Genetic And Environmental Factors Influencing Birth Weight in Yankasa And Yankasa*West African Dwarf Crossbred Sheep in Humid Southwest Nigeria.

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Target Audience: Animal Breeders; Commercial sheep producers; Researchers

Abstract

*The birth weight (BWT) record of purebred Yankasa and Yankasa *West Africa Dwarf (WAD) crossbred lamb raised semi-intensively in a commercial farm at Ibadan were used to estimate the various genetic and non-genetic factors affecting the trait using the General Linear Model (GLM) analysis of variance procedure of the SAS package. Dam breed, type of birth, parity and brith year exerted significant influence (P<0.01) on BWT, sex, dam breed *sex and dam breed *birth season interaction significantly (P<0.05) influenced the trait while birth season did not have any significant influence (P>0.05) on BWT. The least square means±standard errors of BWT were 2.36 ± 0.20kg; 2.53 ± 0.25kg and 2.18±0.21kg respectively for overall, male and female lambs. The phenotypic correlations of dam weight at parturition and BWT of lambs is low in each dam breed but moderately high and significant (P<0.01) in the pooled data of both dam breed. Repeatability of BWT were 0.41 ± 0.006; 0.29 ± 0.14 and 0.43 ± 0.005 in Yankasa, WAD and data of both dam breeds respectively. This study revealed that BWT of lambs is subjected to breed and environmental variations and that the BWT of WAD sheep can be improved by crossbreeding with Yankasa breed.*

Keywords: Birth weight; Genetic and Environmental factors; Yankasa; West African Dwarf sheep

Description of Problem

Birth weight as an early measurable trait is of great interest in meat animal production because of its positive genetic correlation with further live weights (1,2). (3). Reported that the birth weight of lamb is one of the most important factors influencing their survival and growth, with heavier lambs surviving better than the lighter ones. (4) also reported that a high birth weight confers an initial advantage on the animal, which is maintained at least to weaning.

Several authors have noted that, although birth weight might be influenced by various environmental factors, it is a highly heritage trait in sheep and hence can be utilized as a selection criterion in sheep breeding (5,6,7) and can be used reliable to predict survival during the neonatal period. (8).

The Yankasa sheep is the most numerous breed of sheep in Nigeria and also has the widest distribution, being found throughout the eco-zones of the country (9, 10, 11). It is estimated to constitute about 60% of the National sheep

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population of 22.1 million (12). The Yankasa sheep are of medium body size with mature live weight o about 40kg (13). The body colour is typically white with black patches around the eyes, ear, muzzle and sometimes the feet (9).

The West-African Dwarf (WAD) sheep breed is widely distributed in the area south of latitude 14^0 N with a wide range of coat-colours which may be all white, black or brown or spotted black or brown on a white coat (9). They are characterized by small body size with mature live weight of about 30kg (13).

In an attempt to improve on the live weight of the WAD sheep, a crossbreeding programme was initiated under a semi-intensive management system in a commercial farm in the bumid southwest zone of the country. The birth weights of the crossbred lambs from the experiment are being investigated in this report. The aim was to determine the various environmental and genetic factors affecting this trait in the Yankasa *WAD crossbred lambs. The phenotypic corelation between weight of dam at parturitions and lamb birth weithg as well as the repeatability of lamb birth weights are also being estimated.

Materials and Methods

Data Source

The birth weight (BWT) records of 79 purebred Yankasa and 18 Yankasa *West African Dwarf (WAD) crossbred lambs extracted from the records of the animal routinely kept at Zartech Farms, Oluyole Estate, Ibadan, Nigeria was used for this study.

Animal Management

The animals were managed semi-intensively. They were housed in slatted floored pens, released daily for grazing at 0800 hours, and remained on pasture till about 1600 hours. Grazing is rotationally among paddocks planted with Guinea grass (*Panicum maximum*), Elephant grass (*Pennisetun purpureum*) mixed with Centro (*Centrosema pubescens*) legume and *Leucaena leucocephala* and *Gliricidia sepium* browse plants. Salt lick and clean drinking water was provided in the pens. They were provided with protein concentrate of 15.5% Crude Protein at 2.5% bodyweight when they returned from grazing.

Animals were reared in groups separated according to sex and physiological conditions with mating restricted to establish pedigree of progenies. Ewes in advanced stage of pregnancy were restricted to the pen prior to lambing. At lambing, the lambs were tagged and weighted within 12 hours of birth and subsequently at 4 weekly intervals. The weight of the ewe prior to lambing was also recorded. Animals were routinely inspected, dipped, drenched and vaccinated especially for *peste des petits ruminants* (PPR).

