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TESTICULAR MORPHOMETRY AND SOME BIOCHEMICAL CHARACTERISTICS OF TESTICULAR SPERMATOZOA AND FLUID IN RED SOKOTO (MARADI) BUCKS

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ABSTRACT

15 adult Red Sokoto (Maradi) bucks were used to evaluate testicular morphometry and some biochemical characteristics of testicular spermatozoa and fluid in the breed. While paired testes weight, paired tunic weight and mean testis density were 103.58± 7.68g, 4.69±0.26g and 0.97±0.01g/cm^3 respectively, paired caput weight, paired corpus weight, paired cauda weight and paired epididymal weight were 6.99 ± 0.41g, 2.27 ± 0.13g, 5.39 ± 0.31g and 14.26 ± 0.79g respectively. The paired ductus deferens weight was 1.72 ± 0.10g. the derivations from testicular morphormetry showed a normal pattern of development and only similarities (P>0.05) between left and right organs. The linear relationships between the morphometric characteristics showed both significant (P<0.05) and highly significant (P<0.01; P<0.001) positive correlations. There were also only similarities (P>0.05) between testicular spermatozoa and fluid in the concentrations of both total protein and cholesterol.

KEYWORDS: Maradi; Bucks; Testicular Morphometry; Spermatozoa; Testicular Fluid.

INTRODUCTION

Goats occupy a strategic place in the livestock economy of developing countries of the world as more than 90% of the estimated 600 – 627m goats in the world are found in the tropics and subtropics (Bayer and Waters – Bayer 1998). In Nigeria the goat population of over 24.5m representing 4% of the world population (FAO, 1995), still suffers the problem of low productivity with most of the animals reared extensively as scavengers. The improvement of goats in Nigeria will require information on the various aspects of the physiology of reproduction in the male in the various breeds as a lack of experimental data in the indigenous breeds of livestock has been identified as a constraint to their improvement (Osinowo, 1979).

While there are several reports on key aspects of male reproduction in the West African Dwarf (WAD) breed (Akusu et al 1984; Ugwu and Orji, 1984; Agiang, 1986; Bitto et al, 1988, Egbunike et al, 1999 and Bitto et al, 2000a). the Kano Brown breed (Butswat and Zaharaddeen, 1988), the Borno White breed (Kwari, 1992) and the Red Sokoto (Maradi) breed (Ogbuegbu, et al, 1995; Butswat and Zaharaddeen, 1988) else where in the humid tropics, such reports in other breeds of goats in general and in the Maradi breed in particular in the lowland humid tropical (lower) Benue valley are completely lacking. This paucity of base-line data on male reproduction in all breeds of goats in our environment thus constitutes a hindrance to the improvement of goats in the Benue environment where there is at present an increase in the awareness of the technique of artificial insemination (AI). We therefore undertook this study to provide baseline information on testicular morphometry and some biochemical characteristics of testicular spermatozoa and fluid in Maradi bucks.

MATERIALS AND METHODS

Location of the study: This study was conducted in Makurdi, situated at latitude 7^0 14N longitude 8^0 31E.

Sample Collection

Reproductive tracts of mature Red Sokoto (Maradi) bucks were collected *intoto* between 0500 and 0700 hours from the Wurukum Abattoir in Makurdi and brought to our laboratory at the University of Agriculture Makurdi in an insulated ice-box. A total of 15 samples were randomly selected within a period of 4 weeks during the rainy season.

Testicular Morphometry

Each reproductive tract was weighed *intoto* after which the testes were carefully dissected out, trimmed free of adhering fat and connective tissue. The epididymis was also carefully removed and divided into its component parts viz: caput, corpus and cauda epididymis. The tunica albuginea was likewise carefully removed with minimal loss of testicular parenchyma after the volume of the testis was taken. Testicular volume was obtained by water displacement and used to calculate testis density; while all weights were taken using sensitive balances in our laboratory.

Biochemical Studies

(i) Homogenisation
Known weights of both left and right testes were placed in clean beakers and homogenized in 100ml/g of 0.154m NaCl as earlier reported (Egbunike, 1980). Homogenisation was done by mincing with a pair of scissors for 5 minutes after which each homogenate was filtered through two layers of loosely netted bandage into clean test tubes for separation.

(ii) Separation of samples:
250ml from each homogenate were then centrifuged at 4000rpm for 10 minutes, after which the supernatant was aspirated and stored frozen (as testicular fluid) while the pellet was resuspended in 1.00ml deionised water and stored frozen (as testicular spermatozoa) pending biochemical assays.

