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# DIFFERENCES IN TESTICULAR PARAMETERS AND MORPHOLOGICAL CHARACTERISTICS OF SPERMATOZOA AS RELATED TO AGE OF WEST AFRICAN DWARF BUCKS

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**Target Audience:** Animal physiologists

## ABSTRACT

**The effect of age on testicular parameters and morphological characteristics of spermatozoa of male West African dwarf goat (buck) were studied. The age of the bucks did not significantly affect ($P>0.05$) testicular parameters. It was observed that there was a gradual increase in the weights and lengths of testes and epididymis as the bucks advanced in age ($P>0.05$). Similarly, the circumference of the scrotum and the testis increased as the bucks increased in age. Testicular spermatozoa had mass activity of zero while caput, corpus and cauda epididymis were scored 1, 2, 3, respectively.**

**Progressive motile spermatozoa were first observed in the region distal to the mid-corpus of the epididymis. The change in motility pattern in epididymis was similar in all the goats irrespective of the age of the bucks. As the bucks advanced in age more defective or abnormal spermatozoa were observed in the epididymis. The first age group (1-2 years) had the lowest mean count of abnormal 108.0 $\pm$ 11.9 spermatozoa followed by the second age group (2½-3½years) 112.0 $\pm$ 9.8 spermatozoa and the last age group (4 -5 years) 124.0 $\pm$ 17.0 abnormal spermatozoa. The value of the first age group differed significantly ($P<0.05$) when compared with the last age group but not with the second age group. In the second and third age groups caudal epididymis had the lowest mean abnormal sperm cells except in the 1-2 years age group while corpus epididymis had the lowest in the first age group.**

**Keywords:** Testiculars parameters, spermatozoa, WAD bucks

## DESCRIPTION OF PROBLEM

The goat is one of the major sources of animal protein in the tropics especially for the milk, meat essential minerals and fat-borne vitamins they produced (1). Age is one of the major factors that affect libido (2). Male animal shows reduced sex drive below the age of puberty which averages between six to eight months

in the buck, due to androgen level in circulation at the age below six months (3). With the obvious increase in the use of artificial insemination world-wide in animal production, it is imperative that a good quality and quantity of sperm from desirable sire is provided. Sexual interest and level of sperm production decline gradually as the animal increases with age (4) .Skinner (5) observed an increase in testicular weight as the age of Boer buck increases and this determines the amount of spermatozoa present in the epididymis.

Epididymis is a heavy, extremely large convoluted structure which is closely attached along the dorsal part of the lateral surface of the testicle. The wall of the epididymal tract has a prominent layer of circular muscle fibres and a pseudo-stratified columnar epithelium(6). The epididymis can be functionally divided into three recognizable anatomical parts first, the caput epididymis (head), which is a flattened expanded structure at the anterior-lateral aspect of the testis. The efferent duct runs into it and consists of variable numbers of highly convoluted ducters efferentes (7), the corpus epididymis (body). The caudal epididymis (tail) has the capacity to store sperm cells and this is dependent on low scrotal temperature and the male sex hormone(8). Furthermore, Hunter, et. al.(9) reported that less mature spermatozoa are in the corpus epididymis and they have a lower fertilizing capacity than spermatozoa from the caudal epididymis. 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 (10).

The thermoregulation by the pampiniform plexus of the testis is essential in maintaining spermatogenesis. 'However, the scrotal position of the male animal especially in goats are located in such a way that they are prevented from heat or cold shock. It has been reported (11) that impaired spermatogenesis and decreased sperm motility occurred when heat was applied to the scrotum. Likewise, intrascrotal deposition of fat are detrimental to spermatogenesis because of the heat they generate. Every semen sample collected from a male animal usually contains some percentages of abnormal sperm cells. However, values exceeding 20% will result in reduced fertility (12).

