Testicular morphometry and prevalence of hypoplasia among three sheep breeds in the humid tropical zone of Nigeria

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Abstract

This study was carried out to determine and compare the testicular morphometry of three sheep breeds (Uda, Yankasa and Balami) in Calabar, Nigeria. Testicular parameters measured were, weight (kg), length (cm), circumference (cm) and number of descended (or not) testicles. Data were collected from three sheep abattoirs in Calabar. Age of rams was determined by rostral dentition. A total of 90 rams (30 per breed) were used for the study. Balami breed had significantly heavier testes weight (5.65 kg) than Uda and Yankasa (5.32 kg and 5.53 kg, respectively). Age of rams significantly affected the scrotal weight, length and circumference, 4 years old rams were significantly ($p< 0.05$) highest in these traits (6.26 kg, 19.63 cm and 30.06 cm, respectively). No incidence of testicular hypoplasia was observed among the rams irrespective of breed. Correlation results showed that Balami breed had the highest correlation coefficient for testicular weight and age ($r = 0.838$) of the animals and the least was between scrotal weight and length ($r = 0.409$) in Yankasa breed. There were high and significant correlation coefficients in all the parameters across the breeds. Scrotal circumference was highly correlated with testicular weight and length at 2 and 4 years of age ($r = 0.627 – 0.672$). It is recommended that rams be selected for breeding between the ages of 3 - 4 years based on their scrotal circumference and testicular weight.

keywords: Male reproductive disorder, ram, sperm production, testicular morphometry

Introduction

Extant studies have reported that there are one million heads of sheep in the sub-humid region of Nigeria, representing 3% of the total ruminant livestock (Adepoju *et al.*, 2014). Sheep rank third in predominance in sub-Saharan Africa after cattle and goats (Blench, 1999). FAOSTAT (2013) stated that small ruminants (including sheep) are important genetic resources in the tropics, as they serve as veritable means of income and nutritional sustenance especially among the poor in rural areas. Abba *et al.* (2014) asserted that indigenous breeds are more tolerant to prevailing livestock disease conditions and have high growth and reproductive performance. It therefore becomes necessary to preserve these indigenous genetic resources to maintain these unique features. Despite these qualities, small ruminants in sub-Saharan Africa and Nigeria in particular are faced with some debilitating limitations, such as disease prevalence, poor nutrition, poor management practices and uncontrolled

breeding (Oladele *et al.*, 2013). Reproductive abnormality was also identified as a major limitation to livestock production (Igbokwe *et al.*, 2014). Male reproductive abnormality gives rise to poor semen quality that renders the male unfit for breeding (Onugwu *et al.*, 2018). Cryptorchidism, testicular hypoplasia, phimosis, orchitis, testicular atrophy, poor libido and scrotal laceration are some reproductive abnormalities reported among various male livestock breeds in Nigeria (Adeyeye and Wakkala, 2013; Uchendu, *et al.*, 2015 and Olusa *et al.*, 2016).

The testes function in sperm and testosterone hormone secretion (Onugwu *et al.,* 2018). Size of the testes had been reported as a good indicator of sperm production potential in animals (Adeyeye *et al.*, 2021). Besides, reproductive organs morphometric indices give a reliable clue of breeding soundness and probable fertility in breeding males. Similarly, Bousmaha and Khoudja (2013) also reported that measurement of testicular parameters of species or breed is essential in assessing and estimating qualitative changes in testicular components and spermatogenic functions. Knowledge of morphometric data of the testes of any species or breed is essential in evaluating and estimating qualitative changes in testicular components and spermatogenic functions (Adeyeye *et al.*, 2021). Ibrahim *et al.* (2012) argued that in order to increase and improve sheep production in Nigeria, it is essential to evaluate the effect of breed on testicular and epididymal measurements for an all-out and cogent utilization of the breeding stock. This study was therefore conducted to determine the testicular morphometry of Uda, Yankasa and Balami breeds of sheep and the prevalence of hypoplasia in Calabar, a humid tropical zone of Nigeria. Data obtained from this study would serve as a reliable reference point in the preliminary selection of breeding rams in the study area.

