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Repeatability Estimates for Body Weight, Skin and Leather Properties in Pure and Reciprocal Crosses of Nigerian Goats

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Target Audience*:* Geneticists; Animal Breeders; Ruminant farmers; Leather industry

Abstract

This study evaluated repeatability estimates for body weight, skin and leather properties using progenies of pure and reciprocal crossing of West African Dwarf (WAD) and Red Sokoto (RS) goats. The progenies were labelled as RSxRS, WADxWAD, WADxRS and RSxWAD. Data on bodyweights of the progenies were taken at birth, weaning and at yearling when the males were slaughtered to obtain skins which were tanned to leather. Data on physical properties of the skin and the leathers were also taken. The result revealed a low range repeatability estimate for birth weight (0.01 – 0.23) and yearling weight 0.05 – 0.20, while weaning weight ranged from low – high (0.05 – 0.51). Repeatability estimates for leather properties generally ranged from low to moderate among the goat genotypes except for thickness (0.41) and surface area (0.64) of WADxWAD, and distention at crack (0.47) of RSxWAD. The results revealed that genotype is of variable influence on the repeatability estimate of bodyweight, skin and leather traits in the goats. It is therefore concluded that long term breeding of Nigerian goats would result in more consistent body weights, skin and leather properties.

Keywords: Breed, Bodyweight, Leather, Reciprocal crossing

Description of Problem

The potential for genetic improvement in any economically important trait in livestock depends largely on some genetic factors like repeatability, heritability and genetic correlation of the traits with other economically important traits (1). Repeatability as a concept, depicts the ability of an animal to similarly re-express a particular genetic quality in a trait that is measurable beyond one time on the same animal (2; 3). Repeatability estimate is therefore an important parameter that could determine sustainability of a trait in the herd and could therefore aid as basis for selection (4)**.** Greater proportion of Nigerian goats is kept under extensive system within which the environment has vital influence on the performances of the animals (5). Under such conditions, repeatability is subject to reduced reliability and high fluctuations because of high magnitude of uncontrollable factors. More often, accurate records of age and their corresponding performances is hard to obtain. Some information on repeatability estimates are however available on Nigerian goat breeds and mostly dwelled on reproductive performance (6; 7) with little on body weight (8) of each breed. There is virtually nonexistent information on skin traits when the animals are kept in a fixed environment and more especially on the reciprocal crosses of

Nigerian goats. The aim of the present study was to determine the repeatability estimates for growth, skin and leather traits in West African Dwarf and Red Sokoto (WAD and RS) goats and their reciprocal crosses in a comparative manner.

Materials and Method

Experimental Site

The experiment was carried out in the Small Ruminant Research Unit of College of Agriculture, Zuru, Kebbi state Nigeria. Zuru is located in the Sudan savannah agro-ecological zone of Nigeria and lies between latitude 11^{o} 5^{1}N and longitude 4^{o} 5^{1} to 5^{o} 5^{1}E.

Experimental Animals and its Management

One hundred and ninety two progenies produced in four parities by pure and reciprocal crossing of forty does (WAD and RS) with eight bucks (WAD and RS) over a period of three years were used for this experiment. The kids were labeled as RSxRS, WADxWAD, WADxRS and RSxWAD, and were also subjected to uniform management in terms of feeding, housing and other management practices. The males among the goats (progenies produced over a period of three years) were slaughtered at their yearling and the skins processed into leather via vegetable tanning using *Acacia nilotica* extracts.

Statistical Design and Model of the Experiment:

Design: Hierarchal design was used to produce the progenies from which the data were collected.

Model:

$Y_{km} = \mu + \alpha_k + e_{km}$

Y_{km} = observation from k-th individual (doe) with m-th measurements (parity) on a particular trait.

μ = common mean

α_k = effect of k-th individual (doe) which is assumed to be normal, randomly and independently distributed.

e_{km} = environmental deviation of m-th measurement (parity) within an individual doe which is assumed to be normal, randomly and independently distributed.

Data Collection

Bodyweight records of the progenies of the first, second third and fourth parities of the parent stocks was taken at birth, weaning and yearling. The skins and the leathers were assessed for physical properties like thickness, weight, surface area, percentage elongation, load at crack, load at tear, distention at crack and distention at tear.

Leather Assessment

Assessment of the leather properties (physical) was done in the Quality Control Laboratory of NILEST. Leather samples for the test were collected from the butt region which is the official sampling position (9) for physical analysis. The physical properties measured were percentage elongation, thickness and grain properties. The grain properties focused on were load at crack, distention at crack, load at tear and distention at tear.

