GONADAL AND EXTRAGONADAL SPERM RESERVES AND TESTICULAR HISTOMETRY OF POST PUBERTAL MUTURU BULLS.

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ABSTRACT

Testes and epididymides were obtained from three pubertal Muturu bulls aged 11 months and 12 post pubertal bulls aged between 13 and 17 months and weighed between 91 and 148kg. Samples of each testis and epididymal segments namely, caput, corpus and cauda, were processed for histology while samples for gonadal and extragonadal sperm reserves were processed using the homogenisation technique. Paired testes weight increased from $78.99 \pm 8.74\text{g}$ at 11 months of age to $90.10 \pm 10.86\text{g}$, $110.30 \pm 5.67\text{g}$ and $106.34 \pm 6.52\text{g}$ at 13, 15 and 17 months of age, respectively. Paired testes sperm numbers were $3.00 \pm 1.50 \times 10^9$, $5.25 \pm 0.51 \times 10^9$, $10.44 \pm 2.55 \times 10^9$ and $9.14 \pm 3.08 \times 10^9$, during the corresponding periods. Similarly, daily sperm production (DSP) increased by 77%, 250% and 207% at 13, 15 and 17 months of age, respectively. There was a 22% increase in the seminiferous tubule diameter from the time of puberty at 11 months to the time bulls were 15 months old, but the histological characteristics of the different epididymal segments did not follow any definite trend during these periods. Correlations between paired testes weight and other testicular and epididymal parameters were positive and significant ($P < 0.01$). These results suggest that Muturu bulls may be used for breeding from the age of 15 months.

Key Words: Muturu Bulls, Puberty, Sperm Reserves, Testicular/Epididymal Histology.

INTRODUCTION

The reproductive performance of tropical cattle breeds is generally low when judged by temperate standards (Seebach, 1973, Mukasa-Mugerwa, 1989). The low fertility of tropical bulls has been attributed partly to the small size of their testes (Endo *et al*, 1978)

resulting in smaller testicular and epididymal sperm reserves (Igbeoli and Rakha 1971, Entwistle *et al*, (1980). For sustainable beef production in Nigeria, it has become necessary to evaluate the reproductive potential of indigenous cattle breeds and to select those that could be used in a national breeding programme. So far, studies on the reproductive capacity of indigenous Nigerian cattle breeds appear to have concentrated largely on zebu bulls (Osinowo *et al*; 1981, Dauda and Shoyinka, 1983). There is thus a dearth of information on the sperm production potential of the indigenous non-zebu cattle such as the Muturu. Muturu cattle is one of the two most widely recognised trypanotolerant cattle breeds that are indigenous to West Africa. Presently, the Muturu is considered an endangered breed because of their rapidly declining numbers (Nigerian National livestock Survey, 1991).

MATERIALS AND METHODS

The study was conducted at the artificial insemination unit of the Department of Animal Science, University of Nigeria, Nsukka. Twelve post pubertal bulls whose ages ranged from 13 to 17 months and three pubertal bulls aged 11 months were used for the study. The weights of the bulls ranged from 91kg to 148kg. The bulls were grazed on natural pastures and also received brewer's spent grains and palm kernel cake in the ratio of 75:25, as supplement. Mineral salt lick and water were provided *ad libitum*. All the bulls were routinely dewormed and sprayed for the control of internal and external parasites, respectively.

Just before the bulls were slaughtered their scrotal circumference and body weights were taken. After slaughter, the testes were dissected to separate the epididymides which were divided into caput, corpus and cauda

TABLE 1: MEAN SCROTAL CIRCUMFERENCE, TESTES/EPIDIDYMAL WEIGHTS, TESTICULAR/EPIDIDYMAL SPERM NUMBERS OF PUBERTAL AND POST-PUBERTAL MUTURU BULLS

