Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2014; 1(4A):242-248 **p-ISSN 2348–8883**

An International Publisher for Academic and Scientific Resources) DOI: 10.36347/sjavs.2014.v01i04.018

Testicular Morphometry of Red Sokoto Bucks Fed Cotton Seed Cake

***Nasir M.[1], Njidda AA.[2], Duwa H[3], Chibuogwu C. I.[2]**
[1]Department of Animal Science, Bayero University, P.M.B. 3011, Kano State, Nigeria.
[2]Department of Animal Science, University of Maiduguri P.M.B. 1069, Maiduguri, Borno State, Nigeria.
[3]Department of Animal Science, University of Abuja P.M.B. 117, Abuja, Nigeria.

***Corresponding Author**
Name: Njidda, A. A
Email: ahmednjidda7@gmail.com

Abstract: An experiment was conducted to determine the effect of cotton seed cake inclusion on testicular morphometry of Red Sokoto bucks. Sixteen sexually matured Red Sokoto bucks were randomly allotted to four dietary treatments with four animals per treatment. Treatment compared were T1 = 0% cotton seed cake (CSC), T2 = 10% CSC, T 3 = 20% and T4 = 30% CSC respectively. The results of chemical composition show that the crude protein (CP) content was generally high in all the diets. The ash, ether extract (EE), neutral detergent fibre (NDF) and gross energy values (GE) were all highest in T3. The extra gonadal sperm reserve showed significant difference ($p<0.05$) in all the parameters observed except for left caput epididymides and right caudal epididymides. Testicular morphometry showed significant effect ($p<0.05$) in all the parameters observed. Results indicate that 10 and 20% levels of CSC inclusion do not have any negative effect on testicular morphometry of Red Sokoto buck.
Keywords: Testicular, morphometry, goats, sperm, cotton seed cake

INTRODUCTION

Morphometric analysis on the testes of any species or breed is necessary in predicting not only sperm production but also of the storage potentials and fertilizing ability of the breeder male. Osinowo *et al.* [1] and Togun and Egbunike[2] reported that the testes size is a good indicator of the present and future sperm production in bulls. Presently a little information in the available literature on the testicular morphometric characteristics and their application in the prediction of good bucks. Testicular measurement and the changes that occur during growth of the testes from birth to maturity have however been well documented for goats[3], rams[4] and bulls[5, 6].

Cottonseed cake is used as an alternative ingredient to soy bean meal because of its low cost and accessibility in areas, where it is grown[7]. However, cotton seed presents a substance with toxic potential in its composition. The gossypol is a phenolic yellow pigment produced by pigment glands found in cotton roots, branches, leaves, and seeds[8-9] that confers resistance of the plant to pathogens [10].

Gossypol is a compound highly reactive that binds rapidly to different substances, including minerals and amino acids. Iron is the most important mineral capable to bind to gossypol, originating the complex gossypol-iron. Iron bound to gossypol becomes inaccessible and iron deficiency may occur affecting the hematopoiesis. In addition, the presence of this complex in the yolk of eggs determines the formation of a green color[11, 8-9]. Since the level of this substance in the cotton is not high enough to cause acute intoxication, the natural intoxication by gossypol occurs through prolonged ingestion of the plant. The effects of gossypol are cumulative and may appear suddenly after a variable period of ingestion[11, 9]. In males, gossypol promotes reduction of motility and spermatozoid concentration. Besides this effect, testosterone level and testicular morphology remain unaltered [12]. In non ruminant females, the exposure of gossypol has been associated with the interruption of estrous cycle and pregnancy and early embryo development. On the other hand, females from non-ruminant species are less sensitive [13].

MATERIALS AND METHODS

Experimental Location

The study was conducted in Kano which is located within the lines of longitude 9˚30 and 12˚30 north and latitude 9˚30 and 8˚42 east. The area is characterized by tropical wet and dry climate; a wet season (May to September) and dry season (October-April) with annual rainfall that ranges from 600 to 1000mm and temperature regime between 20 and 40˚C in the months of September to February[14].

