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Body Measurement of Red Sokoto Bucks in Nigeria and Their Relationship with Testicular Biometrics

Research Article

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ABSTRACT

Ninety Red Sokoto bucks were used to assess the relationship between body, testicular and epididymal measurements in three age groups (group 1: 7-12 months; group 2: between 1 and 2 years and group 3: older than 2 years). The effect of age on body and testicular / epididymal measurements was analyzed. A predictive model was developed for each of the testicular / epididymal measurements using live body measurements. Age of the buck had a significant effect (P<0.05) on the body weight, paunch girth, scrotal circumference, testicular and epididymal measurements (testicular volume, testicular weight, caput weight and caudal weight). Higher correlation coefficients were recorded between testicular volume and testicular weight and between caput weight and epididymal weight in all groups (group 1: r=0.99 and r=0.95; group 2: r=0.97 and r=0.95; group3: r=0.97 and r=0.93, respectively). Scrotal circumference was found to be independently related to some testicular and / or epididymal measurements in groups 1 and 2. In the multivariate linear regression model, all body parameters used were found to be related to some of the testicular and epididymal measurements. The results indicated that selection for replacement breeding bucks could be done for bulks up to two years of age using data on scrotal circumference.

KEY WORDS age, body condition score, body measurements, epididymal biometrics, Red Sokoto buck, testicular.

INTRODUCTION

Goats are important to a large proportion of the Nigerian rural population as a means of livelihood. They are kept as an important component of farming activities, particularly by smallholders in rural areas. Nearly ninety nine percent of small ruminants in Nigeria are found in the hands of smallholders (Alphonsus *et al.* 2010).

The Nigerian goat population is estimated to be about 53.8 million which constitute an important source of milk and meat for local consumption and hide for export market. There are three breeds of goats in Nigeria out of which, Red Sokoto is the most predominant and the most widely used and distributed breed in the northern savannah belts of the country (Hassan and A. Ciroma). In the production of livestock including goats, the fertility of the male generally has a greater influence on the herd performance than the fertility of individual does (Yoseph, 2004). Screening males intended for breeding is thus of paramount importance to improve goat production as a whole (Chacon *et al.* 1999). In order to improve goat production in the tropics, the reproductive efficiency of the buck has to be put into consideration. Moreover, in most tropical developing countries, the absence of pedigree records and poor breeding infrastructure limit the extent to which the advantages of selection can be exploited (Toe *et al.* 2000). In view of this, parameters that are pertinent to breeding soundness of buck should be evaluated. Fertility studies in livestock have generally tended to focus on the female side with less emphasis on the male side. Since most selection response derives from sire selection, it would be useful to be able to improve reproduction in their female offspring. Indirect selection recognizes that decisions related to selection may be based on parameters that are relatively easy to measure, expressed early in life and are highly heritable.

It has been suggested that, among the alternative selection criteria, testis size may be the most suitable parameter to indirectly improve the reproductive performance of females (Bindon and Piper, 1976; Walkley and Smith, 1980; Schoeman *et al.* 1987). Body size and testicular measurements are important parameters utilized in breeding soundness evaluations (Agga *et al.* 2011). It has also been reported that testicular size shows a reliable parameter of the reproductive growth status, spermatogenesis output and the seminal characteristics (Daudu, 1984). The potential of testicular measurement as selection criteria for improving male fertility has already been indicated in cattle (Morris *et al.* 1992), sheep (Rege *et al.* 2000; Toe *et al.* 2000) and goats (Bongso *et al.* 1982).

The scrotal circumference (SC) which can be measured on live animals has been found to be the best predictor of the testicular and epididymal measurements (Agga *et al.* 2011). Daudu (1984) also found SC to be positively correlated to testicular weight (TW), testicular spermatid and caudal spermatozoa in indigenous Red Sokoto bucks in the northern of Nigeria.

