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Full Length Research Paper

Relationship between scrotal circumference, *in situ* testicular measurements and sperm reserves in the West African dwarf bucks

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Fifteen WAD bucks aged 10 - 12 months and weighing between 14.0 and 16.5 kg were used to determine the relationship between scrotal circumference (SC), *in situ* testicular measurements and sperm reserves. The *in situ* testicular measurements were testis length (TL) and testis width (TW) and these were compared with *ex situ* measurements (in excised testes). The results showed no significant (P>0.05) differences between *in situ* and *ex situ* measurements of TL and TW. SC had highly significant (P<0.01) correlation with testis (0.86) and whole epididymal (0.78) sperm reserves. SC was also significantly correlated with TL (0.72) and TW (0.65), while TL and TW (*in situ*) were correlated respectively with testis sperm (0.70 and 0.55) and epididymal sperm (0.74 and 0.50) reserves. It was 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.

Key words: Bucks, testicular measurements, sperm reserves, scrotal circumferences.

INTRODUCTION

The West African dwarf (WAD) goat is one of the major genotypes of goat reared for meat in various parts of the West African subregion. WAD goats are mostly found in the rainforest zones of West Africa and in parts of guinea savanna adjoining the rain forest belt. Although they have remained genetically un-improved, they are reputed to be trypanotolerant (Igboeli and Orji, 1981) and exhibit satisfactory growth and reproductive performance irrespective of the harsh hot humid climate that characterize their home environment. These qualities have accounted for their successful contribution to all season meat supply in the southern parts of the sub region.

Although WAD goats are known to breed all year round, their fertility characteristics have not been fully documented to facilitate effective genetic improvement by selection and crossbreeding at all levels of production. In the male for instance, there is the need to establish measurable criteria for judging breeding soundness and guiding selection of males for breeding. These criteria include scrotal measurements, libido and semen quality tests (Michelson et al., 1981; Ogwuegbu et al., 1985; Oyeyemi et al., 2002) and the relationships between them. Since local producers may not be in a position to test ejaculate qualities of males before using them for breeding, a procedure that would link external testicular measurements with sperm numbers may provide a good guide to breeding soundness especially where bucks are reputed to have exceptionally high libido (Agunwamba and Mecha, 1982; Ogwuegbu *et* al., 1985). The aim of the present study is to determine the relationship between *in situ* testicular measurements and sperm reserves in WAD bucks.

MATERIALS AND METHODS

Experimental animals

Fifteen post-pubertal WAD bucks aged between 10 - 12 months with body weights ranging from 14 - 16.5 kg were used for the study. They were purchased from local markets in Nsukka and quarantined for 2 weeks before letting them into the goat pens of

Table 1. A comparison of *in situ* and *ex situ* testicular measurements in WAD bucks.

Parameter	*In situ** Mean ± SEM	*Ex situ* Mean ± SEM	Level of Significance
Right testis length (cm)	5.75 + 0.56	5.88 ± 0.48	Ns
Left testis length (cm)	6.15 + 0.45	5.95 ± 0.31	Ns
Right testis width (cm)	3.25 + 0.25	3.19 ± 0.18	Ns
Left testis width (cm)	3.38 + 0.32	3.23 ± 0.23	Ns

*Corrected for scrotal skin thickness

the Department of Animal Science, University of Nigeria, Nsukka. At the time of purchase, the bucks were examined for physical defects especially at the testicular region to ensure normal descent of the two testes. The bucks were housed in three pens (five bucks per pen) and were reared under similar feeding conditions consisting of limitless access to pastures and supplemental feeding with a mixture of maize offals, palm kernel cake (PKC) and toasted bambara chaff at the rate of 1 kg per buck per day. Clean water was supplied liberally in concrete water troughs.

Measurements in live animals

The experiment lasted for 10 weeks. The bucks were weighed weekly but *in situ* testicular measurements (scrotal circumference, scrotal skin thickness, testis length and width) were carried out every 2 weeks till the end of 10 weeks. This was necessary since the bucks have not attained sexual maturity or mature testis size. Scrotal circumference (TC) was measured with a flexible tape at the point of greatest circumference of the scrotum (Ezekwe, 1992) while testis length (TL) was measured with a tape by manipulating the testes to obtain the distance between the distal and proximal poles of the testes avoiding as much as possible, the caput and cauda aspects of the epididymis (Schinkel et al., 1983). Testes width (TW) was measured with vernier calipers at the same point the scrotal circumference was measured (Ugwu and Nwakalor, 2006). Scrotal skin thickness was measured by pushing the testes upwards and using the calipers (Hahns et al., 1969) to obtain the thickness of the scrotal skin. Thereafter, values for testis length and width were corrected by subtracting the values for scrotal skin thickness.

Measurements in excised testis

All the bucks were carefully castrated at the end of 10 weeks by open method after local application of Lidocaine anesthetic. The incisions made were sutured and the subjects were given routine medication until recovery. The pair of testes obtained after castrating each buck was excised and the epididymides extracted. These were respectively weighed to obtain the paired testis weight and epidiymal weights. Paired testes volume was determined by water displacement using a 500 ml glass beaker. Thereafter, the *ex situ* (actual) testes length and width were determined with vernier calipers. Each epididymis was partitioned into three segments (caput, corpus and cauda) and each segment weighed. The testicular and epididymal sperm reserves were determined by homogenization technique as described by Igboeli and Rakha, (1971).