Experimental Animals and Management

The experimental animals were divided into four treatments of four animals each. Treatment 1 was given 0% cottonseed cake, treatment 2 10% cotton seed

cake, treatment 3, 20% cotton seed cake and treatment 4, 30% cotton seed cake. The animals were given the diets in the morning at exactly 7:30 am and the left over was measured on daily basis. Water and mineral salt lick were given *ad libitum* throughout the experimental period. Hay was also given in the evening. Before the commencement of the study animals were given prophylactic treatment using 20% oxytetracycline (Long acting) at the dose rate of 10 mg kg^{-1} body weight. Also they were dewormed using Albendazole suspension at dose rate of 7.5 mg per kg body weight. The experimental house was thoroughly cleaned and disinfected using morigard at dose rate of 2 ml per liter. House sanitation was done on daily basis throughout the experimental period. Feeders and water containers were washed and cleaned on daily basis to avoid contamination.

Semen Collection

Semen were collected and evaluated every fortnight using electro-ejaculator (Lane manufacturing) for a period of ten (10) weeks prior to orchidectomy (castration). Semen volume (ml) was determined by collecting the semen sample in a graduated tube. The colour of ejaculate was determined by visual observation immediately after semen collection and coded as 1= bloody, 2 = watery, 3 = milky and 4 = creamy. Semen pH was determined by the use of pH paper, while sperm mortality was determined by placing a drop of semen on pre-warmed (34^0C to 37^0C) glass slide and covered with 22 x 32 mm cover and examined at X40 eye piece object magnification. Immediately after semen collection and analysis within the period of 10 weeks, orchidectomy (castration) took place and the sample (testis) were taken to Histopathology Laboratory of the Department of Veterinary Medicine Ahmadu Bello University, Zaria for testicular histopathology. Samples of some paired testicules were analyzed for gonadal and extra gonadal sperm reserve. The orchidectomy was preferably done at the liberal area of the caudal part of the scrotum and shaved using soap, water and razor blade. The area was scrubbed with chlorhexidine and methylated spirit. Two ml of local anaesthesia (lidocaine hydrochloride) were infiltrated subcutaneously into the scrotum. An incision was made through the scrotal skin, fascia and then to tunica albuginea. The testis were exposed and adhering tissues removed and the spermatic cord clamped with haemostatic forceps and then legated with size two place cat gut at two different places. The testicles were cut-off and the stump of spermatic cord pushed back and the scrotum sutured with black silk. Two ml of antibiotic (pen-strep) was given intramuscular by diclofenac sodium sulphate and multivitamin were administered at 10 mg per kg body weight while oxytetracycline blue spray were sprayed on the suture immediately for 5 days. The black silk was removed one week post orchidectomy. Both right and left paired testis were measured immediately; right and left epididymides also were measured. Corpus weight epididymides, caput epididymides, and caudal epididymides as well as testicular density and testicular volume were measured immediately. The experimental design used was complete randomized design (CRD).

Chemical analysis

The proximate composition including dry matter (DM), organic matter (OM) and total nitrogen (N) were determined following standard methods of AOAC [15] and CP was calculated as N x 6.25. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined by the methods of [16]. Organic matter (OM) was determined by subtracting ash from dry matter (DM).

Statistical Analysis

Data collected were coded and then subjected to analysis of variance (ANOVA) in a Randomize Complete Block Designed (RCBD) using SAS package [17] where significant differences are observed means were separate using Duncan Multiple Range Test..

