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Phenotypic Relationship Between Body Weight, Body Condition Score and Testicular Traits of Yankasa Rams

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Abstract
Body size and testicular measurements have been found to be important parameters utilized in breeding soundness estimation. The present study therefore, aimed at estimating the phenotypic relationship between body weight (BW), body condition score (BCS), testicular length (TL), testicular diameter (TD) and scrotal circumference (SC) in 50 semi-intensively reared Yankasa rams of age between 1 and 2 years. Pearson's correlation was higher and positive between TD and SC (r=0.431), followed by TL and SC (r=0.430) at (P<0.01), Pearson correlation between BW and TL (r = 0.072) were not significant (P<0.05, 0.01) while BW and SC (r=0.281), BW and TD (r=0.296) at (P<0.05) were slightly correlated. There was strong positive spearman correlation between BCS and BW (r=0.711), followed by TD and SC (r=0.661) and TL and SC (r=0.521) at (P<0.01). Slight positive correlation was found between TL and TD (r=0.333), (P<0.05). BCS and SC (r=0.277), TL and TD (r=0.270), BW and TL (r=0.167) were not significant while BCS and TL showed a negative correlation and were not significant (r= -0.228). This findings could be useful in the management and selection of rams for breeding purposes especially among the rural livestock farmers, which could lead to improvement in productivity and hence profitability of sheep enterprise.
Keywords: *Phenotypic, body condition score, body size, testicular traits, Yankasa rams.*

Introduction

Sheep are reared primarily for meat and play significant socio-economic roles in the lives of rural dwellers (Yakubu and Ibrahim, 2011). Nigeria possesses about 22.1 million sheep. They thrive in a wide variety of environments in the tropics and sub-tropic (F.A.O, 2011). It requires less capital as they can be completely maintained on pasture, browse and agricultural waste products.

Livestock production in developing regions is generally characterized by small flock-size, communally shared grazing, uncontrolled mating and the absence of pedigree and performance record. The emphasis in the conservation of livestock breeds in developing regions should be to maintain diversity to meet current and future livelihood requirements (Yakubu and Ibrahim, 2011). Conservation priorities should be set in consultation with the farmers. 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). The study and management of animal populations requires

information about the factors affecting population dynamic (Agaviezor *et al.,* 2012). Body condition score (BCS), is an important measure of the fitness of an animal for assessing body reserves on a mature sheep. BSC and its use are important in terms of achieving the desired performance in certain physiological periods in sheep breeding where extensive conditions are dominant (Sezenler *et al.,* 2011) as it is useful for dietary management and can be used to assess the health status of animals. Condition score uses manual palpation of tissues cover (muscle and fat) over the backbone and the short ribs (loins) immediately behind the last long ribs. Importantly, assessors also integrate the shape/fullness of the eye muscle between the backbone and ends of the short ribs with their assessment of tissue cover to allocate a score between 1 (very thin) and 5 (very fat or obesed) (Russel *et al.,* 1969). In sheep, the BCS is correlated with a direct measurement of back fat depth or the proportion of fat in the animal body, providing a better estimate than body weight alone (Audige *et al.,* 1998; Van Burgel *et al.,* 2011). However, BCS is not practiced on farms as widely as it should be. This may partly due to dearth of trained specialists especially under the low-input farming systems of developing economics.
Information on body size and testicular traits of various breeds at constant age has paramount importance in the selection of genetically superior animals for production and reproduction purposes (Tariq *et al.,* 2012). The biometrical analysis of testicular development is of great importance since it is significantly correlated with reproductive activity (Koyuncu *et al.,* 2005). In domestic sheep, males with large testes increases their share of paternities when receptive females are in abundance (Preston *et al.,* 2011), presumably because they have better senses to find females rapidly and inseminate more sperm once a receptive female has been found.
Jefferies (1961) discussed the use of condition scoring in sheep management in particular situations, and although the scoring system as such has a very wide application. The relationships between particular scores and levels of individual animal performance are likely to vary between breeds and systems of management. Various traditional modeling approaches have been adopted to show the relationship between BCS, body size (weight) and testicular measurements (Cannas and Boe, 2003; Tarig *et al.,* 2012).
Although previous efforts had been made to show the association between body parameters in Nigeria indigenous sheep (Yakubu, 2010a, 2010b; 2012). Therefore the objectives of this study aimed at to;

(i) Estimate body condition score from body size and testicular traits of Yankasa rams.
(ii) Establish the phenotypic association between body weight, testicular length, testicular diameter and scrotal circumference.
(iii) Quantify the phenotypic relationship between body condition score and body weight, testicular length, testicular diameter and scrotal circumference.

