

EFFECTS OF AGE, SEX, SEASON AND BREED ON THE BODY WEIGHT AND ZOOMETRIC CHARACTERISTICS OF EXTENSIVELY MANAGED NIGERIAN GOATS

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ABSTRACT

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Adaptability of an animal to fluctuating climatic conditions is one of the most important determinants of success in livestock enterprise. The present study was conducted to determine the influence of season on the body weight (BW) and zoometric characteristics of Nigerian goats. A total of 1000 male and female goats belonging to two breeds (West African Dwarf, WAD and Red Sokoto, RS) and 5 age groups were evaluated in the wet as well as dry season using a 2x2x2x5 factorial arrangement experimental of completely randomized design. The zoometric traits considered were body length (BL), heart girth (HG), wither height (HW), neck length (NL), and neck circumference (NC). The results showed that season significantly ($p < 0.05$) affected the overall BW, HW, NL and NC. Measurements in the wet season were significantly higher than those measured during the dry season with the exception of BW (15.19 vs 18.90 kg) and NC (22.54 vs 23.33 cm). Mean BW and all the zoometric measurements were significantly ($p < 0.05$) higher in RS than WAD goats, and male goats had significantly ($p < 0.05$) higher body weight and zoometric measurements than female goats. Interaction between season and age, season and breed, age and sex and between breed and age were significant ($p < 0.05$). It was concluded that sex, age and season have interdependent implications on the BW and zoometric characteristics of RS and WAD goats. Adequate consideration to these factors is therefore recommended for effective management of goats.

INTRODUCTION

Goat is an important livestock in rural communities of developing countries. Goats are regarded as poor persons' bank (Peacock, 1996) with widest ecological distribution (Bitto, 2008) among other common ruminant species. Traditional farmers own above 80% of goats' population in Nigeria. Animals raised under the extensive system in tropical countries like Nigeria are exposed to marked dry and wet seasonal variation (Khavruset and Shelevytsky, 2010) in photo-period, feed and water supply. The dry season is characterised by inadequate and poor nutritive forages and increase in temperature (Lindsay and Attelad, 1993), which may result into malnutrition and unsteady growth pattern of affected animals. Despite the availability of abundant forages for grazing purpose in the raining seasons, the total dry matter intake of goat is restricted as a result of high water content of grasses, reduced grazing periods, chilling effect and increased incidence of parasitism and diseases. Adaptability of farmed specie is often regarded as one of the most important criteria for success in livestock enterprise (Gasparotto, 2009), especially under the traditional system where controlled environment remain unaffordable. The aim of the present study is to assess the effect of seasonal environmental changes on the body weight and zoometric characteristics of the two prominent goat breeds in Nigeria.

MATERIALS AND METHODS

Description of the study locations

The locations where data were collected are Oyo and Zuru towns in the South West and North West of Nigeria, respectively. Oyo town is located in the north of Ibadan (51.50km North of Ibadan) the capital city of Oyo State, situated in the south western part of Nigeria and lies between latitude 7° 8' 67" N and 7° 9' 33" N and longitude 3° 8' 67" E and 4° 0' 00" E (Ayoade, 1993). It is located within the derived savannah agro-climatic zone of Nigeria with an average annual rainfall of 800mm spanning from March/April to October, and annual temperature varying between 25°C and 35°C. Average relative humidity of the area is 91% (Kassali *et al.*, 2012). Two main seasons, namely wet and dry are identifiable in the area. The rainy season usually spans from late March to end October while the dry season extends from November to early March (Faleyimu and Agbeja, 2012). Zuru town is located in Kebbi state and lies between latitude 11° 35' N and 11° 55' N, and longitude 4° 45' E and 5° 25' E of the equator. Zuru falls within the Sudan savannah zone of Nigeria (Girma, 1998). It has a mean temperature of 37 °C with two main seasons of the year (KARDA, 2007). The wet season usually lasts for five to seven months, from April/May to September/October. The town has an annual rainfall of about 200 mm and average relative humidity of about 85% during raining season. The dry season occurs between October/November to March/April (4 - 5 months) with an average relative humidity of 41% (KARDA, 2007).