Parameter	11 months	13 months	Age 15 months	17 months
Scrotal circumference (cm ²)	20.33 ± 1.20 ^a *	20.75 ± 1.03 ^a	21.50 ± 0.65 ^a	22.75 ± 0.25 ^a
Paired testes weight (g)	78.99 ± 8.74 ^a	90.10 ± 10.86 ^b	110.38 ± 5.67 ^b	106.34 ± 6.52 ^b
Paired testes sperm (x 10 ⁹)	3.00 ± 1.81 ^a	5.25 ± 0.51 ^b	10.44 ± 2.55 ^b	9.14 ± 3.0 ^b
Daily sperm production (x 10 ⁹)	0.56 ^a	0.99 ^{ab}	1.96 ^b	1.72 ^b +
Daily sperm production per gram of testis parenchyma (x 10 ⁶ /g)	0.59 ^a	1.03 ^{ab}	2.04 ^b	1.79 ^b ++
Daily sperm production per gram of testis parenchyma (x 10 ⁶ /g)	7.10 ^a	10.96 ^a	17.76 ^b	16.18 ^b +
Paired epididymal weight (g)	7.47 ^a	11.40 ^a	18.48 ^b	16.83 ^b ++
Sperm distribution (x 10 ⁹)	9.74 ± 0.99 ^a	12.01 ± 0.69 ^b	13.15 ± 0.38 ^b	13.67 ± 0.71 ^b
Caput epididymides	0.90 ± 0.22 ^a (41.6) + + +	1.46 ± 0.36 ^a (31.5)	2.15 ± 0.32 ^a (25.6)	1.87 ± 0.73 ^a (27.7)
Corpus epididymides	0.14 ± 0.01 ^a (6.5)	0.22 ± 0.03 ^a (4.7)	0.38 ± 0.01 ^b (5.0 ^b)	0.33 ± 0.03 ^b (5.0)
Cauda epididymides	1.12 ± 0.18 ^a (51.9)	2.96 ± 0.81 ^{ab} (63.8)	4.99 ± 1.01 ^b (66.4)	4.45 ± 0.98 ^b (67.3)
Total	2.16 ± 0.14	4.64 ± 0.40	7.52 ± 0.45	6.61 ± 0.58

* Means with different superscript along the same row are significantly different (P < 0.05)

+ time divisor of 5.32 days used

+ + time divisor of 5.11 days used

+ + + figures in bracket are percentages.

segments. The weights of the testes and epididymal segments were recorded. Samples of the testicular parenchyma and epididymal segments were taken from both the right and left organs and were kept frozen separately until used for the determination of daily sperm production (DSP) and epididymal sperm reserves (ESR) by the homogenisation technique (Amann and Lambiase, 1969; Daudu and Shoyinka, 1983). Each sample was counted twice using the improved Neubauer haemocytometer. A third count was done where the difference between the first and second counts was up to 10%. The data obtained were used to calculate testicular and epididymal sperm parameters. For the calculation of DSP, the time divisors of 5.32 days (Amann *et al*, 1974) for *Bos taurus* bulls and 5.11 days (Salim and Entwistle, 1982) for *Bos indicus* bulls were used. This was to enable a fair assessment of sperm production potential of Muturu bulls. Samples for histology were taken from the equatorial segment of each testis and from the epididymal segments and transferred into

Zenker-formal fixative. The fixed samples were routinely processed, cut at 5 - 7 μ and stained with haematoxylin and eosin for histometric determinations. Seminiferous tubule diameter, epididymal tubule diameter and epithelial cell height measurements were taken from 20 fairly round tubules on each animal.

All the data generated were subjected to one way analysis of variance. Correlation coefficients were also calculated between testicular, epididymal and body parameters. All statistical analysis were as outlined by Steel and Torrie (1980).

RESULTS

Results of testicular/epididymal measurement as well as those of sperm numbers of pubertal and post pubertal Muturu bulls are presented in Table 1. There were non significant differences between paired testes weights of bulls aged 13, 15 and 17 months, although paired testes weight at puberty was significantly (P < 0.05) smaller than at the three other ages.

TABLE 2: HISTOLOGICAL CHARACTERISTICS OF THE TESTES AND EPIDIDYMIDES OF PUBERTAL AND POST PUBERTAL MUTURU BULLS

Parameter	AGE			
	11 months	13 months _p	15 months	17 months
Seminiferous tubule diameter (u)	115.2±17.6 ^{a*}	143.20±15.7 ^b	150.8 ±13.0 ^b	155.6 ±13.6 ^b
Epididymis:				
duct diameter (u)	218.7±22.7 ^a	198.2±22.7 ^a	248.6 ±17.7 ^a	249.2 ±18.6 ^a
Caput:				
Cell height (u)	39.8±6.4 ^a	49.3±2.4 ^b	48.1±5.9 ^b	47.9 ±3.6 ^b
duct diameter (u)	167.9±18.9 ^a	211.1±14.2 ^b	234.3±10 ^b	255.3 ±10.3 ^b
Corpus:				
Cell height (u)	45.0±8.4 ^a	54.2 ±3.5 ^{ab}	57.4±3.6 ^b	50.5 ±5.2 ^a
duct diameter (u)	194.5±19.0 ^a	228.3±29.4 ^b	252.5±19.8 ^b	250.7 ±15.2 ^b
Cauda				
Cell height (u)	42.3±4.3 ^a	47.1±3.0 ^a	46.5±4.8 ^a	49.1±4.1 ^a

*Means with different superscript along the same row are significantly different ($P < 0.05$).

TABLE 3: CORRELATION COEFFICIENTS BETWEEN TESTES WEIGHT AND OTHER PARAMETERS IN POST-PUBERTAL MUTURU BULLS.

