

Testicular Parameters and Morphological Characteristics of Testicular and Epididymal Spermatozoa of White Fulani Bulls in Nigeria

Parámetros Testiculares y Características Morfológicas de los Espermatozoides Testicular y Epididimal de Toros Fulani Blancos en Nigeria

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SUMMARY: Testicular parameters and morphological characteristics of testicular and epididymal spermatozoa of white Fulani bulls were studied using twenty testicles. The objective was to study the normal testicular parameter and morphological changes during epididymal transit in the epididymis of white Fulani bulls. It was observed that there was reduction in the proportion of spermatozoa carrying the proximal cytoplasmic droplet (PCD) along the epididymis as spermatozoa mature. There were more narrow heads in the left (0.40) than the right epididymis (0.10). There was more bent normal tail (16.7) in the left epididymis than in right epididymis (13.0). The sperm cells having looped tails are higher in the left epididymis (caput, 4.90; corpus, 5.30; caudal 4.30) than the right epididymis (caput, 4.70; corpus, 3.20; caudal 5.10) despite the fact that the caudal epididymis in the right epididymis has a higher mean value. In this study the left testicle had more of the morphologically defective spermatozoa (12.96%) than the right testicles (12.42%).

The epididymal and testicular parameters were positively correlated (weight of epididymis, weight of testis and epididymis, length of epididymis, circumference of the testes and epididymis, $p < 0.05$).

KEYWORDS: Tested; Bulls; Spermatozoa; Epididymal transit.

INTRODUCTION

Ruminants play an important role in the economy of Nigeria. Meat and milk obtained from these animals constitute the major source of animal protein for a greater part of the population. Also, by-products such as hides, skin and bone serve as raw materials for some agro-based industries, thereby serving as a source of foreign exchange (Williamson & Payne, 1984).

White Fulani breed of cattle (synonymous with Akou of the Republic of Cameroun, Bunaji, white Bororo, White Kano and Yakanji) is typical of the West African lyre-horned zebu owned by the Fulani people. It is found in Northern Nigeria and in the Federated Republic of Cameroun in a climatic environment that is typical and semi-arid where it is called Akou. White Fulani locally called Yakanji by their owners, the Fulani people. Found mainly in 10-15N belt of

West Africa. They are large animals. The coat is usually white with black points, but a few animals possess coats that are black with blue flecking or red and white. The skin is loose and pigmented and the hair soft. The ears are erect. The horns are medium to long, lyre-shaped and curve outwards and upward, it is a triple-purpose breed used primarily for milk production, as milk constitutes the basic diet of the Fulani (Bonnier *et al.*, 1997; Wosu, 2002).

When the spermatozoa leave the testis as reported by Cole & Cupps, (1977), they pass through the efferent ducts into the epididymis. This is a compact fibrous organ closely applied to the posterior or superior border of the testis, and it consists basically of a single but very convoluted duct. Usually the epididymis is divided anatomically into head, body and tail (caput, corpus and cauda epididymis).

The head and tail are the enlarged portions at the two ends, the body; the thinner part is between (Zemjanis, 1977, Hafez, 1987).

The major site of sperm storage within the male reproductive tract is the caudal portion or tail of the epididymis. This part of the tract has a relatively wide lumen in which high concentrations of spermatozoa are stored (Roberts, 1971; Amann, 1981). A functional disturbance of the epididymis may result in abnormal composition of the epididymal plasma, lowered sperm motility and abnormal clinical pictures of the spermatozoa (Galloway, 1994; Oyeyemi & Ubiogoro, 2005).

It is generally considered that the sperm cells matures in its passage through the epididymis as indicated by the passage of the cytoplasmic droplet from the neck region, down the middle piece and tail from which it is lost before ejaculation. Spermatozoa removed from the tail of the epididymis were 2 to 10 times more fertile than spermatozoa from the caput apparently due to abnormalities in locomotion of the sperm cells from the head of the epididymis (Cole & Cupps).

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MATERIALS AND METHOD

Twenty testicles from sexually matured white Fulani bulls were collected from the Bodija abattoir located about two kilometers away from the University of Ibadan Campus, Nigeria. The intra-scrotal testes were placed in a well-insulated flask maintained at warm condition (37°C) immediately the animals were slaughtered. These were transferred to the laboratory immediately.

