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CELLULAR ASSOCIATIONS IN THE ZEBU WHITE FULANI (BOS INDICUS) BULL TESTIS

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The structural composition and the cycle of the seminiferous epithelium of the testis were determined in 62 White Fulani bulls. The testicular components classified and their respective frequencies of occurrence were as follows: spermatogania A, 2.47%, spermatogonia B, 2.45%, young primary spermatocytes, 3.71%, old primary spermatocytes, 3.71%, secondary spermatocytes, 1.12%, round spermatids, 2.73%, elongated spermatids, 1.13%, spermatozoa, 2.32%, Sertoli cells, 2.15%, basement membrana, 4.60%, Leydig cells, 0.88%, interstitial cells other than Leydig cells, 2.43%, interstitial spaces, 4.86%, cellular cytoplasm, 59.56% and lumen, 5.88%. The respective absolute weights (g) of these components, excepting the interstitial spaces and lumen, were 4.09, 3.94, 5.55, 6.49, 2.02, 5.02, 2.06, 2.77, 3.67, 7.60, 1.59, 4.04 and 105.15. The Sertoli cell index and Leydig cell/Sertoli cell ratio were respectively 8.68 and 0.42. The frequency of occurrence of the eight stages of the seminiferous epithelial cycle averaged 21.71, 11.68, 7.84, 10.73, 7.95, 22.52, 11.04 and 8.55% for stages 1 - 8, respectively.

Key Words: Testis, spermatogenesis, bull, *Bos indicus*

Quantitative aspects of spermatogenesis are particularly important to the livestock industry since there is a relationship between spermatozoal production and the number of offspring that can be produced by the sire particularly now that artificial insemination has become so prominent. Structural and cellular compositions of the testis have been reported for the rat (Roosen-Runge 1955); ram (Ortavant 1959) and cattle (Amman 1962; Swierstra 1966; Humphrey and Ladds 1975). Heller and Leach (1971) reported that the normal function of the Leyding cells may be altered by the administration of certain drugs and hormones. Clermont and Perry (1957), Faulkner (1969) and Heller et al (1971) concluded that unlike the germinal cells within the seminiferous tubules which are sensitive to many noxious agents that affect the testis, the Sertoli cells appear to be highly resistant and are often the only cells remaining after testicular insult; they are also the only somatic elements of the seminiferous epithelium (Kumi-Diaka and Dennis 1978). The Leydig cell/Sertoli cell ratio thus indicates the relative number of Leydig cells in the testis (Heller and Leach 1971) while the Sertoli

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cell index (Germinal cells/Sertoli cells) is a good measure of testicular degeneration (Kumi-Diaka and Dennis 1978).

The eight stages of the cycle of the seminiferous epithelium have been well defined and used on the ram (Ortavant 1959), the bull (Amann 1962; Swierstra 1966; Humphrey and Ladds 1975), the boar(Swierstra 1968; Egbunike 1981), the rabbit (Swierstra and Foote 1963) and the rat (Egbunike et al 1980). The relative frequencies of the stages of the seminiferous epithelial cycle are constant for a given species irrespective of the site or testis of sampling (Amann 1962; Swierstra 1968).

Materials and Methods

Sixty two White Fulani bulls of body weight range of 140 - 330 kg grouped into five according to liveweight (Table 1) were used. The breed of animals has already been described (Olaloku et al 1971) while the bulls used for this study were managed under the traditional extensive normadic system with water but not supplemental diet provided free choice. The bulls were weighed at slaughter and their reproductive tracts removed immediately and taken to the laboratory for processing. The testes were cut midsagitally and tissue samples were taken from one half of each testis and processed for histological analysis by the method of Egbunike and Steinbach (1972).

Structutal composition: The volumetric proportions of the cellular elements of the seminiferous epithelium were determined by the method of Chalkley (1943) as modified by Egbunike and Steinbach (1972). It essentially involved the counting of the number of hits by cellular elements in 20 fields in each of the four slides per animal with an integrating eyepiece (Zeiss Oberkochen) having 25 points assymetrically arranged in a circle and calculating accordingly. The absolute weights of these elements were then determined as outlined by Van Straaten and Wensing (1977). The Leydig/Sertoli cell ratio was determined by a modification of the method used by Heller et al (1971) ie, the number of Leydig cells counted in the four slides per bull was divided by the number of the Sertoli cells. For the Sertoli cell index, the number of the germinal cells was divided by the number of Sertoli cells found in the same tubules (Kumi-Diaka and Dennis 1978). The germinal cells involved were all the spermatogonia, spermatocytes and spermatids.