Materials and Methods

Rams used for this study were selected from three abattoirs (Bogobri, Mami market Ikot Ansa and Nassarawa 8-Miles) in Calabar, Cross River State, Nigeria. A total of 90 rams, 30 each of Balami, Uda and Yankasa breeds, respectively, were carefully selected from their pen and data were collected based on the normal and abnormal testes morphology. The age (1 - 4 years) of the rams was determined using rostral dentition. The testicular samples were collected before slaughter. Measurements of individual sheep testicles were carried out using a measuring tape which was recorded in centimeters. The age, breed, testicular dimensions and type of hypoplasia (bilateral or unilateral) was also recorded.

Testicular morphometry

Testes circumference and length were evaluated using a tailor's tape, placed at the largest diameter. Testicular weight was taken using a digital sensitive scale (new spring laboratory digital weighing balance) after slaughter.

Testicular Length (TL)

This was measured along the longitudinal axis of the testis beginning from one pole of the testes to the other pole, with the use of tailoring measuring tape and recorded in centimeters.

Scrotal circumference (SC)

The Scrotal circumference was measured using a tailor's tape as the largest diameter of the testes and recorded in centimeter.

Testicular weight (TW)

The testicular weight was measured by placing the testes on a sensitive electronic

weighing scale (Gromy®, Made in China) and recorded in grammes according to the procedure of Salhab *et al* (2001).

Statistical Analysis

Data obtained from the study were subjected to one-way analysis of variance (ANOVA) as reported by Steel and Torrie (1996) for completely randomized design (CRD). Significant means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955) using SPSS version 22. Person correlation coefficients (r) were additionally performed utilizing same computer programme to assess the association between pairs of testicular traits.

Results and Discussion

Effect of breed on testicular morphometry of rams

Table 1 shows the results of mean testicular morphometry of the three breeds of sheep. Breed of the rams did not significantly ($p>0.05$) affect their testicular length. Scrotal weight and circumference however differed significantly ($p<0.05$) among the breeds, the Balami breed was significantly ($p<0.05$) highest. The higher testicular weight and circumference of the Balami rams indicated they have higher testicular mass and sperm production in line with the assertion of Fernandez *et al.* (2004). The superiority of the Balami breed in testicular traits could be attributed their larger body size above the Uda and Yankasa breeds. The Uda breed did not differ from Balami in testicular circumference, whereas the Yankasa breed was statistically similar to the Balami in testicular weight. Brito *et al.* (2004) reported that weight of testes of male animals is an important parameter in evaluating breeding soundness of an animal, in that heavier testes produce more spermatozoa than smaller ones. Testicular length values obtained in the present study (18.20 – 18.76 cm) are higher than values (12.25 – 12.75 cm) reported by Ibrahim *et al.* (2012) in Uda, Yankasa and Balami breeds of sheep in Kano, Nigeria. Scrotal circumference values obtained in this present research were lower than values of 38.00, 31.25, and 35.25 cm reported by Mohammed *et al.* (2018) for Uda, Balami and Yankasa rams, respectively as well as values of 31.25, 38.00 and 35.25 cm reported by Ibrahim *et al.* (2012) for Balami, Uda and Yankassa rams, respectively. The difference between the findings of the present research and reports by previous authors could be attributed to differences in age and nutrition of experimental rams used. Besides, Okwun *et al.* (1996) reported that testicular weight and scrotal circumference as well as gonadal sperm reserves were correlated with extragonadal sperm reserves of boars. Invariably, scrotal size and testicular weight are crucial in the selection of potential good breeders. Breed of sheep significantly ($p<0.5$) affected scrotal circumference and weight in the present study, Balami breed showed the highest scrotal circumference, though it was not significantly different from Uda breed. Since larger scrotal circumference signifies propensity to accommodate greater semen volume, therefore, it is pertinent to conclude that the Balami and Uda breeds should be selected as breeders because of their significantly heavier and larger testes.

