population (normal distribution). The t-distribution has heavier tails, meaning that it is more prone to producing outliers.
The study aimed at evaluating the comparative application of normal distribution and student t-distribution using Bayesian approach on Logistic growth model.

Materials and Methods
Three chicken genotypes namely, locally adapted dual purpose genotype - Giriraja (G), the indigenous - Naked neck (NN) and improved indigenous - FUNAAB Alpha chicken (BA) were used for the comparative study. 20-week weight data of a total of 417 birds were used for the analysis. Growth measurements were taken on weekly basis with the aid of sensitive scale of 0.05g sensitivity with the capacity of two decimal digits. The chickens were individually weighed from day old on weekly basis till 20 week.

Statistical Analysis
Chicken growth data were fit to the Logistic (5) growth models. $BW_{ij} = A_i\ (1+ B_i\ exp\{-K_i t_{ij}\})^{-1}$
In these models, BW_{ij} is the body weight of chicken at age (week) t_{ij}; A is the asymptotic weight or an estimation of mature weight as age approaches infinity ($t_i \rightarrow \infty$); B is the integration constant defining the degree of maturity at $t_i = \infty$; k is the rate of maturing and refers to growth rate relative to mature weight. e_i is the residuals with the assumption of $e_i \sim N(0, \sigma^2 I_i)$ where $\sigma^2 I_i$ is the residual variance structure for all subjects, assuming that no covariance structure exists between the residuals of the model. t_{inf} and W_{inf} are the age and weight at the inflection point of the growth model, respectively.

Normal and Student t-distribution
The estimated variances in student t-distribution is described in a simplified form as where n independent observations $X_1 \ldots\ldots X_n$ are taken from a normal distribution, $N(\mu,\sigma)$. The sample mean, $X = (X_1 + \ldots. + X_n) / n$ has a $N(\mu,\sigma/\sqrt{n})$ distribution. The random variable has a standard normal distribution. If we estimate σ^2 by the sample variance, $s^2 = \sum(Xi - X)^2 / (n - 1)$, then the resulting statistic,

$$t = \frac{X - \mu}{s/\sqrt{n}}$$

no longer has a normal distribution. It has a t-distribution on n – 1 degree of freedom.
Bayesian Approach
The distributions of parameters (A, B, k) of Logistic growth models are assumed to be normal.
Age (t_{inf}) and weight (W_{inf}) in the inflection point of growth curve models are obtained as below:

$$t_{inf} = -log(1/B_i)/K_i \qquad W_{inf} = A_i/2$$

Growth curve parameters (A, B, k) for the Logistic growth models were estimated for each chicken using WinBUGS (version 1.4.3) to read the model, priors and data, and run the Markov Chain Monte Carlo simulation (6). t_{inf} and W_{inf} for each chicken were calculated by using estimated growth curve parameters. Then, the arithmetic mean and standard error of arithmetic mean values of the estimates of growth curve parameters and the age and weight at the inflection point (t_{inf} and W_{inf}) were calculated by using R project (7) for genotype of sire (Giriraja, FUNAAB Alpha and Naked neck) within Logistic growth model.

Model Comparison
Model comparisons between the two data distribution pattern were carried out using the Deviance Information Criteria (DIC), which was introduced by (8),

$$DIC(m) = 2\overline{D(\boldsymbol{\theta}_m, m)} - D(\bar{\boldsymbol{\theta}}_m, m) = D(\bar{\boldsymbol{\theta}}_m, m) + 2p_m,$$

Pearson product-moment correlation coefficient
The Pearson product-moment correlation coefficient (r), simply called the correlation coefficient, was used to examine the linear relationship between A and K and it written:

$$r_{AK} = \frac{\sum_{i=1}^{N}\left(\hat{A}_i - \bar{\hat{A}}\right)\left(\hat{K}_i - \bar{\hat{K}}\right)}{\sqrt{\sum_{i=1}^{N}\left(\hat{A}_i - \bar{\hat{A}}\right)^2 \sum_{i=1}^{N}\left(\hat{K}_i - \bar{\hat{K}}\right)^2}} \qquad i = 1, \ldots, N$$

where $\bar{\hat{A}}$ and $\bar{\hat{K}}$ are the arithmetic means for the estimates ($\hat{A}$ and $\hat{K}$) of A and K parameters, respectively and estimated by using the procedure of CORR available in the SAS package (9).

Growth traits

Average lifetime rates of growth and maturing were computed for each genotype using the first derivative of Logistic model with respect to age as shown below,

AGR (dW/dt) = $ABk*exp\{-kt\}$

AMR $\{(1/A)(dW/dt)\}$ = $(1/A)*(ABk*exp\{-kt\})$

RGR $\{(dW/dt)/W_{inf}\}$ = $(W_{inf})^{-1}*(ABk*exp\{-kt\})$

Average lifetime absolute growth rate (AGR) is the average height of instantaneous growth rate (dW/dt) plotted against weight for the entire growing interval (0 to A), and AMR is the average height of growth rate relative to mature weight [$(1/A)$ (dW/dt)] plotted against degree of maturity for the entire maturing interval (0 to 1).

Results and Discussion

The estimates of Logistic model parameters using Bayesian approach with normal and student t-distribution are presented in Table 1. Normal distribution predicted the highest asymptotic weight (A) (occurring as t approaches ∞) for all the genotypes compared to the student t-distribution. The exotic Giriraja chicken (2025.78g) had the highest value followed by the crossbred FUNAAB Alpha chicken (1353.00g) while the least value was recorded in the indigenous naked neck chicken (1227.00g). The superior gene of the exotic over the crossbred and also that of the hybrid vigour of the crossbred over the indigenous played out in this regards. This was in line with the report of (10).

The integration constant (B) which represent the chicken weight at t=0 was highest for all the genotypes with student t-distribution. The highest value of B was recorded in Naked neck (21.17g) followed by the FUNAAB Alpha chicken (20.53g) and lastly the exotic Giriraja (19.73g) chicken.

The maturing rate (k) was relatively higher in the estimates for student t-distribution with a difference of between 0.01 and 0.04 when compared to normal distribution. (11) reported that high maturing rate is strongly related with lighter asymptotic weight. Naked neck (0.27) had the highest maturing rate for student t-distribution while Giriraja (0.25) chicken had the highest with normal distribution.

Age at inflection, represented by t_{inf}, is the point during which the maturing rate was increasing at a decreasing rate. It was highest with normally distributed data. The highest value of 13.03weeks recorded in normal distribution was obtained for the FUNAAB Alpha chicken.

Weight at inflection point (W_{inf}) was highest in Giriraja for both data distribution pattern. However, normally distributed data recorded the highest weight for all the genotypes with the highest value obtained in the Giriraja (1012.80g) followed by FUNAAB Alpha chicken (676.53g) and lastly by Naked neck (613.55g).

The correlation between the asymptotic weight and the maturing rate showed negative correlation for the two data distribution pattern in all the genotypes. Student t-distribution had the highest negative correlation across the genotypes in comparison to the normal distribution. An indication that early maturing chicken tends to attain smaller mature weight, and high mature weight is strongly related with long growth period and/or chicken with lighter asymptotic weight reached that weight at a younger age. Similar findings were also reported by (12).

Considering the asymptotic weight and the weight attained at the inflection point, the relationship showed that 50% of the asymptotic weight had been achieved at the inflection point.

Table 1. Estimates of Logistic model parameters using Bayesian approach with normal and student t-distribution

	Giriraja (G) Chicken		FUNAAB Alpha (BA) chicken		Naked neck (NN) chicken	
Parameters	Normal distribution	Student t-distribution	Normal distribution	Student t-distribution	Normal distribution	Student t-distribution
A	2025.78 ±41.50	1812.75 ±32.83	1353.00 ±44.23	1163.75 ±21.83	1227.00 ±26.95	1125.75 ±15.32
B	18.18 ±0.82	19.73 ±0.78	18.59 ±0.91	20.53 ±0.73	18.91 ±0.83	21.17 ±0.60
k	0.25 ±0.88x10^{-2}	0.26 ±0.64x10^{-2}	0.22 ±0.76x10^{-2}	0.26 ±0.56x10^{-2}	0.24 ±0.66x10^{-2}	0.27 ±0.45x10^{-2}
t_{inf}	11.88 ±0.23	11.54 ±0.20	13.03 ±0.38	11.68 ±0.20	12.15 ±0.25	11.21 ±0.13
W_{inf}	1012.80 ±20.78	906.78 ±16.41	676.53 ±22.10	581.85 ±10.92	613.55 ±13.48	562.93 ±7.66
r_{Ak}	-0.64	-0.72	-0.65	-0.76	-0.61	-0.75

Table 2, showed the mean average growth traits for normal distribution and student t-distribution. There was no significant difference (P>0.05) between the AGR obtained with normal and student t-distribution across the genotypes. However, both the AMR and the RGR showed significant difference (P<0.05) within genotypes and between data distribution.

Table 2. Mean average AGR (g/day), AMR (%A/day) and RGR (%/day) estimated from Logistic model for normal distribution and student t-distribution

	Giriraja Chicken		FUNAAB Alpha chicken		Naked neck chicken	
Growth traits	Normal distribution	Student t-distribution	Normal distribution	Student t-distribution	Normal distribution	Student t-distribution
AGR	125.035^{a}	117.741^{a}	75.669^{a}	75.092^{a}	74.163^{a}	76.700^{a}
AMR	0.0614^{a}	0.0652^{b}	0.0562^{a}	0.0644^{b}	0.0604^{b}	0.0683^{a}
RGR	0.1228^{a}	0.1304^{b}	0.1124^{a}	0.1289^{b}	0.1209^{b}	0.1365^{a}

Mean with same letters for each factors are not significantly different (P>0.05)

According to (13), they stated that smaller value of DIC is an indicative of better data fit. In this study, student t-distribution had the lowest DIC value for all the genotypes. This is an indication that student t-distribution is better with Logistic model for data better fit.

Table 3. DIC values for normal and student t-distribution

	Giriraja Chicken	FUNAAB Alpha chicken	Naked neck chicken
Parameters	DIC	DIC	DIC
Normal distribution	240431	240766	236195
Student t-distribution	227477	227851	223112

Conclusion and Application

This study revealed that data distribution pattern has effect on the performance of Logistic growth model in predicting the growth pattern of chickens. Furthermore, student t-distribution can better represent the chicken data based on better prediction and accuracy of data. This thus represent a respite to farmers that with few data pulled from whatever raw data generated, modeling of growth can be done for selection purposes.

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ABG 003: Evaluation of potentials of ducks in northwest Nigeria for genetic selection and improvement

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Abstract
A study on the potentials of the local duck population in northwest Nigeria for genetic improvement was carried out using univariate and multivariate analysis. The univariate analysis indicated that there was room for improvement for bodyweight although there was no significant (P>0.05) between the traits in the three locations. In the multivariate analysis, seven quantitative traits accounted for the source of variation while the qualitative traits accounted for more than 50 percent of the variation observed. This indicated that there room for improvement of the indigenous duck breeds.

Keywords: Duck, selection, quantitative, qualitative, traits

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Introduction
Duck flock rearing and duck meat production is on a steady rise but selection and genetics are still not advanced compared to chickens and other livestock species. It is imperative to be able to characterise and describe the specie of livestock as this will aid the breeder during selection and improvement programmes (1). This is because genetically and economically important traits can be identified in the process leading to maximum economic returns (2).
A number of multivariate techniques have been applied to animal breeding research (3, 4). Principal component analysis is however a valuable tool especially when characteristics are correlated (5). From the view point of animal genetics and improvement, principal component analysis considers a group of attributes which may be interesting for achieving this purpose (5). The objective of the study is to characterise the ducks in Katsina State, Nigeria for economically important quantitative and qualitative traits that may be useful for breeding and selection purposes

Materials and methods
The study areas were chosen based on purposive sampling method (1) because of the large population of ducks. The study areas were three Local Government Areas (LGA) selected out of the thirty four LGAs in Katsina State. They are Funtua, Jibia and Mashi LGAs. Three wards per LGAs were selected and they include:;Funtua (Maska, Tudun Iya, Goya), Jibia (Jibia A, Jibia B, Magama), Mashi (Mashi, Karau and Tamilo). Selection of the study wards was based on suggestions by extension agents for the wards with a high number of ducks. In each ward, households were randomly selected based on information from the locals about households that are known for rearing ducks. The cross–sectional research design was utilised for the study such that all the information was collected once in the same period from 315 randomly selected ducks from three LGAs in Katsina State using survey form. These comprised of 35 ducks per ward. They were managed through the traditional scavenging system.
Body weight (BW) of individuals was determined by placing each one on the loading pan of the Mettler Toledo® top loading scale. All linear body measurements were determined using a tailor's tape and recorded in centimeter (cm): They include body weight (BWT), body length (BDL), chest circumference (CHC), wing span (WGS), shank length (SKL), shank circumference (SKC). Qualitative trait data were collected using a modified version of FAO (6) structured survey form for morphological description. Morphologically distinct adult ducks of both genders were sampled for breast colour (BRC), shank colour (SHC), neck colour (NKC) , eye colour (EYC), beak colour (BKC) , wing colour (WGC) and web colour (WBC). Data collected were subjected to analysis of variance (ANOVA) using the general linear model and the means were separated using the Duncan multiple range test. From the correlation matrix, data was generated for the principal component factor analysis; this involved the use of the fort miner programme of R version 3.03 statistical software..

Results and Discussion

Means of body weights and linear body measurements of ducks

There were no significant differences (P<0.05) in the quantitative measurements of ducks in all the three locations (Table 1). The result however indicated that there was room for improvement and selection for body weight as the coefficient of variation was high (Table 1). The values for BWT were similar to Yakubu (4), who reported mean BWT to be 2.04 to 2.18kg in guinea savannah and rainforest ducks.

Table 1: Means of body weights and linear body measurements

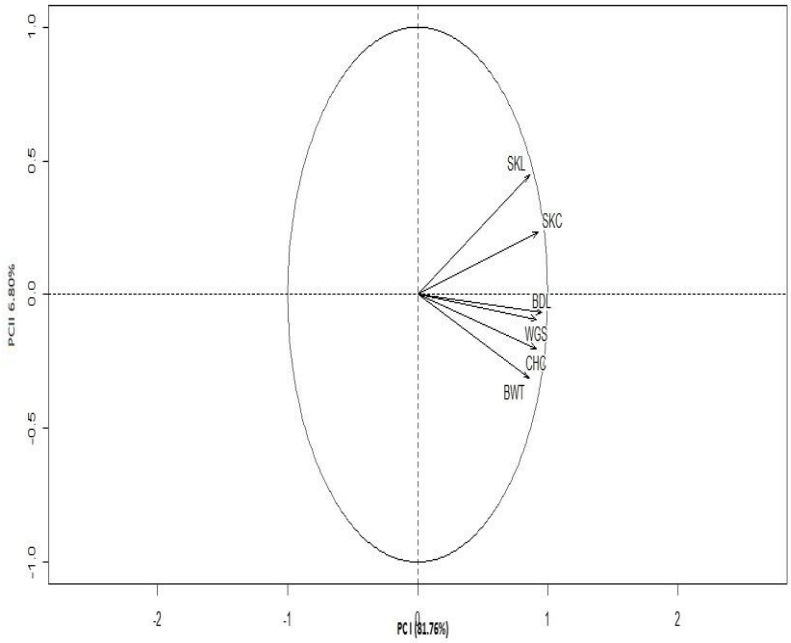
Trait	Funtua	Jibia	Mashi	SD	CV
BWT (kg)	2.36±0.15	2.35±0.16	2.44±0.16	0.93	31.14
BDL (cm)	52.37±1.03	51.50±1.06	53.02±1.06	6.22	11.89
CHC(cm)	36.68±0.80	36.64±0.83	37.60±0.83	4.83	13.06
WGS (cm)	46.21±0.85	46.28±0.87	47.59±0.87	5.08	10.89
SKL (cm)	6.09±0.15	6.14±0.16	6.16±0.16	0.96	15.69
SHC(cm)	5.13±0.13	5.12±0.14	5.38±0.14	0.79	15.29

Principal component analysis for quantitative traits

The cumulative percentage of variance accounted for was used to determine the principal components that were significant for the observed variation. The first principal component (PC I) accounted for 81.76 percent of the cumulative variation observed with high positive loadings for body weight, body length, chest circumference and wing span. This could be an index of general size factor (5). Principal component II (PC II) accounted for 88.56 percent of the cumulative variations observed in the duck population in the study and there were positive loading for shank length and shank circumference. The aggregation of conformation traits into principal components might be related to the different association of each measurement with environmental influence (7). There is also the possibility that the traits strongly associated with each factor are under the same gene influence (5). The exploitation of the multivariate techniques especially the principal components have been found useful for a quantitative measure of animal conformation which is desirable as it will enable reliable genetic parameters for these traits to be estimated and permits its inclusion in breeding programmes (8, 9). Therefore, the seven quantitative traits which accounted for variation among the population of ducks could be used in breeding and selection programmes for improvement of ducks for body weight.

Table 2 Principal component analysis for quantitative traits

TRAITS	PCI	PCII
Body weight	0.86	-0.31
Body length	0.95	-0.07
Chest circumference	0.91	-0.20
Wing span	0.91	-0.09
Shank length	0.86	0.45
Shank circumference	0.93	0.23
Eigen values	14.91	20.41
Percentage variance	81.76	6.80
Cumulative percentage of variance accounted for	81.76	88.56



Principal component analysis for qualitative traits

53.28 percent of the total variations observed in the study were accounted for in PC I and II. Several authors (4, 7) had earlier indicated that the first two PC usually explain the highest source of variation. BRC, WGC and NKC were highly and positively correlated in PCI. BKC, EYC, FEC, SHC, WBC and sex were positively correlated in PC II. This indicates that these traits in clusters probably having similar genes in common (7). FEC, WBC, SHC, EYC and BKC were negatively correlated with BRC, NKC and WGC. The associations between the qualitative traits could be exploited for sexing (1) of the ducks.

Table 3 Principal component weights for qualitative traits of ducks

Traits	PCI	PCII
Sex	0.32	0.35
Body colour	0.62	0.08
Breast colour	0.59	-0.54
Neck colour	0.74	-0.13
Wing colour	0.55	-0.50
Shank colour	0.68	0.46
Web colour	0.17	0.76
Eye colour	0.69	0.09
Bill colour	0.83	0.04
Eigen value	3.33	1.47
Percent variance	36.95	16.33
Cumulative percent of variance	36.95	53.28

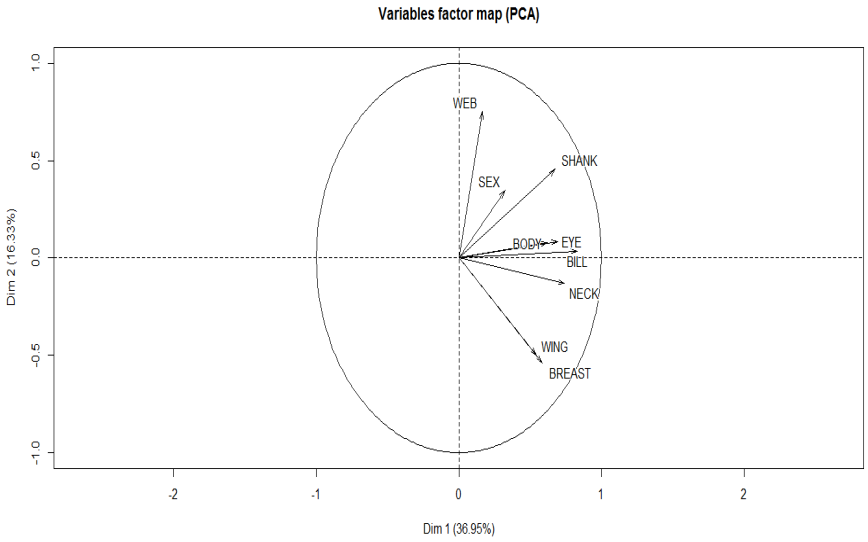


Figure2

Conclusion

The breeders could exploit the linear measurements that have positive correlation with body weight in ducks for selection for improved body weight. Qualitative traits which had positive correlations with sex can be used for future research for sexing of day-old ducklings.

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ABG 004: # Application of Best Linear Unbiased Predictor (Blup) in Genetic Ranking of Rabbit Buck

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Abstract

Best Linear Unbiased Predictor (BLUP) evaluations of the genetic merit of breeding sires of three rabbit breeds namely; Chinchilla (CHI), Dutch (DUT) and New Zealand White (NZW) were computed to identify the sire breed most suitable for selection in crossbreeding program. Records of 302 kittens produced through nested (hierarchical) design of 9 sires mated to 27 dams were used for estimation of heritability for pre-weaning body weights and breeding values of sires. Data were subjected to proc nested analyses of SAS and Least Squares/Mixed Model Methodology procedures, respectively. Heritabilities from sire components (h^2_s) for pre-weaning body weights were moderate to high. The predicted breeding values/ranking of individual sire (S), using Least Squares (LE) and Mixed Model Methodologies (MMM) are $S_3>S_4>S_2>S_5>S_6>S_1$ and $S_3 > S_4 > S_6 > S_5 > S_2 > S_1$ respectively. This study therefore presents the theory of BLUP and its applications in sire evaluation of rabbits in humid tropics.

Keywords: BLUP, Heritability, Genetic merit, Least Square, Mixed Model Methodology

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Introduction

Best Linear unbiased prediction (BLUP) is a procedure which predicts breeding values (BV's) of animals and adjusts simultaneously for fixed effects of the model. Mixed Model Methodology (MMM) on the other hand is a useful tool for obtaining estimates of breeding values specific for populations and for ranking. Flint and Williams [1] reported that this statistical method uses matrix algebra to solve the large number of simultaneous equations generated for estimating BVs and for identifying environmental effects simultaneously. Implementation of BLUP required considerable computing power and skill to solve the matrices generated. In particular, the complexity of the genetic information used dictates the amount of computer space or time required.

Ferraz and Johnson [2] asserted that progress in animal selection could easily be achieved when breeding values are estimated with parameters specific for a particular population. By knowing BVs, changes can be made in traits without knowing what gene(s) are responsible, and this is what has been exploited throughout domestication- the heritability of traits and the similarity of relatives. The development of this process has produced the advanced methods available today, of which BLUP is the finest package for now.

The goal of the animal breeder is to achieve rapid genetic improvement, which accurate estimation of breeding value is crucial. Estimation of breeding value of sire for pre-weaning body weight and litter traits in rabbits will provide useful information to breeders in selecting good stocks and individuals for optimum production. BLUP is the current method of choice for evaluation of breeders in all farm animal stock and is widely implemented. This study therefore, was designed to revalidate the theory of BLUP and its applications in sire evaluation of rabbits in the humid tropics.

Materials and Methods

This study was conducted in the Rabbitry Unit of the Teaching and Research farm of the Ebonyi State University, Abakaliki. Animals used in this study consisted of three (3) rabbit breeds [Dutch (DUT), Chinchilla (CHI) and New Zealand White (NZW)]. Three bucks and nine does (between 8 – 10 weeks of age) of each breed were used in the experiment. These were obtained from random-bred selected population of male and female (parent stock) of each breed from Emmpina Livestock Farms and Goddy Veterinary Services, Uyo, Akwa-Ibom State. All animals were treated and given medication throughout the study period under the same managerial and climatic conditions.

The rabbits were housed in an open sided building, covered with chicken wire mesh. Breeding animals were kept individually in three – tier rectangular cages, measuring 60cm x 38cm x 48cm with aluminum feeders and drinkers attached to the cage with a hook in order to avoid toppling. Additional wooden cages were also provided for mating. The cages were partitioned into seven (7) individual pens, each measuring 62cm x 44cm x 48cm for easy individual mating activities. Cages and nest boxes were regularly cleaned and disinfected before kindling. Urine and faeces dropped beneath the cages were removed in the morning every day.

Data Collection and Analysis.

By equating the mean square of each random effect to its expectation, variance component for sire (σ^2_s), dam (σ^2_d), and error (σ^2_e) were obtained. Similarly, by equating mean cross products for pairs of traits to their expectations, covariance components for sire (COV_s), dam (COV_d) and error (COV_e) were also obtained. These were used to estimate heritability for pre-weaning body weights.

Best linear unbiased prediction (BLUP) procedure was employed to predict breeding values of individual sires based on their breeds in reference to the three parities. The mixed effects linear model, in matrix notation is:

$P = X\underline{b} + Z\underline{u} + e$, where; P= a vector of n observable random variables, $\underline{b}$= fixed effects of parity (p= 3 levels) $\underline{u}$= random effects of sire (s= 6 levels) e = vector of residual error. X and Z = are design (known) matrices

Mathematically, BLUP was used to estimate $\underline{b}$ and $\underline{u}$ as solutions to the general MME:

$$\begin{pmatrix} X' R^{-1}X & X' R^{-1}Z \\ Z' R^{-1}X & Z' R^{-1}Z + G^{-1} \end{pmatrix} \begin{pmatrix} \underline{b} \\ \underline{u} \end{pmatrix} = \begin{pmatrix} X' R^{-1}X \\ Z' R^{-1}Y \end{pmatrix}$$

Henderson (1973; 1975) described the efficient computational procedures to solve the MME for simultaneous estimation of the fixed effects and prediction of breeding values.

Results and Discussion

Heritability estimates for pre-weaning body weights from sire component (h^2_s) are presented in **Table 1.** Moderate to high heritability (0.28±0.17 to 0.93±0.31) obtained in the present study are consistent with those estimates obtained in some studies in Egypt [3, 4], Spain [5, 6], Brazil [7] and Nigeria [8, 9]. Akanno and Ibe [10] studied body weight traits in NZW and DUT and reported moderate to high heritability estimates (0.43 and 0.36 for 6 and 12 week body weights respectively). The results obtained in the present study indicate the strong influence of additive genes in the expression of these traits and at the same time suggest possible improvement of the rabbits through individual selection method.

In contrast, [11] and [12] studied pre- weaning growth traits in Gabali rabbits in North – western coast of Egypt and reported low heritability estimates of 0. 00, 0.05 and 0.07 for pre- weaning body weight at birth, 21 and 28 days using animal model and 0.11, 0.10 and 0.00 for body weight at 4, 8 and 12 weeks respectively. Nevertheless, the difference between heritability estimates in the present study and those reported in the literature

could be attributed to the method of estimation/analysis, strain, environmental effects and sampling error due to a small data set or sample size.

Table 1: Heritability estimates for pre-weaning growth traits of rabbit

Pre weaning body weight	h^2_s
IKWB	0.59±0.24
IK2W	0.55±0.24
IK4W	0.93±0.31
IK6W	0.28±0.17
IK8W	0.64±0.26

h^2_s = heritability from sire components of variance
IKWB, IK2W, IK4W, IK6W and IK8W = Individual kit weight at birth, 2nd, 4th, 6th and 8th week respectively

The predicted breeding values of the sires, using Least Squares (LE) and Mixed Model Methodologies (MMM) are presented in **Table 2** and this shows the respective ranking of sires with the two methods. The ranking based on LS is $S_3>S_4>S_2>S_5>S_6>S_1$ while that of MMM (Best Linear Unbiased Predictor) is $S_3 > S_4 > S_6 > S_5 > S_2 > S_1$.

Table 2: Estimates of the fixed factors and sires breeding values for rabbit.

		LS		MMM
$\hat{p}_1$		0		467.91
$\hat{p}_2$		0		476.49
$\hat{p}_3$		0		426.42
$\hat{S}_1$		405.66		-10.04
$\hat{S}_2$	=	441.44	=	-5.61
$\hat{S}_3$		561.59		14.99
$\hat{S}_4$		511.54		5.61
$\hat{S}_5$		436.39		-5.04
$\hat{S}_6$		426.42		0.00

Least Squares and BLUP ranked sires 3 and 4 highest. Both are Chinchilla and they performed better than the other two breeds of sires. This confirms the earlier better performance of CHI rabbits in other parameters measured over DUT and NZW rabbits in the present study. There is scanty information on estimates of sire breeding values for rabbits in available literature. However, [13] as cited by [14], reported that BLUP estimated by mixed model methodology (MME) can be used to predict animal breeding values and adjust simultaneously for the fixed effect of the model. Ibe [15] stated that BLUP estimations are more reliable than LS estimations of breeding values.

Conclusion

CHI bucks ranked highest in breeding value, indicating that they are the sire of choice in crossbreeding aimed at exploiting non-additive genetic variance for the improvement of growth and litter traits.

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ABG 005: Principal Component Analysis of body measurements of Nigerian Indigenous Chicken in the derived savanna zone of Nigeria

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Abstract

This study was carried out to investigate the relationship among body measurements in Nigerian Indigenous Chickens (NIC) raised in the derived savanna zone of Nigeria. Principal Component Analysis was carried out on data from ninety –six (96) birds using eight body measurements with the view of identifying components that best define their body conformation.. The parameters measured were: body weight (BW), body length (BL), body girth (BG), shank length (SL), thigh length (TL), toe length (TOL), beak length (BEL) and wing length (WL). The results showed that the mean of the measurements taken at eight (8) weeks were, 1.12kg for body weight, 9.01, 15.92, 14.66, 37.76, 23.34cm for the shank length, thigh length, wing length, body length and body girth respectively. Two principal components (PC) accounted for 93% of the total variation in morphological traits for the indigenous chicken population. The first and second PCs included : BG, BL and TL. The multivariate analysis of the principal components with the aid of the scatter diagram showed that there is a no clear clusters for the two sexes which indicates that sexual dimorphism between the males and females in the indigenous chicken population is not clear at week-8. Further effort in the selection towards genetic improvement of this genotype may be effective if efforts are concentrated on the linear body traits in the first two principal components (body girth, body length, wing length and thigh length) that accounted for majority of the variation in the body dimensions of this genotype.

Keywords: Principal Component Analysis, Nigerian Indigenous Chicken, body measurements.

Introduction

Indigenous chicken constitutes 80% of the 120 million poultry type raised in the rural areas in Nigeria (1). It represents a large pool of untapped genetic resource which must not be conserved and improved especially at this moment of export-import deficit in Nigeria. (2).Stated that in spite of increase in the growth of the poultry industry in Nigeria (particularly with the introduction of exotic chicken breeds), the indigenous chicken breeds still remain the largest source of poultry meat and eggs. Although they are generally less productive when compared to the exotic species but they play a vital role in the socio-economic life of their keepers. Other attributes are as stated by (3) which include: better adaptability when compared to the exotic breeds and their high survivability with minimal care and attention. They are preponderant than their exotic counterparts and are mostly found in rural areas. Moreover, they are good scavengers as well as foragers and with good mothering qualities. Other authors (4; 5) also listed the following qualities which include acceptability of the products and that, they are preferred by the majority of Nigerian because of the pigmentation, taste, leanness and suitability for special dishes. Their outputs (egg and meat) are readily available to villagers and people in urban and semi urban areas, thus serves as a good source of protein in their diet and they also serve as good source of income.

Several efforts had been carried out and many are still on-going to improve the Nigerian Indigenous Chicken especially in the area of both genetic and morphological characterization of these chicken stocks but few had used a multivariate approach through Principal Component Analysis (PCA). PCA is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables known as principal components which are ordered so that the first few retain most of the variation present in the original variables (6). From the view point of animal genetics and improvement, principal components simultaneously consider a group of attributes which may be used for selection purpose (7). PCA had been used to describe the relationship between body measurements and body size in chicken (8, 9); duck: (10); in turkey (11); in rabbits: (12) and in sheep (13).

Therefore, the objectives of these study are; to evaluate morphometric traits of Nigerian indigenous chicken using a multivariate approach through principal component analysis, determine morphometric traits that best describe body conformation for selection and breeding purposes and investigate sexual dimorphism in this chicken population at 8-week.

Materials and methods

Experimental Site: The experiment was carried out at the Broiler Unit of Landmark University Teaching and Research Farm, Omu- Aran. It is situated some 88 kilometers South of Ilorin, capital of Kwara State and 16 km North –East of Otun Ekiti, in Ekiti state. It is located on the Latitude 8^0 8' 0″ N and Longitude 5^0 6^1 0″ E (14). Omu-Aran, as with most parts of Igbomina land, is on the highland beautifully nestled in a girdle of hills. It is located on a section of Elliu Hill and is actually the highest point above sea level in Kwara State.
The climate is tropical maritime with a long wet season. The weather is moderate, subject to modest variations of hot and cool as the season changes. Rain is typically heavy and the season lasts for about eight months in a year. It lies within the zone that enjoys the highest rainfall in Kwara State.

Experimental Birds and Management

A total of ninety six (96) day old Nigerian indigenous broiler chickens were used for this experiment. The chickens were obtained from Federal University of Agriculture Abeokuta (FUNAAB), Abeokuta, Ogun state. The birds were raised in a deep litter housing system for the eight weeks period, and were tagged for easy identification. They were fed *ad libitum* with broiler starter diet from day old to four weeks of age and broiler finisher diet from four weeks to eight weeks of age. Water was also served *ad libitum* while necessary prophylaxis and vaccination were administered at the appropriate ages. Natural ventilation was allowed in through the chicken wire mesh that covered the sides of the pen. Tarpaulin covers were used to control air flow through the house. As the weather changes and the temperature increases and decreases the covers will be opened and closed accordingly.
The experimental house was thoroughly cleaned and disinfected using saponated cresol (Lysol)® and water before the arrival of the day old chicks, this was done in order to prevent infections.
The chicks were managed and raised under standard management conditions in a deep litter system with wood shavings as the litter material which was changed as at when due.
Brooding was done for the first 14 days of life using coal pots and electric bulbs as sources of heat.

Data Collection

Body linear measurements were taken on the birds weekly from the fourth to the eighth week of age. The weights of the birds were taken with a Camry® top loader weighing scale with 5 kg capacity.

The following linear body measurements were taken and recorded with the use of a tailor's tape: shank length (SL), body girth (BG), wing length (WL), body length (BL), thigh length (TL), toe length (TOL), beak length (BEL). The linear body measurements were taken as described by (15). The measurements were described as follows: Shank length (SL): length of the tarso-metatarsus from the hock joint to the metatarsal pad, body girth (BG): the circumference of the breast region; wing length (WL): length of the wing from the scapula joint to the last digit of the wing.; body length (BL): distance from the tip of the beak, through the body trunk to the tail; thigh length (TL): length of the femur through the fibula and the tibia to the hock joint.; toe length (TOL): the length of the digit of the birds' foot to the phalanges and beak length (BEL): the length of the beak from the tip to the base.

Statistical Analysis:

Data were analyzed using the univariate and multivariate procedure components of PAST® software (16). Principal component analysis was used to identify variables that could adequately describe the morphological characteristics of the birds in the sampled population. The number of PCs to retain was determined using the scree (elbow) plot (17).

Result and Discussion

Table 1: Univariate body measurements of indigenous Chicken at 8-week

Trait	Mean ±SE	Var.	CV
WT	1.12±0.03	0.07	24.15
SL	9.01±0.83	0.62	8.76
TL	15.92±0.11	1.02	6.35
WL	14.66±0.09	1.02	6.24
TOL	5.58±0.04	0.17	7.46
BEL	1.85±0.01	0.02	6.87
BG	23.34±0.18	2.30	7.42
BL	37.76±0.25	5.70	6.32

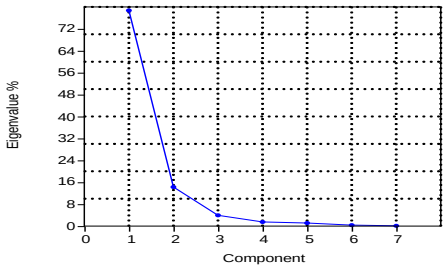

Figure 1: Scree plot for the morphological variables of indigenous chickens.