Examination of the Scrotum: This involves the palpation of the scrotum for fullness and to also assess the testicles for soundness. Examinations include presence or absence of mites, flabbiness, hypoplasia of the testicles, orchitis and degeneration.

The right and left testes were removed by making incision through the scrotal skin, fascia and the tunica vaginalis. The spermatic cords were severed by using the scalpel blade to incise through it. This was done to get the testes removed and after this was done, each testis was put in a labeled nylon.

Procedure. The following procedures were carried out.

1. Weight of the testis and epididymis: The testis and the epididymis while intact were weighed using Microvar® weighing machine and their circumference measured at the widest part using flexible tape rule.
2. Weight of the testes: After epididymides were carefully dissected from the testes, the testes were then weighed, the length and the circumference were then measured using flexible tape rule.
3. Weight of the epididymis: After the epididymides were dissected from the testes, the testes were then weighed on the machine, the length of the epididymis were measured using a flexible measuring tape.
4. Dimensions of the testes like the breadth and thickness of the epididymis were taken using venier caliper.

Semen collection and microscopy. The right and left epididymis were trimmed off the body of the testis and semen samples were collected from the three parts of the epididymis through a 1.0 cm incision made (with scalpel blade) on any of the locations (caput, corpus and caudal epididymis). The incisions of the caput and corpus epididymis were flushed with 2–3 drops of 2.9% buffered sodium citrate kept at body temperature. One half of the collected sperm sample was stained using Wells and Awa stain for morphological studies and Eosin-Nigrosin stain for live-dead ratio. The second half was mixed with 0.5ml of 2.9% sodium citrate to study the progressive motility while undiluted samples were used to study the mass activity. Except for mass activity others were done under high power magnifications.

Statistical analysis. Simple correlation coefficient was calculated for some testicular parameters. Paired comparisons were done using 't' test where applicable. Analysis of variance was used where means was significantly differed; separation of means was also done using Duncan's multiple range test (Steel & Torrie, 1980).

RESULTS

The results of the spermatozoa morphology obtained from different segments of the epididymides and the testes are presented in Tables I and II. The results show that there is a reduction in the proportion of spermatozoa carrying the proximal cytoplasmic droplet (PCD) along the epididymis as spermatozoa mature. There were more narrow head in

the left (0.40) epididymis than the right epididymis (0.10). The spermatozoa with looped tails are more in the left epididymis (14.50) than right epididymis with mean value of 13.00 while both are significantly higher ($p < 0.05$) when

compared with left testis (2.30) and right testis (3.00).

The left epididymis has a higher number of bent tails with mean value of 16.7 than the right epididymis with mean

Table I. Mean value of morphological characteristics of Spermatozoa in the left testes and epididymes.

Testes and parts	Testis	Caput	Corpus	Caudal	Total
Number of testes and epididymis	10	10	10	10	30
Narrow heads	0.2000	0.1000	0.2000	0.1000	0.4000
Proximal cytoplasmic droplets	0.2000	0.1000	0.0000	0.0000	0.1000
Looped tails	2.3000	4.9000	5.3000	4.3000	14.5
Coiled tails	2.700	3.800	3.100	2.400	9.3
Curved mid-piece	3.800	3.200	4.600	3.600	11.4
Bent tails	5.400	5.100	5.600	6.000	16.7
Tailless heads (loose normal head)	4.200	5.600	4.000	3.900	13.5
Bent mid-piece	4.000	4.000	4.300	4.700	13.0
Total abnormal sperm cells	22.60	26.80	27.1	25.0	78.9
% abnormal sperm cells	12.96	12.14	12.15	10.5	11.58
Total normal sperm cells	151.80	194.00	196.00	213.00	603.0
% normal sperm cells	87.04	87.86	87.85	89.50	88.42
Total sperm cells	174.40	220.80	223.10	238.00	681.9

Table II. Mean value of morphological characteristics of Spermatozoa in the right testes and epididymes.