There was no incidence of testicular abnormality observed among the rams examined irrespective of breed. Both testicles of all rams examined were descended into the scrotal sac with no abnormality recorded. Adeyeye *et al.* (2021) noted that hypoplasia reduces spermatogenic activities of testes, accompanied by some testicular degeneration, and that normal

testes did not show any form of testicular degenerations. Bousmaha and Khoudja (2012) recorded a 3.33% incidence of hypoplasia and 3.11% cryptorchidism occurring in Algeria indigenous rams. Reproductive and spermatogenic function of testes of rams used in this study are adjudged to be of optimum rate since no abnormality or hypoplasia was observed among them.

Effect of age on testicular morphometry of rams

Results of the effect of age on testicular morphometry of the rams are presented in Table 2. The results showed that testicular parameters of the rams increased significantly ($p<0.01$) with age. Four-year old rams were significantly highest, followed by three-year old, then two-year old and lastly the one-year-old. This observed increment of testicular parameters with age is in agreement with the reports of Bongso *et al.* (1982) and Sahi *et al.* (2019) in goats. Mukasa-Mugerwa and Ezaz (1992) identified scrotal circumference as an index of testes size. The authors noted that scrotal circumference increased linearly and was strongly correlated with age ($r = 0.83$) and emphasized that scrotal size measurement be a criterion for the suitability of early selection of ram lambs. Al-Ameri (2022) reported a significant ($p<0.05$) increment in testicular biometry of Awassi rams with age. The present research recorded testicular weight range of 4.52 - 6.26 kg between ages 1 - 4 years rams which was very much higher than 0.089 – 0.195 kg reported by Al-Ameri (2022) in Awassi ram lambs aged between less than 1 – greater than 2 years old; as well as testicular length and scrotal circumference. Increment of testicular biometry of rams with age is in agreement with previous authors (Salhab *et al.*, 2001; Kabiraj *et al.*, 2011). Akpa *et al.* (2013) asserted that age and body condition scores were important determinants of testicular measurements in bucks, while Mukasa-Mugerwa and Ezaz (1992) opined that post-weaning nutritional management greatly influenced lamb weight gain, which was in turn related to testicular growth and onset of puberty in Menz ram lambs. Since scrotal circumference and weight are good indications of breeding soundness in male animals (Brito *et al.*, 2004), it is recommended that rams for breeding be selected between the ages of 3 - 4 years of age among the Balami, Yankasa and Uda breeds in Calabar particularly and Nigeria at large.

Age and breed interaction on testicular parameters of sheep

The results for age and breed interaction on testicular parameters of sheep are presented in Table 3. Interaction effect of age by breed was significantly different in all the testicular traits evaluated. Testicular length of 4-years old rams was significantly ($p<0.01$) higher than the 1- and 2- years old across the three breeds, though 2- and 3-years old rams were not statistically ($p>0.01$) different. This observation is in agreement with the finding of Focsãneanu *et al.* (2014) that testicular measurements, viable and motile spermatozoa were optimum in rams over the age of three years. Scrotal circumference of the rams showed a trend of increasing superiority, among the breeds, with increment in age; interaction effect was not statistically different ($p>0.05$) between rams of different breeds within the same age. At the age of 3 - 4 years, rams attain sexual maturity accompanied by increased spermatogenic activities. Younger rams have been implicated with smaller testicular biometry and immature sperm (Salhab *et al.*, 2001; Akpa *et al.*, 2013; Focsãneanu *et al.*, 2014). Differences observed within and

between age and breeds could be due to genotype and nutrition.