Materials and Methods

Study Area/Location

This study was conducted in Lafia Local Government Area of Nasarawa State, Nigeria and lies between latitude 8.4917^{o}N and longitude 8.5167^{o}E (Wikipedia, 2015). It falls within the guinea savannah zone with the total population of 330, 712 (NPC, 2006). It has a total land area of 27,117km^{2} (10,470 square miles) (Wikipedia, 2009).

Data Collection

Data were obtained from 50 rams of the indigenous Yankasa sheep in Shinge, Lafia Nasarawa State, Nigeria. The animal used were within the age range of 1 and 2 years. The rams were reared under semi-intensive system. They were released early in the morning for grazing and return late noon and supplemental feed (concentrates) were provided. The age of the rams were determined from the available records provided by the livestock keepers and where information was missing, the age was estimated using dentition, by counting the number of permanent incisors that had erupted on the lower jaw of the mouth as described by Matika *et al.* (1992). Records taken were body condition score (BCS), body weight (BW), testicular length (TL), testicular diameter (TD) and scrotal circumference (SL) respectively.

Parameter measured

Body Weight (BW)

Body weight of each animal was taken by carrying it individually and standing on a weighing scale. The difference between this weight and individual weight will be taken as the weight of the animal (Akpa *et al.*, 1998) in kilogrammes (kg).

Testicular Length (TL)

This was measured in centimeters (cm) with a flexible measuring tape (Taitor's tape rule) as the distance along the caudal surface of the scrotum, from its point of attachment to the tip of the scrotum as described by Akpa *et al* (2012) and Bratte *et al* (1999).

Scrotal Circumference (SC)

This was measured in centimeters (cm) with a flexible measuring tape at the maximum dimension around the pendulous scrotum after pushing the testes firmly into the scrotal sac (Akpa *et al.*, 2006).

Testicular Diameter (TD)

This was measured in centimeters (cm) with a tailors' flexible tape from the widest anterior – posterior distance of the scrotum.

Body Condition Score (BCS)

The body condition score was taken on the rams based on the procedure for body condition scoring by Russel *et al.* (1969) which states a range of 0 – 5 scores as thus:

BCS 0 (very thin): - Sheep are very thin near death, it is possible to detect any muscle and fat tissue among skin and bone

BCS 1 (emaciated):- Spinous process are sharp and prominent. The loin eye area muscle is shallow with no fat cover the transverse processes are sharp, one can pass fingers under ends. It is possible to feel between each process.

BCS 2 (Thin):- Spinous process are sharp and prominent. The loin eye area muscle has little but full fat cover. Transverse processes are smooth and slightly rounded. It is possible to pass under the ends of the transverse processes with a little pressure.

BCS3 (Average):- Spinous processes are smooth and rounded and one can feel individual process only with pressure. Transverse processes are smooth and well covered and firm pressure is needed to feel over the ends. The loin eye area (muscles) is full with some fat cover.

BCS 4 (Fat):- Spinous process can be detected only with pressure as a hardline. Transverse processes cannot be felt. Loin eye muscle is very full with a very thick fat cover.

BCS 5 (Obese):- Spinous process cannot be detected. There is a depression between fat where spine would normally be felt. Transverse processes cannot be detected. Loin eye muscle is very full with a very thick fat cover.

Data Analysis

Statistical packages for social sciences (SPSS 17.0 and GENSTAT) was used for this analysis. Descriptive statistics was computed such as Mean, Standard deviation, Standard error, Coefficient of variability (CV) for Body Weight (BW), Body Condition Score (BCS), Testicular Length (TL), Testicular Diameter (TD) and Scrotal Circumference (SC) respectively.

The Pearson correlation coefficients was used to assessed the association between BW, TL, TD and SC while the spearman correlation coefficients was estimated to quantify the relationship between BCS and BW, BCS and TL, BCS and TD as well as BCS and SC respectively.

Results and discussion

The descriptive statistics for the body condition score, body weight and testicular measurement are presented in Table 1.

The result indicated that the mean body condition score was 2.810$\pm$0.140, body weight 35.480$\pm$1.680kg testicular length 17.960$\pm$0.34/cm, testicular diameter 7.820$\pm$0.140cm and scrotal circumference was 13.940$\pm$0.330cm respectively. The standard deviation of the body condition, body weight and testicular measurements

were 0979, 11.807, 2.390, 0.983 and 2.312 while the coefficient of variability (CV) were 34.840%, 33.278%, 13.307%, 12.570% and 16.585% respectively.

BCS appears to be the most useful determinant of several reproductive and productive outcomes (Audige *et al.*, 1998). It is important to have information about BCS in all physiological periods to determine the feeding programs to be applied in order to increase lamb production by indigenous sheep breeds, and to allow sheep to feed with balanced ration in different physiological periods (Cannas and Boe, 2003). Higher variation in all body parameters of the present study might be due to individual performance differences of the rams.