RESULTS

Chemical composition of experimental diets

The chemical composition of the experimental diets is shown in Table 2. From the Table, the dry matter content of experimental diets ranged from 934.00 in T_2 (10% cotton seed cake) to 94.50 g kg-1 DM in T_3 (20% cotton seed cake). T_3 had the highest ($P<0.05$) ash content compared to other treatments. Significant differences ($p < 0.05$) were observed in the crude protein values for all dietary treatments with highest (P0.05) value in T_3, (182.00 g/kg^{-1} DM) and lowest ($P<0.05$) in T_1 (154.00 g kg^{-1} DM) among treatments. Both NDF and ADF were significantly different ($p < 0.05$) with T_3 recoding the highest ($P<0.05$) value (388.40 g kg^{-1} DM) and T_1 had the lowest value compared to other treatments. ADIA and hemicelluloses were lowest ($P<0.05$) for T_2 whereas cellulose was lowest ($P<0.05$) for T_1 ADL was higher ($P<0.05$) for T_1 compared to other diets. Gross energy was higher ($P<0.05$) in T_3 and T_4, intermediate in T_2 and lowest in T_1.

Effect of CSC supplementation on testicular morphometry of red sokoto bucks

The result of testicular morphometry is presented in Table 3. Significant effect ($p<0.05$) were observed among the left and right testicular weights with T_4 having the lowest weight and T_1 and T_2 having the highest weight (Table 3). The right testicular length significantly ($p<0.05$) differed among the treatments; T_4 recorded the lowest ($P<0.05$) value of 36.00 cm and T_2 recorded the highest value of 64.10 cm for right testis. However, the left testicular length was significantly ($P<0.05$) for T_1 and T_2, intermediate for T_3 and lowest for T_4.

Effect of CSC supplementation on testicular homogenate and filtrate of Red Sokoto bucks

The result of testicular filtrate and homogenate volume is presented in Table 4. Left testis filtrate was higher (P<0.05) for T_4 than other treatments which were similar. Right testis filtrate was highest (P<0.05) for T_1, and T_2, intermediate for T_3 and lowest for T_4. Left testis homogenate showed the same pattern as right testes filtrate. Right testis homogenate was higher (P<0.05) for T_1 and T_2 than for T_4.

Effect of CSC supplementation on epididymal weight and length of Red Sokoto bucks

The result of CSC supplementation on epididymal weight and length of the bucks is shown in Table 5. Left epididymis length was highest (P<0.05) for T_1 and T_2 intermediate (P<0.05) for T_4 and lowest for T_3, whereas right epididymis length lowest for (P<0.05) for T_4 and highest (P<0.05) for T_1. The weighr of left epididymis was higher (P<.0.05) in T_1 than T_2 which in turn had higher weight (P<0.05) than T_3 and T_4. Right epididymis weight was higher (P<0.05) for T_1 and T_2 than for T_3 and T_4. Right epididymis weight was higher (P<0.05) for T_1 and T_2 than for T_3 and T_4.

Effects of cotton seed cake supplementation on epididymides weight of Red Sokoto bucks

Table 6 shows the effects of cotton seed cake supplementation on epididymides weight. Left caput epididymides weight and right caput epididymides were higher (P<0.05) for T_1 compared to T_4. Right caput epididymides weight was highest for T_1 and lowest (P<0.05) for T_3, whereas left carpus epididymides weight was higher for T_1 compared to other treatments while left cauda epididymides weight was higher (P<0.05) for T_2 than T_3 and T_4, the right cauda epididymides weight was highest (P<0.05) for T_2, intermediate for T_3 and T_4 and lowest for T_1.

Table 1: Composition of the experimental diets (% DM)

	Treatments			
Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
Cottonseed Cake	0	10	20	30
Groundnut Cake	30	20	10	0
Rice Bran	19	19	19	19
Maize Offal	20	20	20	20
Sorghum husk	10	10	10	10
Wheat Offal	20	20	20	20
Bone Meal	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Calculated ME (MJ/Kg DM)	9.77	9.47	9.01	9.19
Calculated CP (g Kg^{-1} DM)	165.00	164.00	161.00	158.00

CP = crude protein, ME = metabolized energy

Table 2: Chemical composition of experimental diets on dry matter (DM) (g kg^{-1} DM)