Testes and parts	Testis	Caput	Corpus	Caudal	Total
N° of testes and epididymis	10	10	10	10	30
Narrow heads	0.2000	0.0000	0.1000	0.0000	0.1000
Proximal cytoplasmic droplets	0.2000	0.1000	0.0000	0.0000	0.1000
Looped tails	3.0000	4.7000	3.2000	5.1000	13.0
Coiled tails	2.000	1.900	3.300	3.600	11.8
Curved mid-piece	3.400	4.900	3.300	3.600	11.8
Bent tails	4.700	3.800	5.500	4.500	13.8
Tailless heads (loose normal head)	4.700	3.800	5.500	4.500	13.8
Bent Mid-piece	4.900	3.400	3.600	4.000	11.0
Total abnormal sperm cells	22.90	23.60	23.0	24.0	70.6
% abnormal sperm cells	12.42	10.65	10.79	10.57	10.67
Total normal sperm cells	161.40	197.90	190.20	203.00	591.1
% normal sperm cells	87.57	89.35	89.21	89.43	89.33
Total sperm cells	184.30	221.50	213.20	227.00	661.7

value of 13.0. The contrary is the case in the mean value of loose normal heads with the right epididymis has 13.80 mean values and the left has 13.50 mean values. The spermatozoa with bent middle piece (mid-piece) were more in the left than right epididymis the mean values were 13.00 and 11.00 respectively. When considered the morphological studies of the tail of the spermatozoa there are more coiled tails in the left epididymis (9.3) than the right (7.8). The spermatozoa having looped tails are higher in the left epididymis (caput, 4.90; corpus, 5.30; caudal, 4.30) despite the caudal epididymis in the right epididymis has a higher mean value.

The spermatozoa with looped tails in right testis are

higher than number of spermatozoa with looped tails in the left epididymis. Both are significantly lower than mean values of left and right epididymis. Spermatozoa with normal head without tail are lower in the left epididymis (caput, 5.60; corpus, 4.00 and caudal, 3.90) than right epididymis (caput, 3.8; corpus, 5.6 and caudal 4.50). A similar reduction is observed in the testicles. Left testis with mean value of looped tail of 4.2, which is lower than that of the right with mean value of 4.7. In general, total abnormal spermatozoa are more in the left epididymis (11.58%) than the right epididymis (10.67%). More of the morphologically defective spermatozoa are found in the left testicles (12.96) and slightly higher than the right testicles (12.42%).

Testicular parameter indicated that weight of the testis and epididymis (WTE) was positively corrected with that of weight of the testis (WT) alone ($p < 0.01$). The weights of epididymis (WE) and circumference of the testes and epididymis (CTE) were positively correlated ($p < 0.05$).

Except the lengths of the testes (LT) and other parameters like (weight of testes and epididymides, {WTE}, weight of testes, {WT}, weight of epididymides, {WE,}, length of epididymides, {LE}, breadth of testes, {BT} and circumference of testes and epididymides {CTE}) were negatively correlated the rest were positively correlated but not significant ($p > 0.05$) (Tables III and IV).

Table III. Correlation table for left testicular and epididymal parameters.

	WTE	WT	WE	LT	LE	BT	CT	CTE
WTE	1							
WT	0.983**	1						
WE	0.139	-0.042	1					
LT	0.616	-0.612	-0.019	1				
LE	0.052	0.013	0.188	-0.128	1			
BT	0.900	0.169	-0.460	-0.168	0.134	1		
CT	0.516	0.403	0.607	-0.543	0.389	0.290	1	
CTE	0.542	0.423	0.644*	-0.558	0.389	0.225	0.992	1

* $p \leq 0.05$ ** $p \leq 0.01$

Table IV Correlation table for right testicular and epididymal parameters.

	WTE	WT	WE	LT	LE	BT	CT	CTE
WTE	1							
WT	0.638*	1						
WE	0.819**	0.310	1					
LT	-0.206	-0.122	-0.508	1				
LE	0.658*	0.591	0.463	-0.056	1			
BT	0.485	0.376	0.480	-0.561	0.465	1		
CT	0.899**	0.406	0.697*	-0.023	0.551	0.464	1	
								1

* $p \leq 0.05$ ** $p \leq 0.01$

WTE = Weight of testes and Epididymes
 WT = Weight of testes
 WE = Weight of epididymes
 LT = Length of testes

LE = Length of epididymes
 BT = Breadth of testes
 CT = Circumference of testes
 CTE = Circumference of testes and epididymes.