Statistical Analysis

The BWT records were analysed by General Linear Model procedure (PROC GLM) of (14) to evaluate the various factors affecting this trait. The model adopted for the analysis is as follows;

$$Y_{ijkmno} = \mu + A_1 + B_j + C_k + D_1 + E_m F_n + (AB)_{ij} + (AF)_{in} + e_{ijkmno}$$

Where;

Y_{ijkmno}	=	the observed BWT
μ	=	overall mean
A_i	=	effect of i^{th} dam breed
B_j	=	effect of j^{th} sex of lamb
C_k	=	effect of k^{th} type of birth
D_i	=	effect of l^h parity
E_m	=	effect of m^{th} birth year
F_n	=	effect of n^{th} birth season
$(AB)_{ij}$	=	interaction of i^{th} dam breed and j^{th} sex of lamb
$(AF)_{in}$	=	interaction of i^{th} dam breed and n^{th} birth season of lamb
e_{ijkmno}	=	the random error term associated with each record of preweaning trait.

All effects were random, normally and independently distrituted (~NID) with zero mean and variance σ_e^2.

Least squares means and standard errors were estimated for all the main effects and the pair-wise difference (PDIFF) option of PROC GLM was used to separate least squares means of significant effects.

The Pearson correlation coefficients of dam weight at parturition and lamb birth weight were estimated using Correlation procedure (PROC CORR) of (14) for both and each dam breed subclasses.

The variance components used in the estimation of repeatability of BWT of lambs from each dam breed and the combined data set were obtained by Variance Components procedure (PROC VARCOMP) of (14) using Restricted Maximum Likelihood (REML) method based on a model that consider only ewe variance (15) as follows.

$$Y_{ik} = \mu + \alpha_i + e_{ik}$$

Where;

Y_{ik} = the observed BWT of individual calves of each dam

μ = the overall mean,

α_i = the effect of the i^{th} dam and

e_{ik} = the uncontrolled environment and genetic deviations attributable to individuals within each dam.
All effects are random, normal and independent with expectations equal to zero.

Repeatability coefficients were esttimated using the formulae after (15) as follows;

$$R = \frac{\sigma^2_B}{\sigma^2_B + \sigma^2_w}$$

Where;

σ^2_B = variance components due to difference between individual dams

σ^2_w = variance components due to differences among records of lamb BWT within individual dams.

R = Repeatability.

The standard errors (SE) of repeatability were calculated according to (16) for unequal numbers of lambs per ewe.

Results and Discussion

The mean squares from the general linear model analysis of variance of BWT of lambs were shown in Table 1. Dam breed, type of birth, parity and birth year exerted a highly significant ($P<0.01$) effects on BWT while sex of lambs, dam breed *sex and dam bred *birth season interactions exerted significant ($P<0.05$) effect. However, birth season did not significantly influence birth weight ($P>0.05$) contrary to the findings of (17,18).

The least squares means and standard errors showing the effects of the various factors on BWT were presented in Table 2. The overall least square mean of BWT agreed with earlier reports on Yankasa sheep (18) but higher than values quoted for WAD sheep (13). It is however lower than the estimates for Yankasa sheep in Nigeria (4,19), Balami and Desert Sudanese sheep in Nigeria (20), Ossimi and Merino sheep in Egypt (21), Black Najdi lambs in Saudi Arabia (22) and Fulani sheep in Central Mali (17).

Expectedly, male lambs were 0.35kg heavier then females at birth and lambs from single birth are heavier than twins which are in turn heavier than lambs born as triplets. Also, within each breed subclass, male lambs were consistently heavier than the females and lower birth weight with increasing litter size is consistnt with reports in literature (9, 17, 18, 19, 23).

The birth weight of purebred Yankasa lambs compares with values earlier reported (4, 24) and is within the range cited by (13). The birth weight of the Yankasa *WAD crossbred lambs although significantly lower ($P<0.01$) than that of the purebred Yankasa, it is however higher than the values estimated for purebred WAD lambs from literature (13, 25, 26). The lower birth weight of WAD compared to Yankasa breed is not suprising since the WAD breed is characterized by small body size (13). This result confirmed that crossbreeding WAD with Yankasa breed increases the birth weight of th crossbred lambs.

The BWT tended to increase with parity with the highest in the third parity. The drop in BWT in the fourth parity could be explained by the sharp decrease in the number of animals in the flock. The improvement of BWT with parity may be due

Table 1: Mean square from the analysis of variance of factors affecting birth weight in Yankasa and Yankasa*West African Dwarf crossbred lambs

Source	df	Mean Squares
Dam breed	1	11.401**
Sex	1	0.840*
Type of birth	2	3.095**
Parity	3	1.833**
Birth Year	1	2.861**
Birth Season	2	0.917^{NS}
Dam breed *Sex	1	0.292*
Dam breed *Birth Season	2	1.272*
Error	83	0.423

**P < 0.01
* P < 0.05
^{NS}Not significant (P>0.05)

To increased efficiency of reproduction as the dam matures (27) and also to the increased uterine capacity with increasing age of the dam. Similar findings were reported by other researchers (17, 18, 28, 29).