	DM	Ash	CP	EE	ADF	NDF	ADIA	CELL	HCELL	ADL	GE
T_1	942.50	89.50^{c}	154.00^{d}	87.00^{d}	341.30^{d}	441.00^{d}	78.10a	99.70^{c}	216.20^{d}	125.10^{a}	5286.50^{c}
T_2	934.00	103.00^{b}	172.00^{b}	112.00^{b}	352.60^{c}	463.40^{c}	69.30c	110.80^{ab}	256.30^{c}	96.30^{b}	5469.49^{b}
T_3	945.00	112.50^{a}	166.00^{c}	145.00^{a}	388.40^{a}	501.10^{a}	58.80d	112.70^{a}	299.50^{b}	88.90^{c}	5663.28^{a}
T_4	942.10	92.80^{c}	182.00^{a}	102.90^{c}	376.40^{b}	492.80^{b}	76.30a	116.40^{a}	304.10^{a}	72.30^{d}	5665.21^{a}
SEM	**1.26**	**2.11**	**0.97**	**1.02**	**0.87**	**0.21**	**0.62**	**3.21**	**0.76**	**0.24**	**0.78**

a, b, c= means within the same rows with different super scripts are significantly different. (P< 0.05); DM=Dry matter; CP=Crude protein; EE= Ether Extract; NDF=Neutral detergent fibre; ADF=Acid detergent fibre; Acid detergent lignin; ADIA=Acid detergent insoluble ash; Cell.=Cellulose and Hemi cellulose; SEM= Standard Error of Means; GE=Gross Energy.

Table 3: Effects of cotton seed cake supplementation on testicular morphometry of Red Sokoto bucks.

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Right testicular weight (g)	59.60^{a}	64.10^{a}	45.00^{b}	36.00^{c}	2.21
Left testicular weight (g)	58.40^{a}	58.20^{a}	46.30^{b}	35.10^{c}	0.22
Right testicular length (cm)	59.60^{b}	64.10^{a}	45.00^{c}	36.00^{d}	1.56
Left testicular length (cm)	58.40^{a}	58.20^{a}	46.30^{b}	35.10^{c}	0.15

abcd means within the same rows with different super scripts are significantly different (P < 0.05).
SEM = Standard error of mean

Table 4: Effects of cotton seed cake supplementation on testicular homogenate and filtrate of Red Sokoto bucks (ml)

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Left testis filtrate	90.00^{a}	83.00^{a}	85.00^{a}	53.00^{b}	4.45
Right testis filtrate	84.00^{a}	85.00^{a}	70.00^{b}	60.00^{c}	3.18
Left testis homogenate	45.00^{a}	45.00^{a}	35.00^{b}	25.00^{c}	3.24
Right testis homogenate	35.00^{a}	30.00^{ab}	35.00^{a}	20.00^{b}	4.86

abc means within the same rows with different super scripts are significantly different (P<0.05).
SEM = Standard error of mean

Table 5: Effects of cotton seed cake supplementation on epididymal weight (g) and length (cm) of Red Sokoto bucks

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Left epididymis length	13.00^{a}	14.00^{a}	10.50^{c}	11.00^{b}	1.54
Right epididymis length	14.20^{a}	12.00^{b}	9.30d^{b}	10.50^{c}	0.47
Left epididymis weight	11.10^{a}	8.80^{b}	5.80^{c}	5.40^{c}	0.37
Right epididymis weight	9.80^{a}	9.10^{a}	6.00^{b}	5.40^{b}	0.44

abcd means within the same rows with different super scripts are significantly different (P< 0.05).
SEM = Standard error of mean

Table 6: Effects of cotton seed cake supplementation on epididymides weight of Red Sokoto bucks (g)