Data collection and analysis

The study was a 2 x 2 x 2 x 5 factorial arrangement of a completely randomized design. A total of one thousand (1,000) male and female goats owned and managed extensively by farmers were used for the study. The goats

belonged to two breeds (West African Dwarf, WAD and Red Sokoto, RS) in equal number (500:500) and 5 age groups (100 per age group). Each of the animals was evaluated in the wet or dry season. The ages of the goats used for the study were determined using dentition model as described by Mitchel (2003). The animals were grouped based on their dentition into five age groups (i.e. < 1, 1– 2, 2 – 3, 3 – 4 and >4 years). Data were collected on body weight and zoometric traits. The zoometric measurements (i.e. body length, heart girth, height at wither, neck length and neck circumference) were all taken as described by Chacon *et al.* (2011). Data obtained were subjected to the analysis of variance (ANOVA) using Minitab Statistical Software Version 14 (MINITAB, 2003).

RESULTS AND DISCUSSIONS

The body weights of WAD of different age groups in the present study are generally comparable to values reported by Egbegbulem *et al.* (2011). Season, breed, sex and age significantly ($p < 0.05$) influenced the body weight (BW) of the extensively managed Nigerian goats (Table 1). The mean body weight at dry season was 3.71 kg higher than that of wet season. The lower performance of goats during the raining season may be due to tethering to prevent them from grazing on cultivated crops, as well as the vast grazing land and crop residues available to the animals in the dry season. This result corroborates Ogebe *et al.* (1996) who reported that goats reared in Southern Nigeria during the raining season are exposed grasses that are high in water content and reduced grazing periods, leading to reduced rumination rate, lowered total dry matter intake, less nutrient absorptions and fall in body weight. Red Sokoto goat had a significantly ($p < 0.05$) heavier mean body weight than the West African Dwarf breed with a difference of 5.63kg. Earlier report by Yusuff *et al.* (2015) also indicated breed difference between RS and WAD goats managed under unified environment. Male goat in the present study was significantly ($p < 0.05$) heavier than female goat, an indication of sexual dimorphism (Polak and Frynta, 2009). Presence of androgen from prenatal (fetal) stage in male have positive effect on its skeletal development than the female fetus with estrogen which suppresses her skeletal growth and thus facilitate heavier weight at birth and subsequent ages (Ositelu, 1981; Odubote and Akinokun, 1992; Ebezoje and Ngere, 1995). Difference in the body weight of goat belong to age groups < 1 and 2, 2 and 3, 3 and 4, and between 4 and >4 years were 7.04, 3.48, 3.53 and 6.92kg, respectively. The results is in corroboration of Pugh and Rankins (2012) who reported that sufficient calories and increased protein yield higher growth rate during pre-pubertal stage of all livestock.