The relationship of SC to age, body weight (BW) and the right and left scrotal length in the Red Sokoto goats have been documented (Adedeji and Gbadamosi, 1999). Hassan and Ciroma (1992) reported that there is relationship in the body weight measurement of Nigerian Red Sokoto goats. However, little is known regarding the relationship of the body measurements to testicular and epididymal biometrics in the male Red Sokoto goats of Nigeria. The objective of this study were 1: to evaluate the effect of age on live body measurements and testicular / epididymal development in Red Sokoto bucks in Nigeria and 2: to investigate which of the live body measurement could be used to predict the testicular and epididymal parameters, with the ultimate aim of establishing prediction models to estimate breeding soundness of this breed.

MATERIALS AND METHODS

This study was conducted on healthy Red Sokoto bucks also known as Maradi at Bodija in Ibadan, which lies within 7 ˚2316 north and 3 ˚53'47' east in Nigeria between June and August 2012. Ninety animals were chosen randomly from a population of bucks presented for slaughter and were identified according to age using the dentition method (Wilson and Durkin, 1984). The animals were reared extensively in the Northern savanna region where Maradi is predominant and as bulks are often not kept in large numbers in the herd, they are sold and transported southwards. Three age categories, namely less than 1 year of age (7-12 months; <1 year; n=11), between 1 and 2 years (12-24 months; 1-2 years; n=55) of age and older than 2 years (above 25 months; >2 years; n=24), were defined in the study. Each animal was chosen based on absence of deformities and conformation to local selection criteria for breeding bucks. Each animal selected for the study was given a tag number that could be used for both ante- and post-mortem examinations. Prior to slaughter, the age, body condition score (BCS), body weight (BW), wither height (WH), paunch girth (PG), heart girth (HG) and SC of each buck were recorded with the animal held in a standing position. The BCS was determined at 0.5 increments according to some studies, based on a 5 point scale (ranging from 1 to 5 representing emaciated, poor, acceptable, fat or obese animals, respectively). BW (kg) was taken prior to slaughter using a 100 kg spring balance. The WH was measured as a vertical measurement from the ridge between the shoulder bones to the fore hoof. The PG was measured across the abdomen lower region, directly before the hind legs. The HG was measured across the chest, directly behind the forelegs.

The SC was measured with at the widest part of the testes, after the testes had been firmly pushed into the scrotum (Coulter and Foote, 1979). All linear body measurements were done in cm with the aid of a flexible measuring tape with the goat standing on all four legs. The post-mortem testicular and epididymal measurements were recorded within 4 hours following slaughter. The organs of each buck were identified, labeled and then transported in an ice box to the histology laboratory at the department of animal science for evaluation. The epididymis was severed from the testes using scissor, before measurements were taking on the testes and epididymis separately. The measurements for each pair of gonads were then averaged for each animal. Testicular length (TL; cm) (largest dorso-ventral distance) was measured with a flexible tape. Testicular diameter (TD; cm) (widest anterior-posterior position) was measured with the aid of a Vernier caliper and recorded (cm). Testicular volume (TV; mL) was measured by using a water displacement technique similar to the described by Toe *et al.* (2000).

TW (g) and epididymal weight (EW; g) (caput, corpus and caudal; these were identified based on anatomical structures and locations and separated along physiological joints) were recorded separately (g) using a general purpose weighing balance. Testicular density was obtained by dividing the TW by the TV. Data collected were subjected to various statistical tools using SAS/STAT (1999) software. The effect of age on live body measurements and on testicular / epididymal biometrics was analysed by one-way analysis of variance. Correlation and regression analysis were performed to assess the relationship among parameters. The final model was set out using the following equation (Kirkwood and Sterne, 2003):

$$Y = a + b_1X_1 + b_2X_2 + \cdots + b_nX_n$$

Where:
Y: testicular / epididymal measurements.
a: intercept.
$b_1, b_2, \ldots, b_n$: coefficients of live animal attributes.
$X_1, \ldots, X_n$: live animal attributes.

RESULTS AND DISCUSSION

The mean values of live body measurements are as detailed in Table 1. The BW was lower in group < 1 year than in group 1-2 years and group > 2 years. (10.27±0.68 kg, 13.04±0.30 kg and 13.58±0.51 kg; P<0.0005, respectively). Mean values for SC, TV and TW were higher (P<0.05) in group > 2 years than group 1-2 years or group < 1 year. Mean values for HG, WH, TD, corpus weight and EW across the three age groups were not significantly influenced by age.