	Treatments				
Parameter	T_1	T_2	T_3	T_4	SEM
Left caput epididymides	4.50^{a}	3.40^{bc}	3.70^{ab}	2.50^{c}	0.39
Right caput epididymides	4.50^{a}	4.00^{ab}	2.30^{c}	3.00^{bc}	0.62
Left carpus epididymides	1.30^{a}	0.70^{b}	0.60^{b}	0.50^{b}	0.19
Right carpus epididymides	0.90^{a}	0.70^{ab}	0.70^{ab}	0.50^{b}	0.12
Left cauda epididymides	3.60^{ab}	4.90^{a}	2.50^{b}	2.30^{b}	0.63
Right cauda epididymides	3.60^{b}	4.90^{a}	2.50^{c}	2.30^{c}	0.45

abc means within the same rows with different super scripts are significantly different (P < 0.05).
SEM = Standard error of mean

DISCUSSION

The chemical composition of experimental diets is shown in Table 1.The crude protein (CP) content of cotton seed cake studied was generally higher. The (CP) content ranging from 354.00 to 382.00 kg^{-1} DM is above 7% CP requirement for ruminants that should provide the ammonia required by rumen micro-organism to support the optimum microbial growth. Brown *et al.* [18] and Bonsi *et al.* [19] justified the use of cotton seed cake in small quantities especially for the

animals in the breeding stock in order to supplement poor pasture and crop residue. High CP content of cotton seed cake is well documented raging from 35 to 46% though Brown *et al.* [18] gave the minimum value of 22%. Generally the CP content of cotton seed cake has been shown to be above the minimum level required (7%) for microbial activities in the rumen[18]. Cotton plants have a higher protein content compared to other species, although species in *G barbadense* family have an average of 35% more protein than species of *G hirsutum.* Bonsi *et al.* [19] also noted that all family of cotton plants is able at all their phonological stage to meet the protein and energy requirements of livestock at maintenance, production and lactating level. The difference in CP can be explained by inherent characteristics of each species in relation to its ability to extract and accumulate nutrients from the soil. The EE content ranging from 87.00 to 145.00 g kg -1 DM. Zahid [20] reported that the protein content of cotton seed cake is depend on the efficiency of oil extraction method. Cellulose content in the present study ranged from 99.70 to 116.40 g kg -1 DM. The cell wall content of hemicelluloses was observed to be fairly high with the mean value of 216.20 to 301.10 g kg^{-1} DM.

The difference observed in the testicular weight among treatment may be due to the fact that cotton seed cake supplementation had a significant effects on testicular morphometry as observed in this study, while the testicular length values ranged from 64.10 to 36.00 cm. T_2 having the highest testicular length while T_4 had the lowest testicular length. Raji *et al*., [21] reported high values of left testicular weight and length of 68.00 g and 65.00 cm.

The testicular homogenate and filtrate volume show some variation in this findings. Fadason, [22] reported that the only difference between homogenate volume and filtrate volume is the tissue and its rate of absorbing water. The difference could be attributed to difference in testicular shape, size and the mass.

The homogenate and filtrate volume of the testis was not found to be affected by the dietary treatments. The values obtained were similar to that obtained by Shoyombo *et al*. [23] who reported mean values of 49.05 to 50.46 ml for bucks between 6 to 12 months of age.

The epididymal length was found not to be significantly different ($p<0.05$) among the treatments. The values obtained agreed with the findings by Oyeyemi and Ubiogoro [24], but were similar to that of Oyeyemi and Ubiogoro[24], while the right epididymal length and weight were significantly different among the treatments. The values reported in the present study are similar to those obtained by Coles [25]. The values of the weights of the testis in the left and right parts obtained from the present study were lower compared to that reported by Oyeyemi *et al*.[26] who recorded values of 52.53 g and 51.79 g in both the left and right testis and Raji *et al*. [21] reported values of 55.00 g for Red Sokoto bucks of less than one year of age. It was observed from the study that the left testis was heavier than the right testis in all the treatments with the earlier reports [27-28] and affirms this assertion.