Cycle of the seminiferous epithelium: The stages in the cycle of the seminiferous epithelium were determined by classifying 20 seminiferous tubules in each of the four slides per bull. The frequency of occurrence of each stage was calculated on percent basis.

Statistical analysis: The data was subjected to analyses of variance and the means were compared by Student's t test (Steel and Torrie 1960).

Results

The volumetric proportions and absolute weights of the testicular elements of White Fulani bulls are summarized in Table 1. There was

Table 1:

Volumetric proportion and absolute weights of testicular elements of White Fulani bulls (mean + SEM)*

	A-Type spermatogonia	B-Type spermatogonia	Young Primary spermatocytes	Old Primary spermatocytes	Secondary spermatocytes	Round spermatids	Elongated spermatids
Group I (141-170 kg) n = 10	2.35±0.25	2.08±0.16	3.65±0.48	4.40±0.34	0.95±0.12	2.66±0.23	1.54±0.3
Group II (171-200 kg) n = 11	3.33±0.46	2.92±0.57	3.06±0.44	3.05±0.40	1.18±0.16	2.20±0.23	0.83±0.1
Group III (201-230 kg) n = 16	2.25±0.13	2.61±0.20	3.51±0.35	3.74±0.31	0.91±0.10	2.51±0.12	1.20±0.1
Group IV (231-260 kg) n = 19	2.26±0.15	2.34±0.20	3.14±0.25	3.71±0.29	1.19±0.08	3.01±0.14	0.96±0.1
Group V (> 260 kg) n = 6	2.36±0.20	1.99±0.21	2.75±0.22	3.64±0.35	1.62±0.25	3.50±0.24	1.36±0.2
All bulls mean (141-300 kg) n = 62	2.47±0.12	2.45±0.14	3.71±0.16	3.71±0.16	1.12±0.06	2.73±0.09	1.13±0.1
Mean absolute	4.09±0.29	3.94±0.26	5.55±0.40	6.49±0.52	2.02±0.21	5.02±0.44	2.06±0.2

* Volumetric proportions in %

Spermatozoa	Sertoli cells	Basement membrane	Leydig cells	Interstital cells (other than Leydig)	Interstitial cell spaces	Cellular cytoplasm	Lumen
1.68±0.24	1.96±0.15	4.09±0.24	0.79±0.06	2.24±0.40	3.41±0.50	56.09±2.00	12.11±1.96
1.17±0.15	1.86±0.16	4.72±0.39	0.74±0.08	2.78±0.29	4.80±0.63	60.58±1.31	6.78±1.32
1.58±0.24	2.22±0.15	5.07±0.20	0.88±0.04	2.38±0.25	5.04±0.41	61.45±0.80	4.65±0.84
1.86±0.16	2.09±0.14	4.44±0.29	0.94±0.04	2.64±0.19	5.69±0.53	61.59±0.71	4.14±0.65
1.34±0.24	2.51±0.19	4.48±0.29	1.11±0.18	1.57±0.24	4.28±0.56	64.78±0.95	2.51±0.80
2.32±0.71	2.15±0.07	4.60±0.14	0.88±0.03	2.43±0.13	4.86±0.26	59.56±0.57	5.88±0.61
2.77±0.24	3.67±0.30	7.60±0.56	1.59±0.16	4.04±0.28		105.15±7.44	

Table 2:
Some histometric characteristics of white fulani testis (mean ± SEM)

Liveweight	Sertoli cell index		Leydig cell/sertoli cell ratio	
	Left testis	Right testis	Left testis	Right testis
Group I (141 - 170 kg)	10.95 ± 1.94	8.97 ± 0.81	0.38 ± 0.03	0.43 ± 0.04
Group II (171 - 200 kg)	10.64 ± 1.65	9.61 ± 1.07	0.37 ± 0.02	0.42 ± 0.04
Group III (201 - 230 kg)	8.87 ± 1.27	7.80 ± 0.71	0.41 ± 0.02	0.40 ± 0.02
Group IV (231 - 260 kg)	7.26 ± 0.38	8.63 ± 0.49	0.43 ± 0.02	0.43 ± 0.02
Group V	7.62 ± 0.83	6.63 ± 0.63	0.44 ± 0.07	0.43 ± 0.04
All Bulls (141 - 330 kg)	8.91 ± 0.57	8.45 ± 0.34	0.41 ± 0.01	0.42 ± 0.01
Overall mean (141 - 330 kg)	0.42 ± 0.01		6.68 ± 0.39	

a relative decrease in the spermatogonial volume percent along with an increase in the body weight while the reverse was the case with the spermatocytes and spermatids. The Sertoli cells did not show a fixed pattern but tended to increase with liveweight unlike the basement membrane which increased up to group III (201 - 230 kg, bw) and decreased thereafter. The cellular cytoplasm also increased with liveweight while the tubular lumen decreased in volumetric proportion (Table 1).