All the examined zoometric measurements were influenced ($p < 0.05$) by both breed as well as age of animals (Table 1). Red Sokoto goat were significantly ($p < 0.05$) higher in zoometric values than WAD. The comparatively higher zoometric measurements in RS corroborate the earlier report by (Yusuff *et al.*, 2015) who reported significantly higher value for RS in all the morphometric traits studied. Significant ($p < 0.05$) increase in zoometric values with increasing age were observed, except for BL, NL and NC in goats of age 2 - 4yrs and HW in goats age 3 or more years. The results suggest variation in the rate of increase in different zoometric traits with increase in the age of goats. The HG of adult goats in this study is comparable to the range reported by Hassan *et al.* (1992). However, Akpa *et al.* (1998) obtained higher HG (56.60 - 70.70 cm) for RS of less than 1 year old. The HW obtained in this study was within the range reported for different categories of RS goats in Nigeria (Ngere *et al.*, 1984; Wilson, 1991, Akpa *et al.*, 1998). Male goats were significantly ($p < 0.05$) higher in zoometric values than the female. This is in line with the report that skeletal development in male is actively aided by hormone factors (Ositelu, 1981; Odubote and Akinokun, 1992; Ebezoje and Ngere, 1995), and which may give competitive advantage during feeding. BL for RS at 1-2 and 3-4 years by Hassan *et al.* (1992) reported higher BL values of 79.15 and 87.33 cm for RS goat that were aged between 1-2 and 3-4 years, respectively. However, Akpa *et al.* (1998) reported generally lower BL values for RS goats of more than 1 year of age. Earlier reports (Wilson, 1991; Akpa *et al.*, 1998) showed that there are variations in RS population which may account for the observable differences in zoometric measurements from different studies. Goats had slightly longer neck length (15.41 vs 14.23 cm) and narrower neck circumference (22.54 vs 23.33 cm) in the wet season compared with the dry season. This may be a reflection of nutritional stress and possibly, a positive correlation of such zoometric traits with body weight, which was lighter in the wet season. BL, HG, HG, NL and NC in RS goats of above 1 year of age were not significantly ($p > 0.05$) influenced by season. This indicates that change in season has no considerable impact on these morphometric features in adult RS goats.

The interactions between season and sex (Season*Sex) and, between breed and age (Breed*Age) were not significant ($p > 0.05$) for all the studied parameters. Interaction between Season*Breed, Season*Age, Age*Sex and between Season*Beed*Age were generally significant ($p < 0.05$) (Table 2). Significant ($p < 0.05$) interaction exists between season and breed, and RS had wider difference (Table 3) in body weight (5.35kg) between the rain and dry seasons than WAD (2.06 kg). The wider seasonal variation in the body weight of RS may be due to the vast grazing land and crop residues available to the animals in the dry season than in the raining season. Goats of more than 1 year had wider variation in body weight between the rain and dry seasons than young goats. The customary long nursing period of kids under extensive management tends to place greater nutritional stress on their dam, leading to greater fluctuation in body weight.

Table 1: Main effect of season, breed, sex and age-group on the body weight (kg) and selected zoometric characteristics (cm) of extensively managed Nigerian goats

Factors		BW (kg)	BL (cm)	HG (cm)	HW (cm)	NL (cm)	NC (cm)
Season	1	15.19b	71.08	56.15	48.89a	15.41a	22.54b
	2	18.90a	70.06	56.19	47.78b	14.23b	23.33a
	SEM(±)	0.53	0.97	0.78	0.64	0.27	0.29
Breed	1	19.86a	73.28a	56.96a	51.47a	17.32a	23.44a
	2	14.23b	67.87b	55.39b	45.19b	12.31b	22.43b
	SEM(±)	0.51	0.96	0.78	0.61	0.22	0.29
Sex	1	17.36a	71.33a	56.69a	48.90a	14.94	22.96
	2	16.73b	69.81b	55.65b	47.76b	14.7	22.91
	SEM(±)	0.55	1.01	0.79	0.64	0.28	0.3
Age group	< 1	6.53e	46.85d	38.28e	35.93d	10.63d	16.40d
	01-Feb	13.57d	69.08c	52.87d	45.52c	13.63c	22.35c
	02-Mar	17.05c	73.70b	56.71c	51.27b	15.29b	24.18b
	03-Apr	20.58b	76.92b	62.96b	54.66a	16.19b	24.39b
	> 4	27.50a	86.32a	70.05a	54.28a	18.35a	27.36a
	SEM(±)	0.48	0.83	0.64	0.73	0.34	0.27

Note: Breed: 1= Red Sokoto, 2 = WAD; Season: 1 = wet; 2 = dry; Sex: 1= Male, 2 = Female; Different superscripts within column for each factor indicates significant ($p < 0.05$) difference. BW = Body weight; BL = Body length; HG = Heart girth; HW = Height at wither; NL = Neck length; NC = Neck circumference.