The left caput epididymides weights were significantly different among the treatments ($P< 0.05$). Also the right epididymides weights were different, both left and right corpus and cauda were significantly different ($P<0.05$) among the treatments observed. This confirms the report of Kessler[29], who reported values ranging from 4.62 to 0.60 g. This might probably be due to the facts that cotton seed cake content in the experimental diets might have had a detrimental effect on reproductive parameters of Red Sokoto bucks. Similar observation was made on testicular morphometry of rabbits fed CSC [30]. The weight of epididymis was very high in cauda or tail which is the major site of sperm storage. The values obtained for the corpus, caput and caudal portion was lower to what was reported by Ugwu [31] with the parts having values of 1.7, 6.8 and 6.43 g for Red Sokoto goats. The differences may be due to age differences as the goats used in the present study were younger. In all the observed differences, it was clear that the corpus portion of the epididymis weigh lower than both the caput and caudal portions respectively. The caput and caudal portions of the epididymis are enlarged parts at both ends with the corpus being the thinner part at their center, which could be the reason for the difference in their weights. It is reported that the weight distribution in the epididymis shows that the cauda epididymis account for half of the total epididymal weight followed by the caput and corpus respectively[32-34].

The volumes of the caput, corpus and caudal filtrate presented no significant differences ($p<0.05$) in all treatments in both the right and left parts with T_5 recording the highest significant value in all the components. In all, the caput portion of the epididymis had higher significant values than the corpus and caudal portions.

CONCLUSION

It was clear from this study that higher levels (30%) cottonseed cake-based diets showed some negative effect on testicular morphometry of red sokoto bucks.

REFERENCES

1. Osinowo EO, Molokwu EC, Osori DC; Growth and testicular development in Bunaji bulls. J. Anim. Res., 1981;16: 55-67
2. Togun VA, Egbunike GN; Seasonal variations in the sperm production characteristics of Zebu (White Fulani) cattle genitalia in the humid tropical environment. Middle East J. Sci. Res, 2006; 1:87-95

