

VALIDATION OF ACCURACY OF BODY SIZE PREDICTION FROM TESTICULAR TRAITS IN RED SOKOTO GOATS

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Abstract

Male fertility is an important factor in caprine reproduction since numerous does are generally bred to a single buck. Hence, evaluation of male fertility prior to breeding is of paramount importance to achieve breeding success. Body size and testicular measurements have been found to be important parameters utilized in breeding soundness evaluation. The present study therefore, aimed at determining the relationship between body weight (BW), scrotal circumference (SC), scrotal length (SL) and testicular length (TL) in 85 extensively reared Red Sokoto (RS) goats. The results obtained from SPSS software were validated using R statistical package. Among the testicular traits, SC was more highly related with BW ($r = 0.863$) in RS goats. It was also the best single trait for the prediction of BW (R^2 , adjusted R^2 and RMSE values of 0.744, 0.741 and 1.771, respectively). The present findings could be exploited in husbandry and selection of breeding stock for sustainable goat production especially within the resource-poor farming system under tropical and subtropical conditions.

Keywords: body size, body conformation, testicular measurements, goats, regression model

Introduction

Improvement in performance of small ruminant flocks or population over time can arise through improvement in management and feeding conditions, and through genetic progress of superior animals (Kosgey, 2004). Generally, body size and testicular measurements are important parameters utilized in breeding soundness evaluation. Knowing the body weight of an animal is important for a number of reasons such as breeding, correct feeding, health matters, growth as well as classification. Live body weight and testicular size have been found to generally indicate the production of viable spermatozoa by the male (Agga *et al.*, 2011). The biometrical analysis of testicular development is of great importance since it is significantly correlated with reproductive activity (Emsen, 2005; Yakubu and Musa, 2013). Sperm competition is a common phenomenon across the animal kingdom and is recognized as a major factor in the sexual selection of males. In the male for instance, there is the need to establish measurable criteria for judging breeding soundness and guiding selection of males for breeding. Since farmers may not be in a position to test ejaculate qualities of males before using them for breeding, a procedure that would utilize external testicular measurements may provide a good guide to breeding soundness especially where males are reputed to have exceptionally high libido (Shoyombo *et al.*,

2012). All else being equal, scrotal circumference as a highly heritable trait, could be used as an effective selection criterion in order to increase flock fertility and reduce the number of breeding rams required (Abbasi and Ghafouri-Kesbi, 2011). In Nasarawa State, Nigeria, there is dearth of information on the association between body size and testicular measurements in Nigerian indigenous goats. The present study was therefore conducted to predict body weight from testicular traits of Red Sokoto goats.

Materials and Methods

Data were obtained from 85 bucks of the indigenous Red Sokoto (RS) goats in Keffi, Nasarawa State, north central Nigeria. The randomly selected animals which were extensively managed were about 17 months old. Measurements were taken on body weight (BW), scrotal circumference (SC) (widest part of the testes, after the testes had been firmly pushed into the scrotum), scrotal length (SL) (the distance between the tip of the scrotal sack and its neck) and testicular length (TL) ((largest dorso-ventral distance) early in the morning before the animals were slaughtered. BW was measured in kilograms (kg), using a hanging spring balance and a sack. The SC in centimetres (cm) was measured with the aid of a flexible tape. The SL and TL were measured with the aid of a vernier caliper and recorded in centimetres (cm).

Data were analyzed for descriptive statistics. They were also subjected to simple linear regression to predict BW from SC, SL and TL. Coefficient of determination (R^2) (to quantify the proportion of variability explained by a model), Adjusted $R^2 = (1 - [(n-1) / (n-p)] (1 - R^2))$ and RMSE (Root mean squares error) were used to assess the accuracy of the regression model. Products from SPSS (2010) were validated using R statistical package (R core Team, 2015).

Results

Means and standard deviations for BW, SC, SL and TL are presented in Table I. Among the testicular traits, scrotal circumference was more highly related with body weight ($r=0.863$) (Table 2).

Discussion

The higher SC measurements for bucks indicate their higher testicular mass and larger sperm production, as reported earlier (Fernandez *et al.*, 2004). The SC is an important trait that is closely associated with the testicular growth and sperm production capacity of domestic animals. Thus, selecting males based on their SC would result in larger testes, potentially with the capacity to produce more spermatozoa (Mekasha *et al.*, 2008; Agga *et al.*, 2011). Being a highly heritable component of fertility, it is important to include SC when evaluating breeding animals. Ugwu *et al.* (2009) concluded that measurements of SC, TL or TW would provide a reliable guide to sperm production capacity of testis in WAD bucks and that these measurements can be applied by farmers in selecting bucks for breeding purposes.

The positive association between SC and BW is an indication that improvement in both traits is possible through selection procedures, considering their high genetic correlations (Pourlis, 2011). This is an indication that genes that contributed to BW had an influence in the reproductive ability of bucks. For the convenience of users who work under field conditions, prediction equations can be constructed involving the SC as a single trait. More so, that the accuracy of the model was validated using two softwares.

Conclusion

The study revealed that interrelationships between BW, SC, SL and TL in RS goats were positive and highly significant. SC was found as the most important single trait for the prediction of BW in RS goats. These findings, especially of the prediction models developed, could be useful in the management and selection of rams for

breeding purposes especially among the rural livestock farmers, which could lead to improved productivity and hence profitability of the goat enterprise in Nasarawa State, Nigeria.

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Table 1. Descriptive statistics of body weight and testicular measurements of Red Sokoto goats

Variables	SPSS software		R package	
	Mean	SD	Mean	SD
Body weight	20.49	3.48	20.49	3.48
Scrotal circumference	23.57	3.61	23.57	3.61
Scrotal length	12.37	2.06	12.37	2.06
Testicular length	5.07	0.83	5.07	0.83

Table 2. Relationship between body weight and testicular traits of Red Sokoto goats

Variables	Correlation (r)	
	SPSS software	R package
BW and SC	0.863**	0.863**
BW and SL	0.811**	0.811**
BW and TL	0.704**	0.704**

**Significant at p<0.01

The estimation of BW from the testicular traits of RS goats is shown in Table 3. The best single trait that could be used to predict BW is SC.

Table 3: Prediction of BW from the testicular traits of RS goats**

Model	Package	R ²	Adjusted R ²	RMSE
BW=0.873 + 0.833SC	SPSS	0.744	0.741	1.771
BW=0.873 + 0.833SC	R	0.744	0.741	1.771
BW=3.566 + 1.368SL	SPSS	0.657	0.653	2.051
BW=3.566 + 1.368SL	R	0.657	0.653	2.051
BW=5.519+ 2.952TL	SPSS	0.496	0.490	2.485
BW=5.519+ 2.952TL	R	0.496	0.490	2.485

**Significant at p<0.01 for all models