Table 2: Interactions summary among season, breed, sex and age-group on the body weight and selected zoometric characteristics of extensively managed Nigerian goats

Interactions	BW	BL	HG	HW	NL	NC
Season*Breed	**	**	**	**	**	NS
Season*Age	**	**	**	**	**	**
Season*Sex	NS	NS	NS	NS	NS	NS
Breed*Age	**	NS	**	**	**	**
Breed*Sex	NS	NS	NS	NS	NS	NS
Age*Sex	*	*	**	NS	**	NS
Season*Breed*Age	NS	*	**	**	**	**
Season*Breed*Sex	NS	**	NS	NS	*	NS
Season*Age*Sex	*	NS	NS	NS	NS	**
Breed*Age*Sex	NS	NS	NS	NS	**	NS
Season*Breed*Age*Sex	NS	NS	NS	NS	*	NS

Note: * indicates significant ($p < 0.05$) difference between / among the factors; ** indicates significant difference ($p < 0.01$) difference between / among the factors; NS indicates no significant ($p < 0.05$) difference between / among the factors; BW = Body weight; BL = Body length; HG = Heart girth; HW = Height at wither; NL = Neck length; NC = Neck circumference.

There was significant ($p < 0.05$) interaction between breed and age for all the morphometric trait considered, except BL (Table 2). RS goat had a longer BL than WAD in the wet season (76.49 vs 65.67cm) while WAD was slightly longer in BL during the dry season (Table 3). Furthermore, the HG of WAD goat was wider with 2.97cm during the dry season than the wet season, while that of RS goat was wider with 2.88cm during the wet season. Measurements of HW and NL in RS goat were influenced by season while there was no effect of season on HW and NL in WAD goats (Table 3). The NL of RS becomes longer with increasing age than that of WAD goat. These results show marked difference between the breeds to change in season. Earlier report by Otoikhian *et al.* (2008) showed that goats of different genotypes react differently to change in environmental conditions. Difference in HW as well as NL was noted among RS goat with change in season while there was no observably different HW and NL for WAD between the two seasons (Table 3).

Season and age interaction generally showed a marked significance ($p < 0.05$) with relatively higher body weight in the dry season than wet season for all the ages of the goats considered. A wider margin (12.43cm) was also noticed between the dry and the wet season BL of goats that were less than one year with higher value recorded in the wet season, while relatively comparable BL and other zoometric measurements were noticed at older ages. This indicates some levels of stress on the nursing dam (Wilson, 1991) as a result of change in season and consequential variation in nutritional sources for extensively managed goats. Longer neck length and thinner long circumference were generally noticed in the wet than the dry season for at all ages of the studied goats, an indication of better nutritional status leading to fat accumulation in the dry season. Heart girth and wither height in both dry and wet season did not follow a fixed trend for all ages except lower age (<1 year) with values in the wet season noticeably higher than what were observed in the dry season (HG: 40.65cm vs 35.90 cm; HW: 37.91 cm vs 33.98 cm).

Table 3: Body weight and zoometric characteristics of RS and WAD goats in different seasons at different age groups

	Season * Breed	BW(kg)	BL (cm)	HG (cm)	HW (cm)	NL (cm)	NC (cm)
1	1	17.18	76.49	58.40	53.33	18.45	22.95
1	2	13.20	65.67	53.90	44.44	12.37	22.14
2	1	22.53	70.06	55.52	49.61	16.20	23.94
2	2	15.26	70.07	56.87	45.94	12.25	22.72
	Season* Age						
1	<1	6.30	53.06	40.65	37.91	12.01	17.73
1	1-2	11.81	68.87	52.38	45.29	14.05	22.14
1	2-3	14.83	73.11	57.81	52.19	15.61	24.05
1	3-4	17.78	77.08	59.75	54.05	16.49	22.46
1	>4	25.26	83.29	70.17	54.98	18.90	26.33
2	<1	6.76	40.63	35.90	33.94	9.25	15.06
2	1-2	15.34	69.29	53.37	45.75	13.22	22.56
2	2-3	19.27	74.28	55.60	50.35	14.97	24.73
2	3-4	23.38	76.76	66.18	55.27	15.88	25.89
2	>4	29.74	89.35	69.92	53.57	17.80	28.37