(iii) Determination of total protein and cholesterol concentration:
The concentrations of total protein and cholesterol in testicular spermatozoa and fluid were determined by methods outlined by the Boehringer Diagnostic Assays Manual (1979) and already fully described by Bitto et al (2000b).

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Statistical Analysis

Data were subjected the student 't' test between left and right organs and correlation analysis (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

A summary of the morphometric characteristics of the reproductive organs of the bucks and the derivations from testicular morphometry are presented in Tables 1 and 2 respectively. The weights of testis in the present study was higher than what was reported in the same breed in Bauchi, Nigeria by Butswat and Zaharaddeen (1988) and also higher than corresponding values in the Kano Brown breed reported by the same authors. Paired testes weight in the present study was however lower than what was obtained in the Borno White breed in the North Eastern part of Nigeria (kwari and Ogbuegbu, 1992). The superiority of the Maradi bucks in the Benue environment to adult bucks of the same breed and other breeds else where in the country could be an indication of a high reproductive potential of these animals in the Benue environment during the wet season. The differences in testicular weights however confirm differences in reproductive parameters based on genotype (Giri, 1994) and other factors like nutrition and season (Egbunike et al. 1985). The superiority of the animals in the present study to bucks of the same breed and the Kano Brown (Butswat and Zaharaddeen, 1998) in the weights of epididymal segments might also imply a higher sperm storage capacity in these animals in this environment. Even though live weights of the animals in the present study could be obtained before slaughter due to a lack of such facilities at the abattoir. The other derivations from testicular morphometry (Table 2) all showed a normal pattern of development. One would therefore expect the paired testes weight expressed on a per kg live weight basis to be high in these bucks.

The similarities between the left and right organs in the distribution of weight (Table 3) might imply a similar trend in sperm production in the gonads and storage in the extragonadal segments as has been reported in swine (Egbunike, 1980) and pubertal WAD bucks (Bitto, 1989). Further work is required in this regard in this breed.

The linear relationships between the morphometric characteristics of the reproductive organs (Table 4) showed significant positive relationships between paired testes weight and paired epididymal weight ($r = 0.47$, $p < 0.05$), paired caput weight ($r = 0.48$, $p < 0.05$) as well as paired cauda weight ($r = 0.48$, $p < 0.05$).

Table 1: The morphometric characteristics of the reproductive organs of Red Sokoto (Maradi) bucks (Mean ± s.e.m.)

Parameter	Values
Left testis weight (g)	52.27 ± 2.84
Right testis weight (g)	51.31 ± 3.10
Paired testis weight (g)	103.58 ± 7.68
Left tunica weight (g)	2.42 ± 0.17
Right tunica weight (g)	2.27 ± 0.11
Paired tunica weight (g)	4.69 ± 0.26
Left testis density (g/cm)	0.96 ± 0.02
Right testis density (g/cm)	0.98 ± 0.02
Mean testis density (g/cm)	0.97 ± 0.01
Left epididymal weight (g)	7.13 ± 0.44
Right epididymal weight (g)	7.13 ± 0.48
Paired epididymal weight (g)	14.26 ± 0.79
Left caput weight (g)	3.46 ± 0.19
Right caput weight (g)	3.53 ± 0.23
Paired caput weight (g)	6.99 ± 0.41
Left corpus weight (g)	1.21 ± 0.09
Right corpus weight (g)	1.06 ± 0.06
Paired corpus weight (g)	2.27 ± 0.13
Left Cauda weight (g)	2.67 ± 0.17
Right Cauda weight (g)	2.73 ± 0.15
Paired Cauda weight (g)	5.39 ± 0.31
Left ductus deference weight (g)	0.88 ± 0.06
Right ductus deference weight (g)	0.84 ± 0.05
Paired ductus deference weight (g)	1.72 ± 0.10

s.e.m = standard error of mean

Table 2: Derivatives* from the morphometric characteristics of the reproductive organs of Red Sokoto (Maradi)bucks

Parameter	Means ± s.e.m
Paired tunica albuginea weight /Paired testis weight (%)	0.047
Paired Carput epididymal weight / Paired testis weight (%)	0.070
Paired Corpus epididymal weight/ Paired testis weight (%)	0.023
Paired cauda epididymal weight/ Paired testis weight (%)	0.055
Paired ductus deferense weight /Paired testis weight (%)	0.018
Paired epididymal weight/Paired testis weight (%)	0.14
Paired carput epididymal weight/Paired epididymal weight (%)	0.49
Paired corpus epididymal weight/ Paired epididymal weight (%)	0.15
Paired cauda epididymal weight / Paired epididymal weight (%)	0.37

s.e.m = standard error of mean

* Relative weights of organs.