Table 2: Eigen values and the proportion of the total variance for derived components for 8-week body measurements

PC	Eigenvalue	% Variance	Cumulative %
1	8.95	78.71	78.71
2	1.62	14.27	92.98
3	0.45	3.94	96.92
4	0.17	1.51	98.43
5	0.13	1.11	99.54
6	0.04	0.35	99.89
7	0.01	0.10	99.99

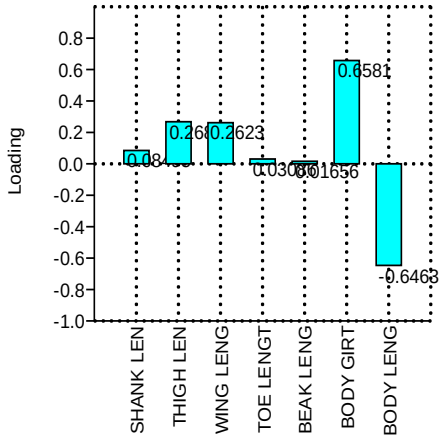

Figure 2: Eigenvectors of PC 1

Figure 3: Eigenvectors of PC 2

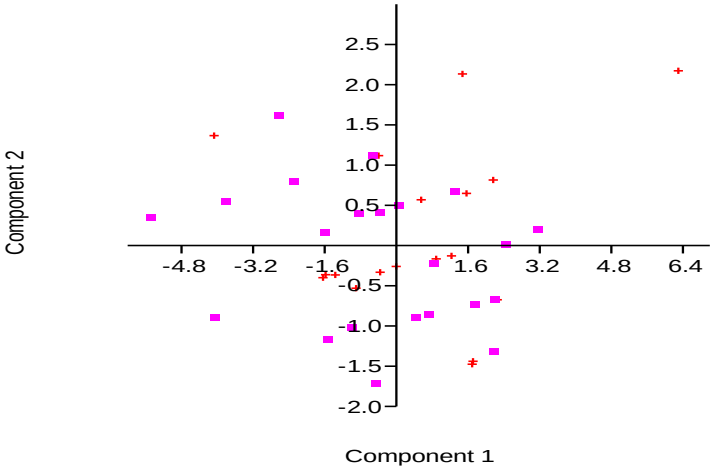

Figure 4: Scatter diagram for 8th week

The information on the mean body weight of the Nigerian indigenous chicken breed showed that they were lower (1.12kg) when compared with the average body weight of the three strains of exotic chickens (1.88 kg, 1.81 kg and 1.65 kg attained by Arbor Acre, Ross and Marshal respectively) reported by (18) at 8 weeks of age. The mean body measurement of the birds showed that, the values for the shank length of this population of birds was higher (9.01cm), the thigh length was lesser (15.92 cm), the wing length was lesser (14.66cm), the body length was higher (37.76 cm), the body girth was higher (23.34cm) than the exotic breeds reported by (18) in Arbor Acre 7.80, 17.16, 32.79, 18.98 and 16.48 for shank length, thigh length, body length, wing length and body girth respectively, Marshal 7.64, 17.39, 31.30, 17.95, 16.45 for shank length, thigh length, body length, wing length and body girth respectively and Ross 7.54, 15.25, 37.12, 18.57, 16.67 for shank

length, thigh length, body length, wing length and body girth respectively. The differences in values are most likely due to the differences in the gene composition of the birds.

Beak length, toe length and shank length had no significant contribution to the body weight and cannot be considered as a problem because these traits are of no economic importance to farmers.
The body length (0.75 and -0.65), body girth (0.49 and -0.66) and the thigh length (-0.29 and -0.27) had the highest contributions to the weight of the birds, from the PC loadings for 1 and 2 respectively. Wing length (-0.57) also had its own contribution which can be noticed in PC 3 loadings, this indicates that these traits can best describe the body dimension of Nigerian indigenous chicken and thus can be used as criteria for selection.
Table 2 shows the eigenvalues and the proportion of the total variance for derived components for the indigenous chickens in the population. The result of the principal component analysis showed that 7 principal components will explain the total variance in the body conformation. The first principal component accounted for 78.71% of the total variation. The second and third principal components accounted for 14.21% and 3.94% respectively. From the scree plot in Figure 1 which is a graph of the eigenvalues against the principal components, the first two principal components appear before the break hence they were retained. The other five components which appear after the curve flattens out are regarded as insignificant. However, the third component was deliberately included to increase the degree of confidence of the result.
Figure 2 shows the eigenvectors for principal component 1 for the linear body measurements of the indigenous chicken population, the three variables that has highest loadings on PC 1 included body length (BL), body girth (BG) and thigh length (TL) with the following loadings 0.75, 0.49 and 0.29 respectively. This implies that the body length is the morphometric trait that can best describe the indigenous chicken followed by the body girth and the thigh length. Figure 3 shows the eigenvectors for PC 2, the variables with the highest loadings are body length on the negative side, body girth and thigh length with the loadings of -0.65, 0.66 and 0.27 respectively. Figure 4 shows the scatter diagram for the first two principal components, the plus sign represent the males while the closed squares represent the females. It was observed that there was no clear clustering of the males and females together while some are dispersed which indicates that there is sexual dimorphism in the population although it is not distinct since the chickens have not fully attained sexual maturity at 8 weeks.

Conclusion

The study showed that, two principal components accounted for about 93 % of total variation in morphological traits for the indigenous chicken population. The first and second PCs included body girth, body length and thigh length. The multivariate analysis of the principal components with the aid of the scatter diagram did not show clear clusters of the two sexes which indicates that sexual dimorphism between the males and females is not clearly pronounced in the Nigerian Indigenous Chicken population at eight weeks of life in this study.

Acknowledgement

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ABG 006: Effect of Sire and Dam Body Condition Score on Milk Yield Characteristics of Friesian X Bunaji Cows

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Abstract
This study was conducted to determine the effect of sire of dam and dam body condition on milk yield characteristics of Friesian x Bunaji cows.Data for the study were collected from sixty (F_1) Friesian x Bunaji cows.The mean initial milk yield (IMY), daily milk yield (DMY) and total milk yield (TMY) were 6.54, 6.51 and 1872 Kg, respectively, while the mean peak yield (PY), peak day (PD), peak week (PWK) and lactation length (LL) were 10.61kg, 26.94 days, 4.33weeks and 283.87days, respectively.The efect of sire of dam was significant ($P< 0.05$) on all the milk yield characteristics. Also, Dam body condition score (BCS) had significant ($P<0.05$) influenceon all the milk yield characteristics except on IMY, PY and ADMY. The distribution of dam BCS showed that the mean BCS of between 2.5 and 3.5 had better milk yield characteristics than those of less than 2.5 or greater than 3.5.This suggested that the good BCS required for optimum dairy performance during lactation is between 2.5 and 3.0 (on a scale of 1 to 5).

Key words: Body condition score, Friesian x Bunaji, Milk yield, Sire
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Introduction
Body condition score (BCS) is a quick, non-invasive, inexpensive visual and tactile way of assessing the degree of fatness of the cow (16). It is a management tool used routinely to assess the body fat reserves and energy status in cattle (9) especially during lactation (4). Changes in BCS over time reflect both the body composition and energy balance, which in turn are critical for metabolic stability (4), health (5) and fertility (3). Although sometimes measured on different scales, BCS or change in BCS overtime is used internationally as a tool to aid herd management (14). Decline in BCS during early lactation has been reported (6). High producing cows normally partition a higher proportion of dietary energy into milk production than into body fat deposits (10). This may partly explain why increased milk production is associated with lower BCS.The milk production of cows correlates with their body condition and body condition scoring is a widely recommended method of evaluating the nutritional management of dairy cows.
Therefore this study had the aim to determine the effect of sire of dam and dam body condition on milk yield characteristics of Friesian x Bunaji cows

Materials and Methods
Study location
The study was conducted on the dairy herd of the National Animal Production Research Institute (NAPRI) Shika, Nigeria, located between latitude 11^0 and 12^0N at an altitude of 640 m above sea level, and lies within the Northern Guinea Savannah Zone (11).

Animals and Managements
Data for this study were collected from sixty (F_1) Friesian x Bunaji cows. The cows were raised during the rainy season on both natural and paddock–sown pasture, while hay and/or silage were offered during the dry season. Concentrate mixture of undelinted cotton seed cake and grinded maize were offered to the cows daily during milking. They had access to water and salt lick *ad-libitum*. Unrestricted grazing was allowed under the supervision of herdsmen for 7 – 9 hours per day (1).

Measurement of Body Condition Score

The body condition score (BCS) of the dams was determine on monthly basis by two evaluators using a scale of 1 to 5 according to (13) on increments of 0.25 with 1(very thin) and 5(very fat) representing the biological extremes. The animals were categorized into 3 groups based on their BCS; low BCS (< 2.5), moderate BCS (2.5 to 3.5) and high BCS: > 3.5.

Data analysis

The effect of sire and BCS on milk yield characteristics was analyzed by Least Squares technique of General Linear Model (GLM) procedure of (15). The model used was

$Y_{ij} = \mu + S_i + BCS_j + e_{ij}$

Where: μ =overall mean; Si = effect of ith sire; BCS_j= effect of jth body condition score; e_{ij}= random error

Results and Discussion

The summary statistics of the experimental data are shown in Table 1. The mean initial milk yield (IMY), daily milk yield (DMY) and total milk yield (TMY) were 6.54, 6.51 and 1872 Kg, respectively, while the mean peak yield (PY), peak day (PD), peak week (PWK) and lactation length (LL) were 10.61kg, 26.94 days, 4.33weeks and 283.87days, respectively.

The genetic effect of sire as a stabilization factor on dairy herd have been described by (2). In this study, the sire efect was significant (P< 0.05) in all the milk yield characteristics (Table 2). This underscored the importance of selecting and using proven sires in the dairy herd.Likewise, the genetic and environmental influences of sire on milk production are known and have been documented (8). The effect of dam body condition score (BCS) was significant (P<0.05) on all the milk yield characteristics except IMY, PY and ADMY (Table 2). Dams whose average BCS during the lactation period were within 2.5-3.5, had longer days to peak yield (PD;27.41±3.27days), peak week (PWK ;4.43 ±0.49wks) and lactation length(LL; 301±31.17days) and consequently produced higher TMY (1995.25kg/lactation). Those with higher BCS (>3.5) had higher IY (7.00± 1.86 kg) and shorter days to peak yield (PD; 20.50 ± 13.12days), PWK (3.0±1.95wks) and shorter LL (275.33±25.44days), which invariably resulted in lower TMY (1819.83± 335.80kg/lactation). In their study, (12) reported that BCS of 2.5 and 3.0 (on a scale of 1 to 5) presents normal BCS for high birthweight and milk yield, also (9) reported an average BCS of 2.74 for Swiss Holstein dairy cows. The relatively low milk yield of dams with higher BCS of > 3.5 may be attributed to the high fat reserve compared to those with moderate BCS. This confirmed the earlier finding of (9) that higher BCS is associated with lower milk production. Also *(*7) reported that overconditioned at calving may be at risk for lesser milk yield and increase reproductive and health problems.

Conclusion

The significant effect of sire on milk yield characteristics is an indication of the importance of selecting and using proven sires in the dairy herd as genetic factor for increase milk production. Also, the best BCS required for optimum dairy performance of Friesian x Bunaji cows during lactation is between 2.5 and 3.0 (on a scale of 1 to 5)

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Table 1: Descriptive statistics of milk yield characteristics

Milk yield Characteristics	**N**	**Mean ± SE**	**CV**	**Min**	**Max**
Initial milk yield (kg)	60	6.54±0.51	47.58	2.0	13.00
Peak day	60	26.94± 3.01	67.13	5.0	83.00
Peak week	60	4.33 ± 0.45	62.17	2.0	12.00
Peak yield	60	10.61± 0.41	23.03	7.0	16.00
Average daily yield (kg)	60	6.51±0.28	26.81	4.04	12.00
Total milk yield (kg)	60	1872±93.95	31.35	926.50	3427.00
Lactation length	60	283.87±7.08	15.38	200.00	305.00

n=number of animals used, SE=standard error, CV= coefficient of variation, Min=minimum, Max= Maximum

Table 2: Least Squares Means and standard error (LSM± SE) for the effect of sire, sex of calf and BCS of dam on the milk yield characteristics

Factors		IMY (kg)	PD (days)	PWK (wks)	PY(kg)	ADMY (kg)	LL (days)	TMY (kg)
Sire	N	**	**	**	**	ns	**	**
1	10	6.25±1.47^{bc}	27.00±9.36^{a}	6.00±1.36^{a}	9.63±1.23^{b}	6.51±0.86^{b}	305.00±21.87^{a}	2014.37±284.62^{a}
2	28	7.16±0.63^{b}	28.22±3.99^{a}	4.27±0.58^{b}	10.84±0.52^{ab}	6.93±0.36^{a}	287.59±9.32^{ab}	1955.46±121.36^{ab}
3	9	9.50±2.08^{a}	17.00±13.23^{b}	2.50±1.92^{c}	12.50±1.74^{a}	6.05±1.22^{c}	304.50±30.94^{a}	1844.40±402.52^{ab}
4	13	4.19±1.04^{c}	25.87±6.62^{ab}	4.13±0.95^{b}	10.00±0.87^{ab}	5.82±0.57^{d}	280.00±14.58^{ab}	1611.38±189.75^{b}
Dam BCSns			**	**	Ns	ns	**	**
<2.5	3	5.00±2.28	26.00±13.12^{a}	4.00±1.95^{a}	10.44±1.73	6.57±0.31	285.47±7.79^{ab}	1869.34±102.82^{ab}
2.5-3. 5	46	6.58±0.58	27.41±3.27^{a}	4.43±0.49^{a}	11.25±0.43	6.63±0.31	301.00±31.17^{a}	1995.25±411.27^{a}
>3.5	11	7.00±1.86	20.50±13.12^{b}	3.00±1.95^{b}	12.75±1.73	6.47±1.02	275.33±25.44^{ab}	1819.83±335.80^{b}

ab= means along columns with different superscript are significantly different (P<0.01), IMY = initial milk yield, PD = peak day, PWK = peak week, PY = peak yield, TMY= total milk yield, ADMY = average daily milk yield, LL= lactation length, ns =not significant, *= P<0.05; ** = P<0.01,

ABG 007: Relationship of Live weight and Linear Body Measurement in Preweaned Nigerian Indigenous Pig (NIP) Crossbreds of Southern Nigeria

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Abstract

The study was carried out at the Southern farm, Piggery unit of the Institute (I.A.R&T.). Forty-seven hybrid progenies from crossbreeding between the NIP and Large white pigs were used. Body measurement was done once in a week from first week of birth to their weaning date. Body measurements taken were Body Weight (BW), Body Length (BL), Body Height (BH), Heart girth (HG) and Rump circumference (RC) of the progeny of crossed breed, Body. All the body parameters measured were positive and highly significantly correlated with body weight. The correlation coefficient ranges between 0.74 and 0.85. Rump circumference and Body height had the highest correlation coefficient of 0.85 followed by Heart girth with values of 0.81 respectively. Procedure regression analysis was used to obtain best prediction equations for body weight from body measurement variables and the presented regression equation were obtained with coefficient determinant (R^2) of 0.86

Introduction

Genetic improvement for reproduction and growth traits of NIP can be brought about by crossbreeding and long term selection within the existing population, provided additive genetic variance exists. Crossbreeding is a successful management practice for improving litter productivity in swine (1). It is also an effective means of improving reproductive performance i.e heterosis or hybrid vigour that comes from an increase in heterozygosity, which leads to better average genotypic values at dominant loci. This offers the opportunity to increase genetic variation from which leaner and more efficient animals can be selected (2). Evaluation of the performance of animals constitutes an essential part of successful breeding plans for sustainable genetics improvement. In order to develop a very good model for the genetic improvement of crossed pigs, it is important to measure the traits of interest. Pigs are mostly kept for their meat and the most important trait of interest for their genetic improvement is the body weight. According to Cam *et al*.,(3) body weight is a very important characteristic in animal husbandry due to selection criteria and

economical profit. Live weight might be affected by different management, environment and enterprise feeding conditions. Proper measurement of this trait on-farm is sometimes difficult because of unavailability of weighing scale in the rural areas. Therefore use of simple linear body measurement parameters to predict live weight will be appreciated by the farmers. Some traits are usually regulated by the same pair of genes. Hence information on associations between traits is highly valuable in genetic improvements. This study is to determine the strength of relationship between bodyweight and linear body measurements, also to predict body weight from linear measurements.

Materials and Methods.

The study was carried out at the Southern farm, Piggery unit of the Institute (I.A.R&T.). Forty-seven hybrid progenies from crossbreeding between the NIP and Large White pigs were used. Body measurement was done once in a week from first week of birth to their weaning date. Body measurements taken were Body Weight (BW), Body Length (BL), Body Height (BH), Heart girth (HG) and Rump (RC) of the progeny of crossed breed. Body Weight (BW), which represent the weight of the animal was measured with weighing scale, (BL), the length of the animal from the last cervical to the lumber vertebra (base of the tail), Heart Girth (HG), the circumference of the chest region and rump circumference (RC) the circumference of the loin region; were measured with a measuring tape in centimeter. The data were analyzed using procedure correlation (PROC CORR) and procedure regression (PROC REG) of SAS (1999).

Results

All the body parameters measured were positive and highly significantly ($p< 0.001$) correlated with body weight (Table 1). The correlation coefficient ranges between 0.74 and 0.85. RC and BH had the highest correlation coefficient of 0.85 followed by HG and BH with values of 0.81 respectively.

Procedure regression analysis was used to obtain best prediction equations for body weight from body measurement variables and the presented regression equations (Table 2) were obtained. For a unit increase in SL, BH, RC and HG, the body weight of pre-weaned hybrid pigs will increase by 0.66, 0.20, 0.01 and 0.11Kg respectively.

Table 1: Pearson correlation Matrix of body weight and linear body measurements in preweaned NIP crossbreds.

Variables	**WT**	**SL**	**BL**	**BH**	**RC**	**HG**
WT	**1**	**0.81**	**0.74**	**0.85**	**0.85**	**0.81**

SL	**1**	**0.68**	**0.71**	**0.73**	**0.76**
BL		**1**	**0.76**	**0.84**	**0.79**
BH			**1**	**0.78**	**0.68**
RC				**1**	**0.86**
HG					**1**

WT= weight, BL=Body length, SL=Snout length, RC=Rump circumference, BH= Body height, HG=Heart girth

Table2: Linear regressions relating body weight to various body linear measurements in preweaning NIP crossbreds.

Regression variable	**Prediction Equations**	**Coefficient Of Determination(R^2)**
BLM	BW=-7.80-0.01BL+0.66SL+0.20BH+0.01RC+0.113HG	R^2=0.86

LM=Body linear measurement, BW=Body weight, BL=Body length, SL=Snout Circumference, RC=Rump circumference, HG=Heart girth

Discussion

One of the most common and most useful statistics that describes the degree of relationship between two variables is the correlation (3). The estimation of accurate body weight from animal's simple body measurements will make it easier for farmers in the rural area, who has no scale to make use of. Due to profitable aims a producer can measure all the body measurements easily from a live animal and can determine body weight approximately. Teghe and Olorunda, (4) and Adeola, (5) reported similar results between body weight and body measurements in pigs and, while Afolayan et al, (6), Salako (7) and Cankaya *et al*., (8) for sheep. In this study, there was high correlation between the weight and all the body linear measurement parameters taken. The highest correlations were found between body weights and

Rump circumference (RC) and body height (BH), while the lowest correlations were found between the body lengths (BL) and snout length (SL).

According to the correlation modules, body weight was found very highly correlated with all body dimensional traits measured (0.74-0.85). Of the body dimensional characters, Rump circumference and body height were the most related trait to weight and the correlation between these two traits was 0.85. Variables such as heart girth, body height, body length, which are directly related to the size and weight of animal, showed moderate to very high positive correlations with each other (0.68-0.86). However, the measure of snout length was lower correlated with body length (0.68).The high correlation coefficient observed between body weight and the linear body measurement parameters shows that selection for these traits will result in correlated response in these traits.

In most studies heart girth was found to be highly correlated with body weight in pig (4), in sheep (9; 10; 6), in cattle (11; 12; 13) and in goat (14; 15). The difference between our study and the mentioned literatures can be attributed to the differences in nutrition and an environment or their rearing conditions.

Fattening status should be taken into consideration in order to predict an animal's bodyweight from its body measurements. In this study results suggest that variables with high correlation coefficients might be used to predict body weight. Khan *et al.,* (14) suggested that the highest relationships amongst body measurement may be used as selection criteria in traditional production systems in rural areas.

Conclusion

The correlation matrix for body weight against linear body measurements in preweaned NIP crossbreds indicates that all the parameters could be used to select for body weight. However, the long snout characterizing the NIP could be difficult to select against in the NIP crossbreds owing to its high level of association to body weight. The linear equation generated by regressing body weight on snout length, body height, rump circumference, heart girth and body length could be used by resource poor pig farmers in the estimation of body weight of pre weaned crossbreds pigs if they cannot afford weighing scales

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ABG 008: Estimating the Productivity of Composite Rabbit Population in the Tropical Rain Forest Zone of Southern Nigeria

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Abstract
A study to monitor the productivity of a composite rabbit population was conducted at the University of Benin Teaching and Research Farm. The rabbits were from a composite population. Data collected included doe and buck weights before mating (DWT and BWT), gestation length (GL), kindling interval (KI). Litter size at birth (LSB), and weaning (LSW), litter weight at 2 weeks (LW_2), litter weight at weaning (LWW), monthly post weaning weights, and % pre-weaning mortality. The effect of parity on performance was also considered. The data collected were subjected to statistical analysis to obtain mean performance of the rabbits. Significant mean differences were separated using Duncan Multiple Range test. Results obtained gave mean and standard error values of 5.08±0.15 and 3.18±0.13, 0.24± 0.001 kg, 0.41±0.01kg, 30.66±0.13 (days), 42.82±2.05 (day), 34.74±2.34% and 140±1.2g/day were recorded for litter size at birth and at weaning, litter weights at 2weeks of age and at weaning, gestation length, kindling interval, percentage pre-weaning mortality and average daily feed intake respectively. The parity of litter in which a rabbit is born had significant effect on all the traits considered except for weight at 2 weeks. Litter size increased steadily with parity. It peaked at the 4th parity and thereafter it gradually declined. The doe productivity indices revealed that a breeding doe can produce 27 weaners/year,23 fryers/year, 42.65kg live weight/year and 23.89 kg dressed weight/year. From the result, better performance can be achieved with good management as reproductive traits showed high percentage of variation.

Key Words: Composite Rabbit, Productivity indices and parity.

Introduction

Genetic improvement of rabbit is important in order to increase the contribution of rabbits to the much needed animal protein in Nigeria. A prerequisite for this improvement is the knowledge of their breeding patterns and performance so as to make selection of highly prolific individuals possible. With the foregoing therefore, the objective of this write up is to determine the productivity of the composite rabbit population in the teaching and research farm of University.

Materials and Methods

Experimental site, animals and design

The experiment was conducted at the Rabbit Unit of the University of Benin Teaching and Research Farm, Benin City, Nigeria. The study was carried out in a complete randomized design. Feeding and management of the animals were in line with the procedure stated in (1).

Offspring of 40 adult rabbits (30 does and 10 bucks) were used for the experiment.

Data Collection and Analysis

Data collected include litter size at birth (LSB), litter size at weaning (LSW), litter weight at weaning (LWW),parity (PRTY), monthly body weight from birth to 22 weeks, Gestation length (GL), Kindling intervals (KI), and productivity indices was also obtained using litter size and weight records according to (2). The data collected were subjected to statistical analysis using the GLM procedure of SAS (2006) version 6, 4th edition. Significant mean were separated using Duncan Multiple Range test.

Doe Productivity Indices

The doe productivity indices under a small holder system were calculated using the method of (2).

Table 1: Mean, performance of composite Rabbits used in the Study

Parameters	Mean	±SEM	Cv(%)
LSB/NBA	5.08	0.15	35.45
$LS_{2=}$	3.71	0.14	45.05
LSW (No.)	3.18	0.13	48.21
$ALWW_2$ (kg)	0.25	0.001	40.00
ALWW (kg)	0.41	0.01	41.36
GL (days)	30.7	0.13	5.22
KI (days)	42.8	2.05	5B.12
PWM (%)	34.7	2.34	81.74
$ALWM_2$ (kg)	0.76	0.02	38.06
$ALWM_3$ (kg)	1.13	0.03	36.95
$ALWM_4$ (kg)	1.49	0.05	38.06
$ALWM_5$ (kg)	1.86	0.06	38.08
ADFI (g)	140.30	1.2	9.50

Where; LSB/NBA = litter size at birth/number of born alive, LSW_2 = litter size at 2 weeks, LSW = litter size at weaning, $ALWM_2$, $ALWM_3$, $ALWM_4$, $ALWM_5$ = average litter weight at months 2, 3, 4 and 5 respectively. GL= Gestation Length, KI = Kindling interval, PWM = Pre-weaning mortality, ADFI = average daily feed intake.

Table 2: Effect of Doe weight and Parity on the Growth performance of composite Rabbits

DWT(Kg)	ALW_2	ALWW	$ALWM_2$ (kg)	$ALWM_3$ (kg)	ALM_4 (kg)	ALW_5 (kg)
1.7	0.24	0.39	0.86	1.32^{a}	1.78^{a}	2.25^{a}
1.8	0.26	0.43	0.78	1.17^{ab}	1.51^{ab}	1.89^{ab}
1.9	0.26	0.42	0.79	1.18^{ac}	1.56^{ac}	1.95^{ac}
2.0	0.23	0.41	0.74	1.10^{abc}	1.46^{abc}	1.82^{ac}
2.1	0.26	0.39	0.49	0.68^{ac}	0.88^{ac}	1.07^{ac}
2.2	0.29	0.37	0.73	1.09^{ac}	1.47^{ac}	1.83^{ac}

Parity	ALW_2	ALWW	$ALWM_2$ (kg)	$ALWM_3$ (kg)	ALM_4 (kg)	ALW_5 (kg)
1	0.26	0.39	0.59	0.87^{a}	1.09	1.37
2	0.25	0.42	0.77^{a}	1.13^{a}	1.49^{a}	1.86^{a}
3	0.21	0.37	0.76^{a}	1.14^{a}	1.52^{a}	1.91^{a}
4	0.23	0.39	0.79^{a}	1.21^{a}	1.63^{a}	2.04^{a}
5	0.27	0.46	0.87^{a}	1.28^{a}	1.69^{a}	2.12^{a}
6	0.31	0.52	0.93^{a}	1.32^{ab}	1.72^{a}	2.11^{a}

Where; DWT = Doe weight, LSB/NBA = litter size at birth/number of born alive, LSW_2 = litter size at 2 weeks, LSW = litter size at weaning, ALW_2 = average litter weight at 2 weeks of age, ALWW = average litter weight at weaning, $ALWM_2$, $ALWM_3$, $ALWM_4$, $ALWM_5$ = average litter weight at months 2, 3, 4 and 5 respectively.

Table 5: Effect of Doe weight and Parity on the Reproductive performance of composite Rabbits

DWT(Kg)	LSB/NBA	LS_2	LSW	ALW_2 (kg)	$ALWM_3$ (kg)	ALM_4 (kg)	ALW_5 (kg)	GL	PWM (%)
1.7	5.27^{ac}	4.45	3.73	3.64	3.64	3.64	3.64	31.64	24.1^{a}
1.8	4.88^{ac}	3.70	3.05	3.50	2.87	2.85	2.83	31.02	32.4^{a}
1.9	4.36^{a}	3.36	3.12	3.00	3.00	3.00	3.00	30.36	25.8^{a}
2.0	5.67^{bc}	3.95	3.40	3.28	3.28	3.28	3.28	30.49	37.9^{a}
2.1	4.50^{ab}	2.50	1.83	1.67	1.67	1.67	1.67	30.67	67.9^{a}
2.2	4.44^{ab}	2.89	2.78	2.78	2.78	2.78	2.78	29.78	41.0^{ab}

Parity	ALW_2(kg)	ALWW(kg)	$ALWM_2$ (kg)	$ALWM_3$,(kg)	ALM_4 (kg)	ALW_5(kg)
1	0.26	0.39	0.59	0.87^{a}	1.09	1.37
2	0.25	0.42	0.77^{a}	1.13^{a}	1.49^{a}	1.86^{a}
3	0.21	0.37	0.76^{a}	1.14^{a}	1.52^{a}	1.91^{a}
4	0.23	0.39	0.79^{a}	1.21^{a}	1.63^{a}	2.04^{a}
5	0.27	0.46	0.87^{a}	1.28^{a}	1.69^{a}	2.12^{a}
6	0.31	0.52	0.93^{a}	1.32^{ab}	1.72^{a}	2.11^{a}

Where: DWT = Doe weight, LSB/NBA = litter size at birth/number of born alive, LSW_2 = litter size at 2 weeks, LSW = litter size at weaning, ALW_2 = average litter weight at 2 weeks of age, $ALWM_2$, $ALWM_3$, $ALWM_4$, $ALWM_5$ = average litter weight at months 2, 3, 4 and 5 respectively.

Table 8: Estimated Doe Productivity Indices

Doe productivity indices	Estimated value
a) Weaners/Doe/year	27
b) Fryers/Doe/year	23
c) Live weight/Doe/year	42
d) Dressed wt/doe/yr	23

Discussion and Conclusion

The average body weight of composite rabbits increased progressively with age. This is in line with previous reports by (3). However the values obtained from this study were higher than 952 ± 18g, 812 ±68g and 790 ± 7g reported for NZW, CHL and CAL rabbits respectively 12 weeks of age by (4). (5) Reported 1.46 kg and 1.66 kg respectively for composite rabbits at 16 and 20 weeks of age respectively. These are however lower than 1.49±0.05kg and 1.86 ± 0.06 kg values obtained for composite rabbits at 16 and 20 weeks from this study. (6) reported 972.2 ± 40.00 g, 1305.0 ± 40.00 g and 1505.6 ± 40.00 g for composite rabbits at 12,16 and 20 weeks respectively. The mean value obtained for litter size at birth was 5.08 ± 0.148. This value falls within range of litter size reported by (7) and higher than values reported by (8). The litter weight of 0.25 ± 0.01 kg at weaning compares favourably with 271.43 ± 40.08 g reported by (8) and 0.239±0.04g by (6) and lower than 525 ± 53.00 g reported by (9). The mean gestation length (GL) observed in this study was within range reported by (10; 11 and 8).

Parity had significant effect on all traits except gestation length, average litter weight at 2 weeks and at weaning. Litter size at birth was significantly different for does in the 2nd, 6th and 4th parity. The litter size increases with parity, it peaks at 4th parity and thereafter gradually declines. This is in line with earlier report by (12) and (6). From the study, it can be reported that the productivity of composite rabbits is affected by the weight of does, and the parity of litters and composite does can produce 27 weaners/doe/year, 23 fryers/doe/year, 42 kg live weight /doe/year and 23kg dressed weight/doe/year. Rabbit with higher weight at weaning yield higher weight at sexual maturity and show low mortality percentage.

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ABG 009: Comparative Genomics of Swine Leukocyte Antigen Class I of Nigerian and Kenyan Pigs

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Abstract

The classical genes are a member of immunoglobulin gene family that is involved in the presentation of antigen peptides. They are located in every nucleated cell surface, except in neurons and trophoblasts. They are synthesized in infected cell (viral infection), binding to viral proteins and giving rise to an SLA I- antigen complex.

This study compares SLA class I gene of Nigerian pigs with pigs from Kenya along with archived sequences from Asia and American pigs available on Genbank to gain a better understanding of matrilineal origin of Nigerian and Kenyan pigs, gain insight into demographic distribution and their domestication and adaptation.

DNA was extracted from 90 pigs (consisting 60 Nigerian pigs (NP) and 30 pigs from Kenya) using Invitrogen Kit, quantified by using Nanodrop, and amplified by using Polymerase Chain Reaction. The expected bands were purified and sequenced for SLA class I. The sequences were aligned and phylogenetic tree was analyzed by using MEGA 6. BLAST (Basic Local Alignment Search Tools) was conducted in NCBI (National Center for Biotechnology Information). The sequences of Nigerian pigs and Kenya pigs were compared with published pig data in GenBank.

The Neighboring Joint (NJ) tree constructed with sequences from Nigeria, Kenya and other pigs from GenBank revealed that some of the Nigerian pigs clustered together with Asian pigs at the middle of the tree while some clustered just above the Kenyan below the tree and the outgroup homosapien stood out. The result from the calculation of total number of segregating sites gave the negative Tajima's D value (-0.181) while the non-significant difference ($p > 0.05$) obtained from the result showed that the null hypothesis was not rejected.

In conclusion, there is genetic difference between the Nigerian and Kenyan pigs based on the phylogeny tree constructed. There is an excess of low frequency polymorphisms relative to population

size. This may be as a result of evolutionary forces during course of adaptation in tropical countries in Africa.

Keywords: Nigerian pigs, Kenya pigs, Swine Leukocyte Antigen class I

Introduction

Over 90 breeds were recognized in the world and 230 varieties were estimated (1). Domestic pigs can be grouped into exotic, indigenous and their crossbreeds. The common breeds found in Nigeria are NIP or Local pigs and the improved pigs from crosses between the NIP and Exotic breeds especially Large White and Landrace.

Swine Leucocyte Antigen Genes Class I can be classified into classical and non-classical genes. The classical genes are a member of immunoglobulin gene family that is involved in the presentation of antigen peptides. They are located in every nucleated cell surface, except in neurons and trophoblasts. While they are synthesized in infected cell (viral infection), binding to viral proteins and hence giving rise to an SLA I- antigen complex. This complex will be recognized by certain T lymphocytes, CD8+ cytotoxic T cells that kill the infected cells. Antigen presentation in infected cells to CD8+ is one of the main functions of SLA I (2). Its structure consists of two chains: a heavy chain, of 45 KDa (KiloDalton), with a great polymorphism. It is codified by SLA genes and known as the A chain. The other chain is a light chain, which is non-covalently associated with the swine ß2-microglobulin, a polypeptide of 11.7 kDa called B. The heavy chain is a transmembrane molecule, encoded within the SLA complex, which expresses all the polymorphisms observed.

The objective of this study is to compare SLA class I gene of Nigerian pigs with pigs from Kenya along with archived sequences from Asia and American pigs available on Genbank to gain a better understanding of matrilineal origin of Nigerian and Kenyan pigs, gain insight into demographic distribution and their domestication and adaptation.