Rajuana *et al.* (2008) noted that the causes of phenotypic variation in traits of farm animals are due to genetic and environmental effect, and the joint effect of genotype and environment. More so, large variation within certain measurement might suggest the absence of selection. Pearson's correlation coefficient among body weight and testicular measurements of Yankasa rams were presented in table 2. This showed the association among body weight and testicular measurements.

Table 1: Descriptive Statistics for Body Condition, Body Weight and Testicular Measurements (TL, TD, SC) of Yankasa Rams

Traits	Mean ($\overline{X}$)	Standard error	Standard deviation	$\overline{X}$± SE	CV %
BCS	2.810	0.140	0.979	2.810±0.140	34.840
BW	35.480	1.684	11.807	35.480±1.684	33.278
TL	17.960	0.341	2.390	17.960±0.3411	13.307
TD	7.820	0.140	0.983	7.820±0.140	12.570
SC	13.940	0.330	2.312	13.940±0.330	16.585

BCS = Body Condition Score, BW = Body Weight, TL = Testicular Length, TD = Testicular Diameter and SC = Scrotal Circumference , CV = Coefficient of variability (variation), X= Mean and SE = Standard Error respectively.

The results showed that, there were correlation among the measured variables which are significant at (P<0.01) while some variable were significant at (P<0.05) respectively. The highest positive correlation was between TD and SC (r=0.431) followed by (r=0.430) between TL and SC at (P<0.01) while at (P<0.05) the correlation (r=0.327) between TL and TD was lower followed by (r = 0.296) between BW and TD while the least correlation was between BW and SC (r = 0.281). The correlation between BW and TL (r=0.072) was not significant (ns) respectively. The positive relationship of body weight and testicular measurements further suggest that rams with large scrotal size might posses larger body size (Akpa *et al.*, 1998).

Table 2: Pearson Correlation Coefficient between Body Weight and Testicular Measurements (TL, TD, SC) of Yankasa Rams

Traits	BW	TL	TD	SC
BW		0.072^{NS}	0.296*	0.281*
TL			0.327*	0.430**
TD				0.431**

*** = Significant at P<0.01 BW = Body Weight (kg) * = Significant at P <0.05 TL = Testicular Length (cm) TD = Testicular diameter NS = not significant SC = Scrotal Circumference*

Table 3 showed the spearman's rho coefficient of body condition score (BCS), body weight and testicular measurements. The phenotypic correlations between BCS and BW (r=0.711) was highly positively significant, followed by TD and SC (r=0.661), followed by TL and SC (r=0.521) at (P<0.01) then BW & SC (r=0.422). Slight positive correlation was found between TL and TD (r = 0.333) (P<0.05), BCS and SC (r=0.277), TL and TD (r = 0.270), BW and TL (r=0.167) were not significant while BCS and TL showed a negative correlation and not significant respectively.
Keith *et al.* (2009) and Tariq *et al.* (2012) reported in goats and sheep that the phenotypic correlations between body condition score (BCS) and Body Weight (BW) were statistically significant. This observation suggest that high energy intakes make rams fit mating (Waye and Mason, 2008). The size of mammalian testes during mating period is a product of their potential capacity for sperm production and their degree of seasonal activation (Preston *et al.*, 2011).

Table 3: Spearman's rho coefficient of body condition and body weight and testicular measurements (TL, TD, SC) of Yankasa Rams

Traits	BCS	BW	TL	TD	SC
BCS		0.711**	-0.228^{NS}	0.219^{NS}	0.277^{NS}
BW			0.167^{NS}	0.270^{NS}	0.422**
TL				0.333*	0.521**
TD					0.661**

** Significant at P<0.01 * Significant at P<0.05 BCS = Body condition score, BW = Body weight, TL = Testicular Length TD = Testicular diameter, SC = Scrotal Circumference NS = Not significant

Conclusion

This study revealed the potential effectiveness for estimating BCS of Yankasa rams from body size and testicular measurements using Pearson's correlation for assessing the association among the body weight and testicular measurements while the spearman's correlation assessed/quantify the relationship between BCS, BW and testicular measurements. However, a slight improvements was observed when BCS was correlated with BW than the other testicular measurements.

Recommendation

In the selection of rams for mating purposes, BCS, BW and testicular measurements could jointly be taken as an important criteria and management support tool for selection of superior animals for sustainable production and improvement of genetic resources of animals.

This findings could also be useful in the management and selection of rams for breeding purposes especially among the rural livestock farmers, which could lead to improvement in productivity and hence profitability of the sheep marketing.

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