The BWT of lambs born in 1996 were significantly (P < 0.01) higher than those born in 1997. This could be attributed to the fact that most of the ewes that lambed in 1996 when the flock was established were older does that were purchased while pregnant.

The lambs born in the early wet season had the highest BWT compared to those born in the late dry and late wet seasons that had similarly lower BWT. This is a reflection of the seasonal fluctuations in forage availability to the dam. Although the animals were semi-intensively managed, grass still remains their basal diet. (18, 19) had reported similar seasonal fluctuations in BWT of Yankasa sheep.

The Phenotypic correlation coefficients of dam weight at parturition and lamb BWT for each dam breed and both combined were presented in Table 3. The correlation coefficients were low and not significant (P > 0.05) in each dam breed but moderately high and significant (P<0.01) for both breeds combined. This implies that the weight of dam prior to parturition significantly influenced the BWT of lambs as reported by (8). In the same vein, (30) noted that the weight of the ewe during gestation among other, is associated with reduced lambs viability and survivability.

The repeatability estimate of lamb BWT as a trait of the ewe is shown in Table 4. The repeatability of BWT for Yankasa ewes and both breeds is higher than the value quoted by (31). The lower estimate for WAD ewes is similar to the value reported by (28) for *Djallonke* sheep in Senegal. The similarity in values of repeatability of WAD in this study and the *Djallonke* sheep reported by (28) is to be expected since both breed of sheep are the dwarf type. This implies that the BWT is moderately heritable in Yankasa while it is highly influenced by environmental factors in the WAD lambs.

Conclusions and Applications

From the results of this study, it can be concluded that;

1. The birth weight of lambs was significantly influenced by both genetic and environmental factors. Thus, there is the need to adjust lamb birth weight for these factors before valid.

Table 2: Least squares means (LSM) and standard errors (SE) of factors affecting birth weight in Yankasa and Yankasa*West African Dwarf crossbred lambs

Factor	N	LSM ± SE
Overall	97	2.36 ± 0.20
Dam breed		
Yankasa	79	2.93 ± 0.21[a]
WAD	18	1.78 ± 0.24[b]
Sex		
Male	41	2.53 ± 0.25
Female	56	2.18 ± 0.21[b]
Type of Birth		
Single	42	2.98 ± 0.17[a]
Twins	52	2.50 ± 0.18[b]
Triple	3	1.60 ± 0.43[c]
Parity		
1	48	2.12 ± 0.21[a]
2	30	2.44 ± 0.25[ab]
3	17	2.91 ± 0.24[b]
4	2	1.97 ± 0.54[a]
Birth Year		
1996	63	2.64 ± 0.23[a]
1997	34	2.08 ± 0.22[b]
Birth Season		
Late Dry (Jan – March)	14	2.17 ± 0.28[a]
Early Wet (April – June)	51	2.73 ±0.26[b]
Late Wet (July – Sept.)	32	2.18 ± 0.26[a]
Dam breed *Sex		
Yankasa *Male	33	3.21 ± 0.23[a]
Yankasa *Female	46	2.66 ± 0.21[b]
WAD *Male	8	1.86 ± 0.38[c]
WAD *Female	10	1.71 ± 0.29[c]
Dam breed *Birth Season		
Yankasa *Late Dry	8	3.12 ± 0.33[a]
Yankasa *Early Wet	48	3.06 ± 0.20[a]
Yankasa *Late Wet	23	2.62 ± 0.27[a]
WAD *Late Dry	6	1.21 ± 0.35[b]
WAD *Early Wet	3	2.39 ± 0.45[a]
WAD *Late Wet	9	1.75 ± 0.33[b]

[abc]Means within main factor with different superscripts are significant different (P<0.05)

Table 3: Pearson correlation coefficients between dam weight at parturition and lamb birth weight in Yankasa and Yankasa*West African Dwarf crossbred lambs

Dam breed	N	Correlation Coefficient
Yankasa	60	0.149
WAD	18	0.157
Both	78	0.490**

** P < 0.01
* P < 0.05

Table 4: Variance components and repeatability estimates ± standard errors of lamb birth weight in Yankasa and Yankasa *West African Dwarf crossbred lambs.

		Variance Components			Repeatability
Dam breed	N	Dam	Error	K[1]value	±SE[2]
Yankasa	79	0.27717	0.39661	2.52	0.41 ± 0.006
WAD	18	0.09756	0.24257	2.16	0.29 ± 0.140
Both	97	0.31106	0.41418	2.46	0.43 ± 0.005

[1]Weight average number of lambs per ewe
[2]Standard error

comparison could be made between individual animals and estimation of reliable genetic parameters.

2. The Yankasa breed of sheep can be profitably reared in the humid south western ecological zone of the country thus confirming the cosmopolitan distribution of the breed in various ecological zones of the country (9, 10).

3. The birth weight of West African Dwarf sheep can be improved by cross breeding with Yankasa.

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