Keywords: Nigeian pigs, Kenya pigs, swine leukocyte Antigen class I

Methodology

Genomic DNA was extracted from blood spots (FTA cards) of 60 pigs from Nigeria, using kit (Invitrogen) at the Biosciences for east Africa-International Livestock Research Institute hub (BecA-Ilri hub, Nairobi, Kenya. The DNA concentration and quality were checked using Nanodrop. The primer pair sequence for SLA class I forward and Reverse primers were: T7-Alpha-TAATACGACTCACTATAGGGACCGCCGTGTCCCGGC(C/T)CGACand Reverse: Sp6-Alpha-

ATTTAGG-TGACACTATAGCCTCGCTCTGGTTGTAGTAGC primers. PCR reaction volume was performed in 25 µl containing of 100 ng genomic DNA, 2.5 µL of 10×PCR buffer. The thermal cycling conditions were as followed; initial temperature at 94°C for 5 minutes, followed by 35 cycles at 94°C for 30 minutes, step up annealing temperatures at 59-60°C for 45 minutes, extension at 72°C for 45 seconds, with a final extension of 5 minutes at 72°C. PCR products were electrophoresed in 1% low-melting point agarose gels (Promega) in 1X TAE. The products of expected size were excised and purified with extraction kit (Thermoscientific) and sequenced at Macrogen (USA). The nucleotide analysis was done by using CLC workbench version 7.6.4. Blast was conducted in NCBI (National Center for Biotechnology Information) using Blast n option to get the similar or homologous sequences from other breed of pigs from GenBank (http\\blast.ncbi.nlm.nih.gov/Blast/). Alignment of sequences was carried out by using CLC workbench version 7.6.4 and Clustal W algorithms in Bioedit sequence alignment editor software. The phylogenetic tree was constructed by using MEGA 6. The confidence of branching order was estimated by the use of the bootstrap analysis using 1000 replicates. Haplotype diversity, nucleotide diversity, number of segregating site and Tajima's D were estimated by using DnaSP version 5.

Results and Discussion

The results obtained from the Neighboring Joint (NJ) tree constructed by using MEGA 6 (Talima *et al*., 2013) with sequences from Nigeria, Kenya and other pigs from GenBank revealed that some of the Nigerian pigs clustered together with Asian pigs at the middle of the tree while some clustered just above the Kenyan below the three and the outgroup homosapien stood out (Figure1). Great differences were observed between the pigs from different countries and sources. The clustering of NIP MHC class 1 gene with Asian pigs was in line with the findings of Oluwole *et al.,* 2016 where the NP SLA class II gene at the exon 2 and 3 regions clustered with that of Asian pigs. Macromolecules, as described by Brinkman and Leipe (2001) data for phylogenetic or cladistics character is the most accepted form than that of morphological and other organismal character. This result show that sequences that clustered together are closely related and there was a high degree of average relatedness among genotypes within the same cluster. Moreover, there is possibility that genotypes within the same cluster had similar genetic background. The NP consisting Nigerian Indigenous pigs (NP 1-3), crossbreds (NP 4-6) and exotic pigs (NP 7-8). The NP 7 and 8 clustered between the Asian and America pigs. Haplotype, haplotype diversity and nucleotide diversity were 19, 0.98 and 0.36 respectively (Table 1). The low haplotype results in evolutionary potential of livestock to rapidly adapt to change in environmental condition. According to Frankham *et al*. (2002), the nucleotide diversity are affected by several factors, including selection, mutation rates, mating system, effective population size, and demography, gene flow between

populations, introgression from hybridisation and historical effects on these factors (e.g., population bottlenecks).

Tajima's D statistics test result from the calculation of total number of segregating sites gave a negative value (-0.181) (Table 1). This negative Tajima's D result signifies an excess of low frequency polymorphisms relative to expectation, indicating population size expansion (e.g., after a bottleneck or a selective sweep) and/or purifying selection. Also, the non-significant difference ($p > 0.05$) obtained from the result shows that the null hypothesis was not rejected. This indicates that the evolution of SLA class I gene is caused by random drift of selectively neutral mutants. This result was in line with Yang *et. al.* (2013) and Wlasiki *et al.* (2009) where the values obtained were non-significant for Toll like receptor.

Conclusion

In conclusion, there is genetic difference between the Nigerian and Kenyan pigs based on the phylogeny tree constructed. There is an excess of low frequency polymorphisms relative to population size. This may be as a result of evolutionary forces during course of adaptation.

Table 1: Population Statistical and Neutrality Test

Population Statistics						**Neutrality Test**	
M	H	Hd	S	Pi	Ɵ	Tajima'sD	NS
23	19	0.98	226	0.36	0.382	-0.181	Not significant (P>0.10)

M-number of sequences, H-haplotype, Hd haplotype diversity. Pi-nucleotide diversity, Ɵ-Theta, NS-number of significance

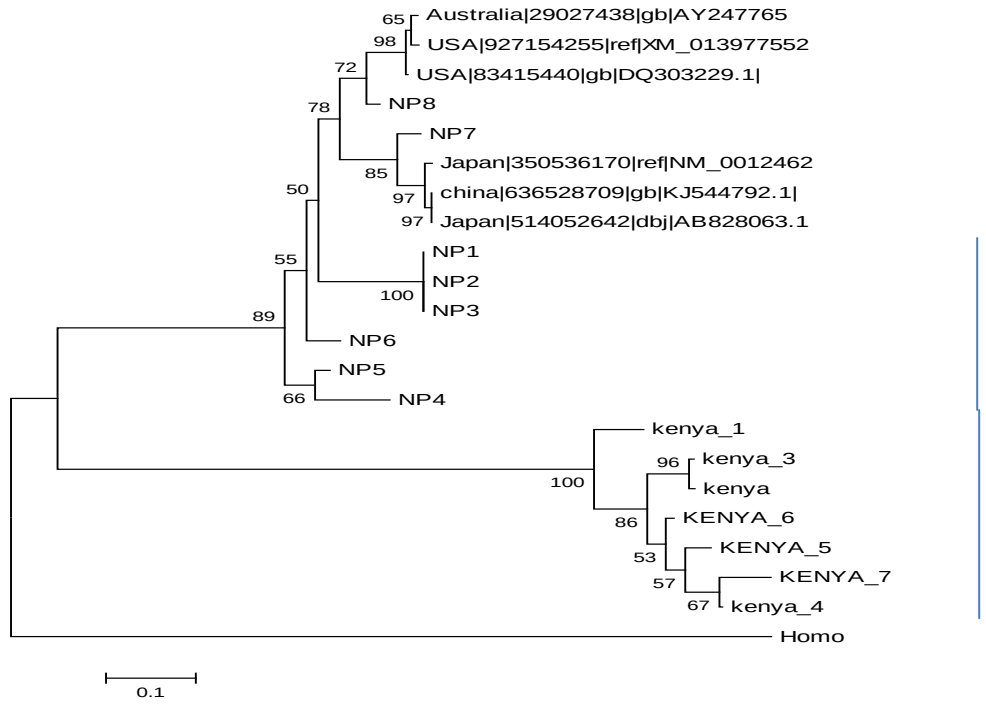

Figure 1: Phylogeny of Nigerian pigs, Kenya pigs and other pigs from genBank
NP-Nigerian pigs, Homo-homosapien

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ABG 010: Effect of Genotype on the Feed Utilization of Four Breeds of Rabbit in the Humid Tropics

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Abstract

The effect of genotype on the feed utilization of ninety-six (96) rabbits which include New Zealand white, Californian, Palomino brown and Havana black rabbits raised in the humid tropics was appraisedat the rabbitry unit of the Department of Animal and Environmental Biology, Adekunle Ajasin University Akungba-Akoko, Ondo state. Feed intake, weight gain and feed efficiency were determined after weaning (at 4 weeks) for a period of 8 weeks. The analysis of variance showed that the genotype of rabbit had significant effect ($P < 0.05$) on feed intake, weight gain and feed efficiency. The highest feed intake (79.95±3.43 g) was recorded for New Zealand White rabbit followed by Palomino Brown and Californian breed while the least value of 68.35±3.94 g was recorded for Havana Black rabbit. There was no significant difference in the weight gain of Palomino Brown and Havana Black breed with 803.42±23.58 g and 798.54 ±19.37 g; respectively. New Zealand White rabbit had the highest value for feed efficiency (0.24±0.02) followed by Californian (0.20±0.01) while the least value of 0.18 ±0.01 was recorded for Havana Black rabbit. Male rabbits were superior to female counterparts with respect to feed intake, weight gain and feed efficiency. In conclusion, New Zealand White rabbit had better feed intake and feed efficiency when compared with Californian, Palomino Brown and Havana Black rabbit in the humid tropics.

Key words: genotype , rabbit, feed intake, tropics.

Introduction

Rabbit production under tropical conditions is affected by environmental stress mainly from the effect of high ambient temperatures and high humidity, low wind speed and indirect solar radiation. Excessive temperature and humidity induces physiological stress in rabbits (1). The impact of heat stress on rabbit has been reported by various authors. Ondruska et al., (2) reported that total and daily feed intake, feed conversion ratio, and total and daily gain in body weight for growing rabbits were affected negatively by elevated temperature. According to Marai et al., (3), animals with higher heat load make effort to dissipate body heat resulting in increased body temperature, as well as increase in consumption of water and a decline in feed intake. The growth of rabbit, like other animals depends on feed consumption and utilization. According to Jiao et al.,(4), there is a moderate positive genetic correlation between growth and feed intake as well as a positive correlation between average daily gain and feed conversion ratio. Feed consumption which is generally expressed in terms of dry matter intake is the weight of feed material consumed excluding the moisture it contains. A large number of factors affect the dry matter intake of animals. This includes breed, age, physiological status, palatability of the feed among others.

Selection of suitable breed of rabbit to particular environment conditions is very much essential for successful rabbit production (5). This study was therefore carried out to investigate the feed utilization of Californian, New Zealand white, Havana Black and Palomino Brown which are all temperate breed when raised in a humid tropical environment that is characterized with elevated ambient temperature and high relative humidity.

Materials and Methods

Experimental site

The experiment was carried out at the rabbitry unit of the Department of Animal and Environmental Biology , Adekunle Ajasin University Akungba-Akoko, Ondo state. Akungba–Akoko is located in Akoko South West Local Government area of Ondo state, Nigeria. The area lies in the south western region of Nigeria (7º28ˈand 5º43ˈ) and has the following environmental condition: ambient temperature of 27°C and relative humidity of 46 mmHg.

Experimental animals and management

Ninety-six (96) rabbits which include (24) California White, (24) Palomino Brown, (24) New Zealand White and (24) Havana Black were used for the experiment. Palomino Brown rabbits are golden brown and lynx, they are large meaty rabbits. Californian White rabbits are rounded in body and have short smooth coat. New Zealand White is multipurpose breed because they can be raised for meat, pets and laboratory purpose. The Havana Black rabbit was first discovered in the Netherland.

The experimental animals were kept in a wooden cage with each compartment of dimension of length × width × height: 80 × 50 × 30 cm^3. Each rabbit was housed in separate compartments of the cages. They were fed with commercial pelleted diet; the diet used contained 15% Crude protein, 7% fat, 10% Crude fibre, 1.0% Calcium, together with available phosphorus of 0.35% and 2550 Kcal/kg metabolizable energy. They were also supplied with forages. Feed and water were provided for *ad- libitum* consumption.

Traits measurements: Feed intake, weight gain and total feed efficiency were determined after weaning (at 4 weeks) for a period of 8 weeks.

Feed intake: A quantity of concentrate feed was given to each of the rabbits housed in the separate compartments of the cages. The amount of feed left over was weighed and subtracted from the amount of feed given to determine daily feed intake within 24 hours.

Weight gain = Final weight – Initial weight

Total feed efficiency: Feed efficiency of rabbits was determined by calculating the ratio of total feed intake to total weight gain as follows:

Statistical analysis

Data obtained from the measurement was analysed using GLM procedures of ANOVA (6). The linear model is as specified below:

$Y_{ijk} = \mu + A_i + B_i + (AB)_{ij} + e_{ijk}$

Y_{ijk} = the parameter of interest

μ = overall mean for the parameter of interest

A_i = Fixed effect of ith genotype (I=1-4)

B_j = Fixed effect of jth sex (j=1-2)

$(AB)ij$ = Interaction effect of ith breed and jth sex

e_{ijk} = random error associated with each record (Normally = Independently and identically distributed with zero mean and variance (σ^2_e)

Means were compared using Duncan multiple range test procedure of the same statistical software

Results and Discussion

Genotype effect was significant ($P < 0.05$) on feed intake. The highest feed intake (79.95±3.43 g) was recorded for New Zealand White rabbit followed by Palomino Brown (73.17±5.24 g) and California White breed while the least value of 68.35±3.94 g was recorded for Havana Black rabbit as shown in Table 1. New Zealand White rabbit had better feed intake when compared with Havana Black rabbit in the humid tropics. This could be as a result of low absorption of heat which is directly related to the degree of pigmentation and this enhances appetite. The lighter coat pigmentation is reflective and absorbs less solar radiation (Adedeji et al., (7); Mc Manus et al., (8); Fadare et al., (9))

The influence of genotype was significant (P < 0.05) on the weight gain of rabbit. The highest average daily weight gain (18.46± 1.02g) and total weight gain (1033.69±76.35 g) was recorded for New Zealand White rabbit as shown on Table 1. The average daily weight gain of Palomino Brown and Havana Black breed were statistically similar. Also, there was no significant difference in the total weight gain of Palomino Brown and Havana Black breed with 803.42±23.58 g and 798.54 ±19.37 g; respectively.

The total feed efficiency was significantly (P < 0.05) affected by the genotype of rabbit. New Zealand White rabbit had the highest value for feed efficiency (0.24 ± 0.02) followed by California White (0.20±0.01) while the least value of 0.18±0.01 was recorded for Havana Black rabbit. The least value of feed intake and total feed efficiency recorded for Havana Black rabbit could be as a result of their dark coat colour which absorbs heat from the humid tropical environment.

Marai et al., (1) reported that elevated temperature and humidity adversely affects live body weight, daily weight gain and feed intake of growing rabbits. Metabolic activities reduce under extreme environmental conditions. Digestibility coefficient for dry matter, crude protein and crude fibre usually decline in rabbit due to heat stress.

TABLE 1: Daily feed intake and weight gain, and feed efficiency of different genotype raised under high ambient temperature and relative humidity

Parameters	New Zealand White	California White	Palomino Brown	Havana Black
Average daily feed intake, g	79.95± 3.43[a]	69.36±4.20[c]	73.17±5.24[b]	68.35±3.94[c]
Average daily weight gain, g	18.46± 1.02[a]	14.81± 0.24[b]	14.37±0.16[c]	14.26±0.21[c]
Total weight gain, g	1033. 69±76.35[a]	829.35±36.53[b]	803.42±23.58[c]	798.54±19.37[c]
Total feed intake, g	4477.20±107.23[a]	3884.16± 141.5[b]	4097.52 ±134.20[a]	3827.60± 154.10[b]
Total feed efficiency	0.24 ±0.02[a]	0.20±0.01[b]	0.19 ± 0.01[b]	0.18 ±0.01[c]

[a b c] Mean on the same row with different superscripts are significantly (P<0.05) different

The effect of sex of animal was significant (P < 0.05) on the average feed intake, average weight gain, total weight gain and total feed efficiency of rabbits in this study. The least square means for these parameters presented on Table 2 show that male rabbits had higher value of average daily feed intake of 78.44± 3.21g compared with their female counterparts with intake of 74.17±3.08 g. Female rabbits had lower average daily weight gain(16.49±0.76g) and total weight gain (923.34± 47.21g) than male rabbits with the average daily weight gain and total weight gain of 18.79± 0.25 g and 1052.37± 54.37g respectively (Table 2). Male rabbits also had better feed efficiency than female rabbits.

TABLE 2: Feed intake, weight gain and feed efficiency of rabbits as influenced by sex

Parameters	**Female**	**Male**
Average daily feed intake, g	74.17±3.08[b]	78.44± 3.21[a]
Average daily weight gain , g	16.49±0.76[b]	18.79± 0.25[a]

Total Weight gain, g	923.34±47.21[b]	1052.37±54.37[a]
Total feed intake, g	4153.52±124.20[b]	4392.64± 131.50[a]
Total feed efficiency	0.21±0.01[b]	0.24±0.01[a]

[a b] Mean on the same row with different superscripts are significantly (P<0.05) different

However ,the interaction effect of genotype and sex was not significant (P>0.05) on any of the parameters studied. Superiority of male rabbits to female counterparts with respect to feed intake, weight gain and total feed efficiency in this study could be as a result of hormonal differences between male and female animals and the aggressive feeding behaviour of male animals. Marai and Raswan (10) also observed that rabbit does are more susceptible to heat stress than their male counterparts.

Conclusion

Feed intake and feed efficiency was affected by genotype. New Zealand White with light pigmentation had higher values for total feed intake, daily feed consumption and total feed efficiency than other genotypes involved in this study in humid tropics. Male rabbit were superior to their female counterparts with respect to feed intake, weight gain and total feed efficiency.

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ABG 011: Heritability of External Egg Quality Characteristics in Japanese Quail

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Abstract

Heritability, genetic and phenotypic correlations for external egg quality characteristics of Japanese quail were estimated using Restricted Likelihood procedure. At the poultry unit of teaching and research farm, university of Maiduguri, 220 eggs were obtained from 110 Japanese quail hens at 20 weeks of age which were caged individually. Heritability of egg weight (EW), Egg height (HE), Egg width (WE), Shell weight (SW), Shell ratio (SR), Egg surface area (ESA), Egg shape index (ESI) and Shell weight per unit surface area (SWUS) were measured. Variance and covariance components and genetic parameters were estimated. Heritability of EW, HE, WE, SW, SR, ESA, ESI and SWUS were 0.33 ± 0.24, 0.91 ± 0.31, 0.81 ± 0.30, 0.42 ± 0.23, 0.69 ± 0.28, 0.50 ± 0.24, 0.41 ± 0.23 and 0.49 ± 0.23, respectively. Traits related with egg size had higher heritability estimates than traits related with egg shell. Egg weight had positive genetic correlations with egg height and egg width (0.78 and 0.84) but negative correlations with ESI (-0.24). The positive correlation between ESI and WE is higher in magnitude than the negative correlations between ESI and HE. SR and SWUS were negatively correlated with EW and HE. The implication is that larger eggs would have proportionately less shell weight and consequently low SWUS. Thus, selection made to improve EW would bring about poor shell quality. The correlations between ESI and SR were positive indicating that round eggs may likely have better shell weight than those of other shapes. Hence, crushing strength of the eggs is improved.

Key words: egg quality, genetic parameters, heritability, correlations, egg weight.

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Introduction

Japanese quail (*Coturnix coturnix japonica*) is one of the farmed avian species for commercial egg production all over the world (1). Apart from being in expensive to keep, these birds are hardy (2). Other distinct features of the birds include fast growth, early sexual maturity, high rate of egg production, short generation interval and incubation period (3). In addition, they are fairly disease resistant (2). The age at point of lay for these birds ranges from 6 to 8 weeks and quail hens can lay between 200 and 350 eggs in their first year of lay under proper managerial care (4, 2).

Egg quality is defined as the characteristics of an egg that affect its acceptability to the consumers (5). Qualities of the breeding eggs have an overall significance for economic breeding. The fact that traits related with external quality of the eggs have effects on hatchability and development of the chicks has been well documented (6). On the other hand, external qualities of the eggs are directly related with the amount of broken eggs, leading to serious economic problems for both the breeders and the dealers (7). Consequently, such traits of the eggs determine their value in the market by affecting the demand of consumers (8). Notably as well, some of the egg quality traits have significant and direct effects on the prices (of especially) commercial flocks (9).

Fundamentally, information on genetic parameters (heredity and correlations) is essential for understanding how individual characteristics changes from one generation to another in response to selection (10). More so, knowledge on the genetic parameters such as heritability and genetic correlations

among concerned traits is important to plan the breeding schemes and to predict the potential progress for commercial quail production especially in country like Nigeria where efforts are concentrated on genetic improvement of chickens' eggs. The objective of this study therefore was to estimate genetic parameters of external characteristics for Japanese quail eggs.

Materials and Methods

Experimental location

The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, university of Maiduguri, Maiduguri, Borno State, Nigeria. Maiduguri, the capital of Borno State is located on latitude 11^0 5' N, longitude 13^0 09' E and at an altitude of 354 m above sea level. The area falls within the Sahelian region of West Africa which is noted for great climatic and seasonal variations. The annual rainfall for this environment is about 3 – 4 months with 645.9 mm as annual rainfall and a long dry season of about 8 -9 months. The ambient temperatures are in the range of 35^0 - 45^0 C which are highest by the month of April and May. The relative humidity is usually 45 % in August and drops to about 5 % in December and January. Day length varies from 11 – 12 hours .

Experimental birds

Two hundred and twenty eggs were collected from one hundred and ten 20 week old wild type Japanese quails was used for the study. Quail chicks were raised in quail brooder till four weeks of age. After sexing, female birds were caged individually in 40 x 30x30 cm wire mesh cages. The birds were provided with feed and water *ad libitum*. They were given quail diet containing 25 % CP and 3000 Kcal ME/Kg in the first six weeks and layer reduced to 24 % CP and 2750 Kcal ME/Kg. Constant sanitation of the pen including the feeder was carried out. Birds were also given antibiotics at regular interval (notwithstanding their hardy nature) as a preventive measure against poultry diseases.

Data collection

The egg weight was measured with a 0.01 g sensitive electronic scale. Egg height and width were measured with a vernier caliper. After removing the internal components, egg shell was carefully washed to remove the remaining albumen and then air dried for 24 hours. This was then weighed using an electronic scale (0.01 g sensitive). Samples taken from sharp, blunt and equatorial parts were measured and the average value of the three was taken. Other traits that were computed are:

$S = 3.9782\ W^{0.75056}$

Where S= Egg surface area (cm^2), W= Egg weight (mg)

Shell weight per unit surface area (mg/ cm^2)= shell weight (mg) / egg surface area (cm^2)

$$Shell\ weight = \frac{\text{Shell weight (g)}}{\text{Egg weight (g)}}\ \text{X } 100$$

Data analysis

Variance and covariance components and genetic parameters were estimated using Restricted Maximum Likelihood (REML) Procedures soft ware (11).

Results and Discussion

Means and standard errors for egg weight and other external characteristics for Japanese quail eggs were presented in Table 1. The values related to egg weight, shell ratio, average shell thickness, egg shape index, egg surface area and shell weight per unit surface area were 9.77 g, 0.90 g, 9.29 %, 0.27 mm, 83.0 %, 21.98 cm^2 and 44.30 mg/ cm^2, respectively. The means observed in this study for egg weight (9.77 g) is similar to 9.60 g reported by (12) in Japanese quail.

Table 1: Means and standard errors for external quality traits of Japanese quail

Traits	Means	± SE
EW (g)	9.77	± 0.07
WE (cm)	2.43	± 0.01
HE (cm)	2.97	± 0.02
ESI (%)	83.0	± 0.01
AVST (mm)	0.27	± 0.12
SW (g)	0.90	± 0.01
SR (%)	9.29	± 0.06
ESA (cm^2)	21.98	± 0.12
SWUS (mg/cm^2)	44.30	± 0.08

EW=egg weight, WE=egg width, HE=egg height, ESI=egg shape index, AVST=average shell thickness, SW=shell weight, SR=shell ratio, ESA=egg shape index, SWUS= shell weight per unit area.

It is however contrary to 11.28 g and 11.06 g reported by (9) and (3). Egg composition of the domestic fowls and other galliforms varies due to differences in genetic makeup, environment and managerial practices.

Heritability, genetic and phenotypic correlations among the studied traits were shown in Table 2. Heritability estimates of external quality traits were ranged high to moderate. Egg height had the highest heritability value (0.91 ± 0.31) while egg weight had the lowest (0.33 ± 0.24). High heritability indicates low maternal effect on the traits while low estimate is an indication of great environmental influence on the traits than the additive genetic makeup of the birds. In general, traits related with egg size (HE, WE, ESA) had higher heritability than those related with egg shell (SW, SWUS). This implies that environmental factors such as feed, management and temperature exert more effects on the traits related with egg egg shell than the additive gene effects. Thus, egg size traits would yield better improvement when subjected to selection.

The low estimate of egg weight (0.33 ± 0.24) as obtained in this study is similar to 0.32 obtained by (13) in chickens. In contrast, higher estimate of 0.38 is obtained by (14) in the early age of Bobwhite quail and lower estimate is observed by these authors in the third year of age. The difference between the results of this study and those cited by other literature could be attributed to differences between strains used, method of estimation and possibly the technique of determining egg quality traits which differ from one laboratory to another (15).

From the point of mechanical handling of eggs, egg shape index and egg weight cannot be over emphasized. In this study, egg weight had positive genetic and phenotypic correlations with egg height and egg width but negative correlations with egg shape index. Similar results have been reported by (3) in Japanese quail and (16) in chickens. Egg shape index had positive correlations with egg width but negative correlations with egg height. However, the positive correlations between egg shape index and egg width are higher in magnitude than its negative correlations with egg height. By implication therefore, these results show that it is the egg width that limits egg size and not the egg height. This fact as well explains the evolutionary consequence of egg shape. (17) reported that shell ratio and shell weight per unit surface area are more reflective values to evaluate shell quality than the absolute shell weight. These traits (shell ratio and shell weight per unit surface area) were negatively correlated with egg weight and egg height. This thus implies that larger eggs would have proportionately less shell weight and consequently low shell weight per unit surface area and selection made to improve egg weight would bring about decreased shell quality.

Table 2: Heritability (h^2, on diagonal), genetic (r_G, above diagonal) and phenotypic (r_P, below diagonal) correlations between external egg quality traits of japanese quail

Traits	EW	HE	WE	SW	SR	ESA	ESI	SWUS
EW	**0.33 ± 0.24**	0.78	0.84	0.65	-0.24	0.13	-0.24	-0.61
HE	0.43	**0.91±0.31**	0.65	0.47	-0.34	0.85	-0.72	0.84
WE	0.46	0.28	**0.81±0.36**	0.63	0.15	0.43	0.06	0.40
SW	0.23	0.25	0.25	**0.42±0.23**	0.55	0.39	-0.06	0.38
SR	0.09	-0.27	-0.02	0.50	**0.69±0.28**	-0.55	0.54	-0.56
ESA	-0.04	0.51	0.29	0.57	-0.42	**0.50±0.24**	-0.68	0.99
ESI	-0.18	-0.75	0.41	-0.07	0.21	-0.26	**0.41±0.23**	-0.69
SWUS	-0.18	0.51	0.28	0.57	-0.42	1.00	-0.26	**0.49±0.24**

EW=egg weight, WE=egg width, HE=egg height, ESI=egg shape index, AVST=average shell thickness, SW=shell weight, SR=shell ratio, ESA=egg shape index, SWUS= shell weight per unit area.

The positive genetic correlations obtained between egg shape index and shell ratio is an indication that round eggs may likely have better shell weight than those of other shapes. Thus, crushing strength of the egg is improved (especially for table eggs).

Conclusion and Application

Heritability estimates of external egg quality traits in Japanese quail were generally high to moderate which indicates low maternal effect on the traits. Traits related with egg size had higher values than that of eggshell is an indication that environmental factors exert more effects on egg shell traits. Thus, egg size traits would yield better improvement when subjected to selection. The positive correlations of egg shape index with egg width and its negative correlations with egg height are an indication that egg width, rather than egg height limits the egg size. Egg shape index showed positive relationship with shell ratio suggests that round eggs may likely have better shell weight which improves the crushing strength of the eggs. The results of this study will be useful in formulating effective breeding schemes with respect to improvement of external quality traits of quail eggs.

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ABG 012: Comparison of live weight and body measurements of broiler Strains using Bartlett Factor Scores in Multiple Regression

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Abstract
In order to compare live weight and body conformation of Arbor Acres (AA) and Annak (AN) broilers under same management and environment, the body weight and body dimensions of a population of one hundred each of Arbor Acres and Annak broilers were collected in a 56-day trial in Ibadan, Nigeria. Eight zoometric measurements namely Live weight (g), Abdominal Circumference, Abdominal length, Breast width, leg length, Height, Wing length and Thigh circumference (all in cm) were recorded for the study. Descriptive statistics, Bartlett Factor scores in multiple linear regression procedure with stepwise method of SPSS Version 17 were employed to compare body parameters of strains. Results indicated that Arbor Acres was heavier by 23.5%, and possessed wider breast by 4.9% than Annak strain at 8 weeks. Regressed normal equations had high Variance Inflation Factor (VIF) values indicating multi-collinearity among independent variables, thus reducing its predictive ability. The loading structure revealed basic differences in body conformation structure between AA (Body and Thigh Factors) and AN (Breast and Height Factors) strain and for the mixed data of both broilers as an index for broilers generally (Thigh/Breast and Body Factors). Bartlett factor scores in multiple linear regression equations yielded highly significant comparative equations with $p<0.0001$; and intercept of 825.51, 788.69 and 807.10 indicating differences in growth of Arbor Acres, Annak and for mixed population of both strains of broilers.

Key words: Arbor Acres, Annak, Live body measurements; Bartlett Factor Scores, Stepwise Regression.

Introduction
Poultry industry is one of the fastest growing segments in the agricultural sector and it undoubtedly plays an important role in the economy of tropical countries (1). Currently several broiler strains are being imported by secondary breeding companies without any dedicated enforcement of laws controlling the industry. Commercial strains under farm conditions are recording variable performances and sometimes below the declared standard. It is also known that different strains of birds respond differently to environmental stresses, thus producing different and specific reactions due to genotype by environment interaction resulting from different sensitivities of genotype to environment (2). The foregoing thus necessitated the need to evaluate growth potential in two strains of broilers to generate baseline information for commercial broiler production in the environment. The Multiple Linear Regression (MLR) is being proposed for estimating, predicting and comparative purposes. The procedure can be used to evaluate growth in modern broilers. Factor score regression method is a three-step approach (3) built on the assumption that scores resulting from factor rotation will be independent and uncorrelated. It thus maximizes validity by producing factor scores that are highly correlated with specific variables. The scores, when used as standardized observed values of the original variables constituting the estimated factors to regress linear equations, give higher precision and predictive ability in subsequent MLR equations (4). This research was designed to compare the live weight and body conformation of two broiler strains using Bartlett Factor Scores (BFS) in Multiple Linear Regression equations.

Materials and Methods

100 day-old chicks each of Arbor Acres (AA) and Anak (AN) broilers were purchased from 2 different Hatcheries in Ibadan Nigeria. Both strains were subjected to same standard management practices prescribed for broiler chickens from day-old to 56th day. Vaccinations were administered as recommended. Feed and water were offered daily to each strain *ad-libitum*. Formulated feed was utilized. The calculated protein contents of the Starter and Finisher diets were 23.80 and 20.01 % while the energy contents were 3025.00 and 2607.00 KCal/kg respectively. Body weight of chicks at day-old was taken by weighing individually with a sensitive egg scale while body weight from second week to the 8th week was determined with a 5-kg capacity Camry dial spring scale. Weekly body measurements were taken early in the morning before feeding at the appointed day and time. Measurements were taken from 20 birds by random sampling from each strain, until all measurements were completed successfully before replacement. Linear measurements were made with a thin thread and the lengths were determined on a metric ruler in centimeters. The eight (8) biometric measurements recorded were: live body weight (LBW), Breast width (BRW), Wing length (WGL), Abdominal length (ADL), Abdominal Circumference (ADC), Leg length (LGL), Thigh circumference (TCF) and Height (HT). The experimental design was completely randomized design (CRD). All measurements taken at 8 weeks were subjected to means procedure and T-test (p<0.05) while all linear measurements recorded were subjected to Multiple Linear Regression (MLR) analyses in order to predict body weight at eight weeks for each strain. Secondly, all body measurements for each strain were subjected to Principal Component Analysis (PCA) to extract two Factors and then generate Factor Scores by Bartlett's method for use as independent variables in the subsequent MLR, to obtain parameters for comparison between strains. Live weight to be estimated was excluded from factor analysis. Factor Scores obtained were then used as independent variables in MLR procedure for the regression of body weight on Factor scores (growth equation) for each strain. The software of SPSS version 17 (5) was used for the analysis. The model for the normal regression of body weight on other body measurements was: $Y_{ijkl} = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + .. + b_n X_n + \varepsilon_{ijkl.}$ Where Y = Response in body weight (g); a = Constant for strain; b = Coefficient of trait $_{i,}$ for i = 1 to n; X= Body trait $_{i}$, for i = 1 to n; while 1 to n = number of traits extracted by the stepwise method. The comparative standard model for the regression of body weight on Bartlett Factor scores was: $y = \mu + \beta_1 * BF_1 + \beta_2 * BF_2 + \varepsilon$. Where y = Live broiler finisher weight (g), μ = Strain Constant, β = Standardized/Unstandardized coefficients of estimated parameters obtained from the regression of LBW on BFS. BF = Bartlett Factor values obtained from an independent data set of similar body measurements from any strain in the same environment. ε = error term of the model. The hypothesis tested was that there was no significant difference between live weight and body conformation of Arbor Acre and Annak 2000 strains at 8 weeks.

Results and Discussion

Table 1 shows the result of descriptive analysis. ANOVA of data at 8 weeks from both broiler strains revealed that AA had significantly (p<0.05) higher maximum live weight than Annak (2470 vs 2000 g), but no significant (p>0.05) superiority in mean values of LBW, ADC, HT, ADL, BRW, LGL, WGL and TCF between the two strains. Maximum weight values revealed that AA was significantly (p<0.05) heavier than AN by 23.5%. This might be due to genetic superiority of AA over AN. The result of AA was above the 8th week bodyweight of 2445g for Ross, 2340g for Annak, 2100g for Marshal (6), but below 2811.3g reported for Arbor Acres strain (7). The high SD (292 vs 165) for LBW in both strains were indications of high variability of body weight in the environment. SD for ADC in both strains and ADL in AA strain also signified low levels of variability. The low CV (<1.00) values implied that each strain had been strictly bred to high level of uniformity in weight, shape and body conformation.

Table 1: Mean values of live weight and other body traits at 8 weeks for Arbor Acres and Annak Broilers

Param.	Strain	Mean	SE	SD	CV	Min	Max
LBW	AA	1991.00	92.30	291.87	0.15	1650.00	2470.00[a]
	AN	1748.00	52.32	165.45	0.09	1500.00	2000.00[b]
ADC	AA	46.72	0.79	2.50	0.05	42.00	50.00
	AN	47.35	0.79	2.51	0.05	43.00	51.00
HT	AA	23.00	0.26	0.82	0.04	22.00	24.00
	AN	22.40	0.35	1.10	0.05	21.00	24.00
ADL	AA	22.75	0.40	1.28	0.06	21.00	24.50
	AN	22.15	0.77	2.43	0.11	19.00	26.50
BRW	AA	21.35	0.56	1.78	0.08	18.00	24.50
	AN	20.35	0.47	1.48	0.07	18.00	22.30
LGL	AA	18.95	0.26	0.83	0.04	17.50	20.00
	AN	18.20	0.52	1.64	0.09	16.00	20.50
WGL	AA	17.55	0.30	0.96	0.05	16.00	19.00
	AN	18.15	0.40	1.25	0.07	16.00	20.00
TCF	AA	13.03	0.19	0.59	0.04	12.00	14.00
	AN	12.38	0.38	1.20	0.10	10.00	14.00

NOTE: AA=Arbor Acres; AN=Anak; SE = Standard Error; SD = Standard Deviation; CV = Coefficient of variation; Min = Minimum Value; Max = Maximum Value; LBW = Live Weight; BRW = Breast Width; LGL = Leg Length; WGL = Wing Length; ADC = Abdominal Circumference; ADL = Abdominal Length; TCF = Thigh Circumference; HT = Height. Means in same cell with different superscripts are significantly different ($P<0.05$).

