SCROTAL AND TESTICULAR DIMENSIONS IN SOME WEST AFRICAN BULLS

By

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SUMMARY

A series of studies were conducted to estimate testicular size from scrotal measurement and determine the relationships between testicular size, age and liveweight in some West African bulls.

Repeatability estimate for scrotal circumference measurements between technicians was 0.96. Scrotal circumference was highly correlated to paired testes weight ($r = 0.88$) and volume ($r = 0.87$). Testes weight and volume were closely related ($r = 0.997$) but their ratio (g/cc) varied in 30 bulls from 0.962 to 1.119, with a mean and standard deviation of 1.027 ± 0.029 . The regression equation for estimating testes weight (Y) from scrotal circumference (X) was $Y = -506.17 + 27.70X$.

Significant correlations existed between scrotal circumference and age (r from 0.59 to 0.79) or liveweight (r from 0.62 to 0.83) in N'Dama, Bunaji and Sokoto-Gudali bulls. However, examination of the partial correlations showed that most of the age effects were attributable to changes in liveweight. Limited evidence indicate that young Bunaji bulls have larger testis than the other two breeds although they may be overtaken by Sokoto-Gudali bulls after 5 years of age.

INTRODUCTION

Testicular size and scrotal circumference are closely related to each other and to spermatozoa production in bulls (Willett and Ohms, 1957; Amann and Almquist, 1962; Hahn et. al., 1976). The simplicity of scrotal circumference measurement on live bulls makes it a useful indicator of sperm output potential, especially in young bulls.

There appears to be no previous report on testicular size of indigenous West

African bulls. This investigation was therefore undertaken to examine the estimation of testicular size from scrotal measurement and determine the relationship between testicular size, age and liveweight in some of these bulls.

MATERIALS AND METHODS

In the first study, a group of twenty bulls from the breeding herd of the National Animal Production Research Institute (NAPRI), Shika, were used to determine the repeatability of scrotal measurements. This group consisted of 5 Bunaji, 3 Sokoto-Gudali, 2 Friesian, and 10 crossbred bulls, ranging in age and liveweight from 13 to 58 months and 164 to 453kg respectively. Each bull was restrained with ropes while scrotal measurements were taken in turn by three technicians using an independent recorder. Scrotal circumference was measured with a flexible canvas tape while the left and right scrotal diameters were measured with a pair of steel calipers. All measurements were taken at the point of greatest circumference of the scrotum.

The second investigation to determine the relationship between scrotal circumference and testicular size in West African bulls was carried out at four abattoirs located at Mokwa, Kaduna, Zaria and Kano in Nigeria. A total of 30 bulls were involved, consisting mainly of Sokoto-Gudali, Bunaji and Rahaji breeds. A few however appeared to be crosses between two or all of these breeds but their precise ancestry could not be

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ascertained. Scrotal circumference was measured either prior to slaughter or immediately after. The pair of testes was excised, trimmed of the epididymides and weighed. The paired testes volume was determined by water displacement using a 2-litre glass vessel with a run-off.

In the third investigation, scrotal circumference measurements were taken on a total of 145 animals consisting of 34 N'Dama, 33 Bunaji and 78 Sokoto-Gudali bulls. All the N'Dama bulls were located at the Fashola Stock Farm, Oyo State. Most of the Sokoto-Gudali bulls were located at four Sokoto State Livestock Investigation and Breeding Centres (L.I.B.C.) while majority of the Bunaji bulls were located at the Shika Dairy Multiplication Centre and Kabomo LIBC, Kaduna State. The rest of the bulls came from the NAPRI herds at Shika.

All measurements were taken between November 1976 and March 1977. Only data for bulls having normal testes were analysed by computer using a statistical package (Nie *et al.*, 1975). In the third investigation, pairwise deletion of missing data was adopted to make maximum use of available data. However, listwise deletion of missing data was used to obtain

the same subpopulation of samples within each breed for the calculation of partial correlations and for regression analysis. Only the regression equations that best fit the data are presented in Table 4.

RESULTS

Results of the investigation into the repeatability of scrotal measurements between technicians are summarized in Table 1.