Correlations among body, testicular and epididymal measurements

Correlations among body parameters and testicular / epididymal measurements as described by Pearson correlation coefficient are presented in Tables 2 and 3. Results indicated that most body parameters and testicular / epididymal biometrics are positively and significantly correlated.

However, some pairs were not related within each age group. Whereas most of the testicular and epididymal biometrics were significantly correlated, BW was not correlated to any of the parameters measured in group 1 bucks. In group 2, the highest correlation coefficients were observed for testicular volume and testicular weight (0.96). Although BW was significantly correlated with SC, it was not correlated to other testicular and epididymal measurements.

Similarly PG was lowly but significantly correlated with TV, but not with any other testicular and epididymal measurements. In group 3, TV and TW (0.97) gave the highest level of correlation.

There was significant but negative correlation between BW and TL (-0.41), whereas there was no significant correlations between BW and other testicular and epididymal measurements.

Regression of testicular and epididymal biometrics on body parameters

The R^2 values of testicular variables from body parameters estimation and their level of significance based on linear regression models is as shown in Tables 4 and 5. The result obtained (Table 4) revealed that in group 1, WH was only related to caudal weight, while HG remained related to the TV, TW, caput weight, caudal weight and EW. The SC was the only predictor variable that was solely related to the testicular measurements. In the multi-variable linear regression, the results suggest that parameters could be added to scrotal circumference to obtain a higher R^2. The regression equation constructed for TD, TV, TW and caput weight from all the independent predictors resulted to higher values of regression coefficients.

Table 1 Effect of age on the mean live body measurements and testicular / epididymal biometrics of Red Sokoto buck in Nigeria

Body parameters	Group 1 year (n:11)	Group 1-2 years (n:55)	Group 2 years (n:24)
BW	10.27±0.68[b]	13.04±0.30[a]	13.58±0.51[a]
BCS	1.68±0.08[a]	1.51±0.02[b]	1.60±0.04[ab]
HG	56.00±1.18	53.29±0.66	56.08±0.78
PG	62.33±1.54[a]	56.71±0.91[b]	61.60±1.00[ab]
WH	51.14±1.45	49.23±0.57	50.18±0.88
SC	18.32±0.75[b]	17.91±0.24[b]	19.46±0.23[a]
TL	6.63±0.32[a]	4.93±0.31[b]	7.14±0.29[a]
TD	3.56±0.17	3.60±0.06	3.84±0.05
TV	32.64±3.46[b]	36.05±1.52[b]	42.67±1.00[a]
TW	34.37±4.04[b]	35.91±1.44[b]	42.40±1.14[a]
Caput wt	2.88±0.38[ab]	2.68±0.11[b]	3.21±0.11[a]
Corpus wt	0.83±0.15	0.73±0.04	0.75±0.05
Caudal wt	2.27±0.27[ab]	2.20±0.09[b]	2.65±0.12[a]
EW	5.98±0.72	5.62±0.20	6.62±0.24

The means within the same row with at least one common letter, do not have significant difference (P<0.05).
BW: body weight; BCS: body condition score; HG: heart girth; PG: paunch girth; WH: wither height; SC: scrotal circumference; TL: testicular length; TD: testicular diameter; TV: testicular volume; TW: testicular weight; Caput wt: caput weight; Corpus wt: corpus weight; Caudal wt: caudal weight and EW: epididymal weight.

Table 2 Correlations between live body measurements and testicular / epididymal biometrics of Red Sokoto buck in Nigeria. Age group 1(<1 year) and age group 2 (1-2 years)