The results of normal MLR on raw data from both strains revealed high R^2 (0.93 vs 0.96), and high Variance Inflation Factor, VIF (12.26 vs 13.98) larger than 10 for both equations of AA and AN strains. Corresponding estimates for combined data were 0.93 and 15.00 (results not shown). Due to these high VIF indicating multi-collinearity among independent variables in the normal regression equations, LBW was regressed on standardized BFS in MLR equations for both strains. Table 2 presents the predicted BFS variance matrix, for body measurements of AA and AN strains. Both factors extracted by the procedure were responsible for 96.3% and 95.1% of the shared variations among linear body measurements. AA scores were equally loaded between BF1 (Body; 48.26) and BF2 (Thigh; 48.04) while AN scores were primarily loaded on BF1 (Breast; 92.97). The combined data produced 95.54% of variability with equally loaded Factor 1 (Thigh and Breast; 48.56) and Factor 2 (Body; 46.98). The extracted Factor score values obtained for combined data revealed a unique and balanced body conformation structure for broilers compared to egg-laying breeds such as guinea fowl-56.3 & 20.9 (8); male Muscovy duck-72.7 & 14.5 (9), female Turkey, 78.0 & 11.6, (10) and Naked Neck chicken-80.9 & 30.4 (11). The loading structures obtained in this work revealed the weight and importance of the extracted factors in describing body conformation, and the basic underlining differences in body shape and size between AA and AN strains. The distribution of weights between extracted Factors could be dependent on weight distribution among component traits and genetic adaptation to physiological needs (12). Results meant that AA could best be examined for conformation using Body and Thigh, and AN, using Breast and Height composite traits. The results also identified Thigh/Breast and Body as two general composite traits that could be used to compare and evaluate conformation in broilers.

Table 2: Predicted Rotated Bartlett Factor Scores for Component Traits of Arbor Acres and Annak Broilers

STRAIN	ARBOR ACRES		ANAK		Combined data	
Traits/Factors	BFS1	BFS2	BFS1	BFS2	BSF1	BFS2
BRW	0.620	0.753	0.844	0.507	0.761	0.613
LGL	0.536	0.826	0.814	0.157	0.836	0.517
WGL	0.741	0.644	0.784	0.578	0.665	0.716

ADC	0.717	0.670	0.775	0.586	0.707	0.673
ADL	0.835	0.531	0.703	0.655	0.537	0.824
TCF	0.594	0.773	0.797	0.564	0.756	0.615
HT	0.770	0.609	0.525	0.843	0.566	0.789
% Variance (RSS)	48.264	48.040	57.065	38.010	48.559	46.982
Total Variance Predicted		96.304		95.075		95.541
Factor Name	Body	Thigh	Breast	Height	Thigh/Breast	Body

Table 3 shows MLR equations with BFS as independent predictors. This procedure yielded VIF values lower than 10, little reductions in DW (1.90, 1.48 vs 1.95, 1.97) and R^2 (0.92, 0.94 vs 0.93, 0.96). There was however slight increase in Standard Error of Estimates (SEE), (180.49, 140.09 vs 174.59, 108.88) compared with normal regression equations. The combined data parameters were 1.46, 0.93 and 165.25 respectively. The two Factor Scores extracted amounted to 96.30, 95.08 and 95.54 for AA, AN and combined data and were higher than 65.0, 74.76 and 85.23 for AA, Marshall and Ross obtained by (13) to define body size in broilers. Values were also higher than 70.58% of variability obtained by (14) from three orthogonal Factors employed to study underlining relationship between production and environmental variables in layer chickens on the deep-litter, and 87.2% and 90.9% from male and female Muscovy duck reported by (15). Live weight was expected to increase as ADL and LGL (in AA); BRW and Height (in AN) and LGL/BRW and ADL (in combined data) increase. The selected Factors had significant and positive linear relationships with live weight ($P<0.0001$), while R^2 though lower, implied that equations could estimate above 92 % of variability in the data set for respective strains. R^2 values obtained were higher than 86.4 and 75.3% obtained for male and female native chickens (16). Comparison between intercepts of equations showed improvement from -7.13, -10.88 and -11.18 to 38.27, 46.12 and 57.79 respectively, revealing progressive improvement in the predictive ability of regressed equations, although these figures were lower than 674.96 and 1197.14 reported for native male and female chickens (16). The regression coefficients were higher than 0.48 and 0.03 (17). Bartlett Factor Scores in MLR procedure thus yielded standard regression models for AA, AN and combined data which could be used to estimate LBW from different broiler data sets in similar environment.

Table 3: Multiple Linear Regression Equations based on Bartlett Factor Scores for Prediction of Live weight for Arbor Acres and Annak Broilers.

Strain	Predicting Factor	Unstd. Coeff.	Std. Coeff. (β)	SE	t-value	P-value	VIF
Arbor Acres	Constant	825.51	-	21.57	38.27	0.0001	-
	BFS1	347.55	0.533	21.73	15.99	0.0001	1.00
	BFS2	521.57	0.801	21.73	24.00	0.0001	1.00
Annak	Constant	788.69	-	17.10	46.12	0.0001	-
	BFS1	453.86	0.808	17.22	26.35	0.0001	1.00
	BFS2	299.50	0.533	17.22	17.39	0.0001	1.00
Combined	Constant	807.10	-	13.97	57.79	0.0001	-
	BFS1	474.76	0.783	14.02	33.87	0.0001	1.00
	BFS2	339.68	0.560	14.02	24.23	0.0001	1.00

Adj. R^2= 0.923/0.935/0.926, SEE=180.49/143.07/165.25, DW= 1.946/1.093/1.467, Model sig. P = 0.0001 /0.0001/0.0001. BFS = Bartlett Factor Score. Values stated are for Arbor Acres/Annak/ combined data of Broilers. Unstd, = Unstandardized, Std.= Standardized.

Conclusion and Application

BFS in MLR compared adequately between AA and AN strains for growth performances. Study also revealed differences in body conformation structure and the basal growth difference between Arbor Acres and Annak broiler strains. The result could be applied to selection between strains and for evaluation of the numerous broiler strains in the commercial world.

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ABG 013: Effect of dam genotype, parity and season on reproductive performance of Rabbits reared in Abeokuta, Nigeria

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Abstract
The study investigated the effects of dam genotype, parity and season on reproductive traits of rabbits reared in the Abeokuta, Nigeria. Thirty dams comprising of California White, New Zealand Red, Chinchilla and their crossbreds (5 per genotype) were mated by nine purebred bucks (3 per genotype) to generate pure and crossbred kittens in five reproduction cycles. Data on gestation length, gestation gain, litter sizeand litter weight of kittens at day old were subjected to analyses of variance. Gestation length and gestation gain was higher ($p < 0.05$) in the crossbred dam than the purebreds. Litter weight at day old was highest ($p < 0.05$) in the Chinchilla x New Zealand Red dam (272.42 ± 2.41 g), while the least was observed in the California White dam (225.23 ± 2.18 g). Gestation length, gestation gain and litter size at day old were significantly ($p < 0.05$) lower in the first parity than the second and third parity and increased gradually till the fifth parity. Means of gestation gain varied significantly ($p < 0.05$) from 395.68 ± 8.79g in the late dry season to 483.22 ± 4.20 g in the early wet season. Litter size and litter weight were significantly ($p < 0.05$) higher in the wet seasons compared to the dry seasons. It was evident from the present study that the impact of dam genotype, parity and season on the reproductive efficiency of rabbits should be considered when embarking on rabbit production and multiplication programme.

Keywords: Rabbit, dam genotype, reproductive traits, parity, season.

Introduction
In recent years, rabbit production is becoming more attractive due to its high reproductive potentials which include high prolificacy, high fecundity, good mothering ability, genetic variability, short gestation period and short generation interval[1] Under the tropical condition, these advantages are influenced to a large extent by several factors which at times are either genetic or non-genetic (environmental or managerial factors). The genetic make-up of different rabbit breeds influence the performance of the animal and further explains the situation where within a breed, individual variation in performance are common[2]. Parity and season variations on the other hand are non-genetic factors that have being reported to have contributed to observed differences in progeny birth mass, litter size and/or birth weight of kittens [3]. Detailed information on the effect of these factors on the reproductive performance of rabbits reared in the tropics is however not completely available. This study therefore attempts to provide such information by determining the effects of dam genotype, parity and season of kindling on some reproductive traits of rabbits raised in the humid tropics of Abeokuta, Nigeria.

Materials and Methods
Location of the study
The study was carried out at the Rabbit Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Alabata Road, Abeokuta, Nigeria. The area lies in the South-Western part of Nigeria and has a prevailing tropical climate with a mean annual rainfall of about 1037 mm and a yearly average relative humidity of about 82% (Department of Water and Agro-meteorology, Federal University of Agriculture, Abeokuta). The period (months) of the research was divided into four seasons which were;

early dry (October to December), late dry (January to March), early wet (April to June) and late wet (July to September) seasons.

Experimental animals and management

Thirty nine (39) breeder rabbits of six genotypes (California White, New Zealand Red, Chinchilla breeds and crosses of Chinchilla x California White, Chinchilla x New Zealand Red and California White x New Zealand Red), comprising of thirty (30) pure and crossbred dams (5 per genotype) and nine (9) purebred bucks (3 per genotype) of proven fertility were mated in five reproduction cycles to generate pure and crossbred kittens. The rabbits were raised intensively and housed individually in wooden cages with cell size of 60 x 40 x 40cm. They were given *ad libitum* access to feed (compound diet that supplied 16.90% crude protein and 2715.35 kcal/kg metabolisable energy) and water. Forages such as *Tridax procumbens* and Vitamins were also given as supplements. Bucks were assigned to mate the dams early in the morning before feeding. The dams were first mated when they reached mean body weight of between 1200 g and 1800 g at 24 to 28 weeks of age. Nest boxes (40 x 30 x 15cm^3) were introduced inside each of the dams' cage four days to the expected kindling date. Litters were counted and weighed within 12 hours after kindling. The kits were weaned at 6 weeks of age. The dams were allowed to rest for a week after weaning before they were re-mated again. Dams were weighed at mating, pre-partum and post-partum.

Data collected

1. Gestation Length (GL): - This was taken as the difference between date of kindling and date of successful mating of the dam.
2. Gestation Gain (GG): - This was taken as the difference between the dam's weight taken a day to parturition and its weight at mating.
3. Litter Size (LZ) at day old: - This was calculated as the number of live kittens kindled.
4. Litter Weight (LW) at day old: - This was calculated by weighing individual litters.

Data analysis

Data collected on dam reproductive traits and litter traits at day old were subjected to analyses of variance (ANOVA), using the General Linear Models Procedure of the Statistical Analyses System Program (SAS, 1999) in order to investigate the effects of dam genotype, parity and season on gestation length, gestation gain, litter size and litter weight of kittens at day old. The significant means was separated using the Duncan's New Multiple Range Test.

Results and Discussion

Table 1 shows the result of means and standard errors for the effect of dam genotype on reproductive traits of pure and crossbred rabbits. The mean values for gestation length and gestation gain were higher ($p < 0.05$) in the crossbred dams compared to the purebreds. The difference in the gestation length and gestation gain observed in this study was similarly confirmed by Prayaga and Eady[2] in their breed comparisons which clearly identified differences in dam reproductive traits. Litter weight at day old was highest ($p < 0.05$) in the Chinchilla x New Zealand Red dam (272.42 ± 2.41 g), while the least was observed in the California White dam (225.23 ± 2.18 g) irrespective of the sire used in the mating. The superior litter weight obtained for kittens of the Chinchilla x New Zealand Red dam reflected superiority in their pre-natal and post-natal maternal abilities and probably also high milk production in the dam. This submission is in line with the report of Kalamah *et al*[4] who reported that the better performance in litter traits of crossbred progenies over their purebred counterparts could be attributed to the effect of heterosis.

Table 1: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by dam genotype.

Dam genotype	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
CW	30.69 ± 0.13^{b}	443.90 ± 19.41^{b}	4.38 ± 0.22^{a}	225.23 ± 2.18^{c}
NZR	30.24 ± 0.16^{c}	434.33 ± 20.03^{b}	4.24 ± 0.23^{a}	244.05 ± 2.74^{b}
CH	30.66 ± 0.13^{b}	403.38 ± 23.08^{c}	4.19 ± 0.23^{ab}	222.62 ± 2.83^{c}
CH x CW	31.19 ± 0.18^{a}	469.79 ± 13.59^{a}	4.28 ± 0.21^{a}	258.47 ± 2.80^{b}
CH x NZR	31.14 ± 0.33^{a}	472.73 ± 11.98^{a}	4.10 ± 0.24^{ab}	272.42 ± 2.41^{a}
NZR x CW	31.00 ± 0.29^{ab}	462.64 ± 16.19^{ab}	4.11 ± 0.23^{ab}	252.45 ± 2.65^{b}

[a, b] Means in the same column with different superscript are significantly different ($p < 0.05$).
Key: CW = California White; CH = Chinchilla; NZR= New Zealand Red

The result of means and standard errors for the effect of parity on dam and litter traits (at day old) are presented in Table 2. Gestation length and gestation gain were significantly ($p < 0.05$) lower in the first parity than the second and third parity and increased gradually till the fifth parity. The increase in gestation length as observed in this study is consistent with the reports of Narayan *et al*[5] who reported that gestation length increased with advancement in parity. Litter size at day old also increased significantly ($p < 0.05$) from 3.03 kittens at first parity to 5.06 kittens at first parity (Table 2). This result is similar with the report of Afifi and Kadry[6] who reported that the presence of significant effect of parity on litter size resulted in the increase of this trait as parity progress. The observed increase in litter size at birth suggests an increase in the ovulation rate of dam (that is the number of ova shed from ovary), implantation and embryo survival rate as parity advances. Litter weight was however observed in this study to be highest ($p < 0.05$) in kittens born during the third parity (308.98 ± 2.87 g), while those born in the first parity (220.93 ± 3.72 g) had the least. This result is comparable to the report of Castellini and Panella[7] with New Zealand White rabbits. The result of this study suggests that as parity level increases, changes in the physiological efficiency of dam, such as those associated with ova wastage, embryonic mortality, uterine capacity would also be affected.

Table 2: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by parity.

Parity	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
First	30.12 ± 0.13^{c}	370.08 ± 7.66^{c}	3.03 ± 0.23^{c}	220.93 ± 3.72^{c}
Second	30.75 ± 0.13^{b}	402.21 ± 8.18^{b}	3.92 ± 0.23^{b}	243.94 ± 3.94^{b}
Third	30.79 ± 0.15^{b}	421.73 ± 8.21^{b}	4.53 ± 0.22^{b}	308.98 ± 2.87^{a}
Fourth	31.00 ± 0.15^{ab}	553.24 ± 8.21^{a}	4.97 ± 0.22^{ab}	242.06 ± 3.23^{b}
Fifth	31.10 ± 0.13^{a}	560.00 ± 9.51^{a}	5.06 ± 0.21^{a}	246.13 ± 2.47^{b}

[a, b, c] Means in the same column with different superscript are significantly different ($p < 0.05$)

Table 3 shows the effect of season on gestation gain, litter size and litter weight at day old. The result showed that season had a non-significant ($p > 0.05$) effect on gestation length. This finding is in agreement with the reports of Gharib[8]. The author reported a non-significant effect of season of kindling on gestation length in Bauscat rabbits. Means of gestation gain varied significantly ($p < 0.05$) from 395.68 ± 8.79 g in the late dry season to 483.22 ± 4.20 g in the early wet season. The observed differences in means for gestation gain within the different seasons might be as a result differences in the seasonal conditions in the geographical location of the rabbitry. Marai *et al*[9] however reported that weight gain and feed intake of pregnant rabbits declined during the hot or dry seasons but increased during the cold or

wet seasons. The result of the study further showed that litter weight was significantly ($p < 0.05$) higher in early and late wet season (265.05 ± 0.60 g and 246.35 ± 4.68 g respectively) kindlers compared to the early and late dry season kindlers (230.59 ± 3.44 g and 223.69 ± 1.50 g respectively). This result agreed with the report of Fayeye and Ayorinde[3]. These authors attributed difference in litter weight of rabbits to variations in climatic or weather conditions, which tend to have direct effect on availability of forages. It could therefore be implied from this study that pregnant rabbits available during the wet seasons were likely to have had unhindered access to adequate feed for proper growth of their litters at these seasons than at the dry season, thereby resulting in higher litter weight recorded during the wet seasons compared to those observed at the dry seasons.

Table 3: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by season.

Season	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
Early dry	31.09 ± 0.23	434.28 ± 13.52^{c}	4.13 ± 0.18^{b}	230.59 ± 3.44^{b}
Late dry	30.95 ± 0.17	395.68 ± 8.79^{d}	4.32 ± 0.23^{b}	223.69 ± 1.50^{b}
Early wet	30.86 ± 0.12	483.22 ± 14.20^{a}	4.84 ± 0.19^{a}	265.69 ± 0.60^{a}
Late wet	30.85 ± 0.14	465.39 ± 11.93^{b}	4.92 ± 0.25^{a}	246.35 ± 4.68^{ab}

$^{a, b, c}$ Means in the same column with different superscript are significantly different ($p < 0.05$)

Conclusion

This study suggest that the influence of dam genotype (irrespective of the sire that was used in the mating) as well as the impact parity and seasonal variations on the reproductive performance of rabbits should be considered when planning a rabbit production and multiplication programme aimed at improving litter traits.

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ABG 014: Age effect on growth traits of helmeted guinea fowl Bird reared on deep litter and cage system

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Abstract

This study was conducted to investigate the growth traits of a helmeted guinea fowl birds reared in deep litter system and cage system. A total number of four hundred keets were obtained for the study. At 8th week of age, the birds were divided into two different housing systems and data were collated on body weight (g), body length (cm) and drumstick (cm) in both cage and deep litter system. The results showed that housing systems was significantly ($P<0.05$) influenced by the body weight, body length, keel length, breast girth, shank length and drumstick of guinea fowl from 8 to 12 weeks of age, Body weight was higher for caged birds (322.50g, 380.87g, 445.53, 10.62g and 556.10g) than deep litter system reared birds (319.62g, 375.37g, 433.50g, 500.38g and 547.03g) guinea fowls respectively for all considered ages. Furthermore, caged reared guinea fowl birds had higher values of body length (16.59cm, 17.48cm, 17.97cm, 18.59cm and 18.92cm) at 8, 9, 10, 11, and 12 respectively than the deep litter reared guinea fowl. It can be concluded that growth traits measured were age dependents and cage reared guinea fowls were better for growth traits especially the body weight and the body length measured.

Keywords: Helmeted guinea fowl, age, cage system, deep litter system, growth traits

Introduction

The production of guinea fowl as an alternative poultry enterprise is gaining ground throughout the world, especially in developing countries which have shown increasing demand for this particular meat (1,2). The gamey flavour of guinea fowl meat may be the factor influencing its preference and demand. Guinea fowl adapt to different environmental conditions and as such, they are ubiquitous (3), as a result of the increasing interest in guinea fowl farming and gradual domestication of the bird. Feeding management and breeding strategies are required that will bring about improvement in its performance (4). However, according to (5, 6), turning guinea fowl production into a profitable enterprise requires understanding of their growth characteristics and patterns as these allow the design of optimum management practices and hence improved profit ability.

Body measurement and its relationship to size and shape have been extensively studied in both large animals and poultry (7, 8, 9). Its use in predicting weight and other characteristics was also elucidated. (10) reported that the relationship existing among body characteristics provide useful information on performance, productivity and carcass characteristics of animals and that these quantitative measures of size and shape are necessary for estimating genetic parameters in animal breeding programmes. Meanwhile, the slow growth rate of guinea fowls is associated with the use of unimproved breeds, extensive production system, poor feeding, poor health care and management and selection (11,12). Guinea fowls reared under the intensive management system have superior production performance than those reared under the semi-extensive management system (13). Therefore, the aim of this study is to evaluate the age responses in relation to growth traits of helmeted guinea fowl birds reared both at cage and deep litter systems.

Materials and Methods

Experimental Site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated in the derived savanna zone of Nigeria on longitude 4° 15' East of the Greenwich meridian and latitude 8° 15' North-Eastward from Ibadan, the capital of Oyo State. The altitude is between 300 and 600m above the sea level. The mean annual temperature is above 27°C while that of rainfall is 1247mm (14).

Experimental Birds

Guinea fowl eggs were obtained from a settlement around Iseyin Township in Oyo state Nigeria. Eggs were candled and fertile ones were set in a reputable hatchery for incubation to obtain day old guinea fowl (keet). Two hundred (200) Guinea fowls were used for the experiment. The keets were managed on deep litter system and housing system having natural ventilation via the side and roof shelter. The pen were clean and fumigated few days before the arrival of the keets, wood shaving of about 5cm depth were spread on the floor.

Feed And Feeding.

Adequate temperature was maintained in the brooding house, clean, drinking water and diet contained 24% Crude Protein and 3000Kcal/kgME were provided for the first four weeks (4 weeks) at the brooding pen followed by diet contained 18% Crude Protein and 2000Kcal/kgME. Feed and water were given *ad-libitum* while routine vaccinations were appropriately ensured as necessary.

Data Collection

A total number of 120 birds were randomly selected at each week for measurement on live body weight, body length, shank length, breast girth and drumstick. The data collection was based on age and housing systems, the initial body weight (BW) of the guinea fowl keets was measured by sensitive scale, and other body linear measurement such as body length (BL), breast girth, thigh length and shank length were measured on weekly basis using tailor's tape rule.

Statistical Analysis

Data collections were subjected to analysis of variance (ANOVA) using general linear model of (15) and the following model were used.

$Y_{ijk} = \mu + H_i + A_j + (HA)_{ij} + E_{ijk}$

Where

$Y_{ijk=}$ the individual measurement on each birds

μ= The overall mean

H_i= fixed effect of housing systems (1, 2)

A_j =fixed effect of the jth age (j=8, 9, 10, 11, 12)

$(HA)_{ij}$ = interaction effect of ith housing system and j^{th} age

E_{ijk} = random error

Results and Discussion

Table 1 shows the effect of age and housing systems on growth traits of guinea fowl at 8th and 9th weeks of age. There are significant ($P<0.05$) differences between the measured parameters and housing systems. At 8th week of age, cage system shows higher values of body weight and body length (322.50g and 16.95cm) respectively while at 9th week of age, cage system shows higher values of body weight and body length (380.87g and 17.48cm) respectively than floored guinea fowl birds. The effect of age and housing systems on growth traits of guinea fowl at 10th and 11th weeks of age is presented in table 2. There are significant ($P<0.05$) differences between the measured parameters and housing systems. At 10th week of age, cage system had higher values of body weight and body length (445.53g and 17.70cm) respectively while at 11th week of age, cage system shows higher values of body weight and body length (510.62g and 18.59cm) respectively than deep litter reared guinea fowl. Table 3 revealed the effect of age and housing system and growth traits of guinea fowl at 12th week of age. There are significant ($P<0.05$) differences between the measured parameters and housing systems. At 12th week of age, cage system shows higher values of body weight and body length (556.10g and 17.72cm) respectively than deep littered birds. Meanwhile, The current study on the age related changes on growth traits of helmeted guinea fowl birds reared on the deep litter and cage system revealed that growth traits was age dependents, such age related response on growth traits were earlier documented by (16) on meat-type chickens, (9) on guinea fowl birds; (4) on indigenous turkey birds. The effect of housing system on the growth, traits of helmeted guinea fowls in this present study that favored the cage systems had earlier noted by (17,18,19) these authors were of the opinion that hens reared on cage were better in growth trait than the floor reared hens. They also noticed that deep litter reared chickens are subjected to a drastic change in environment when housed in cage, the hypothesis considered was that adaptation problems can cause significant economic losses in terms and impair animal production. The observation in this current study for

housing systems that favored cage system disagreed with the findings of (20) that indicated that production performance and growth traits of chicken was similar and relatively high in both battery cages and free range systems but free range provides a more comfortable environment for birds than cage systems. However, the body weight, and body lengths of the of helmeted guinea fowls that were higher in caged system birds than the deep littered chickens were agreed with the opinion of (21, 22). These authors reported better growth traits for chickens in cage systems; they further added that cage system rearing of birds improved feed consumption and feed conversion ratio and lower mortality. The present results revealed that the body measurement increases with advancement of ages of the birds was corroborated with the findings of (23) who reported that body measurement increases with advancement of ages; and the highest values were obtained between the body weights and body lengths measured at various ages.

Table 1. Mean values of growth traits as affected by housing systems at different ages of 8th and 9th weeks

	8th week		9th week	
Variables	**Cage system**	**Deep litter**	**Cage system**	**Deep litter**
BW (g)	322.50±6.41[a]	319.62±6.46[b]	380.87±7.42[a]	375.37±7.29[b]
BL (cm)	16.95±0.20[a]	16.72±0.21[b]	17.48±0.18[a]	17.41±0.17[b]
KL(cm)	6.41±0.70	6.39±0.07	6.74±0.07	6.73±0.06
BG(cm)	3.06±0.05	3.02±0.06	3.14±0.05	3.10±0.05
SL(cm)	4.87±0.05	4.86±0.06	5.07±0.05	5.09±0.05
DS(cm)	8.16±0.07	8.15±0.03	8.26±0.05	8.24±0.09

[ab]Means along the same column with different superscripts are significantly (P<0.05) different
BW = Body weight, BL = Body length, KL = Keel length, BG = Breast girth, SL = Shank length, DS = Drumstick

Table 2. Mean values of growth traits as affected by housing systems at different ages of 10th and 11th weeks

	10th week		11th week	
Variables	**Cage system**	**Deep litter**	**Cage system**	**Deep litter**
BW (g)	445.53±8.38[a]	433.50±8.63[b]	380.87±7.42[a]	500.38±8.84[b]
BL (cm)	17.97±0.16[a]	17.51±0.17[b]	18.59±0.19[a]	18.35±0.19[b]
KL(cm)	7.23±0.07	7.13±0.07	7.57±0.09	7.44±0.09
BG(cm)	3.08±0.03	2.99±0.04	2.97±0.05	2.93±0.05
SL(cm)	5.41±0.04	5.35±0.04	5.37±0.05	5.39±0.05
DS(cm)	9.05±0.06	8.95±0.08	9.06±0.07	9.04±0.07

[ab]Means along the same column with different superscripts are significantly (P<0.05) different
BW = Body weight, BL = Body length, KL = Keel length, BG = Breast girth, SL = Shank length, DS = Drumstick

Table 3. Mean values of growth traits as affected by housing systems at different age of 12th week

Variables	**Cage system**	**Deep litter**
BW (g)	556.10±8.89[a]	547.03±8.71[b]
BL (cm)	18.92±0.11[a]	17.60±0.10[b]
KL(cm)	8.01±0.07	7.94±0.07
BG(cm)	3.27±0.03	3.22±0.09
SL(cm)	6.03±0.04	5.99±0.04
DS(cm)	9.74±0.06	8962±0.08

[ab]Means along the same column with different superscripts are significantly (P<0.05) different
BW = Body weight, BL = Body length, KL = Keel length, BG = Breast girth, SL = Shank length, DS = Drumstick

Conclusion

Base on the current results that shows that the cage housing system had significant influence on the growth traits measured and it was the best to improved growth traits of guinea fowl in terms of body weight and body length than rearing on the floor. This can be easily recommended for more improvement of the animal when kept in cages.

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ABG 015: # Morphometric Attributes of Selected Indigenous Cattle Breeds in Nigeria

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Abstract

Genetic variation is the basis of effective improvement in farm animals. Population differentiation is used for objective choice of parental genotypes that constitutes new hybrids in crossbreeding. 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), 242 Red Bororo (RB), 247 Sokoto Gudali (SG), 233 Bornu Kuri (BK) and 184 Muturu cattle in the age group of 3 to $3^1/_2$ years were purposively sampled from Gombe, Kaduna, Niger and Ogun States where they were abundant. Eighteen (18) 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 EL (cm) for WF (23.86±3.08), SG (24.17±3.82), RB (24.07±3.74) and BK (24.17±3.15) were significantly higher than that of Muturu (14.62±2.01). The FLL of WF, SG, RB and BK were significantly longer than that of Muturu. TL of Muturu was significantly shorter than that of WF, SG, RB and BK. Muturu exhibited a significantly wider HW than WF, SG, RB and BK. The NC ranged from 53.68±13.67 cm to 79.14±8.60 cm among the breeds. The longest genetic distance 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 of cattle in Nigeria.

Keywords: Breed differentiation, Genetic distance, Indigenous cattle, Morphometric attributes.

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Introduction

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. Indigenous livestock resources are also strategic in the socio-economics of rural agricultural systems to ensure food security in developing countries. The initial step however, 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 (1). One of the ways of characterizing livestock breeds is to evaluate their morphostructural characteristics and determine genetic distance among contemporary populations (2). This study is designed to unveil the phenotypic and genetic diversity among the 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. This will help to better understand the genetics of Nigeria breeds of cattle for improvement and conservation goals and unravel the biodiversity that exist among the breeds using morphological analysis. It will also provide a quantitative assessment of the diversity among the selected indigenous cattle breeds in Nigeria and thereafter provides light for objectives prediction and pave way for a better improvement in planning for a productive genetic improvement. It will also help government, department and agencies to maintain good quality breeds of cattle.

Materials and Methods

Animals were sampled from four different isolated areas where they were abundant in Nigeria. The locations were selected because of the availability of the breeds and willingness of the owners to allow the animals for sampling. White Fulani population was sampled from Billiri and Kaltungo (Gombe State), Sokoto Gudali and Bornu Kuri populations were sampled from Funakuna and Bokani (Niger State), Red Bororo population was from Gusau and Birnin Gwari (Kaduna State) and Muturu population from Ipokia (Ogun State). Each location was divided into clusters of ten (10) 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 thousand, two hundred and seven (1207) indigenous cattle comprising three hundred and one (301) White Fulani (male and female), two hundred and forty seven (247) Sokoto Gudali (male and female), two hundred and forty two (242) Red Bororo (male and female), two hundred and thirty three (233) Bornu Kuri (male and female) and one hundred and eighty four (184) Muturu (male and female) were sampled.

Data Collection

Eighteen (18) linear body measurements(cm) were taken on each sampled animal with the use of measuring tape, these include wither height (WH), body length (BL), shoulder width (SW), rump length (RL), rump width (RW), horn length (HL), head width (HW), shin circumference (SC), ear length (EL), tail length (TL), Face length (FL), Foreleg length (FLL), rump height (RH), heart girth (HG), neck circumference (NC), neck length (NL), hock length (HoL) and rear leg length (RLL). Quantitative variables measured in this study were adapted from the standard cattle descriptor list (3) and a final list of variables were developed and used. Documented morphological features described by (4) were used as base line markers to ascribe sampled animals to a breed. Individuals that do not strictly conform to primary breed characters; visibly pregnant, sick and castrated animals were excluded this is because of the effects these physiological changes would have on their body conformation.

Statistical Analyses

Data collected were subjected to Generalized Linear Model Analysis of variance (GLM) procedure of the Statistical Analysis System (5). Least Square Means ($\overline{X}$) and Standard Error (SE) associated with each linear body measurements were estimated. Genetic distances among the five breeds based on their morphometric variables were calculated using DA Euclidean genetic distance measure.

The statistical model used for analyzing quantitative phenotypic variation among the breed populations is as follows:

$Y_i = \mu + B_i + e_i$

Where Y_i = observed value body measurements, μ = overall mean, B_i = fixed effect of breed (i = 1,2,..5) e_i = error

Results

Means values of morphological variables and their standard errors (S.E.) are depicted in Table 1 for aggregated gender. Pairwise mean comparison showed significant differences for most of the morphological variables among the breeds. Morphological variables such as wither height, rump height, body length, and tail length were significantly higher ($p<0.05$) for White Fulani and Sokoto Gudali as compared with any other breeds considered in this study. Muturu breeds were also significantly ($p<0.05$) superior in the measurements of their face length and head width than the quadriad of White Fulani, Sokoto Gudali, Red Bororo and Bornu Kuri. Moreover, Red Bororo and Bornu Kuri were wider at the shoulders than the trio of White Fulani, Sokoto Gudali and Muturu. Similarly, neck circumference of Red Bororo and Bornu Kuri were generally higher than what obtained in White Fulani, Sokoto Gudali and Muturu. The genetic distance among the cattle populations 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 results indicated that the Bornu Kuri and Muturu were less genetically related (145.52) compare with the other paired breeds and a distance of 114.87 between Muturu and White Fulani. These results indicated that Muturu is less genetically related to Red Bororo and White Fulani when compare with Sokoto Gudali that is with a distance of 54.36 with White Fulani on one hand; and a distance of 65.63 with Red Bororo on the other hand. 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. A cluster having the four breeds further branched to form two other clusters having Bornu Kuri and Red Bororo in a branch and White Fulani and Sokoto Gudali in the other.