Correlation coefficients of testicular parameters at ages 1 to 4

Results of the correlation coefficients among testicular parameters of rams at ages 1 - 4 are presented in Table 4. Negative correlation coefficients were recorded between testicular length and testicular weight, as well as between scrotal circumference and testicular weight at one year of age; though a positive but low correlation coefficient was observed between testicular length and circumference at one year of age. Animals at one year of age are still in their active growth and developmental stage, meaning that the testicular traits are not yet developed to perform their reproductive functions. The negative associations recorded imply that selecting rams at this age for breeding may not yield the desired results in terms of reproductive efficiency.

Highest positive and significant ($p<0.01$) correlations were recorded between scrotal circumference (SC) and testicular length (TL) at 4 years of age (r = 0.627) and at 2 years of age (r = 0.627). These values were close to the values (r = 0.77) for SC and TW (testicular weight) and (r = 0.67) for SC and TL reported by Gemede and Workalemahu (2017) in Woyto-Guji breed of goat in Ethiopia. Similarly, the authors found highly positive association between TL and TW (r =0.89). In another study, Sahi *et al.* (2019) reported that SC and TL (r = 0.56) and SC and TW (r = 0.74) were highly associated among Algerian bucks found in the El-Tarf region of the country. More recently, Baldaniya *et al.* (2020) equally reported positive association between SC and TW (r = 0.625). These reports are in tandem with the findings of the present study.

Ogwuegbu *et al.* (1985) asserted that testes weight correlates highly with sperm producing ability of males therefore selection of breeding rams are best achieved at 2 - 4 years of age based on their SC, TW and TL measurements as indicated in this research findings. Besides, ram lambs can be selected based on the testicular measurements of their sires since testicular traits have been adjudged to be hereditary (Akpa *et al.*, 2013). Moreover, Ugwu (2009) attested that a good measurement of the scrotal circumference, length and width would be reliable indicators of spermatogenic ability of males.

Correlation of testicular parameters of Uda, Yankasa and Balami sheep breeds

Correlations of testicular parameters of sheep breeds are presented in Table 5. Coefficients of correlation were highest in the Balami breed between SC & TL (r = 0.814) and SC & TW (r = 0.756) as well as between TW & TL (r = 0.756). The Uda breed followed with an association strength of r = 0.742 between SC & TL, while the Yankasa exhibited a highly positive association between SC & TL (r = 0.692). From the forgoing, the highest correlations or associations were recorded between scrotal circumference and testicular length across the three breeds of rams (r = 0.814, 0.742 and 0.692 for Balami, Uda and Yankasa breeds respectively). Degrees of association between SC and TL obtained in this study are slightly higher than values (r = 0.67 and 0.61) reported between SC & TL for Red Sokoto and Borno White goat breeds respectively by Raji *et al.* (2008). Similarly, Abba *et al.* (2021) reported a high and positive correlation between scrotal circumference and testicular length (r = 0.66) which is in agreement with the present research findings. This high degree of association indicates that SC can serve as a

reliable measure of breeding soundness among the sheep breeds studied. Sizes of the testes and sperm production are highly correlated and SC has been proven to be a good predictor of testis size coupled with strong positive correlation between them (Abba *et al.* 2021). Many factors such as genetics, nutrition, health status, geographical location of animals tend to affect their body size and inherent body parts (Abba and Igbokwe, 2015). Variations between results obtained in the present study and previous authors' reports could be attributed to breed, management and nutritional differences of the animals used for this study and those used by the previous researchers.

Conclusion

This study documented the testicular morphometric indices of the Yankasa, Uda and Balami sheep breeds between the ages of 1- 4 years. It was established that testicular parameters of the rams increased with their age and the Balami had significantly higher scrotal circumference and testicular weight than Yankasa, though it did not differ significantly from the Uda breed. Results of the correlation determination proved that scrotal circumference was highly correlated with testicular weight and length. From the foregoing, it is recommended that rams be selected for breeding between the ages of 3 - 4 years based on their scrotal circumference and testicular weight.