Age group 1 (<1 year old)										
Item	BW	HG	PG	WH	SC	TL	TD	TV	TW	EW
BW	1.00	-0.23^{ns}	-0.07^{ns}	0.27^{ns}	0.45^{ns}	0.16^{ns}	0.13^{ns}	0.02^{ns}	0.07^{ns}	-0.02^{ns}
P-values	-	0.50	0.83	0.43	0.17	0.65	0.69	0.95	0.83	0.96
HG	0.24^{ns}	1.00	0.76**	0.75**	0.04^{ns}	0.42^{ns}	0.52^{ns}	0.69*	0.70*	0.75**
P-values	0.08	-	0.01	0.01	0.90	0.20	0.10	0.02	0.02	0.01
PG	0.28*	0.44***	1.00	0.67*	0.30^{ns}	0.33^{ns}	0.52^{ns}	0.58^{ns}	0.58	0.58^{ns}
P-values	0.04	0.0007	-	0.02	0.37	0.32	0.10	0.06	0.06	0.06
WH	0.11^{ns}	0.28*	0.25^{ns}	1.00	0.05^{ns}	0.25^{ns}	0.32^{ns}	0.47^{ns}	0.48	0.57^{ns}
P-values	0.44	0.04	0.06	-	0.87	0.45	0.33	0.14	0.13	0.07
SC	0.33**	0.004^{ns}	0.16^{ns}	0.23^{ns}	1.00	0.71**	0.79**	0.66*	0.67	0.52^{ns}
P-values	0.01	0.98	0.23	0.09	-	0.01	0.0041	0.03	0.02	0.10
TL	-0.13^{ns}	0.05^{ns}	0.17^{ns}	-0.11^{ns}	0.12^{ns}	1.00	0.90***	0.90***	0.89***	0.85***
P-values	0.34	0.72	0.20	0.43	0.37	-	0.0001	0.0002	0.0002	0.0009
TD	0.23^{ns}	-0.17^{ns}	0.13^{ns}	0.21^{ns}	0.76***	0.25^{ns}	1.00	0.91***	0.95***	0.90***
P-values	0.09	0.22	0.36	0.12	< 0.0001	0.06	-	< 0.0001	< 0.0001	0.0002
TV	0.24^{ns}	0.03^{ns}	0.27	0.14^{ns}	0.72***	0.42**	0.80***	1.00	0.99***	0.93***
P-values	0.08	0.85	0.05	0.29	< 0.0001	0.0013	< 0.0001	-	< 0.0001	< 0.0001
TW	0.23^{ns}	-0.01^{ns}	0.24^{ns}	0.13^{ns}	0.78***	0.31*	0.82***	0.96**	1.00	0.95***
P-values	0.10	0.95	0.08	0.33	< 0.0001	0.02	< 0.0001	< 0.0001	-	< 0.0001
EW	0.21^{ns}	0.02^{ns}	0.22^{ns}	0.19^{ns}	0.75***	0.25^{ns}	0.79***	0.78***	0.78**	1.00
P-values	0.13	0.89	0.10	0.15	< 0.0001	0.06	< 0.0001	< 0.0001	< 0.0001	-

[1] Age group 2 (1-2 years old).

NS: not significant.

*** (P<0.001); ** (P<0.01) and * (P<0.05).

BW: body weight; BCS: body condition score; HG: heart girth; PG: paunch girth; WH: wither height; SC: scrotal circumference; TL: testicular length; TD: testicular diameter; TV: testicular volume; TW: testicular weight; Caput wt: caput weight; Corpus wt: corpus weight; Caudal wt: caudal weight; EW: epididymal weight.

Table 3 Correlations between live body measurements and testicular / epididymal biometrics of Red Sokoto buck in Nigeria. Age group 3 (>2 Years)