3. Bitto II, Egbunike GN; Seasonal variations in sperm production, gonadal and extragonadal sperm reserves in pubertal West African dwarf bucks in their native tropical environment. Livestock Research and Rural Development. 2006;18: 134-134.
4. Setchell BP; The mammalian testes. London, Paul Elek. 1978.
5. Willis BM; Breeding policies in developing regions. In: Dalton's introduction to practical animal breeding. 4th ed. Oxford, Blackwell Science. 2001; 1328
6. Dyce KM, Sack WO, Wensing CJG; The pelvis and reproductive organs of male ruminants: in textbook of veterinary anatomy. 3rd ed. New Tork, Saunders. 2002;713-722.
7. Hagens A, Jimenez BO, Akusu MO, Arie TA; Effects of cottonseed on Gonadal and Extra gonadal sperm reserve of Red Sokoto bucks. Chem Rev, 2009; 60:555-574.
8. Cheeke FA; Few cheapers and balanced rations for animals. Livestock Production Research Institute, Bahadarnagar, Okara. Pakistan. 1998.
9. Roger MHG, Badawy ABA, Kaudil MHA, Shahin Y; Effect of cottonseed (gossypol) on the reproductive performance of male and female buffulos. PhD. Thesis. University of Agriculture Faisalabad Pakistan.buffalos. PhD. Thesis. University of Agriculture. Faisalabad, Pakistan. 2002.
10. Altmam RB; Avian Clinical Pathology, Radiology, Parasitic and Infectious Diseases. In: Proceedings of American Animals Hospitals Association, South Bend, IN. 1979.
11. Kerr NB, Steel RGD; Effects of gossypol on micrometry of testes of teddy male goats. Pakistan Vet. J ., 1989; 22:101-104
12. Qian YA, Wanga EO; Effect of gossypol on scrotal circumference and semen quality of crossbred bull. Msc Thesis. New Mexico state University, Las cruces, NM, 1984; 1-39
13. Randal NR, Vasudev RM, Arora G; Study on male anti fertility agent gossypol acetic acid. III. Effects of gossypol acetic acid on rat testis andrologia, 1992; 13: 242-249.
14. KNARDA; Kano agricultural and rural development authority. Metrological station reports temperature record book and management, 2006; 11: 1-3
15. AOAC; Official Methods of Analysis of Official Analytical Chemists (W. Horwtz ed.) 17th Edition, Association of Analytical Chemists, Washington. DC, 2002.
16. Van Soest PJ, Robertson JB, Lewis B; Methods for dietary fibre, neutral detergent fibre, and nonstarch polysaccharides in relation to animal nutrition. Journal Dairy Scieince, 1991; 74:3583-3597.
17. SAS; The Statistical Analysis System for windows. SAS software, version 9.0. Cary, NC. USA. 2000.
18. Brown JY, Omotola SF, Emanuel JI; Reproductive development and functions of Braham bulls fed diets containing gossypol, Journal of Animal science, 2009; 67(1):368.
19. Bonsi RH; Artificial insemination in reproduction in farm animals fourth ed ESE Harfez (ed) Philadelphia Lea and Feriger, 1997.
20. Zahid AO; Collection and evaluation of semen. in: Diagnostic and Therapeutic Technique in Animal Reproduction. 1997.
21. Raji AO, Igwebuike JU, Aliyu J; Testicular Biometry and Its Relationship with Body Weight of Indigenous Goats in a Semi Arid Region of Nigeria. ARPN Journal of Agricultural and Biological Science. 2008; 3(4).
22. Fadason S; Effects of intratcsticular injection of chlorhexidine gluconatc and cotton seed oil of some reproductive parameters of bucks, MSc. Thesis. Ahmadu Bello University, Zaria, 2001.
23. Shoyombo A, Fasanya O, Bunjah U, Yakubu H; On-Farm Prediction of Testicular Characteristics in Bucks at Specific Ages. World Journal of Life Science and Medical Research, 2012; 2(3):114 - 119.
24. Oyeyemi MO, Ubiogoro O; Spermiogram and Morphological Characteristics in Testicular and Epididymal Spermatozoa of Large White Boar in Nigeria. International Journal of Morphology, 2005; 23(3): 235-239.
25. Coles EH; Veterinary clinical pathology. 4th edition. NB Sandes Company, Harcourt Brace Jovarinch Inc. 1986.
26. Oyeyemi MO, Fayomi AP, Adeniji DA, Ojo K.M; Testicular and Epididymal Parameters of Sahel Buck in the Humid Zone of Nigeria. International Journal of Morpholog, 2012; 30(2): 489-492.
27. Dunn TG; Nutrition and reproduction processing beef cattle. In: Morrow, D. A. (ed.): current therapy in theriogenology, W. B. Saunder Company, Philadelphia. 1980; 456-478.
28. Oyeyemi MO, Davies OE, Ajala OO, Akusu MO; White Fulani bulls seminal characteristics and output as related to age, body weight and scrotal circumference. In: Proceedings of 3rd Annual Conference of Animal Science Association of Nigeria. September, 1998; 22-24: 131-3.
29. Kessler R; Vasectomy and Vasovasostomy in: Current operative Urology, 1992. Whitehesad E.D (Ed) J.B Lippincott Company Philadelphia, 1992;316-320.
30. Amao OA, Adejumo DO, Togun VA; Testicular morphometry and histological changes in rabbit bucks fed cottonseed cake-based diets supplemented with Vitamin E. Journal of Animal Science Advances, 2012; 2 (10): 803-812
31. Ugwu SOC; Relationship between scrotal circumference, in situ testicular measurements and sperm reserves in the West African Dwarf bucks. African Journal of Biotechnology, 2009; 8(7):1354-1357.

32. Zemjanis R; Collection and evaluation of semen. In: Diagnostic and Therapeutic Techniques in Animal Reproduction. 1970; 156-193.
33. Oyeyemi MO, Babalola TE; Testicular parameters and morphologica l characteristics of testicularand epididymal spermatozoa of white Fulani bulls in Nigeria. Inter J Morphol, 2006; 24: 175-180
34. Hafez ESE; Reproduction in Farm Animals**.** 5th ed., Lea and Febiger, Philadelphia, 1987; USA