	Paired testes weight
Body weight	0.82***
Scrotal Circumference	0.76***
Paired testes sperm	0.73***
Epididymal sperm	0.78***

*** $P < 0.001$

Paired testes sperm numbers were lowest at puberty ($P < 0.05$) but sperm numbers of bulls aged 13, 15 and 17 months did not differ significantly. Efficiency of sperm production (DSP/g of testis parenchyma) was observed to increase with the age of bulls. Analysis of date on sperm distribution on the three epididymal segments revealed that significantly more spermatozoa ($P < 0.05$) were encountered in the caput epididymis at puberty than at other ages; being 42% at puberty, 32%, 29% and 28% at 13, 15 and 17 months, respectively. However, the distribution of spermatozoa in the corpus epididymis was relatively uniform during the corresponding periods.

The histological characteristics of the testes and epididymides of pubertal and post-pubertal bulls are shown in Table 2.

Seminiferous tubule diameter of bulls aged 13, 15 and 17 months were significantly higher ($P < 0.05$) than those of bulls at puberty. Significant differences were not observed in the diameter of the duct of the caput epididymis of pubertal and post-pubertal bulls. However, duct diameters of the corpus and cauda epididymis of pubertal bulls were significantly smaller ($P < 0.05$) than those of post pubertal bulls. The correlation coefficients between testes weight and epididymal parameters and body weight are shown in Table 3. There were highly significant correlations ($P < 0.001$) between testes weight and scrotal circumference, bodyweight and epididymal sperm reserves.

DISCUSSION

Results of the present study have shown that regardless of the time divisor used, daily sperm production (DSP) value of early post-pubertal Muturu bulls is low when compared to DSP value of *Bos taurus* breeds of similar ages reported by Coulter *et al* (1987). However, DSP values from the present study are comparable to values obtained by Wildous and Entwistle (1982) for 18 months old zebu bulls but slightly less than 1.99×10^9 reported by Tegegne *et al* (1992) for 21 months old Boran bulls. Breed differences

in DSP values have been reported and are attributed to very wide differences in testicular size between individuals of different breeds (Amann, 1970).

In mature Bunaji and Sokoto Gudali bulls, both of which are indigenous zebu breeds, Dauda and Shoyinka (1983) obtained DSP values of 4.15×10^9 and 3.57×10^9 , respectively. From the DSP values obtained in the present study, it is evident that at an average age of 15 months, Muturu bulls have achieved only about 31% of the DSP of mature bulls. The relative efficiency of sperm production by the testes of Muturu bulls appeared quite low at puberty. However this greatly improved as the bulls grow older. There are indications that mature temperate bulls produce about 18×10^6 spermatozoa per gram of testis parenchyma (Amann, 1970). It has also been found that some bulls of temperate breeds of cattle achieve this mature rate of sperm production at about the age of 12 month (Abdel-Raouf, 1960, MacMillan and Hafs, 1968). It would therefore appear from the present results that at the age of 17 months, Muturu bulls are yet to achieve their mature rate of sperm production.

The relative distribution of spermatozoa within the epididymal segments agrees with earlier reports (Dauda and Shoyinka, 1983; Tagegne *et al*, 1992). At puberty the cauda epididymides (paired sides) accumulated about 1.12×10^9 spermatozoa, representing about 1.9 days sperm production. However, as the bulls grew older with the concomitant increase in testis size and efficiency of sperm production, the storage capacity of the cauda epididymis also appreciated (Table 1). In mature Bunaji and Sokoto gudali bulls, Dauda and Shoyinka (1983) reported an accumulation of 2.39 day's and 0.2 days sperm production in the cauda epididymis, respectively. It has been observed by MacMillan *et al* (1972) that the number of spermatozoa in the cauda epididymis at any given time is influenced by many factors including rate of sperm production by the testis, rate of sperm resorption in the epididymis, and sperm losses due to

copulation and/or masturbation.

Although the histological features of the epididymal segments did not vary much after puberty, a 35 - 40% increase in testicular weight from the age 15 to 17 months, resulted in 31 - 35% increase in the seminiferous tubule diameter during the corresponding period.

The highly significant correlations between paired testes weight and scrotal circumference, testes sperm and epididymal sperm are consistent with earlier reports (Dauda and Shoyinka, 1983, Tagegne *et al*, 1992). This result suggests that scrotal circumference could be used for the selection of young Muturu bulls for sperm production. Although Johnson *et al* (1972) had observed that efficiency of sperm production is more important than testis size in determining sperm production potential of bulls, size of testis is still considered a good indicator of sperm producing potential of bulls. Cates (1975) indicated that the probability of a young beef bull being a satisfactory breeder increases as the scrotal circumference increases regardless of the age or breed of the bull.

In conclusion, it is suggested that based on the present results, Muturu bulls may be used for breeding from the age of 15 months.

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