The Leydig cell/Sertoli cell ratio and the Sertoli cell index averaged 0.42 and 8.68, respectively with ranges of 0.33 - 0.69 and 5.09-20.17, respectively. There was no significant difference between the left and right testes although some individual variations were observed (Table 2).

The frequencies of occurrence of the stages of the seminiferous epithelial cycle are summarized in Table 3. The frequency of each was stable irrespective of liveweight.

Discussion

This study dealt with the absolute weight and the relative volume occupied by each component of the testis. The relative increase in germ cell nuclei indicates that heavier bulls have a greater capacity per unit volume of the testis to produce sperm cells than the smaller bulls. Thus for most of the bulls in this study, active spermatogenesis was in progress.

Table 3:

*Stages of the cycle of seminiferous epithelium of the White Fulani bull as affected by liveweight**

Liveweight group	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Stage VII	Stage VIII
Group I (141-170 kg)	20.84 ± 1.43	10.45 ± 1.04	10.32 ± 0.82	10.10 ± 0.71	4.44 ± 0.63	25.44 ± 1.23	10.67 ± 0.68	7.74 ± 0.88
Group II (171-200 kg)	22.12 ± 1.00	13.24 ± 1.74	7.40 ± 0.62	10.31 ± 0.76	6.28 ± 0.76	21.34 ± 1.31	10.71 ± 0.37	8.60 ± 0.82
Group III (201-230 kg)	24.23 ± 0.82	13.31 ± 1.04	8.752± 0.51	11.29 ± 0.53	5.33 ± 0.40	20.61 ± 1.42	9.84 ± 0.82	6.64 ± 0.56
Group IV (231-260 kg)	20.38 ± 1.11	11.32 ± 0.72	7.15 ± 0.60	11.30 ± 0.57	6.99 ± 0.28	23.32 ± 1.13	11.84 ± 0.86	7.71 ± 0.58
Group V (> 260 kg)	19.92 ± 1.45	10.29 ± 0.39	5.92 ± 0.72	9.20 ± 0.99	6.23 ± 0.36	26.04 ± 1.26	12.92 ± 1.39	9.49 ± 1.68
All bulls mean	21.71 ± 0.54	11.68 ± 0.50	7.84 ± 0.32	10.73 ± 0.30	5.95 ± 0.22	22.52 ± 0.67	11.04 ± 0.39	8.55 ± 0.37

* = % ± SEM

The Leydig cell/Sertoli cell ratio of 0.42 falls within the range reported by Heller et al (1971). However, the non significant difference between the left and right testes is similar to their report thus emphasizing the fact that the Leydig cell/Sertoli cell ratio can be utilised as an accurate and reproducible, quantitative measure for comparing one testis against the other as control whenever some experimental operation are to be carried out on the testis of a bull. The mean Sertoli cell index in the present study agrees with that obtained by Kumi-Diaka and Dennis (1978) from testes of Sokoto Gudali (another *Bos indicus*) bulls having moderate testicular degeneration. A factor in the degeneration of germinal epithelium in the testis is its isolation from the vascular supply subsequent to progressive intertubular fibrosis (Bishop 1970). However, since there were no clinical histories on the bulls used in this study, the presence of any pathogen that may have contributed to the observed degeneration can only be implied. Nevertheless, the fact that the bulls were traditionally managed their normadic Fulani owners, who did not bother about any veterinary care or supplemental feeds, could account, to some extent, for the amount of degeneration observed. Also that the range of Sertoli cell index of these bulls encompassed the value for normal bulls (Kumi-Diaka and Dennis 1978) suggests that some bulls are resistant to the unidentified agents of degeneration.

The non-significant difference between the body weight groups in the eight stages of the seminiferous epithelial cycle supports the earlier observations (Swierstra and Foote 1963; Elsaesser et al 1974; Egbunike 1981) that the kinetics of spermatogenesis is species specific, being similar in pubertal and adult (Egbunike 1981) and temperate and tropical (Egbunike 1981) animals.

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