BREED AND ENVIRONMENTAL FACTORS AFFECTING BODY WEIGHT OF NIGERIAN SHEEP

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ABSTRACT
In Nigeria, sheep are managed mainly under the traditional free-range system in which little or no information is available on factors affecting their productivity. The study was conducted to investigate the body weights of four Nigerian sheep breeds (Balami, Uda, West African Dwarf ie WAD and Yankasa), at various ages and the non genetic factors affecting them. Weights of 156 lambs (33 Balami, 34 Uda, 43 WAD, 47 Yankasa) were measured at birth, days 30, 60, 90, 120, 150, 180, 270 and 360 over three years and analyzed using general linear model of SPSS version 22.0. Generally, body weights in Balami and Uda were higher than in Yankasa while WAD had the lowest. Males were heavier than females from weaning to adulthood. Single born lambs were heavier than multiples from birth to 150 days. Parity affected only birth weight where 3rd parity lambs were heavier that earlier ones. Season and year did not influence weight. Knowledge of factors that affect production traits such as these and correction of records for environmental factors could aid estimated genetic parameters and breeding value to reflect animal's genetic potential.
Keywords: sheep, breed, non genetic factors, body weight.

INTRODUCTION
The indigenous breeds of sheep of Nigeria in the order of importance are Yankasa (60%), West African dwarf (WAD) (20%), Uda (10%) and Balami (10%) (Ajala *et al*., 2008). Ages at first lambing are; 11-18, 11-18, 10-16 and 10-16 months respectively. Lambing intervals are 227 days for Uda, Yankasa and West African Dwarf and 282 days for Balami (Anonynous, 1990). These allow for more rapid improvement as compared to cattle. Sheep are cheaper to rear because they require less space and whereas feeding may account for 70-80% of production cost in swine and poultry, it is less than 50% in ruminants including sheep (Adegbola, 1989).
Fast growth performance allows sheep to breed early and contribute more lambs in their lifetime. Fast growth rate entails reaching market weight early, which brings a quicker income to the farmer. In Nigeria, sheep are managed mainly under the traditional free-range system and information on factors affecting their productivity is important. In animal improvement programmes, genetic progress can be made only if selection is based on genetic merits instead of phenotype (Rashidi *et al.*, 2008). Environmental factors such as age, sex, type of birth, season and year of birth influence the estimation of breeding value. Information on environmental factors that affect production traits such as body weights and correction of records for these factors could cause estimated genetic parameters and breeding value to reflect animal's genetic potential. Therefore, the objective of this study is to determine the effect of breed (Balami, Uda, WAD and Yankasa) and non-genetic factors (sex of lamb, parity of dam, year of lambing, type of birth and season of birth) on body weights of sheep.

MATERIALS AND METHODS
Location and climate
The research was carried out in Pankshin, Jos Plateau. It is a pear-shaped upland located in the middle of Nigeria between latitude $8^{o}$and 10^{0} north and longitudes 7^{0} and 11^{0} east, at an average altitude of 1,200m above sea level. It has near temperate climate with average monthly temperatures ranging between 18 and 25^{o}C. It experiences an average humidity of 60% and rainfall of 1,400mm. Most of it is covered by extensive grassland and few trees. Light forests are however still found along some water courses. The grasses are generally green and nutritive during rainy season (April- October) but less so during the dry season (November - March).
Study sheep and their management
The research commenced with a stock of 64 yearling sheep which comprised 12 each of Uda and Balami and 20 each of West African Dwarf (WAD) and Yankasa in a sex ratio 1: 1 per breed. Later,

156 offspring of the starting stock produced from controlled breeding (only within breed mating) were included.

The sheep were housed in pens constructed with concrete blocks, floored and roofed with corrugated iron sheets. The ewes and a breeding ram of the same breed were housed together. After birth, lambs were kept with their ewes under close observation for 24 hours to ensure that they were suckled with colostrum Ewes were allowed to graze without their lambs after 3 weeks of lambing. Throughout the period of the experimental study (3 years), animals were grazed separately by sex on locally available pasture from 9:00am to 5:00pm. Crop residues and salt lick were made available in the evening. Drinking water was supplied *ad libitum*.