The paired tunic weight was likewise significantly positively related to paired epididymal weight ($r = 0.68$, $p < 0.01$), paired caput weight ($r = 0.72$, $p < 0.01$) paired corpus weight ($r = 0.65$, $p < 0.01$) and paired ductus deferens weight ($r = 0.71$; $p < 0.01$). paired epididymal weight was also highly positively correlated to paired caput weight $r = 0.93$, $p < 0.001$), paired corpus weight ($r = 0.62$, $p < 0.01$), paired cauda weight ($r = 0.85$, $p < 0.001$) and paired ductus deferens weight ($r = 0.78$, $p < 0.01$). Other significant relationships were paired caput and paired corpus weight ($r = 0.50$, $p < 0.01$), paired caput and paired

cauda ($r = 0.64$, $p < 0.01$) and paired caput and paired ductus weight ($r = 0.86$, $p < 0.001$). These results are in agreement with earlier reports in the small ruminants (Evans and Maxwel. 1987; Bitto, 1989; Butswat and Zaharaddeen, 1998).

As sperm production rate as well as storage have been reported to be highly related to organ weights in several mammalian species and breeds (Amann and Almquist, 1962; Swierstra, 1966; Amann et al. 1974; Egbunike, 1980; Egbunike et al. 1985; Bitto, 1989; Kwari and Ogbuegbu, 1992:); the animals in the present study would be expected to show good performance in terms of sperm production and storage.

With regard to the biochemical characteristics of testicular sperm and fluid (Table 5), there were only similarities ($P < 0.05$) between sperm cells and testicular fluid in both total protein and cholesterol concentrations. This result might thus imply a stability in both protein and cholesterol concentrations in ejaculated spermatozoa and seminal plasma. With protein being one of the major organic substances present in ram and buck semen (Evans and Maxwell, 1987) and cholesterol and phospholipids beign involved in cellular actions and functions (Locke, 1984); one would thus expect high fertility rates when these animals are used as sires.

Further studies are required to provide information on other aspects of testis function like gonadal and extragonadal sperm reserves in these animals in the Benue environment.

Table 3: Derivatives from the morphometric characteristics of the reproductive organs of Red Sokoto (Maradi)bucks**

Parameter	Left	Right
Testis	100.00 ± 0.00	98.16 ± 1.57
Epididymais	100.00 ± 0.00	99.58 ± 1.37
Tunica albuginea	100.00 ± 0.00	96.24 ± 4.13
Ductus deferense	100.00 ± 0.00	98.22 ± 4.52

s.e.m Standard error of mean
** Ratios of left to right organs

Table 4: The linear relationships between the morphometric characteristics of the reproductive organs of the Red Sokoto (Maradi) buck

	8	7	6	5	4	3	2	1
1	0.14	0.01	0.48*	-0.14	0.48*	0.47*	0.30	-
2	0.71**	0.26	0.35	0.65**	0.72**	0.68**	-	
3	0.78**	0.26	0.85***	0.62**	0.93***	-		
4	0.86***	0.11	0.64**	0.50*	-			
5	0.61**	0.38	0.34	-				
6	0.42	0.29	-					
7	0.12	-						
8	-							

*P<0.05; **P<0.01; ***P<0.001
1 = Paired testis weight
2 = Paired tunica weight
3 = Paired epididymal weight
4 = Paired carput weight
5 = Paired corpus weight
6 = Paired cauda weight
7 = Paired testis weight
8 = Paired ductus deference weight

Table 5: Some biochemical characteristics of sperm cells and testicular fluid of Red Sokoto (Maradi) bucks (mean + s.e.m)*

Parameter	Sperm cells	Testicular Fluid
Total protein	2.61± 0.29	1.34 ± 0.26
mg/100ml		
Cholesterol	444.44± 74.19	537.04 ± 95.12
mg/100ml		

* = (P>0.05)
s.e.m = standard error of mean

CONCLUSION

Based on the normal pattern of the physiology of reproduction exhibited by these animals in this environment, we conclude that sires could be obtained at our abattoirs and managed intensively for planned breeding programmes.

REFERENCES

Agiang, E.A. 1986. Age and seasonal effects on the reproductive potential of the male West African Dwarf goat in Ibadan. Ph.D thesis, University of Ibadan, Ibadsn.

Akusu, M.O., Agiang, E. A and Egbunike, G.N., 1984 Ejaculate and seminal plasma characteristics of the West African Dwarf (WAD) buck. 10th Int. Congr. Anim. Reprod. And A.I. university of Illinois. Vol. II paper No. 50. 3pp.