Note: Breed: 1= Red Sokoto, 2 = WAD; Season: 1 = wet; 2 = dry; BW = Body weight; BL = Body length; HG = Heart girth; HW = Height at wither; NL = Neck length; NC = Neck circumference.

Breed and age interaction for BW and NL followed a fixed trend (Table 4) in which RS goat at any particular age group had higher measurements than the WAD goat of similar age. This corroborates the earlier report (Yakubu *et al.*, 2010; Yusuff *et al.*, 2015) in which RS was superior in BW and zoometrics values than WAD. A relatively closer measurements were obtained for HG, WH and NC between RS and WAD at the age groups of 1-2, 2-3 and 3-4 years while RS of >4years were markedly higher than WAD in these parameters. Interaction between age and sex for BL, HG and NL (Table 4) were significant ($p < 0.05$). For instance, male and female goats of less than 1 year have lower BL and HG than male goats (BW: 5.79 vs 7.27; BL: 44.64 vs 49.05; HG: 36.62 vs 39.93). Differences between sex (male and female) were also noticeable in older goats (>1year) but not significantly ($p > 0.05$) different, which explains existence of sexual dimorphism in goat (Polak and Frynta, 2009). The results suggest better nutritional advantage and growth of young male goats than the female.

Table 4: Interaction between sex and age group of RS and WAD goats with respect to body weight and zoometric characteristics

	Breed * Age	BW(kg)	BL (cm)	HG (cm)	HW (cm)	NL (cm)	NC (cm)
1	<1	7.98	48.38	37.81	36.45	11.97	15.95
1	1-2	16.43	71.21	53.76	47.46	15.65	22.46
1	2-3	19.14	76.87	58.31	53.66	17.28	24.84
1	3-4	22.71	80.18	62.31	56.42	19.16	24.58
1	>4	33.04	89.76	72.60	63.36	22.15	29.38
2	<1	5.09	45.32	38.74	35.40	9.29	16.84
2	1-2	10.71	66.95	51.98	43.57	11.61	22.24
2	2-3	14.96	70.52	55.10	48.89	13.31	23.94
2	3-4	18.45	73.66	63.62	52.90	13.21	23.77
2	>4	21.95	82.88	67.50	45.19	14.14	25.38
	Age * Sex						
<1	1	7.27	49.05	39.93	37.34	11.20	16.62
<1	2	5.79	44.64	36.62	34.52	10.06	16.17
1-2	1	13.57	69.21	53.97	45.47	13.54	22.37
1-2	2	13.57	68.95	52.78	45.56	13.73	22.33
2-3	1	17.75	74.27	56.79	52.02	15.23	24.23
2-3	2	16.35	73.11	56.62	50.53	15.36	24.56
3-4	1	20.92	76.75	62.62	55.31	16.04	24.36
3-4	2	20.24	77.08	63.31	54.02	16.33	23.99
>4	1	27.30	87.35	71.15	54.38	18.68	27.19
>4	2	27.69	85.23	68.94	54.18	18.02	27.52

Note: Breed: 1 = Red Sokoto, 2 = WAD; Sex: 1 = Male, 2 = Female; BW = Body weight; BL = Body length; HG = Heart girth; HW = Height at wither; NL = Neck length; NC = Neck circumference.

CONCLUSION

Seasons had significant influence on the variations in the body weight and zoometric changes in both Red Sokoto and West African Dwarf goats. However, the effect of season depends on such factor as age and breed of the animal as well as the interaction between fixed effects like breed, age and sex.

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