All data obtained from observations were subjected to standard statistical analysis using the student "t" test and correlation computer packages.

Table 2. Mean ± SEM of scrotal circumference, testis volume, epididymal and testicular weights of WAD bucks.

Parameter	No. of bucks	Mean ± SEM
Body weight (kg)	15	19.52± 1.25
Scrotal circumference (cm)	15	17.25 ± 0.76
Testis volume (cm^3)	15	55.40 ± 0.59
Paired testes weight (g)	15	57.37 ± 2.27
Whole epididymal weight (g)	15	10.76 ± 0.42
Wt. of epididymal segments		
Caput (g)	15	4.68 ± 0.23
Corpus (g)	15	1.56 ± 0.52
Cauda (g)	15	4.22 ± 0.41

RESULTS AND DISCUSSION

The comparison between *in situ* and *ex situ* testicular measurements in WAD bucks are presented in Table 1. There were no significant differences ($P>0.05$) between *in situ* and *ex situ* measurements of the right and left testis dimensions in WAD bucks. Schinckel et al. (1983) reported a similar observation in boar. These results suggest that *in situ* testicular measurements if carefully taken could be a reliable estimate of the actual dimension of the testes.

Table 2 summarizes the values obtained for scrotal circumference, testis volume, epididymal and testis weights of WAD bucks. The values in Table 2 were consistent with results obtained for normal WAD bucks (Oyeyemi, 2002; Inegedu, 2004). They were however generally lower than values reported by Ogwuegbu et al. (1985) for Red Sokoto bucks which are males of a larger genotype of goat found in the savannah belts of Nigeria. This report indicated that Red Sokoto bucks had a mean scrotal circumference of 21.11 cm, mean testis weight of 81.7 g whole epididymal weight of 14.93 g with the segments (caput, corpus and cauda) of epididymis weighing 6.80, 1.7 and 6.43 g, respectively.

The sperm reserves of the testes and epididymides are presented in Table 3. The mean testicular sperm content was 0.98×10^9 while that of the whole epididymis was

Table 3. Mean ± SEM of testicular and epididymal sperm reserves of WAD bucks.

Parameters	No. of bucks	Mean ± SEM
Paired testes (x 10^9)	15	0.98 ± 0.18
Whole epididymis (x 10^9)	15	1.96 ± 0.21
Epididymal segments		
Caput (x 10^9)	15	0.32 ± 0.15
Corpus (x 10^9)	15	0.20 ± 0.12
Cauda (x 10^9)	15	1.46 ± 0.26

Table 4. Correlation between *in situ* testicular measurements and sperm reserves in WAD bucks.

Testicular measurements (cm)	Sperm reserves						
	Testis	Whole epididymis	Epididymal segments			Testis dimensions	
			Caput	Corpus	Cauda	TL	TW
Scrotal circumference	0.86**	0.78**	0.56*	0.48	0.65*	0.72**	0.65*
Testis length	0.70**	0.74**	0.60*	0.45	0.65*	-	-
Testis width	0.55*	0.50*	0.35	0.46	0.40	-	-

TL = Testis length; TW = testis width; * significant (P<0.05); ** significant (P<0.01)

1.96 × 10^9. These values were much lower than 1.91 × 10^9 and 3.01 × 10^9 recorded respectively for Red Sokoto bucks (Ogwuegbu *et* al., 1985). The bucks used by these authors though genetically larger, were also sexually mature compared to the WAD bucks used in this case which were barely post-pubertal. Therefore the gap existing between WAD bucks and Red Sokoto bucks (Ogwuegbu et al*.,* 1985) in gonodal and extra-gonadal sperm reserves may not only be due to genetic differences but may also involve differences in age and level of maturity at the time they were studied.

The result in Table 4 showed that scrotal circumference had a highly significant positive correlation with testis sperm reserve (r= 0.86, P<0.01) and whole epididymal sperm (r= 0.78; P<0.01). There were also positive correlations between scrotal circumference and sperm reserves of caput (r= 0.56; P<0.05) and cauda (r= 0.65; P<0.05) epididymis. Dauda (1984) had earlier reported similar relationships between scrotal circumference and sperm reserves of the testes and epididymis in Red Sokoto bucks. The significant relationships between scrotal circumference and *in situ* testis length (r= 0.72; P< 0.01) and width (r= 0.65; P<0.05) were rather noteworthy, especially where these testis dimensions are also positively correlated with sperm reserves of the testis and epididymis (Table 4). Scrotal circumference has been reported to have a high correlation (0.90) with testis weight in the bull (Osinowo et al., 1977), while testis length was also found to be highly correlated (0.80) with paired testis weight in white Fulani and N'Dama bulls (Nwakalor and Obasi, 1991). Since testis weight is known to be very highly correlated (0.93) with testicular sperm reserves (Ogwuegbu et al., 1985) and males with larger testes tend to produce more sperm (Okwun et al., 1996), it follows that a good measurement of scrotal circumference, testis length or width would be a reliable predictor of the sperm producing capacity of WAD bucks. From the foregoing therefore the results of this study have demonstrated reliable relationships between *in situ* testicular measurements and sperm production capacity of WAD bucks. Based on these findings and the naturally high libido in goats and bucks, they can be reliably selected for breeding based on measurements of scrotal circumference, length or width of the testes.

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