Amann, R. P. and Almquist, J. O. 1962. Reproductive capacity of dairy bull. VIII., Direct and indirect measurement of testicular sperm production. J.Dairy Sci. 45:774-781

Amann, R. P., Kavanaugh, J. F., Griel, Jr. L C., Vouglmayr, J. K., 1974. Sperm production of Holstein bulls determined from testicular spermatid reserves, after cannulation of rete testis or vas deferens and by daily ejaculation J. Dairy Sci. 57: 93.

Bayer, W. and Waters – Bayer, A. 1998. Forage husbandry. CTA, Macmillan Publishers, Wagenigen, Netherlands, pp 1 – 3.

Bitto, I.I., 1989. Seasonal changes in the physiological and reproductive responses of the West African dwarf buck in Ibadan. Ph.D thesis, University of Ibadan.

Bitto, I. I., Akusu, M.O., Egbunike, G. N., and Akpokodje, J. U., 1988. Comparative studies of the physical and micrometric characteristics of ovine and caprine semen in the humid tropics, 11th Congr. on Anim. Reprod. And AI. Dublin, Ireland. Vol. 3: 230 (3pp).

Bitto, I.I., Akusu, M.O., Egbunike, G.N. and Akpokodje, J.U, 2000a. A comparative study of spermatozoal abnormalities and some biochemical characteristics of ovine and caprine semen in the humid tropicsa. Trop. J. Anim. Sci. 3 (1): 169 – 174.

Bitto, I.I., Sende, C. T. and Eze, P. U., 2000b. preliminary investigation on the effect of cassava peel meal on testicular morphometry and some biochemical characteristics of serum in cockerels. Global J. of pure and Appl. Sci. 6 (2): 161 – 165.

Boehringer Diagnostic Assays' Manual, 1979. Boehringer Mannheim CmbH (Germany) diagnostica. Pp 97 – 102.

Butswat, I.S. and Zaharaddeen, D.T. 1988. Comparisons of some reproductive parameters in Red Sokoto and Kano Brown breed of bucks. Nig. J. Anim. Prod. 25 (1): 1 – 5.

Egbunike, G.N., 1980. Sperm storage capacity of the indigenous West African Boar *Int. J. of Androl.* 3:210-216

Egbunike, G.N, Bitto, I.I.and Akusu, M.O. 1999. Effect of acute heat stress on circulating testosterone level in the West African Dwarf buck. Trop J. Anim. Sci. 2 (1): 223 – 229.

Egbunike, G.N., Togun, V.A and Agiang, E.A. 1985. Sperm production in ruminants in hot humid climates. World Rev. of Anim. Prod. 21 (3): 11 –17.

Evans, G. and Maxwell, W.M.C. 1987. Salmon's artificial insemination of sheep and goats. Butterworths. Pp 1 – 16.

Food and Agricultural Organisation, 1995. quarterly Bulletin of Statistics. Vol. 8 N0. 2, 3 and 4. Rome, Italy.

Giri, S.C., Mohanti, B.N., Ray, S.K.H. and Mohanty, D.N., 1994. Biometry of scrotum and testicles in Black Bengal and Ganjam breed of bucks with relation to fertility. Indian Vet. J. 17: 561 – 564.

Kwari, H. D. and Ogwuegbu, S.O., 1992. Morphometric studies of the reproductive organs, gonadal and extragonadal sperm reserves of the Kuri bull and Borno White buck of the Sahelian zone of North-Eastern part of Nigeria. Trop. Vet 10: 83 – 87.

Locke, M., 1964. Cellular membranes in development. The 22nd symposium of the society for the study of development and growth. Academic press, New York.

Ogbuegbu, S. O., Oke, B. O., Akusu, M. O. and Aire, T.A ., 1985. Gonadal and extragonadal sperm reserves of the Maradi (Red Sokoto) goat. Bull. Anim. Hlth. Prod. Afr. 33: 139 – 141.

Osinowo, A.O., 1979. Testicular growth and semen qualities of West African Bulls, PhD thesis A.B.U. Zaria.

Steel, R.G.D. and Torrie, J.O.H., 1980. *Principles and procedures of statistics: A Biometrical Approach.* 2nd Ed. Mc Graw-Hill Book Co. Inc. New York

Swierstra, E.E., 1966. Structural composition of strorthorn bull testes and daily spermatozoa production as determined by quantitative testicular histology. Can. J. Anim. Sci. 46: 107 – 119.

Ugwu, S. O. C. and Orji, B. I. , 1984, Ejaculate characteristics of West African Dwarf goats. Nig. J. Anim. Prod. 11(1): 94.