Item	BW	HG	PG	WH	SC	TL	TD	TV	TW	EW
BW	1.00	0.31^{ns}	0.48*	0.56***	0.04^{ns}	-0.41*	0.20^{ns}	0.09^{ns}	0.17^{ns}	0.22^{ns}
P-values	-	0.13	0.02	0.00	0.86	0.05	0.35	0.66	0.44	0.30
HG	-	1.00	0.77***	0.44*	-0.24^{ns}	0.00^{ns}	-0.22^{ns}	-0.14^{ns}	-0.06^{ns}	0.30^{ns}
P-values	-	-	< 0.0001	0.03	0.25	0.99	0.31	0.52	0.76	0.16
PG	-	-	1.00	0.54**	-0.21^{ns}	-0.14^{ns}	0.08^{ns}	0.05^{ns}	0.10^{ns}	0.34^{ns}
P-values	-	-	-	0.01	0.33	0.50	0.72	0.82	0.64	0.11
WH	-	-	-	1.00	0.18^{ns}	-0.34^{ns}	-0.02^{ns}	-0.11^{ns}	0.00^{ns}	0.23^{ns}
P-values	-	-	-	-	0.40	0.10	0.94	0.61	0.99	0.29
SC	-	-	-	-	1.00	-0.39^{ns}	0.34^{ns}	0.04^{ns}	0.09^{ns}	0.30^{ns}
P-values	-	-	-	-	-	0.06	0.11	0.85	0.66	0.15
TL	-	-	-	-	-	1.00	0.12^{ns}	0.55**	0.47*	-0.05^{ns}
P-values	-	-	-	-	-	-	0.58	0.01	0.02	0.80
TD	-	-	-	-	-	-	1.00	0.81***	0.82***	0.34^{ns}
P-values	-	-	-	-	-	-	-	< 0.0001	< 0.0001	0.11
TV	-	-	-	-	-	-	-	1.00	0.97***	0.33^{ns}
P-values	-	-	-	-	-	-	-	-	< 0.0001	0.12
TW	-	-	-	-	-	-	-	-	1.00	0.36^{ns}
P-values	-	-	-	-	-	-	-	-	-	0.08
EW	-	-	-	-	-	-	-	-	-	1.00

NS: not significant.

*** (P<0.001); ** (P<0.01) and * (P<0.05).

BW: body weight; BCS: body condition score; HG: heart girth; PG: paunch girth; WH: wither height; SC: scrotal circumference; TL: testicular length; TD: testicular diameter; TV: testicular volume; TW: testicular weight; Caput wt: caput weight; Corpus wt: corpus weight; Caudal wt: caudal weight and EW: epididymal weight.

BW and BCS were not significant in the prediction of any of the dependent variables. In group 2, WH was found to be related to caudal weight and PG was related to TV (Table 4). However, they are weak predictors.

SC was considered to be a good estimate of the dependent variables, with the exception of corpus weight and TL; this last parameter was not found to be related to SC in univariable linear regression model. The results obtained in the multi-variable linear regression (Table 5) indicates that addition of all the independent variables tends to increase the rate of reliability on predicting the dependent variables. The regression coefficients of TD, TV, TW, caput weight,

Table 4 Univariable linear regression analysis of testicular and epididymal measurements of Red Sokoto buck in Nigeria

Group	Variables		Regression equation	R^2	Adjusted R^2	Significance
	Dependent	Explanatory				
Group 1 (<1 year)	Cauda wt	WH	Cauda wt= -3.94 + 0.12 WH	0.44	0.373	0.027
	TV	HG	TV= -80.84 + 2.03 HG	0.47	0.414	0.019
	TW	HG	TW= -99.91 + 2.39 HG	0.49	0.429	0.017
	Caput wt	HG	Caput wt= -10.15 + 0.23 HG	0.53	0.478	0.011
	Cauda wt	HG	Cauda wt= -6;97 + 0.16 HG	0.53	0.476	0.011
	EW	HG	EW= -19.96 + 0.46 HG	0.57	0.518	0.008
	TL	SC	TL= 1.11 + 0.30 SC	0.50	0.449	0.014
	TD	SC	TD= 0.35 + 0.17 SC	0.62	0.575	0.004
	TV	SC	TV= -23.16 + 3.05 SC	0.44	0.374	0.027
	TW	SC	TW= -31.70 + 3.61 SC	0.45	0.388	0.024
Group 2 (1-2 years)	Cauda wt	WH	Cauda wt= -0.24 + 0.05 WH	0.11	0.090	0.015
	TV	PG	TV= 10.79 + 0.45 PG	0.07	0.054	0.049
	TD	SC	TD= 0.001 + 0.20 SC	0.57	0.566	< 0.0001
	TV	SC	TV= -45.43 + 4.55 SC	0.52	0.507	< 0.0001
	TW	SC	TW= -47.93 + 4.68 SC	0.61	0.600	< 0.0001
	Caput wt	SC	Caput wt= -2.78 + 0.13 SC	0.48	0.473	< 0.0001
	Corpus wt	SC	Corpus wt= -0.30 + 0.06 SC	0.14	0.126	0.005
	Cauda wt	SC	Cauda wt= -2.50 + 0.26 SC	0.53	0.519	< 0.0001
	EW	SC	EW= -5.59 + 0.63 SC	0.56	0.551	< 0.0001
Group 3 (>2 years)	TL	BW	TL= 10.24 – 0.23 BW	0.16	0.127	0.049
	TD	BCS	TD= 3.07 + 0.48 BCS	0.19	0.155	0.032
	TV	BCS	TV= 26.32 + 10.18 BCS	0.18	0.147	0.036
	TW	BCS	TW= 19.86 + 14.06 BCS	0.27	0.240	0.009
	Caput wt	BCS	Caput wt= 0.83 + 1.48 BCS	0.35	0.324	0.002
	EW	BCS	EW= 2.59 + 2.51 BCS	0.20	0.165	0.028