Table 1: Means of body measurements amongst the five cattle breeds

	WF	**SEM**	**SG**	**SEM**	**RB**	**SEM**	**BK**	**SEM**	**MU**	**SEM**
Face Length (FL)	49.37^{b}	0.44	47.51^{c}	0.36	40.35^{c}	0.33	45.44^{d}	0.57	54.03^{a}	0.39
Head Width (HW)	22.62^{c}	0.16	22.57^{c}	0.15	21.21^{d}	0.14	24.11^{b}	0.18	28.53^{a}	0.68
Horn length (HL)	45.16^{a}	0.84	4.56^{d}	0.44	38.05^{b}	0.32	38.39^{b}	0.57	8.30^{c}	0.35
Ear length (EL)	23.86^{a}	0.52^{a}	24.17^{a}	0.65	24.07^{a}	0.52^{a}	24.17^{a}	0.56	14.61^{b}	0.24
Neck length (NL)	54.56^{a}	0.58	51.34^{b}	0.41	38.97^{c}	0.40	38.79^{c}	0.51	25.40^{d}	1.09
Neck Circumference (NC)	54.71^{c}	0.51	59.08^{b}	0.51	76.85^{a}	0.32	77.75^{a}	0.81	60.93^{b}	0.18
Wither Height (WH)	130.39^{a}	0.21	129.21^{a}	0.23	125.65^{b}	0.11	125.18^{b}	0.15	82.41^{c}	0.07
Foreleg length (FLL)	78.39^{b}	0.45	80.39^{b}	0.45	85.96^{a}	0.41	87.59^{a}	0.43	56.71^{c}	0.25
Hearth Girth (HG)	83.20^{c}	0.18	95.92^{b}	0.28	144.41^{a}	0.12	144.40^{a}	1.12	57.03^{d}	0.43
Body length (BL)	116.45^{a}	0.11	116.03^{a}	0.08	111.17^{b}	0.06	112.64^{b}	0.41	73.55^{c}	0.21
Rump Height (RH)	135.40^{a}	0.17	134.22^{a}	0.21	130.59^{b}	0.09	131.53^{b}	0.50	88.46^{c}	0.54
Rump Length	30.56^{a}	1.19	30.58^{a}	0.26	31.03^{a}	0.75	30.97^{a}	0.21	20.89^{b}	0.41

(RL)										
Rearleg Length (RLL)	105.45[a]	0.21	105.41[a]	1.01	104.64[a]	0.19	105.06[a]	1.17	73.93[b]	0.63
Tail length (TL)	96.10[a]	0.49	94.98[a]	0.36	91.89[b]	0.17	91.30[b]	0.14	55.98[c]	0.41
Shin Circumference (SC)	25.06[a]	0.43	2475[ab]	0.39	24.66[ab]	0.22	24.40[b]	0.08	21.86[c]	0.14
Hock length (HoL)	50.90[a]	1.11	50.05[b]	0.71	50.07[b]	0.47	49.41[b]	0.43	32.74[c]	0.35
Rump Width (RW)	35.19[a]	0.56	35.38[a]	0.42	34.45[b]	0.41	35.18[a]	0.20	28.32[c]	0.24
Shoulder width (SW)	68.02[b]	0.52	69.59[b]	0.34	80.89[a]	0.46	81.85[a]	0.11	63.58[c]	0.22

Means with same superscript are not significantly different (P>0.05).
WF =White Fulani, SG = Sokoto Gudali, RB = Red Bororo, BK = Bornu Kuri, MU = Muturu

Table 2: Euclidean genetic distance estimate based on morphometric variables

Breed / Breed	White Fulani	Sokoto Gudali	Red Bororo	Bornu Kuri	Muturu
White Fulani	**				
Sokoto Gudali	54.36	**			
Red Bororo	70.44	65.63	**		
Bornu Kuri	54.54	76.54	43.77	**	
Muturu	114.87	83.86	136	145.52	**

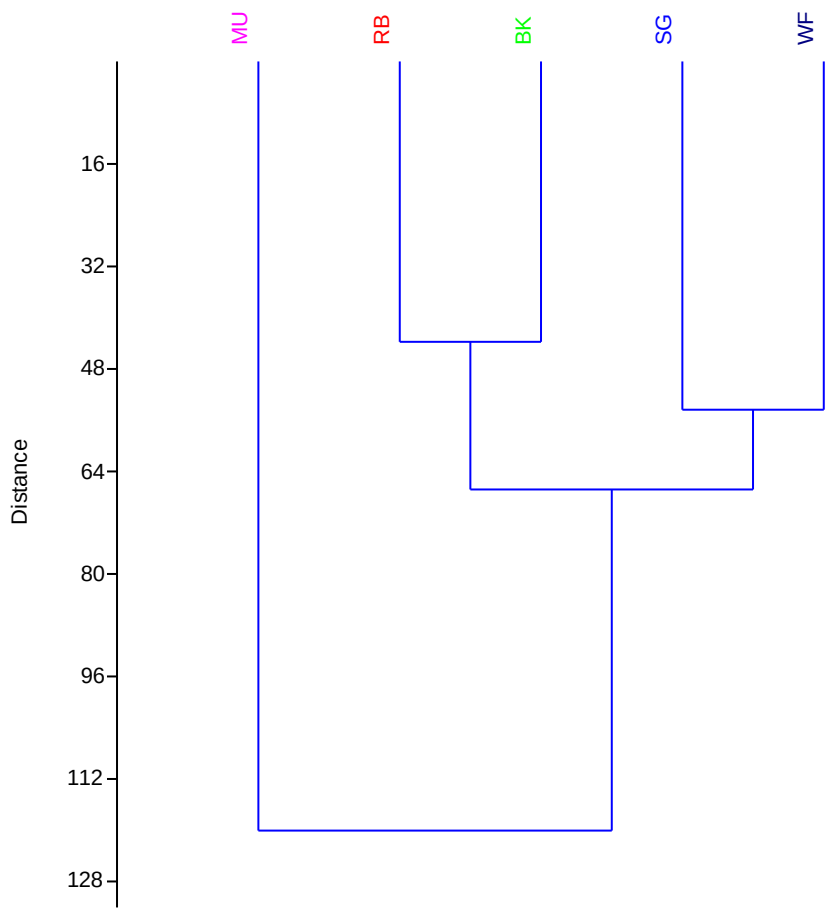

Fig. 1: Dendrogram showing genetic relationship among White Fulani (WF), Sokoto Gudali (SG), Red Bororo (RB), Bornu Kuri (BK) and Muturu (MU) breeds of cattle based on morphometric variables

Discussion

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 (4) and (6) 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 (7). The small stature of Muturu might, therefore be an adaptive mechanism to poor availability of feed due to shortage of grazing land caused by high human population pressure and expansion of cropping activities. 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 constructed separated the five cattle breeds into two main clusters. The closer genetic relationship between White Fulani and Sokoto Gudali breeds may be attributed to possible interbreeding between these two populations which are predominantly in the northern part of the country forming homogeneous population separated by no physical geographic boundaries. 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 (6). 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.

Conclusion

Morphometric attributes are very good tools in differentiating cattle on the basis breeds.

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ABG 016: Heritability of internal egg quality characteristics in Japanese quail

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Abstract
Heritability, genetic and phenotypic correlations of internal quality traits for Japanese quail eggs were estimated using Restricted Maximum Likelihood procedure. 220 eggs were collected from 110 Japanese quail hens raised at the Poultry Unit of Livestock Teaching and Research Farm, University of Maiduguri. Heritability of egg weight, albumen length, albumen width, albumen weight, yolk diameter, albumen ratio, yolk index, yolk ratio and albumen index were estimated at 0.33 ± 0.24, 0.91 ± 0.31, 0.75 ± 0.37, 0.72 ± 0.28, 0.97 ± 0.32, 0.60 ± 0.26, 0.40 ± 0.22, 0.98 ± 0.32, 0.77 ± 0.29, 0.84 ± 0.30 and 0.77 ± 0.29, respectively. Traits related with albumen (AL, AH, WA, AW, AR, AI) had higher heritability than traits related with yolk (YD, YW, YI, YR). Egg weight had positive correlations with internal qualities except yolk index while high negative correlations between yolk and albumen ratio were detected. This implies that albumen qualities would have better improvement than yolk traits in selection. Improved egg weight would bring about better yolk and albumen weights but increased yolk will lead to poor albumen quality part of egg.
Key words: Heritability, Egg quality, Genetic correlations, Japanese quail, Egg weight.

Introduction
The Japanese quail is used in commercial production for its meat and eggs. The quail meat and eggs are reckoned for their high biological and caloric values. These birds have shorter generation interval, early maturity (5-6 weeks), fast growth rate and the birds attain market weight (150 g -180 g) in just 6 weeks. Quail can produce 250-280 eggs per year and they have short incubation period of 17-18 days (1).

Egg qualities are the characteristics of an egg that affect its acceptability to the consumers (2). The significance of egg as a source of nourishment for humans led theconsumer to demand for these traits (3). In addition to this, the content and composition of an egg have direct effect on the heritability, chicks' quality and future performance of the flock (4). This makes the egg qualities to become traits of economic interest in commercial egg production. The trend in egg consumption today is towards industrially processed egg products (5). The major component parts of egg are the shell, albumen and yolk (6). Among these traits, yolk and albumen weight and their ratios to total egg weight are the main concern in egg processing and baking industries (7).

Information on heritability is essential for understanding the genetics of individual characteristics in respect to selection (8). On the other hand, knowledge on the genetic correlations among concerned traits is important to plan the breeding schemes and to predict potential progress for commercial quail production (9). Therefore, this study intended to estimate the genetic and phenotypic parameters of internal egg quality traits for Japanese quail.

Materials and Methods
Experimental location, climate and vegetation
The study was conducted at the Poultry Unit, University of Maiduguri Livestock Teaching and Research Farm, Maiduguri, Borno State. Maiduguri is located within the Sahelian (semi-arid) region of West Africa on latitude 11.38^0 North and longitude 37.17^0 East of the equator at an altitude of 354 m above sea level. The temperature of the area ranges from 34.0^0 - 40.7^0 C (10).

Management of experimental birds

Quail chicks were raised in quail brooder till four weeks of age. After sexing, female birds were caged individually in 40 x 30x30 cm wire mesh cages. The birds were provided with feed and water *ad libitum*. They were given quail diet containing 25 % CP and 3000 KCal ME/Kg in the first six weeks and later reduced to 24 % CP and 2750 KCal ME/Kg. Constant sanitation of the pen including the feeder was carried out. Birds were also given antibiotics at regular interval (notwithstanding their hardy nature) as a preventive measure against poultry diseases.

Data collection

A total of 220 eggs were collected from 110 quail hens pedigreed by 60 dams and 220 sires at 20 weeks of age. Egg weight was taken using a 0.01 g sensitive electronic scale. The eggs were broken on a white tile. The measurement of yolk height and diameter, albumen length, width and height were taken using a pair of vernier calipers. Thereafter, the yolk was carefully separated from the albumen after which yolk weight was measured with the scale. These data were used to determine the additional internal quality traits of eggs with the following formulae:

$$Albumen\ index\ (\%) = albumen\ height(mm)(albumen\ lenght\ (mm) + albumen\ width\ /2)X\ 100$$

$$Albumen\ ratio\ (\%) = \frac{albumen\ weight(g)}{egg\ weight\ (g)}\ X\ 100$$

$$Albumen\ weight\ (\ g) = egg\ weight(g) - (yolk\ weight\ (\ g) + shell\ weight\ (g)\ ))$$

$$Haugh\ unit\ (HU) = 100\log(H + 7.57 - 1.7\ W^{\ 0.37}$$

Where H= albumen height (cm), W= egg weight (g)

$$Yolk\ index\ (\%) = \frac{yolk\ height(cm)}{yolk\ diameter\ (cm)}\ X\ 100$$

$$yolk\ rtatio\ (\%) = (yolk\ weight(g)/\ egg\ weight\ \ (g)X\ 100$$

Data analysis

Variance and covariance and genetic parameters were estimated using Restricted Maximum Likelihood (REML) Procedure soft ware (11).

Results and Discussion

Means and their standard errors for egg weight and the internal egg quality characteristics for Japanese quail were presented in Table 1. Albumen and yolk weight made up the egg weight as they covered the highest ratio of the egg weight. In this study, yolk ratio was 34.98 % while albumen ratio was 55.72 % suggesting that albumen ratio to almost doubled yolk ratio as both of them constituted over 90 % of the total egg weight. Haugh unit and yolk index were calculated as 87.77 ± 0.26 and 40.59 ± 0.32, respectively. These values are in conformity with the reports of (12,13) but slightly different from (9). This variation may not be unconnected with the fact that egg composition of the domestic fowls and other galliformes varies due to differences in birds genotype, management, age as well as managerial environment (9). This further shows that changes in internal egg quality characteristics could be expected during egg production (14).

Estimates of heritability, genetic and phenotypic correlations for egg weight and other studied internal quality traits were presented in Table 2. Heritability estimates for egg, yolk and albumen weights were moderate to high. These were 0.33 ± 0.24, 0.40 ± 0.22 and 0.97 ± 0.32, respectively. Albumen weight value being the highest while the lowest estimate was for egg weight. Generally, the heritability for other traits were high with albumen ratio having the highest value (0.98 ± 0.32) while the lowest is yolk diameter with a value of 0.60 ± 0.26.

In general, traits related with albumen had higher heritability estimates (0.77 – 0.98) than the traits related with yolk (0.40 – 0.84). These results suggest that improvement would be achieved with albumen related traits than the yolk related traits when subjected to selection at age 20 weeks. Similar findings have been observed by other researchers (15, 16) both in Japanese quail.

Table 1: Means and standard errors for internal quality characteristics of Japanese quail eggs

Traits	Means	± SE
EW (g)	9.77	± 0.07
AL (cm)	4.38	± 0.04
AH (cm)	3.95	± 0.04
WA (cm)	3.46	± 0.04
AW (g)	5.45	± 0.06
YH (cm)	1.00	± 0.01
YD (cm)	2.48	± 0.01
YW (cm)	3.41	± 0.04
AR (%)	55.72	± 0.38
YI (%)	40.59	± 0.32
YR (%)	34.98	± 0.36
HU (%)	87.77	± 0.26
AI (%)	6.58	± 0.10

EW=egg weight, AL=albumen length, AH=albumen height, WA=albumen width, AW=albumen weight, YD=yolk diameter, YW=yolk weight, AR=albumen ratio, YI=yolk height, YR=yolk ratio, AI=albumen height

However, the heritability estimates as observed in this study (0.33 ± 0.24 – 0.98 ± 0.32) were generally higher than that of (9) (0.38 ± 0.035 – 0.83 ± 0.012) at 12 weeks of age. The difference in the values of this study and that of (9) may be attributed to the ages of the birds when the studies were conducted. Egg weight had positive genetic and phenotypic correlations with all the internal traits except for yolk index. This finding thus suggests that egg weight could be used to improve the internal quality traits. Not surprising as well, negative correlations between egg weight and yolk index could be expected because yolk index is calculated using yolk diameter and height. High negative correlations were detected between albumen and yolk ratio.

Table 2: Heritability (h^2, on diagonal), genetic (r_G, above diagonal) and phenotypic (r_P, below diagonal) correlations between internal egg quality traits of Japanese quail

Traits	EW	AL	AH	WA	AW	YD	YW	AR	YI	YR	AI
EW	**0.33 ±0.24**	0.64	0.13	0.31	0.98	0.74	NA	0.28	-0.20	0.12	0.43
AL	0.26	**0.91±0.31**	0.52	0.86	-0.23	0.34	0.03	-0.18	0.17	0.13	-0.36
AH	0.10	0.24	**0.75±0.37**	0.78	-0.07	0.57	0.45	-0.24	0.48	0.25	0.61
WA	0.10	0.55	0.38	**0.72±0.28**	-0.22	0.28	-0.03	-0.15	0.34	0.09	0.08
AW	0.58	0.02	-0.01	0.04	**0.77±0.32**	0.17	-0.7	0.91	-0.02	-0.89	0.18
YD	0.59	0.25	0.25	0.23	0.26	**0.60±0.26**	0.38	-0.07	-0.38	0.14	0.25
YW	NA	0.13	0.14	0.17	-0.15	0.25	**0.40±0.22**	-0.87	0.11	0.11	0.35
AR	0.10	-0.07	-0.10	-0.01	0.76	0.00	-0.75	**0.98 ±0.32**	-0.08	0.87	-0.01
YI	-0.12	-0.05	0.17	-0.03	-0.02	-0.54	0.02	-0.02	**0.77 ± 0.29**	-0.99	0.36
YR	0.05	0.07	0.11	0.08	-0.71	0.04	0.79	-0.98	0.01	**0.84±0.37**	0.06
AI	0.27	-0.68	0.46	-0.21	0.03	-0.05	0.03	-0.01	0.21	0.02	**0.77±0.29**

EW=egg weight, AL=albumen length, AH=albumen height, WA=albumen width, AW=albumen weight, YD=yolk diameter, YW=yolk weight, AR=albumen ratio, YI=yolk height, YR=yolk ratio, AI=albumen height

Meanwhile, high positive genetic and phenotypic correlations were obtained between egg weight and albumen weight. These findings indicated that selection for improved egg weight would improve the yolk and albumen ratios. However, an increase in proportion of yolk would lead to antagonistic effect on albumen qualities.

Conclusion and Application

Albumen and yolk weights covered the highest proportion of the total egg weight as they constituted over 90 % of the total egg weight of Japanese quail. Better improvement would be achieved with albumen related traits than the yolk qualities when these traits were subjected to selection at age 20 weeks. Egg weight appears to be the best trait to improve the yolk and albumen qualities of the egg. Selection for improved yolk qualities would however lead to antagonistic effect on albumen qualities. This result is a prerequisite for the planning breeding programmes for the improvement of quail eggs.

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ABG 017: Comparison of Egg Composition of Two Avian Species

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Abstract

Avian eggs are of high biological value and they contain more essential minerals and vitamins than any other animal products. The aim of the present investigation was to compare the chemical compositions of chicken and quail eggs in order to determine their relative superiority in terms of protein, crude fibre and other interior qualities. Quail birds were raised in both cages and floor, while ISA Brown (IB) birds were reared in cages. Freshly laid eggs were collected from the IB chicken and Coturnix quails. Four (4) freshly laid eggs were collected from Isa Brown birds, numbered and labelled accordingly. For quails, eight (8) freshly laid eggs were equally collected each from floor and cage birds. All the eggs were immediately transferred to laboratory for chemical analysis. The laboratory analysis was carried out on one-to-two basis, i.e., 1 IB egg : 2 quail eggs. Data collected and analyzed included egg weight, crude protein, crude fibre, total ash, moisture and NFE. Analysed results reveal that eggs from IB and quail birds were similar ($P>0.05$) in all the traits considered, except in egg weight. The results of this study indicate that consumption of one IB chicken egg or two quail eggs will supply equal amount of nutrients at any given time.

Key words: Isa Brown, quail, eggs, crude protein, crude fibre.

Introduction

The production of eggs with high grade interior nutrients is an important concern of the egg industry. Traditionally, eggs from poultry species are produced for domestic consumption, processing industry and hatching purposes. Pertaining to human health, (1) stated that animal proteins in sufficient and balanced proportions have significant impact on physical and mental abilities. In egg products industry, the demand for liquid egg, egg powder and yolk oil depends on interior characteristics and chemical composition of eggs (2). Besides, successful and profitable hatchery enterprise is determined by production of good, sound and quality breeding eggs (3). It could be deduced from the above-mentioned reports that acceptability of eggs for domestic and industrial usage depends not only on external qualities such as cleanliness, freshness, egg weight, shell weight and shell thickness, but also on the quality of internal contents and chemical compositions. These chemical compositions include proteins, fat content, total ash and moisture content.

Several studies had been conducted on egg internal and external qualities of different poultry species. Orunmuyi *et al.* (4) analyzed and compared external and internal egg qualities of local chicken, exotic chicken, quail, guinea fowl and ducks. The authors reported significant differences among the species for all the traits considered.

The aim of the present investigation was to compare the nutritional values (as represented by their chemical compositions) of chicken and quail eggs in order to ascertain which of the avian species was superior.

Materials and Methods

The study was carried out at the Animal Breeding Unit of the Teaching and Research Farm, Ekiti State University, Ado-Ekiti, within the period of November - December, 2014. Ado-Ekiti is situated along latitude $7^{0}31^{1}$ and $7^{0}49^{1}$ North of the Equator and longitude $5^{0}71^{1}$and $5^{0}27^{1}$East of the Greenwich Meridian. The city is located in the Derived Savannah zone, and it enjoys two separate seasonal periods, namely, Rainy (May-October) and Dry (November-April) seasons, respectively.

Isa Brown birds and Coturnix quails used for this study were reared inside the specially constructed cages on our experimental farm. Some quails were also raised on the floor for egg examination during the period. The birds were raised under similar nutritional regimen, uniform management and environmental conditions. They were given layers mash containing 16%CP and 2600 Kcal/kg ME throughout the laying period. Feed and water were supplied *ad libitum.*

Data collection

Four (4) freshly laid eggs were collected from Isa Brown birds, numbered and labelled accordingly, while eight (8) freshly laid Coturnix quail eggs were equally collected each from floor and cage birds. All the eggs were immediately transferred to laboratory for chemical analysis. The eggs were divided into four (4) replicates. For laboratory analysis, it was one egg/replicate for Isa Brown, while two eggs/replicate for both cage and floor quails.

Statistical analysis

Data collected were subjected to T-test statistical analysis using the SAS (2001) package. Mean values as well as the standard errors of the mean were calculated for all traits. Differences between species, and between quails raised in cage and on floor, with regard to egg compositions were determined.

Results and Discussion

Egg weight in this study differed significantly (P<0.01) between the two avian species considered (Table 1). Isa Brown (IB) has higher and superior egg weight compared to the Coturnix quail (CQ). This was in agreement with previously published work (4). Pertaining to protein content based on one Isa Brown egg to two Coturnix quail eggs (i.e., 1 IB egg : 2 CQ eggs), there were no significant (P>0.05) differences between IB, cage quail and floor quail eggs. This implies that two quail eggs contained same amount of protein with one IB egg. It is therefore, suggested that two pieces of CQ quail eggs or one IB egg should be consumed at any given time in order to derive equal nutritional benefits.

Table 1: Least square means showing egg composition of avian species

Traits	Avian Species			SE
	Isa Brown	Floor Quail	Cage Quail	
Egg weight (g)	64.0[a]	10.65[b]	9.50[b]	1.52
Crude Protein (%)	11.93	11.58	12.49	0.52
Crude Fibre (%)	10.55	9.36	10.40	0.64
Total Ash (%)	1.05	0.93	1.03	0.06
Moisture content (%)	74.20	69.40	70.48	1.44
NFE (%)	5.38	8.74	5.61	1.56

ab, means with different superscripts along rows are significantly different (P<0.01)

It was also found in this study that both cage and floor quail eggs were similar (P>0.05) in protein content. With regard to crude fibre, total ash, moisture and NFE, the values obtained for IB, cage and floor CQ eggs were similar (P>0.05), implying that the two species did not differ with respect to afore-mentioned egg internal qualities. The analyses here were similar to that of crude protein, that is, 1 IB egg : 2 quail eggs. Conversely, the results could likely be different if tests were to be carried out on the basis of one IB egg to one CQ egg.

Conclusion

Egg weight differed significantly between Isa Brown and Coturnix quail eggs regardless of housing environment used for rearing the latter. On one-to-two egg basis, IB and CQ eggs recorded similar mean values in crude protein, crude fibre and other interior qualities. This indicates that consumption of one chicken egg or two quail eggs will supply equal amount of these nutritional benefits, most probably on account of weight differences existing between the eggs of the two avian species.

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ABG 018: Morphology defects of semen as affected by age and genotypes in the Nigerian indigenous chicken

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Abstract
A comparative study was conducted to evaluate the morphological defects of the Nigerian indigenous roosters as affect by age (24, 28 and 32weeks) and genotypes (normal, frizzle and naked neck feathers). Results obtained showed that both age and genotype had significant ($P<0.05$) on the morphological defect apart for mid piece drop (MPD) at 32 weeks. It was concluded that the Nigerian indigenous rooster morphological defect is within the range for good semen and that the roosters can possibly be used beyond one year.

Key words: Morphological defects, Indigenous chickens, Age, Genotypes
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Introduction
The reproductive potential of poultry birds (cocks) is determined to large extent by the quality of the semen it produces. The importance of semen evaluation in poultry breeding (natural and artificial breeding) for selecting breeding males or for routine monitoring of their reproductive performance cannot be overemphasized (1). Sperm morphology just like semen quality characteristics is used as one of the most important criteria in the evaluation of semen quality to ascertain the potential of semen on fertility and subsequent hatchability of hatchable egg (2, 3). Several reports on semen quality characteristics and morphological defects of the domestic fowls have indicated that breed, strain and age significantly affects semen quality and quantity (4, 5, 6). The Nigerian indigenous chicken breed have been reported to have many be advantageous gene complexes or gene marker that could be harnessed in the development of meat and egg type chicken suitable for use in tropics (7). Also, these indigenous chickens as been classified into several genes but among these genes are the naked neck, frizzle and normal feathers (8). Therefore, the object of the study is to determine a comparative effect of age and genotype on morphological defect of the Nigerian indigenous chicken.

Materials and Methods
Experimental site
The study was conducted at the Poultry Unit of the Department of Animal Science Research Farm, Faculty of Agriculture, Ahmadu Bello Univerity Zaria. Description of the experimental location was earlier given by (9).

Experimental birds and management
A sum total of sixty roosters from three genotypes (normal, frizzle and naked neck feathers) were used for the study comprising of twenty roosters for each genotype. The birds were generated from a pure mating programme of the Nigerian indigenous chickens. The roosters were fed breeder mash with metabolizable energy (ME) of 2520.08kcal/kg with crude protein (CP) of 18.05%. The roosters were raised on the deep liter system of management with each genotype housed in different pens. Feed and water were provided *ad libitum* and necessary medications and management practices were provided.

Semen evaluation on morphological defects

Semen slides used for evaluation of live and dead ratios were used for the morphological defects (abnormal spermatozoa) evaluation in the Nigerian indigenous roosters. The morphological defect examined include: acrosome swelling, detached head, mid-piece droplet and bent tail, curl tail and full tail. The morphological defects spermatozoa were counted using a hand tally counter. A total of fifty spermatozoa were examined for each of the samples to see the various defects under a light microscope at x100 magnification. The total number of abnormal or morphological defect sperm cells were counted and recorded in percentage. The acrosomal abnormalities were determined by using smears made from the raw semen and stained by Giemsa stain according to (10). The morphological defects of the semen were evaluated at 24, 28 and 32 weeks of age comprising the three genotypes.

Statistic Analysis

Data collected were subjected to the GLM procedure of (11) and significant means were separated using the Tukey HSD of the same soft ware. The model for the investigation of age and genotype effect on the morphological defect is as thus:

$$Y_{ijk} = \mu + A_i + G_j + e_{ijk}$$

Where: Y_{ijk} = Observation on the ith age of the jth genotype; μ = overall population mean; A_i = fixed effect of age (i= 24, 28, 32); G_j = fixed effect of genotype (normal, frizzle, naked neck) and e_{ijk} = random error.

Table 1: Morphological as affected by age and genotypes in the Nigerian indigenous chickens

			Genotype		
Age (Weeks)	**Sperm segment**	**Defects (%)**	**Normal**	**Frizzle**	**Naked neck**
24	Acrosome	Acro. Swelling	1.39±0.77^{b}	0.89±0.64^{c}	1.77±0.72^{a}
	Head	DH	0.50±0.56^{b}	0.84±0.46^{a}	0.92±0.52^{a}
	MPD	MPD	0.18±0.15^{b}	0±00^{c}	0.44±0.15^{a}
	Tail	BT	1.40±0.65^{a}	1.68±0.54^{a}	0.06±0.60^{b}
		CT	0.50±0.37^{ab}	0.1±0.31^{b}	1.3±0.35^{a}
		FT	0.69±0.48^{ab}	0.86±0.40^{a}	0.59±0.45^{b}
Overall (%)			**4.66±2.98^{b}**	**4.37±2.35^{b}**	**5.08±2.79^{a}**
28	Acrosome	Acro. Swelling	3.61±0.54^{ab}	3.24±0.7^{b}	4.00±0.54^{a}
	Head	DH	4.08±0.60^{c}	4.48±0.77^{b}	5.50±0.60^{a}
	MPD	MPD	1.72±0.99^{b}	1.60±1.29^{b}	4.00±0.99^{a}
	Tail	BT	3.59±0.49^{b}	4.06±0.64^{a}	3.00±0.49^{c}
		CT	3.59±0.64^{a}	3.67±0.82^{a}	3.25±0.64^{b}
		FT	3.09±0.78^{ab}	3.26±0.78^{a}	2.75±0.78^{b}
Overall (%)			**19.68±4.04^{b}**	**20.31±5.0^{b}**	**22.50±4.04^{a}**
32	Acrosome	Acro. Swelling	3.52±0.66^{a}	1.95±0.13^{b}	3.28±0.66^{a}
	Head	DH	4.18±1.12^{b}	5.35±1.12^{a}	4.22±1.26^{b}
	MPD	MPD	1.73±0.60	1.71±0.60	1.82±0.67
	Tail	BT	5.56±1.17^{b}	6.56±1.17^{a}	4.17±1.31^{c}
		CT	3.74±0.76^{a}	2.47±0.76^{b}	2.98±0.85^{ab}
		FT	2.88±0.99^{b}	3.63±0.99^{a}	2.42±1.11^{c}
Overall (%)			**21.61±5.3^{a}**	**21.67±4.77^{a}**	**18.89±5.86^{b}**

^{abc}= Means with different superscript within the same row for a trait differ significantly (P<0.05), Acro. Swelling= Acrosome swelling, DH = Detached head, MPD= Mid piece drop, BT= Bent tail, CT= Curl tail, FT= Full tail.

Result and Discussion

Table 1 shows the mean values of the morphological defects of semen for the Nigerian indigenous roosters. There were significant ($P<0.05$) differences in all the parameters considered with reference to age and genotypes apart for mid piece drop at 32 weeks. The overall morphological defect shows that the naked neck genotype had the highest abnormal sperm cells of 22.50% at 28 weeks of age while the normal and the frizzle genotype had 21.61 and 21.67% respectively. The acrosome swelling in this result at 24 weeks of age was between 0.89±0.64 to 1.77±0.72% which was in the range reported by (12) for Ross cocks. The percentage of detached head (0.50±0.56% - 5.50±0.60) was high and did not conform to the report by (12) and with those of (1) at all ages for the same genotypes. The percentage of mid piece detachment obtained in this study was similar to those of (12) for indigenous cocks at 30 weeks. However, this result was not in agreement with the report of (1) that reported a higher value using similar type of genotypes but at an age range of 50 – 86 weeks and those of (13) was the authors reported between 6.36 to 11.23% in Nigerian local chickens in two age groups. These variations could thus be as a result of age and strain differences.

Conclusion

The implication of the values obtained for the morphological defects is that the sperm cells have negligible numbers of abnormal or defect cells and is good enough for breeding purpose as it was within the 20 to 22% defect range to qualify the semen as good for breeding or artificial insermiation.

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ABG019: Comparison of the growth patterns of male and female pigeons with the gompertz growth model

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Abstract

This study was conducted to compare the growth patterns of male and female pigeons using the gompertz growth model. Body weight data was obtained using a weighing balance at hatch, 3, 7, 10, 14, 18, 21, 24 and 27 days of age from 192 male and female pigeons from different households in Maiduguri, metropolis. Sexual dimorphism in weight was not observed for the pigeon at all ages studied. Similarly, asymptotic weight was very close for male and female (342.54 vs 340.58 g). They also did not differ in the rate of maturity (0.13). The inflexion age (7.78 v 8 days) and weight (126.05 vs 125.33 g) also varied slightly. The shape of the growth curve was sigmoid for both male and female and did not show much difference. In addition, the gompertz model had high R^2 (0.92 and 0.97 for male and female, respectively) which showed that the model adequately described the growth of male and female pigeons. Thus, it may be concluded that male and female pigeons do not differ in their growth pattern from hatch to 27 days of age.

Keywords: Growth, Gompertz, Models, Pigeons,

Introduction

The pigeon (*Columba livia)* is a relatively under-utilized poultry species and has the potential to contribute to solving the problem of insufficiency of animal protein in the diets of Nigerians. Ekumankama (1) observed that despite all efforts to improve livestock production in Nigeria, animal protein is still in short supply and has become prohibitively expensive. The major protein sources (cattle, sheep and goats) have long generation intervals and require huge capital outlay and large space for rearing. In order to widen the scope of meat supply, relatively underutilized poultry species such as the pigeon should be the focus.

Pigeon farming can be a great source of income to resource poor farmers in developing countries like Nigeria. Adult females start to lay eggs at 5-6 months of age and young ones are suitable for consumption at 3-4 weeks of age. In addition, pigeons are less susceptible to diseases than domestic chickens and the enterprise requires small capital outlay and space to start.

It has been observed that animal growth follows a sigmoid pattern (S-shape), therefore numerous non-linear growth equations have been developed to describe and fit the sigmoid relationship between weight and time in poultry. The commonly used nonlinear growth models are Brody, Bertalanffy, Gompertz, Richards, Logistic, Morgan Mercer Flodine (MMF) and Weibull (2). These curves start at some fixed points, following which growth rate increases up to an inflection point after which it decreases asymptotically to a final value (3). The Richard and Gompertz models have been shown to give good descriptions of growth in species such as cattle, elks, chicken, ostrich, turkey and emus (4).

Growth mathematical functions can be useful for optimizing the management and efficiency of animal production and can be used to relate body weight to age of the animals, to determine efficiency of nutrient utilization, or to predict daily energy, protein, and mineral dietary requirements (5). There is a dearth of Information on the characterization of growth in the pigeon in Nigeria. Therefore, this study was designed to describe the growth of male and female pigeons in Nigeria using the Gompertz model.

Materials and Methods

The study was carried out in Maiduguri Metropolis, Borno State, Nigeria. Maiduguri, the Borno State capital is situated on latitude $11^0 5^{'}$ N, longitude $13^0 09^{'}$ E (Encarta, 2007) and at an altitude of 354 m above sea level. The area falls within the Sahelian region of West Africa, which is noted for great climatic and seasonal variations. It has very short period (3 – 4 months) of rainfall of 645.9 mm/annum with a long dry season of about 8 – 9 months. The ambient temperature could be as low as 20^0C during the dry cold season and as high as 44^0C during the dry hot season. Relative humidity is 45% in August which usually lowers to about 5% in December and January. Day length varies from 11 to 12 hours (6). Body weight on 192 pigeons of both sexes (102 males and 90 females) from different households keeping pigeons were measured with a weighing balance at hatch and three days intervals thereafter till 27 days of age. The pigeons were housed in constructed boxes fixed to high walls and eaves of houses. They were feed grains thrown on the floor in the morning and evenings. The collected data was subjected to analysis of variance with sex as a fixed factor. The model for the analysis was $Y_{ij} = U + S_i + e_{ij}$

Where Y_{ij} =individual observation based on the ij classification

U = overall mean

S_i = effect of sex

e_{ij} = random error

The weight and age data were further fit to the gompertz model given as $Y_x = a \exp(-b\exp(-cx))$

Where: Y_x is the body weight (g) of birds at x days of age; a, b and c are model parameters where a is asymptotic weight when time goes to infinity; b is a scaling parameter (constant of integration), which is related with initial values of Y, and c is relative growth rate. Weight and age at the inflection point (POI) were calculated as IPa = a/e and IPw = b/c, respectively. Maximum incremental rate (Minc) or highest growth rate = c*IPw and e is eulerian number or base of natural logarithm (2.71828).

Curve parameters were obtained with the Levenberg-Marquardt iteration method using the nonlinear regression procedure of Statistix 9.0 software. Goodness of fit for the model was determined by the coefficient of determination (R^2).

Results and Discussion

Means of body weights of male and female pigeons at the different ages are presented on Table 1. There was no significant sex effect on body weights at the different ages. This may indicate that there is no sexual dimorphism in the pigeons at the early ages. This agrees with the report of (7) but contradicts those of (8) who reported significantly heavier males than females at all ages. However, the authors reported an average weight of 12.81 g at hatch which was within the range of 12.73 to 13.51 g reported in this study.

Parameter estimates and their correlation coefficients, goodness of fit criteria and coordinates of inflection points for male and female pigeons as estimated by the gompertz growth model are presented on Table 2. High R^2 (0.92 and 0.97) obtained for both male and female pigeons indicates that the data were

adequately fit by the model. This is further buttressed by their ease of convergence (10 and 8 for male and female, respectively). High R^2 (0.99, 0.99 and 0.98) was also reported by (9), (10) and (11) in chickens, partridges and Japanese quails, respectively. Thus, the model adequately fit the pigeon weight data. In order words, the accuracy of the curve fit was high. Similarly, the curves on Figure 1 showed good fit of the data by the gompertz model for both male and female pigeons with the characteristic sigmoid shape. However, the curve overestimated weight at hatch for the male and early growth period (0 -7 days) for the female.

Asymptotic weight (a) was slightly higher in males (342.54 g) than females (340.58 g). The closeness of the values maybe a confirmation that there is low or no sexual dimorphism in pigeons as reported by (7). They further observed that growth of male and female may be controlled by the same genes. Though no report of asymptotic weight was found in literature, (10) reported higher values for males than females in partridges using the gompetz model while (12) and (11) reported higher asymptotic weights in female Japanese quails than male.