Body weight measurement and data analysis

Body weights were measured in kilogramme using the Salter scale. The weights measured included at birth (within the first day), monthly up to the 12th and at weaning, 90th day. Data generated were analyzed using the General Linear Model (GLM) of SPSS (Statistical Packages for Social Sciences, 2013) version 22.0. Differences among breed, sex, year, season, parity, and birth type in terms of body weight were determined. Ryan-Einot-Gabriel-Welsch post hoc-test was performed to separate any more-than-two means that were statistically different. The statistical model used is;

$Y_{ijklpqr} = \mu + G_i + S_j + P_k + B_l + N_i + E_q + e_{ijklnlqr}$

Where:

$Y_{ijklpqr}r$ = observable characteristic;

μ = overall mean;

$G_i = i^{th}$ effect of breed (i = 1, 2, 3, 4);

$S_j = j^{th}$ effect of sex (j = 1, 2);

$P_k = k^{th}$ effect of parity (k = 1, 2, 3);

$B_l = l^{th}$ effect of birth type (l = 1, 2, 3);

$N_i = p^{th}$ effect of season (p = 1, 2, 3, 4);

$E_q = q^{th}$ effect of year (q = 1, 2, 3) and

$e_{ijklnlqr}$ = Random error

RESULTS

Body weight of sheep

The least squares mean weights of sheep at various ages are shown in Tables 1 and 2. The effect of breed was significant ($p<0.001$) at all ages; Balami and Uda did not differ significantly except at days 270 and 360 (when the former was heavier) followed by Yankasa while West African Dwarf was lightest. Sex effect was not significant at the ages of 90 days and below but had statistical influence at various levels from 120 to 360 days. The effect of lamb's birth type was significant at earlier ages (0-150 days) only. Parity effect however was significant ($p<0.01$) only at birth. The effects of season and year were not significant at all ages.

Table 1: Least squares means of sheep weights at various ages by breed and sex

Fixed factors	**Days**								
	0	**30**	**60**	**90**	**120**	**150**	**180**	**270**	**360**
Overall	2.37	4.21	6.72	10.30	12.31	14.09	17.24	23.41	29.82
Breed									
Balami	3.21[a]	6.22	9.42[a]	11.48[a]	14.21[a]	16.48[a]	19.93[a]	26.91[a]	32.32[a]
Uda	3.12[a]	6.10	9.40[a]	11.44[a]	13.92[a]	16.10[a]	20.0[a]	24.82[b]	30.65[b]
WAD	1.39[c]	2.79	5.82[c]	7.81[b]	10.71[c]	12.47[c]	14.64[c]	17.46[d]	21.90[d]
Yankasa	2.32[b]	5.24	6.99[b]	8.00[b]	11.27[b]	14.09[b]	17.21[b]	22.01[c]	25.03[c]
Sex within breed									
Balami									
Female	3.18	6.21	9.40	12.00	14.01	16.40	18.93	24.21	28.01
Male	3.20	6.24	9.41	12.07	15.52	17.92	21.04	28.20	34.31
Uda									
Female	3.18	6.12	9.42	11.41	13.47	15.91	19.01	23.08	26.80
Male	3.10	6.02	9.38	10.98	14.08	17.84	21.82	28.00	31.20
WAD									

Female	1.40	2.70	5.80[a]	7.01[a]	10.10[a]	12.03[a]	13.01[a]	14.46[a]	19.10[a]
Male	1.38	2.80	6.21[b]	8.24[b]	11.90[b]	13.14[b]	15.48[b]	17.49[b]	24.50[b]
Yankasa									
Female	2.33	5.25	6.90	7.91	10.92	12.98[a]	14.74[a]	18.89[a]	24.10[a]
Male	2.32	5.20	6.89	7.68	11.82	14.27[b]	18.74[b]	23.92[b]	27.10[b]
Sex									
Female	2.42	4.82	7.42	10.32[a]	12.03[a]	14.02[a]	16.11[a]	21.50[a]	26.02[a]
Male	2.46	4.93	7.41	12.08[b]	14.03[b]	16.46[b]	21.12[b]	25.06[b]	28.81[b]

Means in the same column with different superscripts differ significantly, ($p<0.05$)

Table 2: Least squares means of sheep weights at various ages by birth type, parity, season and year

Fixed factors	**Days**								
	0	**30**	**60**	**90**	**120**	**150**	**180**	**270**	**360**
Birth type									
Single	2.87[a]	4.53[a]	7.70[a]	10.68[a]	12.32[a]	15.12[a]	17.52	24.71	29.32
Twin	2.30[b]	4.49[b]	6.99[b]	9.69[b]	12.03[b]	15.01[ab]	17.20	23.81	28.99
Triplet	1.96[b]	3.92[b]	5.23[b]	8.90[c]	11.12[c]	14.94[b]	17.02	24.01	28.58
Parity									
1	2.02[a]	4.52	6.99	9.67	11.92	15.01	17.00	23.99	29.30
2	2.22[b]	4.40	6.59	8.99	12.03	14.96	17.21	23.82	29.31
3	2.42[c]	3.98	7.00	9.48	12.32	15.08	17.22	23.90	28.99
Season									
Early dry	2.42	4.82	7.33	10.90	12.52	15.20	17.51	23.01	27.40
Late dry	2.32	4.79	7.38	11.32	12.62	14.99	18.01	23.80	27.61
Early rainy	2.40	4.90	7.42	10.99	12.41	15.67	17.42	22.90	27.80
Late rainy	2.42	4.82	7.29	11.08	12.50	15.71	17.90	23.40	26.90
Year									
2012	2.42	4.99	7.49	10.91	12.62	15.66	17.80	22.89	27.70
2013	2.41	5.0	7.77	10.46	13.0	15.72	17.46	23.06	26.99
2014	2.38	4.72	7.81	10.78	12.78	15.56	18.00	23.45	27.80