HG: heart girth; WH: wither height; SC: scrotal circumference; TL: testicular length; TD: testicular diameter; TV: testicular volume; TW: testicular weight; caput wt: caput weight; cauda wt: cauda weight; EW: epididymal weight.
R^2: regression coefficient; * P<0.05; ** P< 0.01.

Table 5 Multi-variable linear regression analysis of testicular and epididymal measurements of Red Sokoto buck in Nigeria

Dependent variable	Regression equation	R^2	Adjusted R^2	Significance
	Group 1 (<1 year)			
TD	TD= -3.28 – 0.04 BW + 0.17 BCS + 0.10 HG – 0.03 PG – 0.01 WH + 0.20 SC	0.90	0.744	0.0548
TV	TV= -111.03 – I.39 BW – 8.13 BCS + 1.94 HG – 0.79 PG + 0.75 WH + 4.04 SC	0.96	0.908	0.0078
TW	TW= -148.19 – 0.87 BW – 4.61 BCS + 2.84 HG – 0.99 PG + 0.41 WH + 4.43 SC	0.96	0.897	0.0097
Caput wt	Caput wt= -12.39 – 0.28 BW + 1.23 BCS + 0.19 HG – 0.13 PG + 0.11 WH + 0.41 SC	0.90	0.760	0.0486
	Group 2 (1-2 years)			
TD	TD= 0.51 + 0.002 BW + 0.02 BCS – 0.02 HG + 0.006 PG + 0.01 WH + 0.19 SC	0.62	0.567	< 0.0001
TV	TV= -48.87 – 0.21 BW – 0.31 BCS – 0.07 HG + 0.31 PG – 0.14 WH + 4.52 SC	0.54	0.487	< 0.0001
TW	TW= -45.79 – 0.32 BW – 0.22 BCS – 0.09 HG + 0.26 PG – 0.17 WH + 4.74 SC	0.63	0.586	< 0.0001
Caput wt	Caput wt= -2.88 – 0.01 BW + 0.01 BCS – 0.0005 HG + 0.02 PG – 0.02 WH + 0.31 SC	0.51	0.450	< 0.0001
Cauda wt	Caput wt= -3.67 – 0.04 BW + 0.18 BCS + 0.005 HG – 0.002 PG + 0.02 WH + 0.26 SC	0.57	0.512	< 0.0001
EW	EW= -6.8 – 0.06 BW + 0.44 BCS – 0.004 HG + 0.03 PG – 0.002 WH + 0.63 SC	0.58	0.524	< 0.0001
	Group 3 (>2 years)			
TD	TD= 2.71 + 0.0004 BW + 0.57 BCS – 0.04 HG + 0.03 PG – 0.014 WH + 0.071 SC	0.53	0.366	0.0270
Caput wt	Caput wt= -3.40 – 0.03 BW + 1.50 BCS + 0.02 HG + 0.001 PG + 0.005 WH + 0.16 SC	0.48	0.299	0.0540

HG: heart girth; WH: wither height; SC: scrotal circumference; TL: testicular length; TD: testicular diameter; TV: testicular volume; TW: testicular weight; caput wt: caput weight; cauda wt: cauda weight and EW: epididymal weight.
R^2 : regression coefficient.
** (P<0.01) and * (P<0.05).