The scale parameter (b) is related to initial weight and was found to be the same for the fitted pigeon data. (13) also reported same values for male and female quails in their study.

Parameter c which describes the earliness or rate of maturity did not differ between males and females (0.13). This may be an indication that male and female pigeons did not differ in their maturation or growth rate. For a given data set, higher c usually indicates a shorter period of growth (early maturity) and results in a lower asymptotic weight. Similarly, (14) reported no difference in parameter c in the Japanese quail however, (11) reported difference in the same parameter for the same species.

The correlation between the growth curve parameters were found negative for a-b, a-c but positive for a-c. This indicates that animals with lower values of parameters b and c usually had higher asymptotic weights. This is consistent with the report of other authors who analysed growth curves in poultry with the gompertz model (13; 11).

Inflexion age and weight of male and female pigeons showed slight variation. The inflexion age for males was 7.78 days with a weight of 126.05 g while for females it was 8 days at 125.33 g. The maximum growth rate for male and female pigeons were 16.39 g and 16.29 g, respectively.

Conclusion

From this study, it can be concluded that the gompertz model adequately described the growth of male and female pigeons. In addition, there is no sexual dimorphism in pigeons and male and female pigeons do not differ in their growth patterns.

Table 1. Means and SE of bodyweights (g) of pigeons as influenced by sex

Age (days)	Male	Female
0	13.51±0.35	12.73±0.77
3	59.80±1.54	56.32±3.31

7	119.96±2.84	110.05±6.10
10	178.90±4.05	169.14±8.73
14	230.11±5.01	215.27±10.79
18	264.47±5.57	260.73±11.98
21	292.56±5.45	292.36±11.74
24	312.12±5.41	307.55±11.66
27	325.14±5.19	313.45±11.18

Means within rows without superscripts are not significantly different

Table 2. Parameter estimates, goodness of fit criteria and coordinates of inflection points for male and female pigeons

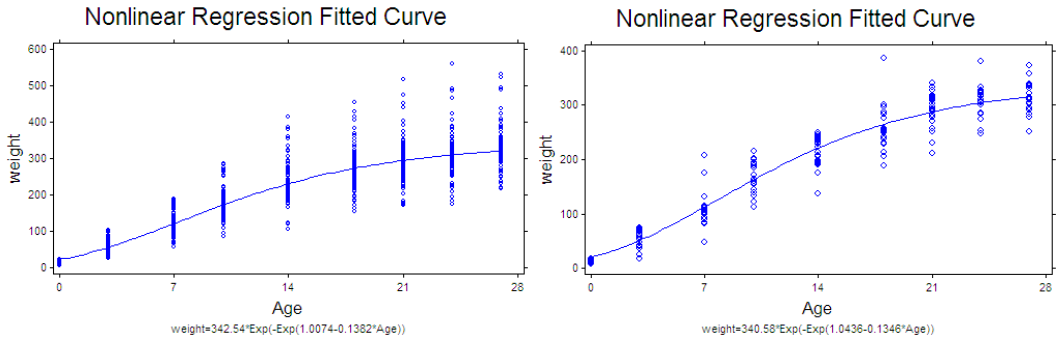
Parameters	Male	Female
a	342.54	340.58
b	1.01	1.04
c	0.13	0.13
R^2	0.92	0.97
Convergence criterion	10	9
IPa (days)	7.78	8
IPw (g)	126.05	125.33
Winc (g)	16.39	16.29
rab	-0.47	-0.49
rac	-0.86	-0.87
rbc	0.78	0.79

a =Asymptote weight — IPa = inflexion age

b = Scale parameter (constant) — IPw = inflexion weight

c =Relative growth rate — Winc= Maximum weight increment

R^2= Coefficient of determination — r = correlation



Male Female

Figure 1. Fitted curves for male and female pigeons

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ABG 020 : **Diversity of growth traits among breeds and sex of weaner Sheep**

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Abstract
Diversity of growth traits among the four breeds and sexes of weaner sheep in Nigeria was studied using data on body weight and linear body measurements which were collected from Bauchi, Katsina, Nasarawa and Anambra States for Balami, Uda, Yankasa and West Africa Dwarf (WAD) sheep, respectively. Effect of breed and sex on body weight and linear body measurements were analyzed using General Linear Model (GLM) procedure of SAS. Breeds of sheep affected ($P<0.01$) body weight and linear body measurements of weaner sheep. Balami and Uda weaners were generally superior ($P<0.01$) to

WAD and Yankasa. Balami differs from Uda only on ear length, which was longer in Balami than Uda. WAD sheep were mostly smaller than the other three breeds of sheep in relation to BWT and linear body measurements. BWT of males were superior ($P<0.01$) to the females. Linear body measurements of males differ from the females only on loin girth and tail length. There is high genetic diversity in growth traits (BWT and linear body measurements) among breeds of weaner sheep in Nigeria. Weaner Balami and Uda sheep had highest body weight among breeds of sheep. The potential for rapid growth of Balami and Uda sheep should be exploited for improved sheep in Nigeria.

Keywords: Growth traits; Diversity; Weaner sheep; Nigeria.
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Introduction

Sheep breeds like other livestock species are recognized as important components of world biodiversity. They are important for socio-economic and food security of many smallholder farming communities. Sheep are also storehouse of genetic materials due to acclimatization to local environmental conditions, nutritional fluctuations and resistance to diseases and parasites (1), (2) and (3). Study of diversity among sheep breeds is necessary in other to prioritize them for conservation purposes. The first step towards an efficient conservation strategy for sheep genetic resources is the proper characterization (4). Accurate classification of weaner sheep population will not only have impact on management of these animals but also reduce mis-identification by livestock traders and help in the conservation of their genetic resources. This study was therefore aimed at evaluating diversity of growth traits among the four breeds and sexes of weaner sheep in Nigeria.

Material and Methods

Data on body weight and linear body measurements of weaner sheep were collected from Bauchi, Katsina, Nasarawa and Anambra States for Balami, Uda, Yankasa and West Africa Dwarf sheep, respectively. Weaner sheep were sampled from two Local Government Areas (LGAs) from each senatorial zones of each of the selected States. The animals were chosen on the basis of distance from each other and abundance of sheep in sampled communities. Thirty-six weaner sheep aged between 6 and 11 months were sampled and used for this study. Documented morphological features described by (5) were used as baseline markers to ascribe sampled animals to a breed. Animals were reared through intensive/extensive management system and originated from different herds. Anatomical reference points described according to the method of (6) and (7) were used for linear body measurements. Body weight (BWT) was determined using an Avery® weighing scale (bathroom weighing scale) measured in kilogram (kg). Linear body measurements were however obtained using a flexible tape rule calibrated in centimeter (cm). The linear body measurements were head length (HL), neck length (NL), height at wither (WH), chest girth (CH), loin girth (LG), back length (BL), leg length (LL), neck circumference (NC), scrotal circumference (SC), ear length (EL) and tail length (TL).

Effect of breed and sex on body weight and linear body measurement were analyzed using General Linear Model (GLM) procedure of SAS (8). The model used was $Y_{ijk}= \mu+B_j+S_k+\varepsilon_{ijk}$, where Y_{ijk}= trait of interest in weaner sheep; μ=population mean; B_i = effect of ith breed (i = 1, 2, 3,4); S_j = effect of jth sex (j = 1, 2); ε_{ijk} = random error within experimental units, independently and identically normally distributed with zero means and constant variance $(0,\sigma^2)$. Means were separated within breed and sex groups using Duncan Multiple Range Test. Standard error of the mean and overall mean for each trait were calculated.

Result and Disscussion

Table 1 showed the effect of breed on body weight and linear body measurements of the four breeds of sheep in Nigeria. Breeds of sheep affected (P<0.01) body weight and linear body measurements of weaner sheep. Body weight (BWT) of weaner Balami (33.16±2.53kg) was similar (P>0.05) to that of weaner Uda (30.30±3.67kg). BWT of Yankasa (20.11±9.85kg) and WAD (9.28±3.45kg) were lower than the values recorded for Balami and Uda. Weaner Balami and Uda sheep had similar values (P>0.05) in all linear body measurements except for ear length (21.65±0.46cm) of Balami which is longer than ear length of Uda (18.75±0.67cm). Least values for head length, neck length, height at withers, chest girth, tail length, ear length and tail circumference were obtained by weaner WAD. Weaner Yankasa and WAD had similar values for loin girth, back length, leg length and scrotal circumference.

In terms of diversity for body weight and linear body measurements; Balami and Uda weaner were generally superior (P<0.01) to WAD and Yankasa. Balami differs from Uda only on ear length, which was longer in Balami than Uda. WAD sheep were mostly smaller than the other three breeds of sheep in relation to BWT and linear body measurements. WAD weaners however had similar (P>0.05) values of loin girth, back length, leg length and scrotal circumference with Yankasa. The result in this study is in line with studies reported by (9) and (10).

Effect of Sex on Body Weight and Linear Body Measurement of Weaner Sheep

Table 2 showed the effect of sex on body weight and linear body measurement of weaner sheep. Sex affected (P<0.01) body weight and linear body measurements of weaner sheep. Body weight (26.10±3.00kg) of males was higher than body weight (20.32±3.77kg) of females. Head length (24.91±0.90cm), neck length (28.85±1.62cm), height at wither (63.16±2.02cm), chest girth (68.37±2.77cm), back length (40.75±1.22cm) leg length (41.03±1.37cm and tail circumference (8.10±0.41cm) of males are similar (P>0.05) to those of female sheep. Loin girth (77.97±4.23cm) and tail length (35.08±1.51cm) of males had higher values than the females (68.39±5.31cm and 32.14±1.90cm, respectively). Scrotal circumference of males was (19.92±1.66cm).

For body weight and linear body measurements of weaner sheep, males BWT were superior (P<0.01) to the females. Linear body measurements of males differ from the females only on loin girth and tail length. The result in this study is similar with what was recorded in the previous works of (9), (11) and (12). Consistent superiority of male sheep over females had been reported by (13) and (14). The possible reason for higher BWT and linear body measurement for males could be attributed to differences in the inherent genetic and gene-by-environment differences in skeletal size and or body mass and hormonal action which lead to differential growth rates.

Table 1: Effect of Breed on Body Weight and Linear Body Measurement of Weaner Sheep

	Breeds						
Variables	Balami	Uda	WAD	Yankasa	Mean	SEM	LOS
N	9	7	8	7			
BWT(kg)	33.16±2.53 [a]	30.30±3.67 [a]	9.28±3.45[c]	20.11±9.85[b]	26.58	2.49	**
HL(cm)	28.70±0.76 [a]	27.46±1.10 [a]	19.05±1.03[c]	21.19±2.95[b]	25.87	0.90	**
NL(cm)	33.43±1.36 [a]	32.31±1.98 [a]	21.17±1.87[c]	25.16±5.32[b]	29.94	1.30	**
HW(cm)	76.40±1.70 [a]	74.86±2.47 [a]	42.37±2.33[c]	54.99±6.64[b]	66.81	2.90	**
CG(cm)	81.06±2.33 [a]	78.71±3.39 [a]	48.62±3.19[c]	56.97±9.20[b]	71.84	2.90	**
LG(cm)	88.98±3.56 [a]	89.60±5.17 [a]	55.93±4.87[b]	58.21±13.89[b]	80.68	3.62	**

BL(cm)	46.85±1.02 [a]	45.56±1.49 [a]	32.56±1.40[b]	33.93±3.10[b]	42.65	1.33	**
LL(cm)	47.14±1.16 [a]	45.10±1.68 [a]	31.92±1.58[b]	34.68±4.51[b]	42.65	1.41	**
TL(cm)	43.97±1.27[a]	45.93±1.85 [a]	17.01±1.74[c]	27.53±4.96[b]	37.26	2.36	**
EL(cm)	21.65±0.46 [a]	18.75±0.67[b]	7.19±0.63[d]	12.27±1.80[c]	16.90	1.15	**
TC(cm)	9.80±0.35 [a]	9.10±0.50 [a]	5.55±0.47[c]	6.69±1.35[b]	8.52	0.40	**
SC(cm)	25.44±1.77 [a]	24.25±2.66 [a]	15.00±2.38[b]	15.00±5.32[b]	21.89	1.57	**

N = Number of weaner sheep, BWT=body weight, HL= Head length, NL = Neck length, HW= Height at withers, CH =Chest girth, LG =Lion girth, BL=Back length, LL= Leg length, TL= Tail length, EL=Ear length, TC=Tail circumference, SC=Scrotal circumference, WAD=West African Dwarf, SEM=Standard error of mean, LOS=Level of significant

Table 2: Variation in body weight and linear body measurements between sexes of weaner sheep

	Sex				
Variables	Female	Male	Mean	SEM	LOS
N	12	24			
BWT(kg)	20.32±3.77[b]	26.10±3.00 [a]	26.58	2.49	**
HL(cm)	23.89±1.23 [a]	24.11±0.90 [a]	25.87	0.90	NS
NL(cm)	27.18±2.03 [a]	28.85±1.26 [a]	29.94	1.30	NS
HW(cm)	61.15±2.54 [a]	63.16±2.02 [a]	66.81	2.90	NS
CG(cm)	64.31±3.48 [a]	68.37±2.77 [a]	71.84	2.98	NS
LG(cm)	68.39±5.31[b]	77.97±4.23 [a]	80.68	3.62	**
BL(cm)	38.60±1.53 [a]	40.75±1.22 [a]	42.65	1.33	NS
LL(cm)	38.39±1.72 [a]	41.03±1.37 [a]	42.65	1.41	NS
TL(cm)	32.14±1.90[b]	38.08±1.51 [a]	37.26	2.36	**
EL(cm)	15.24±0.69 [a]	14.70±0.55 [a]	16. 90	1.15	NS
TC(cm)	7.47±0.52 [a]	8.10±0.41 [a]	8.52	0.40	NS
SC(cm)	-	19.92±1.66	21.89	1.57	

N = Number of weaner sheep, BWT=body weight, HL= Head length, NL = Neck length, HW= Height at withers, CH =Chest girth, LG =Lion girth, BL=Back length, LL= Leg length, TL= Tail length, EL=Ear length, TC=Tail circumference, SC=Scrotal circumference, SEM=Standard error of mean, LOS=Level of significant

Conclusion And Application

There is high genetic diversity in growth traits (BWT and linear body measurements) among breeds of weaner sheep in Nigeria. Weaner Balami and Uda sheep had highest body weight (33.16±2.53kg) among breeds of sheep. The potential for rapid growth of Balami and Uda sheep should be exploited for improved sheep in Nigeria.

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ABG: 021: Prediction of body weight from linear body measurements in matured female West African dwarf goats in humid tropics

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Abstract

The aim of this study was to determine the relationship between body weight and linear body measurement, which included heart girth(HG), body depth (BD), body length (BL), rump height (RH) and height at wither (HAW) in adult female West African dwarf goats (WAD). A total of 212 adult female WAD goat's body weight and body measurements (HG, BD, BL, RH and HAW) were used to develop the stepwise multiple regression equations. The results showed that average BWT, HG, BD, BL, RH and HAW were 18.042kg, 23.993cm, 27.735cm, 24.466cm, 19.374cm and 17.481cm respectively. Prediction of body weight based on heart girth alone or combined with other body measurement had higher coefficient of determination (R^2) and had lower residual mean square (MSE). This suggests that estimation of body weight is more precise when prediction is based on heart girth alone or combination with other linear measurements in adult female West African dwarf goats.

Key words: WAD goat, Body weight, Linear Body Measurements, Regression, Prediction Equation
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Introduction

The main purposes of animal breeding practices are to improve traits of economics values; body weight being an important economic trait in the selection of animals demands an accurate estimation to enhance livestock breeding and production. Furthermore, knowledge of animal live weight is an important tool for

farmers in making decisions, such as estimation of market prices for live animals, determining correct dosages in drug administration, determining animal's feed requirements for growth, maintenance, and production '1'. The conventional method of estimating live weight is the use of weighing scale/ balance. However, in the rural communities under field condition where the goats are kept for commercial purposes, these scales are not in use partly due to cost, labour and technicality involved in the use of weighing scales. This has led to difficulty in live animal marketing in relation to price setting. Nevertheless, there is need to estimate live weight of animals especially goats from simple and easily measurable morphological traits such as linear body measurements. '2' indicated that different models might be needed to predict body weight in different environmental conditions and breed. The use of linear body measurements in estimating live weight in goats has been reported by several authors '3, 4, 5'. Most of these reports are however limited to research institutes without major effect on the goat based population. Therefore, the aim of this study was to establish regression equation models that could be potentially used to predict body weight in West African dwarf female goats under field conditions.

Materials and Methods

Study Location

The study was carried out in Obio Akpa community in Oruk Anam LGA of Akwa Ibom State, South-South Nigeria. 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%. It is in the tropical rainforest zone of Nigeria, '6'.

Data collection methods

A total of 212 West African dwarf mature female goats of ages 10 – 36 months were examined for their body weight and linear body measurements, which included Body length (BL), Heart at wither (HAW), Rump height (RH), heart girth (HG) and Body depth (BD). All measurements were done early in the morning before the animals were released for grazing. All animals were under semi-intensive system of management. The animals were measured in their standing position under field conditions using flexible tape, as previously described for goats '7, 8'. Body weight was measured using a measuring scale in kg. Body Length (distance from the occipital protuberance to the base of the tail), Height at Withers (distance from the ground to the withers), Heart girth (circumference of the chest), Rump height (distance from the ground to the rump) and Body Depth (circumference of the region immediately after the hind leg towards the abdomen), all in centimeters.

Statistical analysis: The data obtained were analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0 '9'. Stepwise multiple regression analysis was used by including the different linear measurements individually and collectively, to identify the best predictor variable for estimating the body weight. Body weight and regression equation was compared based on coefficient of determination.

The full regression model of the measurements (all the five linear body measurements) was defined as:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$

Where, *Y = dependent variable (body weight), a = intercept, b's = regression coefficients, X's = independent variables (HG, BD, BL, RH and HAW).*

Results and Discussion

Body weight and body measurements

The live body weight and body measurements (heart girth, body depth, body length, rump height and height at wither) are presented in Table 1.The result indicate average body weight to be 18.042kg while linear body measurements were 23.993cm, 27.735cm, 24.466cm and 19.374cm for heart girth, body depth, body length, rump height and height at wither respectively.

Table 1: Summary statistics for body weight (kg) and linear body measurements (cm)

Variables	No	Min	Max	Means	S.E	SD

BWT	212	13.00	34.00	18.042	0.495	7.219
HG	212	16.00	31.00	23.993	0.194	2.826
BD	212	19.00	36.00	27.735	0.259	3.781
BL	212	17.00	32.50	24.466	0.178	2.559
RH	212	14.00	23.50	19.374	0.146	2.131
HAW	212	11.50	21.50	17.481	0.131	1.917

BWT-Body weight, HG-heart girth, BD-body depth, BL-body length, RH-rump height, HAW- height at withers, Min- minimum, Max-maximum, S.E-standard error, SD-standard deviation

Prediction of Body Weight from Body Measurements:

Regression equation which predict body weight (dependent variable) from linear body measurement (HG, BD, BL, RH and HAW), residual mean square and coefficient of determination are shown in table 2. Coefficient of determination was highest in the model using HG (0.719), followed by BD and BL which were 0.649 and 0.559 respectively. While regression model constructed by using HAW was 0.387 and body length (RH) was 0.487. Residual mean squares were found to be 25.325, 30.319 ,36.036, 39,950 and 44,526 for HG, BD, BL. RH and HAW respectively. It was observed that as coefficient of determination increased, the residual mean square decreased. This findings is in consonance with reports of '10,11' .

Table 2: Regression of body weight on body measurements

	Intercept		Regression	coefficient					
PREDICTION EQUATIONS	a	b1	b2	b3	b4	b5	MSE	R^2	P-value
$Y=a+b_1 x_1$	-26.004	1.836	-	-	-	-	25.325	0.719	0.000
$Y=a+b_2 x_2$	-16.324	-	1.239	-	-	-	30.319	0.649	0.000
$Y=a+b_3 x_3$	-19.904	-	-	1.551	-	-	36.036	0.559	0.000
$Y=a+b_4 x_4$	-13.927	-	-	-	1.650	-	39.950	0.487	0.000
$Y=a+b_5 x_5$	-7.444	-	-	-	-	1.458	44.526	0.387	0.000
$Y=a+b_1 x_1+b_2 x_2$	-26.247	1.502	0.298	-	-	-	25.067	0.724	0.000
$Y=a+b_1 x_1+b_3 x_3$	-31.590	1.543	-	0.515	-	-	24.325	0.733	0.000
$Y=a+b^1 x_1+b_4 x_4$	-25.234	1.897	-	-	0.115	-	25.416	0.719	0.000
$Y=a+b_1 x_1+b_5 x_5$	-28.527	1.755	-	-	-	0.255	25.258	0.721	0.000
$Y=a+b_2 x_2+b_3 x_3$	-27.059	-	0.935	0.783	-	-	27.609	0.689	0.000
$Y=a+b_2 x_2+b_4 x_4$	-28.211	-	0.889	0.740	0.180	-	27.659	0.691	0.000
$Y=a+b_2 x_2+b_3 x_3+b_4 x_4+b_5 x_5$	-28.531	-	0.890	0.731	0.139	0.078	27.781	0.692	0.000
$Y=a+b_1 x_{1+} b_2 x_2+b_3 x_3+b_4 x_4+b_5 x_5$	-31.308	1.444	0.239	0.492	0.469	0.293	24.073	0.741	0.000

R^2-Coefficient of determination, MSE- Residual mean square, X_1- Heart girth, X_2-Body depth, X_3-Body length, X_4-Rump height, X_5- HAW.

When two independent variables were included in the model, the equations with heart girth as one of the independent variable was observed to be higher in R^2 value (0.724, 0.733, 0.719 and 0.721) for equations having HG and BD, HG and BL, HG and RH, HG and HAW respectively. The R^2 value was lower in the models combining BD and BL, BD, BL & RH and BD, BL, RH and HAW which were 0.689, 0.691 and 0.692 respectively. The residual mean squares were also found to be lower in equations predicting with heart girth as one of the independent variable, which implies that the variation in body weight was

explained to a large extent by heart girth which is in line with a number of reports '12,13'. The results also indicated a trend of increments in R^2 value as the number of variable increased, '2' noted that anyone of R^2 or MSE may be confidently applied to investigate the fitting state of simple and multiple regression models to actual data for estimation of body weight in small ruminant. Several reports indicates that HAW and RH are limited in their values as predictors of body weight in goats, '10'

Conclusion

The study has revealed that estimation of the body weight is more accurate when prediction is based on heart girth alone or combination with other body measurements in adult female West African dwarf goats.

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ABG 022: Some factors affecting preweaning milk consumption of dairy calves

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Abstract

This study was carried out to evaluate the effects of genotype, sex, birth weight and weaning weight on preweaning milk consumption of Friesians cattle and their F_1 and F_2 crosses. The data used were obtained from the West African milk company-Integrated dairy farm, Vom-Jos, Plateau State. The data were subjected to analysis of variance using the general linear model, and Duncans multiple range tests were used to determine the differences between means. Milk consumption were found to differ significantly ($P<0.001$) among genotypes, sex and birth weight ($P<0.05$) but not in weaning weight. For better performance there is the need for improved management practice such as proper management. This could make animals express their true potentials.

Key Words: Genotype, Sex, Birth Weight, Weaning Weight, Milk Consumption
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Introduction

There are several factors that have been reported to affect milk consumption in cattle, among whichis weight of the calves, genotype, diseaseand differences in body weight of calves. Effect of weight

of calves on milk consumption may be responsible for low milk consumption of indigenous breed that are known to be light breed (1).

(2) reported that cows with heavier body weight at parturition gave birth to heavier calves. (3) and, (4) reported high genetic correlation between cow longevity and traits describing udder characteristics. (5) reported that 100% Friesian consumed more of milk than 75% Friesian while 50% Friesian consumed the least. This has been attributed to large body size of the Holstein than the local or crossbreds (6). The lager the cow, which correlates to body size, the lager the uterine capacity, birth canal, bigger calf, faster growth rate and more milk consumption (7).The objective of the study wasto assess the influence of genotype, sex,birth and weaning weights, on milk consumption of Friesian and Friesian white Fulani F_1 and F_2 crosses.

Materials and methods

The data used in this study were obtained from the West AfricanMilk Company – Integrated Dairy Farm, Vom- Jos, Plateau state.

The breeds on the farm are the Friesian, the white Fulani and their crosses. The crossbred genotypes are 50 and 87.5 % Friesians. The husbandry system on the farm is semi intensive and the farm land has been partitioned into paddocks ranging in size from 1.2 to 7 hectares. The cows were machine milked twice daily at 0600 hours and 1500 hours.The calves were separated from their dams 3 days after calving and then held in individual stalls where they were bucket fed a known quantity of fresh whole milk.

The data collected for purpose of this study incude:genotype, birth weight, sex, weaning weight daily and total milk consumed by each calf and subjected to analyzed using the statistical package of SAS. They were subjected to analysis of variance using the general linear model as follows:

$$Y_{ijlm} = u + G_i + S_j + B_i + W_m + (GB)_{il} + (SB)_{ji} + e_{jkm}$$

Where Yijlm = m^{th} observation fori^{th} genotypeof the jth sex among the kth birth weight and the I^{th}weaning weight.Where:

u	=	overall mean
G_i	=	effect of the i^{th}genotype
S_j	=	effect of the jth sex calf
B_i	=	effect of the kth birth weight
W_l	=	effect of the L^{th}weaning weight
$(GB)_{il}$	=	interaction effects of the i-th genotype k^{th}birth weight
$(SB)_{ji}$	=	interaction effect of the jth season k^{th} birth weight

e_{ijlm} = error term.

Duncans Multiple range tests was used to determine the differences between means.

Results and Discussion

The least squares means ± standard error of milk consumption of dairy calves by genotype, sex, birth weight and weaning weights are presented inTable 1. The result shows significant difference (P<0.001) among genotype, sex, birth weight and weaning weight (P>0.05).

The result shows that the 100% Friesian consumed more of milk (384.24 ± 4.93) than 75% Friesian (370.066.51), while 50 % Friesian consumed the least (350.71 ± 6.99). This result is in agreement with the findings of (8) who reported that Holstein calves consumed more milk than Hereford and Hereford-Holstein crossbreds due to larger body size. Similar results of local African calves consuming less milk as compared to Angus and Brangus calves was reported by (9).This has been attributed to large body size of exotic breed. The lager the cow, which correlates to body size, the lager the uterine capacity, birth canal, bigger calf, faster growth rate and more milk consumption (7). The milk consumed by Friesian calves in this study is lower than those reported for Hereford and their crossbreds in U.S.A (5). This may probably due to strain and environmental differences.

The effect of sex on milk consumption shows that males consumed more milk than their female counterparts. The males consumed kg, while the females consumed 358.75 his could be due to the fact that males are heavier than the females and it has been reported that the heavier they are, the more milk they consumed. The result of this study is in agreement with the findings of (10) on beef cattle. The result is however different from those of (11) and Reynolds (1976)who reported no sex effect on calves growth and milk consumption.

The effect of birth weight of calves on milk consumption was significant (P<0.05).The result shows that milk consumption increased with increasing birth weight of calves, it was lowest in calves with 25 kg birth weight, and highest in calves greater than 47 kg birth weight (396.31±12.13kg)However, there was no significant difference in milk consumption among calves of birth weights of ≤ 25 kg and 39 kg. **(1) reported that differences in body weight of calves affect milk consumption. They reported that about 20 to 30 percent of the variation in milk consumption is explained by variation in body weight**

The effect of weaning weight of calves on milk consumption was significant (P<0.05). The result shows that calves with weaning weight greater than or equal to 91 kg consumed more milk (373.19) than those with weaning weights of 70 kg to 90 kg. The result shows that maternal influence on growth in relation to milk consumption seems to be less or insufficient in calves with weight of 70- 90 kg.

Table1: **Least square means± standard error of milk consumption (kg) of calves by genotype, sex, birth, and weaning weight**.

Variable	Milk Consumed(kg)	Daily Milk Consumption
Overall Mean	370.616±3.453	6.62±0.06
Genotype ******		
50% Friesian	350.71±6.99^{c}	6.26± 0.12^{c}
75% Friesian	370.06	6.61± 0.12^{b}
100% Friesian	384.24±4.93^{a}	6.86± 0.18^{a}
Sex **		
Male	384.54±5.23^{a}	6.87± 0.09^{a}
Female	358.57±4.58^{b}	6.40± 0.08^{b}
Birth weight (kg)*	*	
≤25	355.68±5.09^{c}	6.35± 0.09^{c}
26-32	368.82±6.10^{bc}	6.59± 0.11^{bc}
33- 39	373.49±8.54^{bc}	6.67± 0.15^{bc}
40-46	388.14±13.19^{ab}	6.93± 0.24^{ab}
≥47	396.31±12.13^{a}	7.08±0.22^{a}
Weaning weight (kg)**		
≤70	363.43±7.83^{b}	6.49± 0.14^{b}
71-76	355.73±9.25^{b}	6.35± 0.17^{b}
77-83	355.43±7.15^{b}	6.35± 0.13^{b}
84-90	363.65±7.39^{b}	6.49± 0.13^{b}
≥91	387.91±6.64^{a}	6.91± 0.12^{a}

abc = means within subsets in a column withdifferent superscripts are statistically significant*=P<0.05

Interaction effects between variables

The least square means± standard error of milk consumption of dairy calves by sex and birth weight, and genotype and birth weight interactions are presented in Table 4.2. The result shows significant difference (P<0.001) among sex x birth weight interaction as well as genotype x birth weight

interaction. The result shows a trend where the heavier the weight of the male calves, the more the milk consumption. Contrarily in the female calves, the lighter the birth weights the more the milk consumption. Milk consumption of male calves increased with increasing birth weight but decreased with increasing birth weight of female calves. Dams weight at calving may also influence birth weight and pre-weaning growth rate of the calf..(2) reported that cows with heavier body weight at parturition gave birth to heavier calves. The interaction effect of genotype x birth weight shows that milk consumption increase with increasing birth weight in 50% and 75% Friesian. In 100% Friesian however, milk consumption decreased with increasing birth weight**.**

Table 2: Least squares means± standard error of milk consumption (kg) of calves by sex x birth weight and genotype x birth weight interactions

Variable		Milk Consumed (kg)	Daily Milk Consumption
Overall Mean		370.616±3.453	6.62±0.06
Sex x birth weight		***	***
Male			
	≤ 25	369. 933 ± 15.98^{c}	6.61± 0.29^{c}
	26 – 32	379.431 ± 7.99^{c}	6.76± 0.14^{c}
	33 – 39	387.160 ± 9.79^{b}	6.91± 0.17^{b}
	40 – 46	387.458 ± 12.84^{b}	6.92± 0.23^{b}
	≥ 47	415.867 ± 19.71^{a}	7.43± 0.35^{a}
Female			
	≤ 2.5	449.800 ± 18.25^{a}	8.03± 0.33^{a}
	26 – 32	345.561 ± 6.58^{b}	6.17± 0.12^{b}
	33 – 39	346.587 ± 7.67^{b}	6.19±0.14^{b}
	40 – 46	349.306 ± 11.27^{b}	6.24± 0.20^{b}
	≥ 47	323.556 ± 17.56^{c}	5.78± 0.31^{c}
Genotype x birth weight		******	
50% Friesian	≤ 2.5	341.333 ± 23.56^{c}	6.09± 0.42^{c}

	26 – 32	342.031 ± 7.56[c]	6.11± 0.14[c]	
	33 – 39	364.139 ± 14.16[b]	6.50± 0.25[b]	
	40 – 46	385.000 ± 40.80[a]	6.88± 0.73[a]	
75% Friesian	≤ 25	332.000± 28.85[c]	5.92±0.52[c]	
	26 – 32	375.966± 10.06[b]	6.71± 0.18[b]	
	33 – 39	365.841±9.17[b]	6.53± 0.16[b]	
	40 – 46	362.250 ± 17.67[b]	6.47± 0.32[b]	
	≥47	450.000± 40.80[a]	8.04± 0.73[a]	
100% Friesian	≤ 2.5	482.133 ±15.98[a]	8.61±0.29[a]	
	26 – 32	396.138 ± 9.31[b]	7.07± 0.17[b]	
	33 – 39	364.454 ± 8.53[c]	6.51± 0.15[c]	
	40 – 46	367.512 ± 8.38[c]	6.56± 0.15[c]	
	≥ 47	353.653 ± 13.54[c]	6.32± 0.24[c]	

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abc =means within subset in column bearing different , superscripts are statistically significant ***=P<0.001

Conclusions

The result from this study shows that the effect of genotype sex, birth weight and weaning weight on milk consumption of Friesian and their F_1 & F_2 crosses varies significantly. Milk consumption increased with increasing Friesian genotype, being lowest in 50% and highest in 100% Friesian. Male calves consumed more milk during the preweaning phase than the Females. Milk consumption of Friesian and crosses increased with increase in birth weight, it was lowest in lighter calves and highest in heaviest calves. Milk consumption also increased with increasing weaning weight of calves. There is a need for further studies in aspect of dairy milk production in the tropic so as to exploit the milk production potentials of cattle to express their full potentials.

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ABG 023: **Carcass characteristics of Turkey (*Meleagris Gallopavo*) as influenced by Breed and Sex**

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ABSTRACT

A study was conducted to assess the effect of breed and sex on haematological parameters of Turkey, the data was generated from 100 Turkeys which comprised of 50 Norfolk breed and 50 Mammoth breed. Carcass parameters considered are live weight, carcass weight, dressed weight, thigh weight, breast weight, wing weight, back weight, drumstick weight and neck weight. Measurement of these parameters was taken at 20 weeks. The results obtained for live weight at 20 weeks were 3.7kg and 3.3kg for Norfolk and Mammoth turkey breeds, respectively. Males were found to be significantly heavier (4.2kg) than the females (2.8kg). Result of carcass and dressed weights were also significantly different, with the carcass weight of the Norfolk (3.2kg) being higher than that of Ma mmoth (2.8kg). Other carcass characteristics showed no difference in the two breeds. However, sexual dimorphism affected all carcass traits except breast weight. This study revealed that meat proportion increased and bone percentage decreased significantly for Norfolk than for Mammoth breed and in males than the females at 20 weeks of age.

Keywords: Genotype, sexual dimorphism, carcass, turkey, Zaria.

INTRODUCTION

Growth is a fundamental property of biological systems and it can be defined as an increase in the number of cells in the body size/unit of time (1). Reports on body weight and some linear body measurement in

broiler chickens have been documented and found useful in quantifying body size and shape (2; 3). Body length and chest girth, among others, had been used by several authors in predicting body weights of chickens (2; 3), sheep (4), goats (5) and cow (6). The objective of this study is to apply body volume (BV) formula and assess its efficacy in predicting live weight in Arbor Acre and White Rose broiler breeds.