DISCUSSION

The testicular parameters and morphological changes which spermatozoa undergo during their passage through the epididymis observed in the study were similar to the reports of Akusu *et al.* (1985) in bull; Oyeyemi *et al.* (1998) in buck.

The observed changes in the morphology of testicular spermatozoa indicated that left testes had a slightly higher percentage (12.96%) that the right testes. This is still lower than 20.0% recommended for the maximum percentage of spermatozoa with morphological abnormalities (Zemjanis). The weight of the left testes with epididymis is higher than

the right testes with epididymides. This indicates that more sperm cells are resident in the left testes and epididymis since the weight is correlated with sperm production. The reports of other scientists alluded to this fact (Oyeyemi *et al.*, 1998; Dunn, 1980).

The lengths of right epididymides were higher than the lengths of left epididymides; this is contrary to the weight values, which was higher than the right. While weight of testes and weight of epididymis were negatively correlated indicated that as one value was increasing, the second value was decreasing. It is observed that the length of testes (LT)

were negatively correlated ($P=0.01$) when compared with other testicular parameters like WTE, WT, WE, LE, BT and CTE. There was significant correlation ($=0.01$). Also there is significant correlation ($=0.05$) between WTE and WT, CT and CTE.

It was concluded that left caput epididymides has a higher percentage (12.14%) of abnormal epididymal spermatozoa than right caput epididymides with 10.65%. The left corpus also had a high percentage (12.15%) of abnormal sperm cells than 10.79% of the right corpus. While the left caudal epididymides had a lower percentages (10.57%). On the average the left epididymides had a higher percentage (11.58%) than the right epididymides (10.67%). These percentages are still within normal range of value allowed for bull (Amann & Almquist, 1962; Igboeli & Foote, 1968 and Hafez). Proximal cytoplasmic droplet were only found in the caput of both right and left epididymides.

The reduction in the proportion of spermatozoa carrying the proximal cytoplasmic droplet (PCD) along the epididymis appeared to be a useful indicator for assessing the functional state of testis and epididymis. This observation conforms to valid scientific findings of Egbunike & Elemo (1978) and Akusu *et al.* It also agrees with other workers like Van Demark & Free (1990) and Arthur (1977) that proximal cytoplasmic droplet decreases from the testis down to the caudal epididymis as indication for maturity.

The distal cytoplasmic droplet (PCD) has the highest mean value in the corpus than the rest of the epididymal segment. This is the indication of the morphological changes that occur when sperm cells migrate along different segment of the epididymis. This is similar to the report of Cole & Cupps; Galloway (1994) and Oyeyemi *et al.*, (2002).

It can be concluded therefore that spermatozoa can be collected for artificial insemination by any method from either left or right caudal epididymis.

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RESUMEN: Se estudiaron parámetros testiculares y características morfológicas de los espermatozoides testiculares y epididimarios en 20 testículos de toros Fulani blancos. El objetivo fue determinar parámetros testiculares normales y los cambios morfológicos de los espermatozoides durante su trayecto en el epidídimo. Se observó que hubo disminución de espermatozoides llevando droplet citoplasmático proximal (PCD) en el epidídimo, durante la maduración espermática. Se presentaron más cabezas estrechas en el epidídimo izquierdo (0,40) que en el derecho (0,10). Hubo más espermatozoides con cola normal (16,7) en el epidídimo del lado izquierdo que en el lado derecho (13,0). Las células espermáticas tenían colas en loop en mayor cantidad en el epidídimo izquierdo (cabeza, 4,90; cuerpo, 5,30; cola 4,30) que en el lado derecho (cabeza, 4,70; cuerpo, 3,20; cola 5,10). Sin embargo, en la zona caudal del epidídimo derecho el valor promedio fue más alto. En este estudio, en el testículo izquierdo los espermatozoides presentaron más defectos morfológicos (12,96) que en el derecho (12,42).

Entre los parámetros epididimarios y testiculares hubo correlación positiva (peso del epidídimo, peso de los testículos y epidídimos, longitud del epidídimo y circunferencias de los testículos y epidídimos $p<0.05$).

PALABRAS CLAVE: Testículo; Toro; Espermatozoide; Tránsito epididimario.

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