caudal weight and EW were highly significant (P<0.001). The higher BW, SC, TV and TW observed in group > 2 years than in group <1year in the present study was in line with the previous reports in Boran, Woito–Guji and Afar bucks studied by Agga *et al.* (2011) and White Borno goats (Raji *et al.* 2008) in Nigeria. This observable significant difference may be due to age dependent growth and development of the measured variables. The older the animals the heavier they become. The same will be true for SC, TV and TW since puberty does not stop testicular development even though the rate of increase may be reduced as the animals mature. An earlier study has established that BCS of animals generally reflects their nutritional status (Mekasha *et al.* 2007). In the present study, the mean values of BCS reflect the same nutritional status across the three age groups studied; this is so because the animals were raised in similar environments on the same nutritional plain which is predominantly forages and agricultural waste such as groundnut waste, maize husk and sorghum waste. Contrarily to the caput weight and caudal weight, the corpus weight was not influenced by age. This may be attributed to the fact that the corpus is just a passage through which spermatozoa will flow from caput to caudal region for storage after formation in the testis. The results observed indicate that the corpus may not grow or increase significantly after puberty has been attained.

A large SC was reported in large framed genotypes, as compared to small and medium framed breeds of the same age (Al Ghalban *et al.* 2004). This corroborates the present study as age group three recorded higher values for SC than those of age groups one and two. The observable difference in SC between age group is largely due to physiological development. The highest correlation coefficients across the three age groups that were obtained between TV and TW with r= 0.99 (<1 year), 0.96 (1-2years), 0.97 (>2 years) and also between caput weight and EW with r= 0.99 (< 1 year) were similar to r= 0.98 reported for TV and TW in Afar, Boran and Woito-Guji bucks (Agga *et al.* 2011).

The correlation of SC with most of the genital measurements post slaughter recorded in this study for groups 1 and 2 are in agreement with previous findings in Ogaden bucks (Mekasha *et al.* 2007; Mekasha *et al.* 2008). Other studies have shown SC to be strongly correlated with *in situ* TL and TW.

It was also reported that SC could provide a reliable guide to sperm production capacity of the testis (Raji *et al.* 2008; Ugwu, 2009). The results also showed that the segments of epididymis caput and caudal were more correlated between themselves and had higher correlation coefficient with epididymis than corpus. This could be due to the fact that together they form the portions which make up the epididymis.

All body parameters that were independently related to testicular measurements under univariable linear regression analysis corroborated the findings of Agga *et al.* (2011) in three breeds of goats in Ethiopia. However, the multivariable linear regression model showed that addition of all the independent variables will lead to increase in the rate of reliability on predicting the dependent variables. In age group three, all the live body attributes were slightly significant to predict testicular diameter and caput weight.

CONCLUSION

The study confirmed buck age to have influence on some of the body parameters and testicular / epididymal measurements. The most appropriate live body measurement that could be used to predict the testicular and epididymal biometrics was found to be scrotal circumference in bucks not older than 2 years.

REFERENCES

Adedeji O.S. and Gbadamosi A.J. (1999). Relationship of scrotal circumference to age, body weight and the right and left scrotal length in the red Sokoto goats. Pp. 21-25 in Proc. 26th Ann. Conf., Nigerian Soc. Anim. Prod., Ilorin, Nigeria.

Agga G.E., Udala U., Regassa F. and Wudie A. (2011). Body measurements of bucks of three goat breeds in Ethiopia and their correlation to breed, age and testicular measurements. *Small Rumin. Res.* **95(2),** 133-138.

Al Ghalban A.M., Tabbaa M.J. and Kridli R.T. (2004). Factors affecting semen characteristics and scrotal circumference in Damascus bucks: technical note. *Small Rumin. Res.* **53,** 141-149.

Alphonsus C., Akpa G.N., Sam I.M., Agubosi O.C.P., Finangwai F.I. and Mukasa C. (2010). Relationship of parity and some breeding characteristics in red Sokoto goats. *Contin. J. Anim. Vet. Res.* **2,** 25-30.

Bindon B.M. and Piper L.R. (1976). Assessment of new and traditional techniques of selection for reproduction rate. Pp 387-401 in Proc. Sheep Breed. Int. Cong., Muresk, Perth, WA, Inst., Perth.