The scrotal circumference (SC) of bulls involved in the second investigation ranged from 21.1 to 40.0 cm. Corresponding ranges for paired testes weight (TW) and volume (TV) were 145.2 to 645.6 g and 142 to 620 cc respectively. There was a highly significant correlation ($P < 0.001$) between SC and TW (Fig. 1), and also between SC and TV ($r = 0.87$). TW and TV were highly significantly correlated ($r = 0.997$, $P < 0.001$). Weight per volume of testicular tissue ranged from 0.962 to 1.119, with a mean and standard deviation of 1.027 ± 0.029 g/cc respectively. The regression equation for estimating TW from SC is presented in Figure 1, while that for predicting TV (Y') from SC (X) was $Y' = -502.20 \pm 28.28x$.

TABLE 1

Comparison of means¹ of scrotal measurements obtained by three technicians on the same 20 bulls

Scrotal measurement (cm)	Technician			Repeat-ability
	A	B	C	
Scrotal circumference ²	30.6 $\pm$ 4.0	31.3 $\pm$ 4.2	30.4 $\pm$ 4.3	0.96
Left scrotal diameter ²	4.8 $\pm$ 1.1	5.1 $\pm$ 1.1	5.2 $\pm$ 1.1	0.83
Right scrotal diameter ³	4.8 $\pm$ 1.0	5.0 $\pm$ 1.1	5.1 $\pm$ 1.1	0.78

¹ $\pm$ Standard deviation.

² Measured with a tape.

³ Measured with pair of steel calipers.

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FIGURE 1. Relationship between scrotal circumference and testes weight in bulls.

Fig. 2. Scrotal circumference of bulls in relation to log (age) & log (liveweight).

Table 2 shows the average SC of bulls by breed and age group in the third investigation. In all three breeds, SC was highly significantly correlated to age and liveweight (Table 3). However, the partial correlation coefficients between SC and age, keeping liveweight constant were 0.22, 0.23 and 0.10 for N'Dama, Bunaji and Sokoto-Gudali bulls respectively, none of which was statistically significant. By contrast the correlation coefficients

between SC and liveweight, keeping age constant were 0.30 (P. 0.05), 0.44 (P. 0.05) and 0.47 (P. 0.05) respectively for the three breeds. Scatter diagrams illustrating the relationship of SC to log of age and to log of liveweight are presented in Figure 2. Regression equations derived from the data for the prediction of SC from age or liveweight of bulls are given in Table 4.

TABLE 2
Age and scrotal circumference in N'Dama (N), Bunaji (B) and Sokoto—Gudali (SG) bulls

Age (months)	Number of bulls			Average scrotal circumference (cm) ¹		
	N	B	SG	N	B	SG
10—15	—	3	12	—	25.4 ± 2.3	16.2 ± 5.7
16—20	2	3	8	20.3 ± 4.2	25.2 ± 0.4	20.8 ± 4.5
21—25	18	4	12	23.7 ± 1.9	25.4 ± 2.6	21.0 ± 3.9
26—30	9	2	4	24.8 ± 1.8	26.6 ± 4.0	23.8 ± 4.7
31—35	2	—	6	25.2 ± 2.7	—	25.8 ± 3.9
36—60	2	3	8	26.6 ± 4.8	34.3 ± 3.1	30.1 ± 2.6
61—85	—	—	5	—	—	34.3 ± 1.4
120	—	—	2	—	—	36.8 ± 0.4

¹ ± Standard deviation.

TABLE 3
Relationships between scrotal circumference, age and liveweight in W. African bulls

Measurement	Correlations* within breeds					
	N'Dama		Bunaji		Sokoto-Gudili	
	B	C	B	C	B	C
A. Scrotal circumference	.59	.62	.79	.82	.77	.83
B. Age	—	.79	—	.89	—	.90
C. Liveweight	—	—	—	—	—	—

*All correlations highly significant, P 0.001.