Thickness

Thickness of all the leather samples were measured using standard type thickness gauge (Model: REF S 4/9) at three different locations on the cut leather samples.

Percentage Elongation

This was obtained using tensometer (Model: 9019 GAF 2620) which operates on the principle of two directional pull of the leather samples in two opposite directions. The tensometer has two jaws which move in two opposite directions at equal speed until the leather samples break. The distances between

the jaws at initial stage and break of the leather sample were then used to calculate percentage elongation as indicated below.

Percentage Elongation = (Distance at Break – Initial Distance) x 100 / Initial Distance

Grain Properties (Load and Distension at crack and burst)

Circular leather samples were cut to perform an experiment conventionally referred to as ball burst process in leather assessment. These samples were clamped on electronic lastometer (Model: 5077-ET- MUVER) which performs the test procedure on the grain surface of the leather. The extent of leather sample distension (mm) and the corresponding load (kg) before the notice of crack and that of burst (tear) were recorded by the lastometer.

Data Analysis and Estimation of Repeatability

Records of bodyweight in addition to skin and leather data were subjected to ANOVA to generate VARCOM via the procedure of (10). Generated variance components within individuals and between measurements within individuals were used to compute repeatability estimates (R) components according to (11) as indicated below.

$R = \sigma^2_{w/(}\sigma^2_e + \sigma^2_{w);}$

Where: σ^2_e = variance within individuals;

σ^2_w = variance between measurements within individuals; and

R = Repeatability

Results and Discussion

Estimates of repeatability for body weight at different stages (Table 1) varied among the genotypes under consideration (birth weight: 0.01 – 0.23; weaning weight: 0.05 – 0.51; and yearling weight: 0.05 – 0.20). Pure RS crossing (RSxRS) had the highest repeatability estimates for body weight at all stages under consideration. However, the repeatability of body weight in WADxWAD increased with increase in age, and generally fell within a low range (0.01 – 0.18). The birth weight repeatability estimates for the reciprocal crosses were higher than that of WADxWAD goats. Repeatability estimate for birth weight in RSxWAD goats was also higher than that of WAD x RS with 0.07.

Table 1: Repeatability estimates for body weight in WAD, RS and their crosses

Traits	RSxRS	WADxWAD	WADxRS	RSxWAD
Birth	0.23± 0.20	0.01± 0.24	0.09± 0.14	0.16± 0.26
Weaning	0.51± 0.28	0.06± 0.27	0.07± 0.29	0.05± 0.29
Yearling	0.20± 0.32	0.18± 0.24	0.15± 0.33	0.05± 0.18

Footnote: RSxWAD = Progenies kidded by WAD dams and sired by RS bucks; and WADxRS = Progenies kidded by RS dams and sired by WAD bucks.

The birth weight repeatability estimate in RSxRS (0.23) is comparable with 0.20 (12) reported for progeny of three way crossbred goats in Tanzania. Weaning weight repeatability estimates were also generally low with the exception of RSxRS which has a repeatability estimate (0.51) that conforms to the report of (13). Although, the two reciprocal crosses were low in repeatability estimates for weaning and yearling weight, estimate of WADxRS cross was higher than that of RSxWAD at the two stages. The yearling weight repeatability estimates of WADxWAD goats was slightly higher than that of WADxRS cross with 0.03. The range of repeatability estimates for body weight in the present study were generally lower than the range (0.70 – 0.890) reported by (8) for red Sokoto goat. (14) also reported the likelihood of low to moderate range of repeatability

estimate for body weight which corroborates the present finding. This may be due to variation in the number of records as well as environmental influence rather than change in heredity.

Estimates of repeatability for skin traits (Table 2) vary among the genotypes and traits under consideration. The estimates ranged from 0.02 – 0.23 for skin thickness, 0.01 – 0.33 for skin surface area and, 0.01 – 0.67 for skin weight. The highest repeatability estimates for surface area (0.33) and skin weight (0.67) were obtained on WADxWAD. RSxRS and WAD had higher estimates than the reciprocal crosses for thickness and surface area of the skins. RSxWAD also had higher repeatability estimates for skin thickness and surface area than WADxRS (Thickness: 0.16 vs 0.02; Surface area: 0.17 vs 0.01). Skin weight was highly repeatable in WADxWAD (0.67) while other genotypes had low estimates of repeatability. The repeatability estimate for skin weight in WADxRS was however higher than that of RSxWAD with 0.14.