Bongso T.A., Jainudeen M.R. and Zahrah A.S. (1982). Relationship of scrotal circumference to age, body weight and onset of spermatogenesis in goats. *Theriogenology*. **18(5),** 513-524.

Coulter G. and Foote R. (1979). Bovine testicular measurements as indicators of reproductive performance and their relationship to productive traits in cattle: a review. *Theriogenology*. **2,** 298-311.

Chacon J., Perez E., Muller E., Söderquist L. and Rodriguez-Martinez H. (1999). Breeding soundness evaluation of extensively managed bulls in Costa Rica. *Theriogenology*. **52,** 221-231.

Daudu C. (1984). Spermatozoa output, testicular sperm reserve and epididymal storage capacity of the Red Sokoto goats indigenous to northern Nigeria. *Theriogenology*. **21,** 317-324.

Hassan A. and Ciroma C. (1990). Body weight measurements relationship in Nigerian Red Sokoto. Pp. 428-432 in Proc. 1th Biennial Conf. African Small Rumin. Res. Networks, ILRAD, Nairobi, Kenya.

Kirkwood B.R. and Sterne J.A.C. (2003). Essential Medical Statistics. Blackwell Publishing Company, Massachusetts, USA.

Mekasha Y., Tegegne A. and Rodríguez-Martínez H. (2007). Effect of supplementation with agro-industrial by-products and khat (*Catha edulis*) leftovers on testicular growth and sperm production in Ogaden bucks. *J. Vet. Med. A.* **54,** 147-155.

Mekasha Y., Tegegne A., Abera A. and Rodriguez-Martinez H. (2008). Body size and testicular traits of tropically-adapted bucks raised under extensive husbandry in Ethiopia. *Reprod.*

Domest. Anim. **43(2),** 196-206.

Morris C., Baker R. and Cullen N. (1992). Genetic correlation between pubertal traits of males and life time pregnancy rate in beef cattle. *Livest. Prod. Sci.* **39,** 291-297.

Raji A.O., Igwebuike J.U. and Aliyu J. (2008). Testicular biometry and its relationship with body weight of indigenous goats in semi-arid region of Nigeria. *ARPN J. Agric. Biol. Sci.* **3,** 6-9.

Rege J.E., Toe F., Mukasa-Mugerwa E., Tembely S., Anindo D., Baker R.L. and Lahlou-Kassi A. (2000). Reproductive characteristics of Ethiopian highland sheep. II. Genetic parameters of semen characteristics and their relationships with testicular measurements in ram lambs. *Small Rumin. Res.* **37(3),** 173-187.

SAS Institute. (1999). SAS®/STAT Software, Release 6.11. SAS Institute, Inc., Cary, NC.

Schoeman S.J., Els H.C. and Combrink G.C. (1987). A preliminary investigation into the use of testis size in cross-bred rams as a selection index for ovulation rate in female relatives. *South African J. Anim. Sci.* **17,** 144-147.

Toe F., Rege J., Mukasa-Mugerwa E., Tembely S., Anindo D., Baker R. and Lahlou-Kassi A. (2000). Reproductive characteristics of Ethiopian highland sheep. I. Genetic parameters of testicular measurements in ram lambs and relationship with age at puberty in ewe lambs. *Small Rumin. Res.* **36(3),** 227-240.

Ugwu S.O.C. (2009). Relationship between scrotal circumference, *in situ* testicular measurements and sperm reserve in West African dwarf bucks. *African J. Biotechnol.* **8,** 1354-1357.

Walkley J.R.W. and Smith C. (1980). The use of physiological traits in selection for litter size in sheep. *J. Reprod. Fertil.* **59,** 83-88.

Wilson R. and Durkin R. (1984). Age at permanent incisor eruption in indigenous goats and sheep in semi-arid Africa. *Livest. Prod. Sci.* **11,** 451-455.

Yoseph M.G. (2004). Reproductive traits in Ethiopian male goats Ph D. Thesis. Faculty of Veterinary Medicine and Animal Science, Swedish University of Agricultural Science, Swed.