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Table 1: Effect of breed on testicular parameters of sheep

	Breeds			
Parameters	**Uda**	**Yankasa**	**Balami**	**SEM**
Testicular Length (cm)	18.20	18.59	18.76	0.12
Testicular Circumference (cm)	27.47^{ab}	26.51^{b}	27.79^{a}	0.21
Testicular Weight (kg)	5.32^{b}	5.53^{ab}	5.65^{a}	0.05
Number of descended testes	2.00	2.00	2.00	0.00

^{ab}Means on the same row with different superscripts are significantly different ($p<0.05$), SEM= Standard error of mean

Table 2: Effect of age on testicular parameters of sheep

	Age				
Parameters	**1**	**2**	**3**	**4**	**P value**
Testicular Length (cm)	15.55±0.32^{d}	17.55±0.25^{c}	18.56±0.17^{b}	19.63±0.16^{a}	0.1
Testicular Circumference (cm)	20.95±0.55^{d}	24.88±0.42^{c}	27.04±0.29^{b}	30.06±0.27^{a}	0.1
Testicular Weight (kg)	4.52±0.10^{d}	4.74±0.07^{c}	5.31±0.05^{b}	6.26±0.05^{a}	0.1
Number of descended testes	2.00±0.00	2.00±0.00	2.00±0.00	2.00±0.00	-

^{abcd}Means on the same row with different superscripts are significantly different ($p<0.01$), SEM= Standard error of mean

Table 3: Age and breed and interaction on testicular parameters of sheep

Parameter	Age 1			2			3			4			P - value
	Uda	Yankasa	Balami	Uda	Yankasa	Balami	Uda	Yankasa	Balami	Uda	Yankasa	Balami	
Testicular Length (cm)	15.79^{c}	15.71^{c}	15.14^{c}	17.83^{ab}	17.81^{ab}	17.00^{b}	18.54^{ab}	18.61^{ab}	18.53^{ab}	19.22^{a}	19.53^{a}	20.13^{a}	0.225
Testicular Circumference (cm)	22.29^{d}	20.57^{d}	20.00^{d}	26.33^{b}	23.94^{c}	24.36^{c}	27.63^{b}	26.00^{b}	27.50^{b}	30.25^{a}	29.44^{a}	30.47^{a}	0.408
Testicular Weight (kg)	4.34^{d}	4.71^{c}	4.50^{cd}	4.78^{c}	4.76^{c}	4.67^{c}	5.23^{b}	5.22^{b}	5.47^{b}	4.11^{d}	6.36^{a}	6.31^{a}	0.257
Number of descended testes	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	-

^{abcd}Means on the same row with different superscripts are significantly different ($p<0.01$)

Table 4: Correlation of testicular parameters or rams at ages 1 to 4 years.

Age	Testicular parameters	Length	Circumference	Weight
1	Length	1.000		
	Circumference	0.186	1.000	
	Weight	- 0.167	- 0.202	1.000
2	Length	1.000		
	Circumference	0.621**	1.000	
	Weight	0.173	0.248	1.000
3	Length	1.000		
	Circumference	0.427**	1.000	
	Weight	- 0.040	0.100	1.000
4	Length	1.000		
	Circumference	0.627**	1.000	
	Weight	0.357**	0.395**	

**p<0.01

Table 5: Correlation coefficients of age and testicular parameters among sheep breeds.

Breed	Parameter	Length	Circumference	Weight
Uda	Length	1.000		
	Circumference	0.742**	1.000	
	Weight	0.466**	0.617**	1.000
Yankasa	Length	1.000		
	Circumference	0.692**	1.000	
	Weight	0.409**	0.646**	1.000
Balami	Length	1.000		
	Circumference	0.814**	1.000	
	Weight	0.756**	0.756**	1.000

** = P<0.01