Table 2: Repeatability estimates for skin traits in WAD, RS and their crosses

Skin Traits	RSxRS	WADxWAD	WADxRS	RSxWAD
TN (mm)	0.23 ± 0.31	0.23 ± 0.21	0.02 ± 0.19	0.16 ± 0.18
S/Area (dm^2)	0.22 ± 0.27	0.33 ± 0.22	0.01 ± 0.28	0.17 ± 0.35
Weight (g)	0.12 ± 0.30	0.67 ± 0.19	0.15 ± 0.22	0.01 ± 0.23

Footnote: TN = Thickness; S/ Area = Surface Area. RSxWAD = Progenies kidded by WAD dams and sired by RS bucks; and WADxRS = Progenies kidded by RS dams and sired by WAD bucks.

Repeatability estimates for physical leather properties (Table 3) generally ranged from low to moderate in the goat genotypes except for thickness (0.41) and surface area (0.64) in WADxWAD and distention at crack (0.47) in RSxWAD. The WADxWAD genotype also had a moderate estimate of repeatability (0.30) for percentage elongation while other genotypes had low values for the trait. The only moderate repeatability estimate in RSxRS (0.33) was obtained for load at tear. Estimates of repeatability for weight, load at crack and distention at tear of the leathers in all the genotypes were generally low. Although, some of the estimates for each trait across the genotypes were closer and fell within the same hierarchy of repeatability classification but breed differences were noticed. This is suggestive of genetic influence on the measured leather properties which was earlier indicated by (15). Earlier reports on physical leather traits of Ostrich skin (16) generally indicated a range of moderate to high repeatability estimate which is not in total agreement with findings in the present study. Selection of animal for a particular trait over a period of time tends to cause reduced variability and enhanced repeatability of such trait (17). The present results virtually showed little or no likelihood of earlier selection for leather traits particularly among the pure breeds. Although, Red Sokoto goat are usually acknowledged as leather breed (18) but variants of the breed were reported (19) and this may account for reduced uniformity or high degree of inconsistence in their leather properties.

Table 3: Repeatability estimates for leather properties in WAD, RS and their crosses

Traits	RSxRS	WADxWAD	WADxRS	RSxWAD
TN (mm)	0.10 ± 0.22	0.41 ± 0.23	0.01 ± 0.31	0.01 ± 0.18
PE (%)	0.18 ± 0.19	0.30 ± 0.29	0.07 ± 0.19	0.24 ± 0.21
S/Area (dm2)	0.14 ± 0.15	0.64 ± 0.27	0.01 ± 0.23	0.01 ± 0.29
Weight (g)	0.04 ± 0.26	0.02 ± 0.26	0.06 ± 0.27	0.19 ± 0.26
LC (kg)	0.17 ± 0.26	0.11 ± 0.26	0.18 ± 0.25	0.02 ± 0.26
DC (mm)	0.22 ± 0.27	0.17 ± 0.25	0.24 ± 0.26	0.47 ± 0.14
LT (kg)	0.33 ± 0.24	0.07 ± 0.25	0.22 ± 0.26	0.21 ± 0.26
DT (mm)	0.10 ± 0.26	0.11 ± 0.26	0.19 ± 0.26	0.24 ± 0.25

Footnote: TN = Thickness; PE = Percentage Elongation; S/ Area = Surface Area. LC = Load at crack; DC = Distention at crack; LT = Load at Tear; DT =Distension at Tear. RSxWAD = Progenies kidded by WAD dams and sired by RS bucks; and WADxRS = Progenies kidded by RS dams and sired by WAD bucks.

Higher repeatability observed on WADxWAD genotypes for thickness and surface area may be indicative of resistance to ecto-parasites or for the regulation of internal temperature in the breed. Preponderance of extremely low estimates of repeatability for the measured traits particularly in the reciprocal crosses may not be unexpected as it signals no earlier selection for the traits which resulted into higher incidence of genetic variation (17). Poor and non-uniform adjustment of the reciprocal crosses to the prevalent environmental factors (20) may also account for the observed trends.

Conclusions and Applications

Based on the results of this study, it was concluded that:

1. Pure and reciprocal crossing influences the repeatability estimate for bodyweight, skin and leather traits in Nigerian goats to a variable extent.
2. Long term close breeding of Nigerian goats would facilitate more consistent body weights, skin and leather properties.

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