MATERIALS AND METHODS

Site location

The experiment was conducted at the teaching and research farm of the Department of Animal Science, Ahmadu Bello University (ABU) Zaria, Nigeria. Zaria is located within the Northern Guinea Savannah zone of Nigeria, at a longitude of 7038'8'East, Latitude of 1109'45"North-East of the equator and at altitude of 610 m above sea level (7). The climate is characterised by a well defined dry and wet seasons. The dry season lasts from mid October to April and consists of a period of low relative humidity with strong cold and dry weather followed by over-casting fine dust particles. Detailed description of the site had been given by (8).

Experimental chickens and management

A total of 120 day-old Arbor Acre (n=60) and White Ross (n=60) broiler chickens were obtained for the purpose of this study. They were brooded and reared in deep litter pens from 0-8 weeks of age. Their individual live body weights and some linear body measurements (body length and chest girth) were taken. They were fed similar ration containing 22% CP and 2900kcal ME at the starter phase (0-4 weeks) and 20% CP during the finisher phase (5-8 weeks). Feed and clean drinking water were provided *ad-libitum* throughout the experimental period. Routine medication was adequately adhered-to as preventive measures.

Parameters considered and data collection

Body weight was taken using a sensitive digital weighing scale (g) at day-old and weekly thereafter. Feed intake was calculated as the difference between feed offered and feed left-over (g). Body length was measured in centimeters (cm) from the base of the neck to the uropygial gland at the base of the tail. Chest girth was measured also in (cm) across the keel from one side of the armpit to the other armpit.

Calculation of body volume

The bird's body volume (BV) was estimated by cylinder volume. Theoretically, a circumference of a circle (C) was calculated as follows: $C = 2\pi r$, where; $\pi = 3.14$ and r = radius. Sized squared area (A) of a circle is given by: $A = \pi r^2$ Or $A = \pi\{(½\ C)/\pi\}^2$. It was also obtained that cylinder volume (V) could be derived by the following formula: $V = \pi r^2 h$, where; h = height (length) of cylinder. The detailed formula was as described by (6). All measurements were taken in the morning before birds were fed.

Prediction equation and statistical model

To predict live body weight from body measure (body length, chest girth and body volume), a regression analysis was used as follows: $Y_{ij} = a_i + bX + e_{ij}$ where; Y_{ij} is the dependent variable (bird's body weight), a_i is the intercept, and X is the independent variable (body length, chest girth or body volume), e_{ij} was random error.

The model considered was as follows: $Y_{ij} = \mu + \alpha_i + e_{ij}$ where; Y_{ij} was the record of body weight and body measurement of each bird, μ was overall mean, α_i was the fixed effect of ith age of the bird and e_{ij} was random error associated with record of each bird. The age group was considered fixed at 4, 6 and 8 weeks respectively.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using (9) and significant differences between means were determined by Duncan Multiple Range Test (DMRT) according to (10).

RESULTS AND DISCUSSION

Growth performance

The least square means for Body weight (BW), chest girth (CG), body length (BL) and body volume (BV) in two broiler breeds at various ages is presented in Table 1. The results showed that age significantly ($P<0.05$) affected BW at all ages, where the White Rose breed consistently weighed heavier than Arbor Acre. (1) worked on Anak and Hubbard breeds of broiler chickens and reported that breed is responsible for variation in body weight with regards to age. Similarly the BV of White Rose breed is significantly ($P<0.05$) higher than that of Arbor Acre at week 2. However, no significant difference ($P>0.5$) was obtained for the other parameters investigated across age.

Correlation among growth traits

Coefficient of correlation among tested parameters is given in Table 2. The values obtained in this study were low and insignificant ($P>0.05$). Result from other studies revealed high coefficients of correlation for similar traits (11; 4). This could be attributed to dissimilar population of animals used, method of

computation and sampling error. However, all the values recorded in this study were positive indicating that selection for any of them will lead to correlated response in the others.

Table 1: Least square means (±SE) of body weight, body volume and some linear body traits in Abor Acre and White Rose broiler chickens

		Age (Weeks)			
Breed	Variable	2	4	6	8
	BW (g)	344.96±14.16[b]	1279.17±27.13[b]	2373.79±38.66[b]	3216.21±42.21[b]
Arbor Acre	CG (cm)	18.37±0.16	25.20±0.13	27.91±0.11	28.66±0.19
	BL (cm)	12.33±0.08	15.00±0.12	15.62±0.14	17.87±0.15
	BV (dm^3)	22.82±3.22[b]	26.07±3.56[b]	28.24±3.74[b]	31.55±3.32[b]
	BW (g)	351.16±14.35[a]	1312.25±25.33[a]	2497.50±37.24[a]	3244.88±42.13[a]
White Rose	CG (cm)	18.79±0.24	24.75±0.18	27.25±0.23	28.58±0.16
	BL (cm)	12.66±0.08	14.79±0.19	15.83±0.24	17.62±0.21
	BV (dm^3)	23.59±4.01[a]	27.58±3.33[a]	29.91±3.66[a]	33.83±3.21[a]

[a,b] = Means with different superscripts within the same column for a particular variable are significantly different (P<0.05), BW=body weight, CG=chest girth, BL=body length, BV=body volume,

Table 2. Coefficient of correlation for body traits in Abor Acre and White Rose breeds of broiler chickens

	BW2	BW4	BW6	BW8	BL2	BL4	BL6	BL8	CG2	CG4	CG6	CG8
BW2	1											
BL2	0.154				1							
CG2	0.482				0.373				1			
BW4	0.068	1			0.085				0.139			
BL4	0.062	0.218			0.099	1			0.026			
CG4	0.371	0.193			0.245	0.403			0.134	1		
BW6	0.199	0.051	1		0.240	0.083			0.231	0.033		
BL6	0.341	0.091	0.284		0.123	0.260	1		0.110	0.266		
CG6	0.181	0.061	0.287		0.112	0.393	0.473		0.042	0.169	1	

BW8	0.021	0.186	0.400	1	0.033	0.025	0.044		0.116	0.019	0.260	
BL8	0.137	0.007	0.077	0.006	0.108	0.300	0.076	1	0.078	0.055	0.158	
CG8	0.438	0.189	0.015	0.224	0.179	0.059	0.011	0.564	0.056	0.050	0.355	1

Prediction of live body weight using body volume

Table 3 shows the regression model for predicting live weight from chest girth, body length and body volume in Abor Acre and White Rose breeds of broiler chickens. The values of coefficient of determination (R^2) obtained for body volume (BV) were higher (0.96–0.98) than those obtained using chest girth (0.56–0.73) and body length (0.81–0.88). This indicated that BV better predicted live body weights at various ages of Abor Acre and White Rose breeds than BL and/or CG. (3) worked on prediction equation in two broiler breeds and reported a high R^2 value of 0.98.

Conclusion

Body volume (dm^3) of Abor Acre and White Rose breeds of broiler chickens was found to be the best predictor of live weight with coefficient of determination (R^2) ranging from 0.96–0.98. This high R^2 d value can be interpreted to mean that 96% of the changes in the body weight in the two breeds were as a result of changes in body volume, while the remaining 4% were due to other unknown factors.

T**able 3. Regression models for predicting live weight from chest girth, body length and body volume in Abor Acre and White Rose breeds of broiler chickens**

Age (Weeks)	Dependent variable (Y)	Independent variable (X)	Regression equation	R^2 value
2	Live weight	BL	12.73 (0.267) + 6.87	0.84
		CG	18.37 (0.493) + 5.33	0.56
		BV	12.82 (1.749) + 7.94	0.97
4	Live weight	BL	15.00 (0.317) + 5.55	0.79
		CG	25.20 (0.511) + 4.87	0.61
		BV	16.77 (0.956) + 6.48	0.96

		BL	15.62 (0.590) + 5.36	0.88
6	Live weight	CG	27.91 (1.133) + 4.75	0.73
		BV	19.64 (1.434) + 7.13	0.98
		BL	17.87 (0.836) + 4.99	0.81
8	Live weight	CG	28.66 (0.493) + 5.18	0.66
		BV	23.55 (1.749) + 6.82	0.97

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ABG 024: Physical Properties of Leathers from Nigerian Goats: Influence of Breed, Sex and Slaughter Age

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Abstract

The influence of breed, sex and slaughter age was examined on the physical properties of leathers of red Sokoto (RS) and Sahel (SH) goats using a total of forty-eight skins. The skins used for the research were obtained in equal age and sex ratios for the two breeds and the experiment was laid out in a completely randomized factorial design. The skins were tanned using vegetable method. The leather properties examined are percentage elongation (PE), force at crack (FC), distension at crack (DC), force at tear (FT) and distension at tear (DT). The result revealed that PE and FT of the leather samples were not influenced ($p>0.05$) by breed. Similarly, age and sex has no effect ($p>0.05$) on the DT of the leathers while age had effect ($p<0.05$) on PE. The higher the age the higher the PE across the two breeds. Male goats had better leathers than female with respect to PE and DC while female goats' leather were better in FC and FT. Leathers from goats of 3 years age group had higher ($p<0.05$) values for PE = 34.75%; FC = 21.56kg; DC = 4.39mm than that of lower age groups in all the parameters except FT of age 1 class (25.84kg). It is concluded that the RS and SH goats of different sex and ages produce leathers of different physical properties. It is therefore recommended that the required properties of leather should determines the choice of age, breed or sex of goats from which skins are collected.

Key words: Leather; Breed; Force; Elongation; Distension.

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Introduction

A typical goat in Nigeria is raised for meat but the availability of the meat processing by-products like skin for leather purpose is inevitable. Nigeria has 53.8 million goats' population (1) which is an indication that with good management, there is higher tendency of getting more goats for slaughter and invariably more skin for leather processing. Since the commodity trade pattern has changed, skin classification and evaluation has therefore become necessary (2). The increase in disposable income has been indicated to be fueling the international demand for high quality leather products, making the market to grow at 3% per annum (3). Thus, there is prospect in channeling the skins of goat to leather production.

The value of goats' leather is ultimately governed by their quality. Earlier research reports indicated that a number of factors influence the characteristics of goats leather. These factors are sometimes linked with breed (4)), conditions of the animal before and after slaughter (5; 6) and alteration to the basic nature of the skins (7). Meanwhile, these factors are limitless and may also include age as well as sex of the animal from which the skin is harvested. This area of research has however received little research attention particularly with respect to Nigerian breeds of goat. Thus, this study is aimed at determining the influence of sex and slaughter age on the physical properties of leather from two Nigerian goat breeds.

Materials and Methods

Sources of Skin: A total of forty-eight fresh skins were obtained from two Nigerian breeds of goat namely Red Sokoto (RS) and Sahel SH) at the point of slaughter. Prior slaughter the animals were aged into three classes (1, 2 and 3 years) using dentition as reported by (8). The skins from each breed were obtained from both male and female animals in equal ratio (4 skins/sex/age group/breed).

Pre-tanning of Skin: The skins were immediately cured after flaying using salt to prevent putrefaction. This was followed by soaking, depilation, liming, de-liming and bating as described by (9).

Tanning of skin: The pelts were subjected to vegetable tanning using derivatives of *Acacia nilotica* - "Bagaruwa".

Experimental design: The experiment was laid out in a 2x2x3 factorial model of Completely Randomized Design as indicated. The factors are breed, sex and age at 2, 2 and 3 levels respectively (Breed: Red Sokoto and Sahel goat; Sex: male and female; Age: 1, 2 and 3).

Data collection and Analysis: After tanning process, samples of the leather were taken to the Quality Control Laboratory of Nigerian Institute of Leather and Science Technology (NILEST) where they were subjected to physical analysis. Data collected on the leather samples are percentage elongation, force at crack (FC), distension at crack (DC), force at tear (FT) and distention at tear (DT). The data generated were subjected to ANOVA using the procedure of (10).

Result and Discussion

Main effect of breed, age and sex on the leather samples used for the experiment was indicated in Table 1. The result indicated that there were significant effects ($p<0.05$) of breed on force at crack (FC), distension at crack (DC) and distension at tear (DT). Leather of Sahel (SH) goat was observed to have higher ($p<0.05$) DC (4.54mm) and DT (5.34mm) than the leather of red Sokoto (RS) red goat. RS leather had 20.78kg as its FC which was significantly higher ($p<0.05$) than 20.36kg observed on SHG. Genotype of the animal is one of the factors influencing some physical properties of its leather (11). Variation in the genetic make-up of RS and SH could therefore be responsible for the observed differences in these parameters. However, the result obtained corroborates the findings of (12) who reported that genotype did

not influence the percentage elongation of sheep leather. The mean percentage elongation obtained for the breeds were however lower than what were reported as acceptable range (40 -80%) by (13) and what were also reported for the two breeds by (4).

Table 1: Main influence of breed, sex and age on physical properties of leathers of two Nigerian goats.

Factors	Parameters				
	PE (%)	FC (kg)	DC (mm)	FT (kg)	DT (mm)
Breed: RS	29.17 [a]	20.78[a]	3.90[b]	25.64[a]	4.68[b]
SH	28.79 [a]	20.36[b]	4.54[a]	25.29[a]	5.34[a]
Sig. test:	NS	*	*	NS	*
Age (yrs): 1	23.75[c]	20.71[b]	4.22[b]	25.84[a]	5.06[a]
2	28.41[b]	19.44[c]	4.03[c]	23.63[b]	5.07[a]
3	34.75[a]	21.56[a]	4.39[a]	26.94[a]	4.90[a]
Sig. test:	*	*	*	*	NS
Sex: Male	35.50[a]	19.49[b]	4.62[a]	23.85[b]	4.96[a]
Female	22.44[b]	21.64[a]	3.81[b]	27.09[a]	5.06[a]
Sig. test:	*	*	*	*	NS

Note: Means with different values for each factor in the same column are significantly different ($p < 0.05$) from one another. PE denotes per cent elongation; FC = force at crack; DC = distension at crack; FT = force at tear and DT = distension at tear.

Slaughter age, as well sex (Table 1) of the goats were observed to have significant effects ($p < 0.05$) in all the examined properties of the leather samples used for experiment except DT. Leathers obtained from goats of 3 years age group were generally noticed to have higher ($p<0.05$) values (PE = 34.75%; FC = 21.56kg; DC = 4.39mm) than that of lower age groups in all the parameters except FT of age 1 class (25.84kg) which was significantly comparable with that of age 3 class (26.04kg). Mean values of FC (20.71kg), DC (4.22mm) and DT (25.84kg) obtained on leathers from age group 1 were significantly higher ($p<0.05$) than the corresponding mean values at age group 2. Leathers of male goats were also observed to be higher ($p<0.05$) in PE and FC than that of female goats' leathers which were comparatively ($p<0.05$) higher in FT and FC. Earlier research indicated that sex (14) and age (15) had effect on the leather properties of animal skin. This is in line with what is observed in the present study. A female animal that has undergone repeated pregnancy has higher tendency of weaker leather for some properties (9) because of distended skins as a result developing foetus. This may account for the differences observed in the present study. However, the previous pregnancy history and management procedures of the animals were considered in this study. The lower values obtained for most these properties can however be improved using chrome tannage (9).

The interactions between breed, slaughter age and sex of the goats from which leathers were collected is presented in Table 2. The interactions between breed and age (BreedxAge), breed and sex (BreedxSex) and breed, sex and age (BreedxAgexSex) were not significant ($p>0.05$) with respect to PE. Similarly BreedxSex was not significant ($p>0.05$) for DT. With respect PE the interaction between the age and sex was significant ($p<0.05$). The PE of male goats' leather slaughtered at age 1 was slightly lower than of age 2 which was also lower than that of age group 3. Leather female goats however had a different pattern of PE as its age increases. The PE of female leathers slaughtered at age 1 was less than that of age 2 which was higher than that of age group 3. The implication of this result is that age, breed and sex have

simultaneous influence on most of the studied leather properties which is in corroboration with earlier report by (13).

Table 2: Interaction effects between the factors used in the analysis of leather traits

Interactions	Parameters				
	PE (%)	FC (kg)	DC (mm)	FT (kg)	DT (mm)
BreedxAge	NS	*	*	*	*
BreedxSex	NS	*	*	*	NS
AgexSex	*	*	*	*	*
AgexBreedxSex	NS	*	*	*	*

Note: * denotes there was significant difference (P < 0.05) between treatment means within the designated interaction. NS denotes no significant difference (P >0.05) between the treatment means within the designated interaction. PE = per cent elongation; FC = force at crack; DC = displacement at crack; FT = force at tear; and DT = displacement at tear.

Conclusion

It is therefore concluded that the RS and SH goats of different sex slaughtered at different ages produce leathers of different physical properties. It is therefore recommended that the required properties of leather should determines the choice of age, breed or sex of the animal from which the skins is collected.

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ABG 025: Prediction of Giant African land snails [*archachatina marginata var. ovum* (pfeiffer, 1858)] body weight using dimensional shell parameters

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Abstract

Measurements of phenotypic traits taken on one hundred (100) adult *Archachatina marginata var. ovum* snails with live weights ranging from 33.1 – 349.0 g sorted out of a base population on the basis of active appearance and lack of injury on the foot and on shells were subjected to simple and multiple regression analyses to establish relevant relationships among the traits. The phenotypic traits measured on each snail included shell length (cm), shell width (cm), aperture length (cm), aperture width (cm), spiral length (cm), spiral width (cm), diagonal length (cm), length between aperture and first spiral (cm), number of whorls and body weight (g). Results from the analyses showed that the regression estimates of parameters and coefficients of determination for the simple linear function had slightly high and a very strong relationship (r_p = 0.89) between body weight and a phenotypic or dimensional shell trait (i.e. shell length). The multiple linear function for predicting body weight using two (shell length and shell width) and four (shell length, shell width, aperture length and aperture width) phenotypic traits showed highly significant ($p<0.01$) and very strong association (r_p = 0.98) and (r_p = 0.99) for two and four traits

respectively. Similarly, the multiple linear function for predicting body weight using three to eight phenotypic traits showed highly significant ($p<0.01$) and very strong relationships ($r_p = 0.99$) between body weight and dimensional shell parameters. When all nine parameters evaluated in this study were fitted into the multiple linear regression function, a perfect relationship ($r_p = 1.00$) was obtained between body weight and the dimensional shell parameters. Coefficient of determination (r^2) results varied from 0.78 to 1.00 %. This range of r^2 indicated that weight can be predicted using the dimensional shell parameters. Weight was more closely predicted when more than two dimensional shell parameters were used to explain the contribution of the independent variables to the prediction of the dependent variable. The r^2 results also revealed that 78 to 100 % of the variability in *A. maginata var. ovum* snails' body weights can be explained by changes in the considered dimensional shell parameters. The results of comparison between the actual body weight and the predicted body weights using the functions showed little or no difference, but 113.55 g and 113.57 g were the closest predicted body weights to the actual body weight (113.58 g). It could therefore be inferred that the linear function with four traits best predicted the live or actual weight of *A. marginata var. ovum* snails. The results of this study also revealed that dimensional shell measurements were closely related to actual or live weights of the snails.

Keywords: *Archachatina marginata var. ovum, body weight, dimensional shell parameters, prediction, snails*

Introduction

The improvement of micro-livestock sub-sector of animal agriculture is of great interest to animal breeders and geneticists in recent years. Snails and other micro-livestock species (grasscutter, rabbit, African giant rat, quail and guinea pig) constitute emerging or new, but rapidly expanding area of animal production and research (1). Ojating (2) stated that snails are the cheapest source of animal protein, especially for rural people. Ibom *et al*. (3) and (4) identified the potentials of snails to bridge the animal protein intake deficit or gap of Nigerians with their characteristics of large number of offspring per snail, large heritable traits, relatively short generation interval, convenience and low-cost of production, low labour requirement, no problem of adaptation in the humid tropics and less bias to snail meat. Snail is rich in protein (88.37%), so it compares well with conventional protein sources such as beef (92.75%), mutton (86.34%), chicken (92.2%), chevon (86.63%), pork (82.42%) and fish (91.99%) (5). This implies that snail (Congo) meat can serve as a substitute for other conventional animal protein sources.

Nigeria is richly endowed with snail breeds (*Archachatina marginata, Achatina achatina, Achatina fulica* and *Limicolaria* species) that are being domesticated and hence produced on large scale in recent times for local consumption and export (4 and 6). Amongst these snail breeds, the farming of *A. marginata* is most common in Southern and Western Nigeria, perhaps because of its bigger size (7). Besides, Akinyemi *et al.* (8) reported that *A. marginata* has the advantage of high adaptability, survivability, high fecundity and prolificacy, fleshier and are hardy in addition to their abundance in Nigeria and along African coast. The *A. marginata* snail breed has two varieties; *A. marginata var. ovum* and *A. marginata var. saturalis* which are similar in various characteristics (meat quality, habitat etc).

Genetic improvement of snails is important in order to increase their contribution to the much needed animal protein in Nigeria. According to (9), one of the prerequisites for genetic improvement is the knowledge of genetic parameters of important economic traits. Body weight (an important economic trait) is the commonly reported measure of size and it has been used by local sellers/buyers and researchers as a parameter for selection (10). On the other hand, (11) reported that since there is relationship between body measurements and live weight, body measurements can be used to predict body weight. In the same vein, (12) reported that the interrelationship existing between body weight and linear body traits of meat animals have found useful application in quantifying productivity and carcass characteristics of animals.

Body dimensions have often been used in estimating body weight and appropriate prizing of meat animals (13, 14). Weight of snails according to (4) can be predicted using phenotypic dimensional shell traits. The author enumerated the phenotypic dimensional shell traits of snails to include shell length, shell width, shell 'mouth' length and shell 'mouth' width. Whereas (15) reported shell length as a better predictor of body weight in growing *A. marginata* snails, (16) reported shell length and shell width as better predictors of body weight in juvenile *A. marginata* snails. However, (17) stated that *in vivo* prediction of carcass components based on a single trait is usually imprecise. The success of a breeder to produce for maximum economic returns relies on ability to establish relationship that exist between identified parameters and an organization of breeding programme to suit a desired aim (18).

There are limited reports on body weight prediction from phenotypic dimensional shell traits of *A. marginata* snails in the literature. This study was therefore designed to derive simple and multiple regression equations in the prediction of body weights of *A. marginata var. ovum* snails.

Materials and Methods

Experimental site: The research was carried out at the Department of Animal Science Laboratory, University of Calabar, Calabar, Nigeria. The area is located between latitudes 4^0 58′ and 15^0 39′N and longitudes 8^0 17′ and 10^0 43′E of the equator and has an annual temperature and rainfall ranges of 25 – 30^0 C and 1260 – 1280 mm respectively (19).

Experimental animals: One hundred (100) adult *Archachatina marginata var. ovum* snails sorted out from a base population purchased from snail vendors in Calabar were used in the study. The live weights of the snails ranged from 33.1 – 349.0 g. Selection of the snails used in this study was based on active appearance and lack of injury on the foot and on shells.

Data collection: Data collected on each snail included shell length (cm), shell width (cm), aperture length (cm), aperture width (cm), spiral length (cm), spiral width (cm), diagonal length (cm), length between aperture and first spiral (cm), number of whorls (counted as number of complete rings on the shell) and body weight (g). Body weight was measured using S. Miller® electronic scale, while the dimensional shell parameters were measured using vernier caliper.

Statistical analysis: Data collected were subjected to simple and multiple regression analyses to establish relevant relationships among the traits investigated using the General Linear Model of (20) procedures. The regression model used for the analysis is:

$$Y = a + b_iX_i + E$$

Where: Y = body weight

a = constant

b_i = regression coefficient of the ith independent variable,

X_i = the value of the independent variable

E = error term

$X_i = X_1 + - - - - + X_9$ (X_1 = shell length, X_2 = shell width, X_3 = aperture length, X_4 = aperture width, X_5 = spiral length, X_6 = spiral width, X_7 = diagonal length, X_8 = length between aperture and first spiral, X_9 = number of whorls)

The goodness of fit (r^2) was tested to determine the contribution of each of the independent variables measured to the prediction of the dependent variable, body weight.

The accuracy of the regression equations were estimated by using residuals (absolute value of the difference between predicted weight by using the developed equations and actual weight measured with the scale).

Results and Discussion

The results of regression equations, correlation coefficients and coefficients of determination relating snails' body weights and dimensional shell parameters are shown in Table 1. The regression estimates of parameters and coefficients of determination for the simple linear function ($Y = – 244.63 + 37.14X_1$) showed slightly high and a very strong relationship ($r_p = 0.89$) between body weight and a phenotypic or dimensional shell trait (i.e. shell length).

The multiple linear function for predicting body weight using two phenotypic traits (shell length and shell width) showed highly significant ($p<0.01$) and very strong association ($r_p = 0.98$). The use of four phenotypic traits (shell length, shell width, aperture length and aperture width) in the multiple linear function to predict body weight also gave highly significant ($p<0.01$) and very strong association ($r_p = 0.99$). Likewise, the multiple linear function for predicting body weight using three to eight phenotypic traits evaluated in this study (Table 1) showed highly significant ($p<0.01$) and very strong relationships ($r_p = 0.99$) between body weight and dimensional shell parameters. However, when all nine parameters evaluated in this study where fitted into the multiple linear regression function, a perfect relationship ($r_p = 1.00$) was obtained between body weight and the dimensional shell parameters (Table 1).

The results of this study contrasted (15) and, (16) who reported that shell length and, shell length and shell width respectively are better predictors of body weight in *A. marginata* snails. The application of four phenotypic traits (shell length, shell width, aperture length and aperture width) best predicted body weight of *A. marginata* snails in this study (Tables 1 and 2). This is in line with (17) who reported that the use of several parameters/traits as independent variables in multiple regression equations gives more accurate and reliable results.

The coefficient of determination (r^2) results varied from 0.78 to 1.00 % (Table 1). This range of r^2 indicated that weight can be predicted using the dimensional shell parameters. Weight is more closely predicted when more than two dimensional shell parameters are used to explain the contribution of the independent variables to the prediction of the dependent variable. The r^2 results also revealed that 78 to 100 % of the variability in *Archachatina maginata var. ovum* snails' body weights can be explained by changes in the considered dimensional shell parameters.

The results of this study are in line with reports by (21) and (22) who reported that snail weight can be predicted using shell parameters.

The results of predicted and actual body weights of *A. marginata var. ovum* generated from Table 1 are presented in Table 2. The results showed that the actual body weight of snails measured with scale was 113.58 g. On the other hand, the predicted body weights of snails using the linear functions ranged from

113.28 g to 113.72 g. A comparison between the actual body weight and the predicted body weights using the functions showed little or no difference. This might be as a result of the positive, strong and closely correlated response of body weight with the phenotypic quantitative traits used in the predictions.

The results in Table 2 showed that 113.55 g and 113.57 g were the closest predicted body weights to the actual body weight. By implication, the linear function with four parameters best predicted the live or actual weight of *A. marginata var*. *ovum* snails (Table 2). The results in Table 2 also revealed that dimensional shell measurements were closely related to actual or live weights of the snails. It could be inferred that snails' age can be predicted by the body weight since both are closely related. Okon *et al.* (23) could not closely predict the body weights *of A. marginata* hatchling (Juvenile) snails using just shell length and shell width. The differences between the results of this study and that in available literature could be due to the effect of strain, variety or size of the snails used, statistical methods used and prevailing environmental conditions.

Ta**ble 1:** Regression Analysis of body weight on other phenotypic traits of *Archachatina marginata var. ovum*

Traits	**Prediction equation**	**r**	**r^2**
BW/SL	$Y = -244.63 + 37.14X_1$	0.89	0.78**
BW/SL, SW	$Y = 283.74 + 18.87X_1 + 47.43X_2$	0.98	0.97**
BW/SL, SW, AL	$Y = 275.828 + 24.672X_1 + 49.60X_2 - 13.099X_3$	0.99	0.98**
BW/SL, SW, AL, AW	$Y = -282.674 + 27.333X_1 + 52.514X_2 - 13.600X_3 - 8.422X_4$	0.99	0.98**
BW/SL, SW, AL, AW, LS	$Y = -287.879 + 21.159X_1 + 44.988X_2 - 17.651X_3 - 9.164X_4 + 26.205X_5$	0.99	0.99**
BW/SL, SWAL, AW, LS, WS	$Y = -289.22 + 20.95X_1 + 38.575X_2 - 26.028X_3 - 5.406X_4 + 43.122X_5 - 10.926X_6$	0.99	0.99**
BW/SL, SW, AL,AW, LS, WS, DL	$Y = -306.069 + 12.008X_1 + 50.545X_2 - 37.820X_3 - 4.279X_4 + 40.060X_5 - 24.294X_6 + 35.967X_7$	0.99	0.99**
BW/SL, SW, AL, AW, LS, WS, DL, LBAF	$Y = -303.371 + 12.3032X_1 + 51.407X_2 - 39.363X_3 - 3.898X_4 + 39.850X_5 - 23.775X_6 + 37.909X_7 - 3.773X_8$	0.99	0.99**
BW/SL, SW, AL, AW, LS, WS DL, LBAF, NWLS	$Y = -275.100 - 5.039X_1 + 54.531X_2 - 51.282X_3 + 29.175X_4 + 65.763X_5 - 6.919X_6 + 69.142X_7 - 36.307X_8 - 259X_9$	1.00	1.00

Y = BW = Body weight, X_1 = SL = shell length, X_2 = SW = shell width, X_3 = AL = Aperture length, X_4 = AW = Aperture width, X_5 = LS = spiral length, X_6 = WS = spiral width, X_7 = DL = diagonal length, X_8 = LBAF = length between aperture and first spiral, X_9 = NWLS = Number of whorls, r = correlation coefficient, r^2 = coefficient of determination, ** = significant ($p<0.01$).

Table 2: Comparison between actual and predicted weights of *Archachatina marginata var. ovum* using regression equations.

Actual body weight (g)	Predicted body weight (g)
113.58	113.71
113.58	113.29
113.58	113.43
113.58	113.57*
113.58	113.50
113.58	113.55
113.58	113.72
113.58	113.34
113.58	113.28

Value with asterisks best predicted live weight.

Conclusion

From the findings of this study, it could be concluded that multiple linear regression model best predicted live or actual body weights of *Archachatina marginata var*. *ovum* snails. A combination of shell length, shell width, aperture length and aperture width in the multiple linear function best predicted the live weight of this *A. marginata* variety (sub-species). It is recommended that in the prediction of live weight, breeders should consider the use of multiple phenotypic traits as this gives a better and more reliable results than the use of single phenotypic trait.

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ABG 026: Effect of Dam Genotype, Parity and Season on Reproductive Performance of Rabbits Reared in Abeokuta, Nigeria

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Abstract

The study investigated the effects of dam genotype, parity and season on reproductive traits of rabbits reared in the Abeokuta, Nigeria. Thirty dams comprising of California White, New Zealand Red, Chinchilla and their crossbreds (5 per genotype) were mated by nine purebred bucks (3 per genotype) to generate pure and crossbred kittens in five reproduction cycles. Data on gestation length, gestation gain, litter size and litter weight of kittens at day old were subjected to analyses of variance. Gestation length and gestation gain was higher ($p < 0.05$) in the crossbred dam than the purebreds. Litter weight at day old was highest ($p < 0.05$) in the Chinchilla x New Zealand Red dam (272.42 ± 2.41 g), while the least was observed in the California White dam (225.23 ± 2.18 g). Gestation length, gestation gain and litter size at day old were significantly ($p < 0.05$) lower in the first parity than the second and third parity and increased gradually till the fifth parity. Means of gestation gain varied significantly ($p < 0.05$) from 395.68 ± 8.79 g in the late dry season to 483.22 ± 4.20 g in the early wet season. Litter size and litter weight were significantly ($p < 0.05$) higher in the wet seasons compared to the dry seasons. It was evident from the present study that the impact of dam genotype, parity and season on the reproductive efficiency of rabbits should be considered when embarking on rabbit production and multiplication programme.

Keywords: Rabbit, dam genotype, reproductive traits, parity, season.
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Introduction

In recent years, rabbit production is becoming more attractive due to its high reproductive potentials which include high prolificacy, high fecundity, good mothering ability, genetic variability, short gestation period and short generation interval[1] Under the tropical condition, these advantages are influenced to a large extent by several factors which at times are either genetic or non-genetic (environmental or managerial factors). The genetic make-up of different rabbit breeds influence the performance of the animal and further explains the situation where within a breed, individual variation in performance are common[2]. Parity and season variations on the other hand are non-genetic factors that have being reported to have contributed to observed differences in progeny birth mass, litter size and/or birth weight of kittens [3]. Detailed information on the effect of these factors on the reproductive performance of rabbits reared in the tropics is however not completely available. This study therefore attempts to provide such information by determining the effects of dam genotype, parity and season of kindling on some reproductive traits of rabbits raised in the humid tropics of Abeokuta, Nigeria.

Materials and Methods

Location of the study

The study was carried out at the Rabbit Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Alabata Road, Abeokuta, Nigeria. The area lies in the South-Western part of Nigeria and has a prevailing tropical climate with a mean annual rainfall of about 1037 mm and a yearly average relative humidity of about 82% (Department of Water and Agro-meteorology, Federal University of Agriculture, Abeokuta). The period (months) of the research was divided into four seasons which were; early dry (October to December), late dry (January to March), early wet (April to June) and late wet (July to September) seasons.

Experimental animals and management

Thirty nine (39) breeder rabbits of six genotypes (California White, New Zealand Red, Chinchilla breeds and crosses of Chinchilla x California White, Chinchilla x New Zealand Red and California White x New Zealand Red), comprising of thirty (30) pure and crossbred dams (5 per genotype) and nine (9) purebred bucks (3 per genotype) of proven fertility were mated in five reproduction cycles to generate pure and crossbred kittens. The rabbits were raised intensively and housed individually in wooden cages with cell size of 60 x 40 x 40cm. They were given *ad libitum* access to feed (compound diet that supplied 16.90% crude protein and 2715.35 kcal/kg metabolisable energy) and water. Forages such as *Tridax procumbens* and Vitamins were also given as supplements. Bucks were assigned to mate the dams early in the morning before feeding. The dams were first mated when they reached mean body weight of between 1200 g and 1800 g at 24 to 28 weeks of age. Nest boxes (40 x 30 x 15cm^3) were introduced inside each of the dams' cage four days to the expected kindling date. Litters were counted and weighed within 12 hours after kindling. The kits were weaned at 6 weeks of age. The dams were allowed to rest for a week after weaning before they were re-mated again. Dams were weighed at mating, pre-partum and post-partum.

Data collected

5. Gestation Length (GL): - This was taken as the difference between date of kindling and date of successful mating of the dam.
6. Gestation Gain (GG): - This was taken as the difference between the dam's weight taken a day to parturition and its weight at mating.
7. Litter Size (LZ) at day old: - This was calculated as the number of live kittens kindled.
8. Litter Weight (LW) at day old: - This was calculated by weighing individual litters.

Data analysis

Data collected on dam reproductive traits and litter traits at day old were subjected to analyses of variance (ANOVA), using the General Linear Models Procedure of the Statistical Analyses System Program (SAS, 1999) in order to investigate the effects of dam genotype, parity and season on gestation length, gestation gain, litter size and litter weight of kittens at day old. The significant means was separated using the Duncan's New Multiple Range Test.