Means in the same column with different superscripts differ significantly, ($p<0.05$)

DISCUSSION

Balami and Uda were superior to Yankasa, in body weight which in turn had higher value than WAD. Adu and Ngere (1979)) reported that Balami and Uda were the fastest growing breeds in Nigeria. Blench (1999) stated that Balami and Uda were heavier than other breeds (Yankasa and WAD). Adu and Ngere (1979) described the Yankasa as medium size while WAD is the smallest sheep breed in Nigeria. The non-significant difference between Balami and Uda in most body weights contradict the report of Rotim*i et al*. (2013). The authors observed that Balami was significantly heavier than Uda at birth, weaning and 6-month of age. However, the present study agrees with the authors that at 9 and 12 months of age, Balami is heavier than Uda. The mean weight of Balami at birth (3.21kg) in this study is lower than the 3.55kg reported by Rotimi *et al.* (2013) but higher than 2.60 (Iyiola-Tunji, 2012). Furthermore, the mean weight of Yankasa at birth (2.32kg) in this study is lower than 2.73kg reported by (Iyiola-Tunji (2012). These differences had been attributed to variation in management, ecology and other environmental factors (Fasae *et al*., 2012).

The non-significant effect of sex on body weights at early ages corroborated the reports of Fasae *et al*. (2012) and Iyiola-Tunji (2012). They found non significant sex effect on body weight from birth to weaning. However, this is contrary to the report of Klindt (2005) that sex influenced birth weight and subsequent growth rate. The author explained that endocrine functions are often sexually dimorphic, and that programming of sexual dimorphism begins with embryonic expression of sex-determining gene (SRY) in males and secretion of Mullerian-inhibiting hormone (anti-Mullerian hormone, MIH), which prevents development of internal reproductive traits in females.

The significant influence of lambs birth type to 5 months of age agrees with previous reports (Barber

et al., 2004; Fasae *et al*., 2012; Iyiola-Tunji, 2012). The superiority of single over multiple born lambs is attributed to the stress the multiple lambs suffer due to diminished nutrient availability to each in the uterus (Ngere *et al.*, 1979; Taiwo *et al.,* 1982). As the number of foetuses increases, the number of caruncles attached to each foetus decreases thus reducing nutrients supply to foetuses resulting in lower birth weight (Robbinson *et al*., 1977). Authors have reported that as the number of foetuses increased, lambs' birth weight decreased; Fogarty *et al.*, 2005). At later ages (6 to 12 months old), non significant difference was observed between body weights.. This contradicts the reports of Carrillo and Segura (1993) on Mexican sheep, Salako (2002) on WAD and Yankasa sheep, Ceythan *et al* (2011) on Sakiz sheep and Iyiola-Tunji (2012) on various Nigerian breeds and their crosses. The multiple born might have demonstrated compensatory growth after weaning.

Birth weight increased with advancing parity. This is in agreement with the reports of Fasae *et al*. (2012) and Momoh *et al*. (2013) who showed that birth weight of lambs at first parity was least and increased significantly to the third parity. However, this finding contradicts those of Mandal *et al*. (2003) in Muzaffarnagari and Mecheri sheep respectively.

That season did not influence body weight in the present study is contrary to the report of Fasae *et al*. (2012) that found that lambs born in the wet season were heavier than their dry season counterparts. The authors attributed it to the greater availability of fodder in the wet season as compared to the dry. The present finding could have been because, the experimental sheep were supplied adequate supplementary feeds that probably cancelled out seasonal differences in feed availability. Furthermore, that in the present study, year had no influence on the body weights at all ages contradicts some reports (Hassan and Seyed, 2009 ; Momoh *et al.*, 2013). These reports attributed the significant difference between years in body weights of sheep to nutrition, management, hygiene and climatic condition. However, in the 3 years of the present study management practices and climatic conditions were similar.

CONCLUSION AND APPLICATIONS

Breed, sex, birth type, and parity influenced weights of sheep at various ages while season did not. Generally, body weights in Balami and Uda were higher than in Yankasa while WAD had the lowest. Males had greater body weights than females from weaning to adulthood. Single born lambs were heavier than multiples from birth to 150 days. Parity affected only birth weight where 3rd parity lambs were heavier that earlier ones.

Information on factors that affect production traits such as these and correction of records for environmental factors could aid estimated genetic parameters and breeding value to reflect animal's genetic potential.

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