TABLE 4
Regression equation for predicting scrotal circumference (Y), from age (X₁) or Liveweight (X₂)

Breed	Predictor	Prediction equation	S.E.b	S.E.e
N'Dama	X ₁	Y = 2.091 ± 15.628 logX ₁	3.622	1.935
	X ₂	Y = -26.198 ± 22.433 logX ₂	3.561	1.621
Bunaji	X ₁	Y = 106.047—131.493 logX ₁ ± 53.442 (log X ₁) ²	62.797; 22.638	2.983
	X ₂	Y = 15.444 ± 0.444X ₂	0.005	1.634
Sokoto-Gudali	X ₁	Y = 3.690 ± 15.822 logX ₁	1.937	2.468
	X ₂	Y = 41.122 ± 28.095 logX ₂	2.209	1.709

S.E.b = Standard error of slope

S.E.e = Standard error of estimate.

DISCUSSION

The repeatability estimate obtained in this study for scrotal circumference measurements between technicians agrees closely with an earlier estimate of $r = 0.98$ obtained with Holstein bulls by Hahn, *et. al.*, (1969). The inclusion of Bunaji, Sokoto-Gudali, Friesian, and crossbred bulls in the present investigation makes it possible to infer that repeatability of scrotal measurement is unaffected by breed. The lower repeatability estimates obtained for scrotal measurements with a pair of still calipers may be partly due to the greater difficulty experienced by technicians in manouvering the calipers into position.

Previous studies with temperate cattle breeds demonstrated the close relationship between scrotal circumference and testicular size in bulls. A correlation of $r = 0.94$ between scrotal circumference and weight or volume of excised testes was reported by Willett and Ohms (1957). Hahn *et. al.* (1969) similarly reported a high correlation ($r = 0.92$) between scrotal circumference and testes weight in Holstein bulls.

In the present study, a highly significant correlation was found between scrotal circumference and testes weight or volume. However, the actual correlation was somewhat lower than those obtained by previous workers and only 76 percent of the total variation in testes size was accounted for by scrotal circumference. This may be attributed to three factors, namely, variation in scrotal skin thickness, differences in testis shape, and the compounding breed effects. Considerable within and between-breed variation in skin thickness had previously been reported for both temperate and tropical cattle breeds (Osinowo and Steinbach, 1973). Hence, it is suggested that a higher correlation between scrotal circumference and testes size may be obtained by adjusting for scrotal skin thickness.

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Testicular shape varied from fairly oval

in some bulls to cylindrical in others. Testicular size tends to be overestimated by scrotal circumference in oval organs but underestimated in cylindrical ones. However, the proportion of the total variance attributable to differences in testis shape in these breeds is unknown. It is probable that a breed by breed examination will yield higher correlations.

Testes weight and volume were closely related in all bulls although their ratio to one another varied by up to 5 percent. The significance of the observed variation is not known but it may be related to variations in testicular consistency of bulls reported by Coulter *et. al.* (1975).

The regression equation for estimating testes weight (Y) from scrotal circumference (X) in West African bulls was calculated for 30 slaughter-house bulls. The equation is comparable to the one calculated by Willett and Ohms (1957) for 16 bulls ($Y = -776.18 + 37.73X$), and another computed by Hahn *et. al.* (1969) for 35 bulls ($Y = -1298.5 + 5.2X$). However, the equation obtained in the present study reduces the minimum value of scrotal circumference from which testes weight may be estimated, and therefore may be useful in young bulls.

The scrotal circumference of N'Dama, Bunaji and Sokoto-Gudali bulls are smaller than those reported for most temperate breeds at corresponding ages (Ball *et. al.*, 1974; Coulter *et. al.*, 1976). In view of the close relationship between scrotal circumference and spermatozoa production (Willett and Ohms, 1957; Hahn *et. al.*, 1969; Almquist *et. al.*, 1976), it may be expected that sperm output potential in the West African breeds will be lower than in temperate breeds, although this needs to be investigated. On the basis of either simple correlation or partials, scrotal circumference appears to be more related to body weight than to age. Nevertheless the high correlations obtained makes it possible to predict scrotal circumference from age or liveweight. Ball *et. al.* (1974) suggested incorporating scrotal circumference

measurements for evaluating bulls for breeding soundness because it is a more accurate index of semen producing capacity. However, further research needs to be done before standards for selection can be set. There is work in progress at Shika to relate scrotal circumference to spermatozoa production in West African bulls.

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