Results and Discussion

Table 1 shows the result of means and standard errors for the effect of dam genotype on reproductive traits of pure and crossbred rabbits. The mean values for gestation length and gestation gain were higher ($p < 0.05$) in the crossbred dams compared to the purebreds. The difference in the gestation length and gestation gain observed in this study was similarly confirmed by Prayaga and Eady[2] in their breed comparisons which clearly identified differences in dam reproductive traits. Litter weight at day old was highest ($p < 0.05$) in the Chinchilla x New Zealand Red dam (272.42 ± 2.41 g), while the least was observed in the California White dam (225.23 ± 2.18 g) irrespective of the sire used in the mating. The superior litter weight obtained for kittens of the Chinchilla x New Zealand Red dam reflected superiority in their pre-natal and post-natal maternal abilities and probably also high milk production in the dam. This submission is in line with the report of Kalamah *et al*[4] who reported that the better performance in litter traits of crossbred progenies over their purebred counterparts could be attributed to the effect of heterosis.

Table 1: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by dam genotype.

Dam genotype	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
CW	30.69 ± 0.13^{b}	443.90 ± 19.41^{b}	4.38 ± 0.22^{a}	225.23 ± 2.18^{c}
NZR	30.24 ± 0.16^{c}	434.33 ± 20.03^{b}	4.24 ± 0.23^{a}	244.05 ± 2.74^{b}
CH	30.66 ± 0.13^{b}	403.38 ± 23.08^{c}	4.19 ± 0.23^{ab}	222.62 ± 2.83^{c}
CH x CW	31.19 ± 0.18^{a}	469.79 ± 13.59^{a}	4.28 ± 0.21^{a}	258.47 ± 2.80^{b}
CH x NZR	31.14 ± 0.33^{a}	472.73 ± 11.98^{a}	4.10 ± 0.24^{ab}	272.42 ± 2.41^{a}
NZR x CW	31.00 ± 0.29^{ab}	462.64 ± 16.19^{ab}	4.11 ± 0.23^{ab}	252.45 ± 2.65^{b}

[a, b] Means in the same column with different superscript are significantly different ($p < 0.05$).

Key: CW = California White; CH = Chinchilla; NZR= New Zealand Red

The result of means and standard errors for the effect of parity on dam and litter traits (at day old) are presented in Table 2. Gestation length and gestation gain were significantly ($p < 0.05$) lower in the first parity than the second and third parity and increased gradually till the fifth parity. The increase in gestation length as observed in this study is consistent with the reports of Narayan *et al*[5] who reported that gestation length increased with advancement in parity. Litter size at day old also increased significantly ($p < 0.05$) from 3.03 kittens at first parity to 5.06 kittens at first parity (Table 2). This result is similar with the report of Afifi and Kadry[6] who reported that the presence of significant effect of parity on litter size resulted in the increase of this trait as parity progress. The observed increase in litter size at birth suggests an increase in the ovulation rate of dam (that is the number of ova shed from ovary), implantation and embryo survival rate as parity advances. Litter weight was however observed in this study to be highest ($p < 0.05$) in kittens born during the third parity (308.98 ± 2.87 g), while those born in the first parity (220.93 ± 3.72 g) had the least. This result is comparable to the report of Castellini and Panella[7] with New Zealand White rabbits. The result of this study suggests that as parity level increases, changes in the physiological efficiency of dam, such as those associated with ova wastage, embryonic mortality, uterine capacity would also be affected.

Table 2: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by parity.

Parity	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
First	30.12 ± 0.13^{c}	370.08 ± 7.66^{c}	3.03 ± 0.23^{c}	220.93 ± 3.72^{c}
Second	30.75 ± 0.13^{b}	402.21 ± 8.18^{b}	3.92 ± 0.23^{b}	243.94 ± 3.94^{b}
Third	30.79 ± 0.15^{b}	421.73 ± 8.21^{b}	4.53 ± 0.22^{b}	308.98 ± 2.87^{a}
Fourth	31.00 ± 0.15^{ab}	553.24 ± 8.21^{a}	4.97 ± 0.22^{ab}	242.06 ± 3.23^{b}
Fifth	31.10 ± 0.13^{a}	560.00 ± 9.51^{a}	5.06 ± 0.21^{a}	246.13 ± 2.47^{b}

$^{a, b, c}$ Means in the same column with different superscript are significantly different ($p < 0.05$)

Table 3 shows the effect of season on gestation gain, litter size and litter weight at day old. The result showed that season had a non-significant ($p > 0.05$) effect on gestation length. This finding is in agreement with the reports of Gharib[8]. The author reported a non-significant effect of season of kindling on gestation length in Bauscat rabbits. Means of gestation gain varied significantly ($p < 0.05$) from 395.68 ± 8.79 g in the late dry season to 483.22 ± 4.20 g in the early wet season. The observed differences in means for gestation gain within the different seasons might be as a result differences in the seasonal conditions in the geographical location of the rabbitry. Marai *et al*[9] however reported that weight gain and feed intake of pregnant rabbits declined during the hot or dry seasons but increased during the cold or wet seasons. The result of the study further showed that litter weight was significantly ($p < 0.05$) higher in early and late wet season (265.05 ± 0.60 g and 246.35 ± 4.68 g respectively) kindlers compared to the early and late dry season kindlers (230.59 ± 3.44 g and 223.69 ± 1.50 g respectively). This result agreed with the report of Fayeye and Ayorinde[3]. These authors attributed difference in litter weight of rabbits to variations in climatic or weather conditions, which tend to have direct effect on availability of forages. It could therefore be implied from this study that pregnant rabbits available during the wet seasons were likely to have had unhindered access to adequate feed for proper growth of their litters at these seasons than at the dry season, thereby resulting in higher litter weight recorded during the wet seasons compared to those observed at the dry seasons.

Table 3: Means and standard errors for gestation length, gestation gain, litter size and litter weight (at day old) of rabbits as affected by season.

Season	Gestation length (days)	Gestation gain (g)	Litter size at day old (No)	Litter weight at day old (g)
Early dry	31.09 ± 0.23	434.28 ± 13.52^{c}	4.13 ± 0.18^{b}	230.59 ± 3.44^{b}
Late dry	30.95 ± 0.17	395.68 ± 8.79^{d}	4.32 ± 0.23^{b}	223.69 ± 1.50^{b}
Early wet	30.86 ± 0.12	483.22 ± 14.20^{a}	4.84 ± 0.19^{a}	265.69 ± 0.60^{a}
Late wet	30.85 ± 0.14	465.39 ± 11.93^{b}	4.92 ± 0.25^{a}	246.35 ± 4.68^{ab}

$^{a, b, c}$ Means in the same column with different superscript are significantly different ($p < 0.05$)

Conclusion

This study suggest that the influence of dam genotype (irrespective of the sire that was used in the mating) as well as the impact parity and seasonal variations on the reproductive performance of rabbits should be considered when planning a rabbit production and multiplication programme aimed at improving litter traits.

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ABG 027: **Reproductive Performance of African Swine Fever- recovered pigs in South -West Nigeria**

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Abstract: This study was carried out to investigate litter traits performance of African Swine Fever (ASF) -recovered pigs at Teaching and Research Farm of Federal University of Agriculture, Abeokuta. The study was based on 52 progenies farrowed by eight sows and two boars (4 Large White sows, 2-Large Black sows, 2-Duroc sows, 1- Large White boar and 1-NigerHyb boar) that recovered from ASF outbreak in 2005. Data collected on the litter traits were subjected to General Linear Model (GLM) procedure and Pearson's correlation. The litter traits estimates for the cross among the Large White were 6.52±0.26 (litter size at birth), 5.72±0.23(litter size at weaning),6.92±0.34kg(litter weight at birth),1.05±0.01kg(average pig weight at birth), 7.08±0.35(average pig weight at weaning), 12%(pre-weaning mortality) and sex ratio at birth(52%) and at weaning(54%).In the crosses between Duroc and NigerHyb, and Large Black and NigerHyb, effect of dam genotype was significant ($p<0.01$) on litter weight at birth and weaning, litter size at weaning and average pig weight at birth, higher values were observed in the cross between Large Black and NigerHyb, but not significant on litter size at birth and average pig weight at weaning. The litter traits estimates observed in this study are similar to those reported before the outbreak of ASF in 1997 in Nigeria.

Key words: ASF, litter size, litter weight, pig weight and pigs
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Introduction: Nigeria was free of African swine fever disease (ASF) [1] up to 1996. Unconfirmed ASF outbreak was suspected in 1978 [2]. It was not confirmed because of insufficient evidence to verify the diagnosis. Sufficient evidence was however available to confirm the outbreak in 1997-1998. [3] isolated ASF virus from 1997-1998 outbreak and thereby recorded the first confirmed outbreak of ASF in South-West Nigeria. The second outbreak was in 2001-2002 and was confirmed by [4]. The third wave of the outbreak occurred between 2004 and 2005. ASF can be confused with several other diseases. The differential diagnoses of ASF are implicated in the following five diseases namely: hog cholera, haemorrhagic septicaemia, encephalomyocarditis of pigs, trypanosomosis and anthrax [1]. The disease can be confirmed and differentiated from these diseases by conducting virus isolation and characterization detection of genuine DNA by PCR and serological tests such as immunoblotting assay and ELISA etc. High mortality [1] among pigs of all ages is a strong suspicion of ASF.
There have been several works on the reproductive performance of pigs before the outbreak of ASF in Nigeria [6]; [7] and [8], knowing that this factor determines the profitability of pig enterprise. Much consideration has however not being giving to the health status of the animals relative to this factor. The serological test carried out throughout the South West Nigeria between 2006 to 2007 showed that 92.9% of the sampled herds were positive [4]. This showed that virtually the whole region is endemic with ASF. Furthermore, there is no vaccine against the disease and mass slaughtering of the infected and survivors has been the only available means of preventing further transmission even though the disease is not zoonotic [9]. This result in the reduction in the total pig population which in turn results in drastic reduction in the yield of animal protein from pig industry. There is an urgent need to look beyond slaughtering of these survivors and infected pigs, therefore the objective of this study was to confirm the presence of ASF antibody in the survivors and investigate their reproductive performance.

Materials and Methods: Location of the experiment: the experiment was carried out at the Piggery Unit, Teaching and Research Farm, Federal University of Agriculture, Abeokuta. Nigeria. A total of

eight sows (4- Large White, 2- Large Black and 2- Duroc) on third parity and two boars (Large White and NigerHyb) that survived ASF outbreak of 2005 at the piggery Unit of the institution were mated and produced 52 progenies. The animals were housed in pens throughout the study and daily routine management practices which include cleaning and washing of pens and utensils, *ad libitum* provision of feed and water. Boars were introduced to sows in heat and monitored through mating, gestation, farrowing and nursing. Blood samples were collected from the foundation stock and subjected to ELISA test to confirm the presence of ASF antibody in their blood serum. The foundation stocks were grouped into two based on the optical density of their sera. Group A comprised four Large White sows and one Large White boar with high optical density (≥0.50). Group B comprised two Large Black sows and two Duroc sows and one NigerHyb boar with low optical density (< 0.50). Mating was carried out in each group as showed below:

♂		♀	
LW	X	LW	= LW
NH	X	LB	=LBNH
NH	X	D	=DNH

Data collection: Data were collected on the litter traits (Litter size at birth (LSB), Litter weight at birth (LWB), average pig weight at birth (APWB), Litter size at weaning (LSW), Litter weight at weaning (LWW), Average pig weight at weaning (APWW), sex ratio at birth and weaning and pre-weaning mortality) performance of the pigs as reported by [10]. Data collected on the litter traits were subjected to General Linear Model (GLM) procedure to compare the means. New Duncan Multiple Range Test was used to separate the means that differed significantly [11]. The statistical model used is as follows:

$Y_{jk} = \mu + B_j + \varepsilon_{jk}$

Yjk = Observation on reproductive traits

μ = Overall means

Bj = effect of genotype (1-3)

Ɛjk = experimental error

The correlation among the litter traits were computed using Pearson's correlation using procedure correlation (PROCCORR) of [12].

RESULTS: Tables 1 and 2 show the litter traits performance of Large White (LW) pigs with high optical density and the effect of dam genotype on the litter traits performance of pigs with low optical density, respectively. The LSB, LSW, LWB and LWW for the Large White were 6.52±0.26, 5.72±0.23, 6.92±0.34 kg and 38.85± 1.31 kg, respectively, while APWB, APWW, pre-weaning mortality, sex ratio at birth and at weaning were 1.05±0.01 kg, 7.08±0.35 kg, 12%, 52% and 54% respectively. Effect of dam genotype was highly significant (P<0.001) on LSW, LWB, LWW and APWB. However, the effect was not significant (P>0.05) on LSB and APWW. The cross between NigerHyb and Large Black had the highest mean value for LSW (7.57±0.53), LWB (10.00±0.19); LWW (44.04±1.99kg) and APWB (1.40±0.09kg) while the mean values for cross between NigerHyb and Duroc were lower in the four traits. The pre-weaning mortality for the cross between NigerHyb and Duroc was 30.8% while for NHLB was 0%. The sex ratio at birth and at weaning for NHLB showed more females while NHD showed more males at birth and at weaning.

Table 1: Litter traits performance of LW with high optical density

Parameters	Means
Litter size at birth	6.52±0.26
Litter size at weaning	5.72±0.23
Litter weight at birth (kg)	6.92±0.34
Litter weight at weaning (kg)	38.85±1.31
Average pig weight at birth (kg)	1.05±0.01
Average pig weight at weaning (kg)	7.08±0.35
Pre-weaning mortality %	12
Sex ratio at birth (%males)	52
Sex ratio at weaning (%males)	54

Table 2: Effect of dam genotype on litter traits performance of pigs with low optical density

Parameters	Genotypes		
	NHLB	NHD	Overall
Litter size at birth	7.57±0.53	6.85±0.42	7.22±0.34
Litter size at weaning	7.57±0.53a	4.62±0.14b	6.15±0.40
Litter weight at birth	10.00±0.19a	7.91±0.25b	8.99±0.25
Litter weight at weaning	44.04±1.99a	28.18±1.31b	36.40±1.96
Average pig weight at birth	1.40±0.09a	1.18±0.04b	1.29±0.05
Average pig weight at weaning	5.98±0.18	6.29±0.49	6.13±0.25
Pre- weaning mortality(%)	0	30.8	14.8
Sex ratio at birth (%males)	35.7	53.5	44.4
Sex ratio at weaning(%males)	35.7	77.8	52.2

[A,b] Means in the same row with different superscripts are significantly different (P<0.05)

Estimates of correlation coefficients of litter traits among pigs with high optical density is shown in Table 3. The estimates ranged between -0.915 to 0.957. The correlations between LSB/LSW, LWB/APWB were positive and highly significant (p<0.001). Low and non-significant (p>0.05) correlation existed between LSB/LWW(-0.228). The correlation between LSW with LWB, LWW,APWB and APWW were 0.927, -0.133,0.583 and -0.857 respectively.

Table 3: Correlation coefficients among litter traits of pigs with high optical density

Parameters	LSB	LSW	LWB	LWW	APWB	APWW
LSB	1.000	0.957***	0.993***	-0.228ns	0.767***	-0.881***
LSW		1.000	0.927***	-0.133ns	0.583ns	-0.857
LWB			1.000	-0.337ns	0.837***	-0.915***
LWW				1.000	0.679ns	0.624ns
APWB					1.000	-0.829
APWW						1.000

***p<0.0001; ns - Not significant

The correlations among the litter traits of pigs with low optical density are shown in Table 4. The litter size at birth was significantly correlated (p<0.05) with all the traits considered, and the values ranged from -0.789 to 0.776. The correlations between LSW with LWB, LWW, APWB and APWW were 0.905, 0.870,-0.337 and -0.484 respectively. Low and non-significant relationship (p>0.05) existed between LWW/PWB and LWW/PWW.

Table 4: Correlation coefficients among litter traits of pigs with low optical density

Parameters	LSB	LSW	LWB	LWW	APWB	APWW
LSB	1.000	0.776***	0.729***	0.392***	-0.789***	-0.849***
LSW		1.000	0.905***	0.870***	-0.337***	-0.484***
LWB			1.000	0.684***	0.157**	-0.660***
LWW				1.000	-0.004ns	0.007ns
APWB					1.000	0.596***
APWW						1.000

**p<0.05; ***p<0.0001; ns - Not significant

Discussion

The litter traits of Large White pigs with high optical density can be compared with the works of earlier researchers. The litter size (6.52±0.26) is similar to 6.3 reported by [13] for the same breed while higher value was reported by [14]. Litter size at weaning (5.70), litter weight at birth (6.92) and litter weight at weaning (38.85) are lower to the values reported by [15], though these can be compared with the work of [16] in India. The pre-weaning mortality (12%) observed in this study can be compared with the work of [17]. Larger percentage of the mortality resulted from neonatal mortality which occurred as a result of cold and crushing by the dam. The differences observed between the litter traits of Large White in this study and estimates reported by earlier researcher can be attributed to differences in management and environmental factors.

The litter traits observed for the cross between NigerHyb and Large Black, and NigerHyb and Duroc are comparable to the findings of [18]. Dam genotype had significant effect (P<0.0001) on litter size at weaning, litter weight at birth, litter weight at weaning and average pig weight at birth. These agree with the observations of [14]. The effect of dam genotype was not significant (p>0.05) on litter size at birth and average pig weight at weaning. This could be attributed to similarity in ovulation rates and nursing ability respectively. Most of the litter traits were significantly higher in the cross between NigerHyb and Large Black than the cross between NigerHyb and Duroc. This indicates that the genetic diversity between NigerHyb and Large Black is likely to be more than that of NigerHyb and Duroc. The sex ratio at birth and at weaning for the genotypes shows that more females were farrowed and weaned. This is in line with the findings of [19]. The 30.8% mortality reported for NHD is higher than what [19] reported but similar to the findings of [20].

Correlations among the litter traits of different crosses considered show variations and similarities. The estimates ranged from low to high, negative to positive and some were significant while some were not as reported by earlier researchers [21] and [15]. The litter traits performance of ASF recovered pigs are comparable to those reported in Nigeria before the outbreak in 1997.

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ABG 028: Characteristics of West African Dwarf (WAD) Goats in Bassa Local Government Area of Kogi State.

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Abstract

This study was conducted to evaluate the body characteristics of West African Dwarf (WAD) goats in Bassa local government Area of Kogi State, Nigeria. A total of one hundred and nine (109) matured WAD goats, comprising of twenty-seven (27) males and eighty-two (82) females, were randomly selected for the study. Animals were randomly selected across locations in the local government area. Data were measured from body parameters, these include; Body Weight (BW), Chest Girth (CG)**,** Height at Withers (HW)**,** Body Length (BL), Head Length (HL), Neck Length (NL), Ear Length (EL), Horn Length (HnL), Tail Length (TL) and Leg Length (LL). Data collected were subjected to statistical analysis. Results obtained showed that sex had a significant effect ($p< 0.05$) on all the body parameters considered.

Keywords: Characteristics, body parameters, West African Dwarf goat,

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Introduction

Linear body measurements of animals have been used extensively to assess the growth of skeletal parts, it is also useful in describing changes in animals' conformation with age. Relationship between body weight and linear body measurement such as heart girth (circumference), body length and height at withers has been used [1].

Goats are reared primarily for meat production, as such body weight is a major trait of interest. It is an important criterion in meat producing animals. An animal that will have to command high premium has to be one that has well established body composition, well-built head, meaty flanks and an appreciable weight. [2]. A recent live-stock survey, however, puts the goat population in Nigeria at 34.5 million [3]. The keeping of goats in any community is related to the value attached to their production. Goats in Nigeria are kept mainly for meat and hide [4]. The role of livestock in human development is enormous. Livestock production is an instrument of socio-economic change through enhancing the farmer's income and quality of life [5]. The objective of this study therefore, is to investigate the extent of variation in body characteristics of the West African dwarf goat in small holder herd in Bassa Local Government Area of Kogi State.

Materials and Methods

Description of study area.

The study was conducted in Bassa local government area of Kogi state, Nigeria. Bassa local government area is located between longitude 8° 47' E and latitude 10° 3' N (Worldatlas.com). The area falls within the sub-humid climate having annual rainfall range of 1250 – 2000 mm, annual temperature range is 32 - 50^0C. [6].

Experimental animal

A total of one hundred and nine (109) matured West African Dwarf (WAD) goats were used for this study. These comprise of eighty-two (82) females and twenty-seven (27) males. The animals were semi-intensively managed with little or no feed supplementation with kitchen waste or grain by-products.

Data collection and analysis

Data were collected between April and October 2009. Twelve (12) body traits were taken, including the body weights (kg) and linear body measurements (cm), from the animals. Pregnant animals were excluded from the samples. Animals were restraint and calm before measurements were taken. All measurements were taken according to the method described by [7].

1. **Live Body Weight (LBW):** Live body weight of the animal was obtained by placing them on the weighing scale.
2. **Chest Girth (CG):** The chest girth was measured as the circumference of the body, slightly behind the shoulders and perpendicular to the body axis.
3. **Height at Withers (HW):** This was measured at the highest point on the dorsum of the animal to the platform at the level of the forelegs while the animal was standing.
4. **Body Length (BL):** Measured from the tip of the scapula close to the neck region to the pin bone of the tail region.
5. **Head Length (HL):** This was measured from the tip of the skull at the mouth region to the point where the cervical vertebrae connect to the skull.
6. **Neck Length (NL):** The entire region of the cervical vertebrae was measured as neck length.
7. **Ear Length (EL):** This was measured from the point where the ear is attached to its tip.
8. **Horn Length (HnL):** The point of attachment of the horns to the head up to its tips.
9. **Tail Length (TL):** This was measured as the distance between the beginning of the caudal vertebrae to its tip.
10. **Leg Length (LL):** The leg length was measured as the distance from the tips of the hoofs to the point where the tarsal joined to the tibia and fibula.

Data Analysis.

Data collected were subjected to descriptive statistical analysis using [8], statistical software package.

Results and Discussion

Table 1 showed the sex distribution of the animals sampled in the study area. Percentage distribution for female animal was higher than that of males (75.23% and 24.77% respectively). This might be as a result of preference of female animal in the herd for multiplication. Males are majorly sold out or slaughter for festival.

Table 1: Total number of goats sampled per sex and at different location.

Location	Number of females	Number of males	Total
A	27	9	36
B	28	9	37
C	27	9	36
Total observation	82	27	109
Percentage (%)	**75.23**	**24.77**	**100**

A = Bassa, B = Gbokolo and C = Mozum Districts

Table 2 shows the descriptive statistics of body weight and morphometric traits of WAD goats in the study area. Results showed that average body weight was significantly ($P < 0.05$) affected by sex. Body weight was higher in female WAD goats than males compared to their male counterparts in the three locations (18.93±5.50 and 18.49±2.60, 17.82±4.30 and 15.67±6.00 and 18.42±5.70 and 14.39±4.70 respectively). However, there are no significant differences observed among locations.

Table 2: Least square means of body weight (Kg) of male and female West African Dwarf Goats in the study locations.

Location	Sex	Body Weight (±SD)
A	**F**	18.93 ± 5.50^{a}
	M	18.49 ± 2.60^{b}
B	**F**	17.82 ± 4.30^{a}
	M	15.67 ± 6.00^{b}
C	**F**	18.42 ± 5.70^{a}
	M	14.39 ± 4.70^{b}

A = Bassa District, B = Gboloko District, C = Mozum District.

Means with the same superscript are not significantly different ($P<0.05$).

Table 3 shows the mean values of other parameters considered in the study. Sex had significant ($P<0.05$) effect on all the parameters. However, location had no significant effect on the parameters.

This report is contrary to the reports of [9], [10] and [7] who reported higher values for males over females' mammalian and goats. This trend, though common, may not be exclusive pattern. However,

[11] reported no sexual dimorphism in the body parameters measured in *Lama guanicoe guanicoe* in Argentina. [12] in his report stated that the morphological traits of male and female kids were similar. Sexual dimorphism in farm animals can be phenotypically expressed as differences in skeletal size and body mass.

The influence of sex on the body weight and morphometric parameters in this present study may be due to hormonal action which leads to differential growth rates. However, the trend observed in this study can be partially explained by different methodologies used in measurements.

Conclusion

Results obtained in this study revealed that sex had significant effect (P>0.05) on the body parameters considered with females having higher values. However, location had no significant effect (P>0.05). Therefore, the information obtained in the present study would be useful for phenotypic characterization of West African Dwarf (WAD) goats in the study area and could assist farmers and breeders when conducting management, selection and preservation programs.

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Table 3: Least square means of some body measurements (cm) of male and female West African Dwarf (WAD) Goats in the study locations.

Loc.	Sex	WH	CG	BL	HL	NL	EL	HnL	TL	LL
A	F	41.39±9.50[a]	60.89±7.0[a]	52.00±11.30[a]	13.63±3.00[a]	14.56±3.10[a]	9.26±2.20[a]	7.19± 2.80[a]	8.40± 1.91[a]	12.77±2.80[a]
	M	37.66±3.30[b]	57.44±3.30[b]	50.89± 1.90[b]	11.66±1.30[b]	12.54±1.30[b]	9.56±0.93[b]	6.11±1.97[b]	6.67± 1.10[b]	11.56±1.30[b]
B	F	41.96±4.60[a]	59.21±5.16[a]	51.86±5.60[a]	14.00±1.00[a]	15.18±1.10[a]	8.85±1.70[a]	7.72±2.90[a]	8.40±1.50[a]	12.55±1.30[a]
	M	39.11±4.20[b]	56.00±3.90[b]	46.56± 3.92[b]	11.67±1.30[b]	12.33±1.30[b]	8.89±0.90[b]	5.67±1.60[b]	6.66±1.20[b]	11.88±1.60[b]
C	F	40.86±10.00[a]	60.46±12.60[a]	50.25±11.10[a]	14.95±3.20[a]	14.95±3.21[a]	8.71±2.10[a]	7.09±2.90[a]	7.78±1.80[a]	13.29±2.90[a]
	M	36.88±2.60[b]	54.00±3.80[b]	48.22±3.50[b]	11.00±1.00[b]	10.57±1.80[b]	8.28±1.00[b]	4.94±1.93[b]	5.61±1.70[b]	9.94±1.00[b]

A = Bassa District, B = Gboloko District, C = Mozum District.

BWT = Body Weight, WH = Wither Height, CG = Chest Girth, BL= Body Length, HL = Head Length, NL = Neck Length, EL = Ear Length, HnL = Horn Length, TL = Tail Length and LL = Leg Length. Means with the same superscript are not significantly different ($P<0.05$)

ABG 029: Reproductive abilities of New Zealand white, Dutch and their crosses raised in south – south Nigeria

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Abstract
A total of twenty- four does of New Zealand White (NZW), Dutch (DUT) and their crosses i.e. NZW x DUT were used 12to determine the effects of breeds on the reproductive abilities of rabbits in South-South Nigeria as well as to investigate the correlation between the breeds and these reproductive abilities. The following reproductive abilities were considered: Body weight before mating (BWBM), Body weight after mating (BWAW), Body weight before kindling (BWBK), Body weight after kindling (BWAK), Litter size (LS), Litter weight (LW) and Average litter weight (ALW). Body weight was measured using weighing balance. Data generated were analyzed using Statistical Package for the Social Sciences (SPSS). The result showed significant difference ($p< 0.05$) in BWBM and BWAM between DUT and NZW x DUT breeds of rabbits, DUT recorded the highest value of BWBM and BWAM while NZW x DUT had the least performance. However, there was no significant different ($p>0.05$) between NZW and DUT. Furthermore, NZW recorded the highest value in BWBK, BWAK and BALW. There was no significant different ($p> 0.05$) among the breeds for WBK, L S, L W and ALW. BWAK showed a significant difference between DUT and NZW x DUT. More so, NZW x DUT recorded the highest values for L S and LW. The results also showed that breed effect had negative correlation with BWBW, BWAM, BWAK, BWBK and ALW with correlation values of -0.64, -0.64, -0.207, 0.385 and 0.045 respectively. The breed of rabbits also revealed a high correlation between BWBM and BWAM. BWAK showed a high correlation between BWAM and BWBK. The information provided by this study is relevant in developing improvement programme for these rabbit breeds. Keywords: Dutch, New Zealand White and Reproductive abilities.

Introduction

In many countries of the world, rabbit breeding plays an indispensable role in meat and fur production. In recent years, there has been a rising awareness in South-South of Nigeria on the virtues of rabbit production as an alternative means of alleviating food shortages and the problem of inadequate animal protein supply in developing Countries. Apart from its high reproductive performance, the rabbit has numerous benefits over many other domestic or farm animals, including its high meat quality due to higher protein and much lower fat/cholesterol contents (1). As production directly depends on reproduction, reproductive performance of rabbits becomes an important aspect in determining profitability of commercial rabbit breeding. Factors such as breed, season, age, and weight of females have great impact on the reproductive performance of animals (2). The production efficiency of commercial rabbit farms is largely dependent on the litter size at kindling and the survivability of the bunnies up to weaning (3). In addition, the pre-weaning growth is very critical in meat rabbits due to its

impact on the meat produced at the finisher stage of production (4). El-Maghawry (5) also noted higher values for litter size at weaning in spring, while litter size at birth and weaning (6) and sex ratio (7) has also been reported of having significant different on breeds of rabbits (8). Shahin *et al*. (9) reported that the choice of high growth rate in rabbits had improved slaughter performance, but that it can lead to a high risk of lowering the quality of meat. Crossbreeding according to (10) 1is one of the fast implement offered to the breeders to improve many traits in farm animals. In a study involving New Zealand White and California, (11) observed that crossbred rabbits performed better than purebred rabbits in terms of growth rate. Oke *et al*. (12) and (13) also observed significant differences in growth traits among breeds of rabbits. In addition, variations in growth rate or weight gain of rabbit within the same breed or among different breeds could be attributed to environmental factors such as nutrition, disease, hormone and general management. The documented breed differences in growth rate for exotic breeds could be exploited and used in breeding programme to develop a fast growing indigenous strain adaptable to hot environment. Das and Yadav (14) reported no significant difference between NZW and SC for prolificacy and litter weights at birth and weaning. Ponce de León *et al*. (15) reported that the New Zealand had the highest performance in terms of reproductive ability compared to Semi-giant, Chinchilla, and California breeds. It is expected that the outcome of this study will serve a useful implement to the rabbit farmers to stay in business as well as attract perspective farmers into the business and this will ultimately bridge the protein deficiency gap. The objective of this study is to determine the effect of breeds on the reproductive abilities of rabbits in South- South Nigeria as well as to investigate the correlation between the breeds and these reproductive abilities. As well as investigating the correlation that may like exist among the reproductive abilities.

Materials and Method

The experiment was conducted at Rabbitry unit, Teaching and Research Farm, University of Port Harcourt Rivers State. The animals were housed in hutches made of metals and dimension of each hutch is 60cmx 60cm x 60cm. The hutches are large enough to allow for easy movement. Feeders and drinkers were also provided. The research involved twenty four rabbits (does) of three different genotypes i. e. New Zealand White (NZW), Dutch (DUT) and New Zealand White X Dutch (NZW X DUT). The following reproductive parameters were measured; Body weight before mating (BBBM) , Body weight after mating (BBAM), Body weight before kindling (BBBK) , Body weight after kindling (BBAK) , Litter size (LS),Litter weight (LW) and Average litter weight (ALW). The body weight was measured using a balance. Data collected from this research were subjected to statistical analysis using SPSS. Correlation matrix among the various parameters considered.

Results

Table 1 shows the mean and standard error for the reproductive abilities among the three genotypes of rabbits used for the investigation, the genotypes include; NZW, DUT and NZW x DUT. The result shows significant different ($p< 0.05$) in WBM and WAM between DUT and NZW x DUT breeds of rabbits, DUT recorded the highest value of WBM and WAM while, NZW x DUT had the least performance, but there was no significant different between NZW and DUT. NZW recorded the highest values in WBK, WAK and ALW. There is no significant different ($p< 0.05$) among the breeds for WBK, L S, L W and ALW. WAK shows significant different between DUT and NZW x DUT. NZW x DUT recorded the

highest values for L S and LW. Table 2 shows the correlation between all the parameters considered in this study. The result shows that breeds effect has negative correlation with WBW, WAM, WAK, WBK and ALW i.e. -0.64, - 0.64, -0.207, 0.385 and 0.045 respectively. Breeds of rabbits also recorded a high correlation between WBM and WAM. WAK showed a high correlation between WAM and WBK.WBM recorded positive correlation with different breeds of rabbits. It is also observed that WAM had positive correlation the WBM. WAM also recorded positive correlation with WBM. WBK also had a positive correlation with WAM while, LS, LW, and ALW recorded a very correlation with AK, LS and ALW respectively.

Table 1. Reproductive Abilities of NZW, DUT and crosses of rabbit breeds

BREEDS	WBM	WAM	WBK	WAK	LS	LW	ALW
NZW	2006.14 ± 71.02^{ab}	2154.29 ± 113.95^{ab}	2597.14 ± 95.86	2382.86 ± 94.06^{a}	5.57 ± 0.30	291.43 ± 10.56	0.529 ± 0.21
DUT	2218.33 ± 86.49^{a}	2415.83 ± 90.06^{a}	2496.67 ± 103.33	2356.67 ± 82.75^{a}	5.50 ± 0.52	259.58 ± 20.88	0.482 ± 0.26
NZW x DUT	1912.00 ± 57.32^{b}	2261.25 ± 69.43^{b}	2424.00 ± 109.44	2070.00 ± 55.32^{b}	5.80 ± 0.20	304.00 ± 7.48	0.527 ± 0.22

Values within each group with different superscripts differ significantly ($p < 0.05$).

Table 2. Pearson's correlation coefficient of reproductive abilities among three breeds of rabbits

	TRT	BWBM	BWAM	BWBK	BWAK	LS	LW	ALW
TRT	1							
BWBW	- 0.064	1						
BWAM	- 0.064	0.569**	1					
BWBK	- 0.204	0.78	0.493*	1				
BWAK	- 0.385	0.193	0.711**	0.811**	1			
LS	0.054	- 0.400	0.020	0.212	0.215	1		
LW	0.039	- 0.440*	- 0.120	0.219	0.066	0.765**	1	
ALW	-0.450	0.015	-0.129	0.480	- 0.173	- 0.384	- 0.280	1

Discussion

The result from Table 1 indicated that there was a significant different ($p<0.05$) of breeds on the BWBM, BWAM and BWAK. The result obtained is in agreement with the findings of (16). Breeds effect showed no significant on the BWBK, LS, LW and ALW, DUT recorded the highest values for BWBM and BWAM. Also, NZW x DUT recorded the lowest values in BWBM, BWAM, BWBK, BWAK and ALW. It is also observed that NZW had highest values of BWBK, BWAK and ALW. This in concordance with the report of (17) where there were significant ($p < 0.05$) breed effects on litter weights at birth and litter size at weaning with New Zealand White breeds being superior to their California White counterparts.

The New Zealand White breed has been identified as a suitable dam breed due to its favourable maternal qualities (16), hence its superior reproductive performance. NZW XDUT recorded the highest values for LS and LW. This agrees with the results of (17) but, however, disagrees with the findings of (18), (19), (14), and (20) who found no significant differences among similar breeds maintained under similar environments. Table 2 showed the correlation between some reproductive abilities among the three breeds of rabbits. The results showed that there were various significant ($p<0.05$) positive correlation between BWAM and BWBM also between BWBK and BWBM/BWAM, likewise between BWAK and BWBM, BWAM and between BWBK. In contrary, negative correlation were recorded between the breeds and BWBM, BWAM, BWBK, BWAK and ALW.

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