The aim of this study is to determine the effect of age on the differences in testicular parameters and morphorlogical characteristics of spermatozoa of West African Dwarf (WAD) bucks. It is believed that such a study will add more knowledge to the interpretation of testicular parameter and morphological characteristics of the sperm cells as related to the age of West African Dwarf (WAD) bucks as well as assist in designing artificial insemination programme.

## MATERIALS AND METHODS

### Sample Collections

Testes from 30 sexually matured West African dwarf (WAD) bucks, aged between

1.0 and 5.0 years (aged by dentition) and weighing between 15-25kg, (10 bucks per age group) used for this study were collected from the Bodija Abattoir in Ibadan located at about two Kilometers from the University of Ibadan campus. The body weight, scrotal circumference, and scrotal length were measured for each animal prior to slaughter. The intrascrotal 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.

***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 1.0cm incision made (with scapel blade) on any of the locations (caput, corpus and caudal epididymis). Sperm cells were sucked into a Pasteur pipette from the 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 station for morphological studies and Eosin and 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 (13).

## RESULTS AND DISCUSSION

Testicular spermatozoa had a mass activity of zero (0). The mass activity for the caput, corpus and caudal epididymis were estimated as 1, 2, and 3 respectively. The progressive motility increase in all the age groups from caput to the caudal epididymis, while only very slight vibratile motility was observed from the testes. Mean values of progressive motility for the different portions of the epididymis were estimated to be between 8-10% for the caput, 20-30% for the corpus and 30-40% for the caudal epididymis. Percentage live spermatozoa was generally high ranking between 40 – 50% in the testes, 70-80% in the caput and 80% and above in the corpus and caudal epididymis.

The percentage values of proximal and distal cytoplasmic droplets (PCD) decreased through the corpus to the caudal epididymis in all ages (Table 1). The percentage values were 2.7% , 2.1% , and 1.3% for the 1-2 years; 1.5% , 1.0% and 0.5% for the 2½ -3½ years and 2.2%, 1.0% and 0.6% for 4-5years

**Table1: Morphological Characteristics of Spermatozoa in different Segments of Epididymis as related to different ages of WAD, Bucks**

| | Abnormal Sperm Head | Abnormal Acrosome | Proximal Cytppalsmic Droplets | Distal Cytplasmic Droplets | Abnormal Mid-piece | Detached Sperm Heads | Simple Bent Tails | Tail Coiled Around Heads | Tailed Coiled Below Head | Looped Tails | Total Abnormal Spermatozoa | Total Normal Spermatozoa | Total Spermatozoa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-2 years | | | | | | | | | | | | | |
| CAPUT | 15(0.6) | 0(0) | 22(2.7) | 0(0) | 06(07) | 27(2.1) | 02(0.2) | 01(0.1) | 27(3.3) | 07(0.8) | 107(12.9) | 190(23.0) | 291(35.9) |
| CORPUS | 30(0.4) | 0(0) | 17(2.1) | 07(0.8) | 02(0.2) | 15(1.8) | 17(2.1) | 01(0.1) | 17(2.1) | 15(1.8) | 94(11.4) | 123(14.9) | 217(26.3) |
| CAUDA | 17(2.1) | 0(0) | 11(1.3) | 06(0.7) | 02(0.2) | 29(3.5) | 19(2.3) | 01(0.1) | 22(2.7) | 16(1.9) | 123(14.9) | 189(22.9) | 132(37.4) |
| TOTAL | 35(4.2) | 0(0) | 50(6.0) | 13(1.6) | 10(1.2) | 71(8.6) | 38(4.6) | 03(0.4) | 66(8.0) | 38(4.6) | 324(39.2) | 502(60.8) | 826(10.0) |
| X±SEM | 11.7±6.2 | 0(0) | 16.7±4.5 | 4.3±3.1 | 3.3±1.9 | 23.7±6.2 | 12.7±7.6 | 1.0±0.0 | 22.0±4.1 | 12.7±4.0 | 108±11.9 | 167.3±31.3 | 269.3±39.3 |
| 2½—3½ Years | | | | | | | | | | | | | |
| CAPUT | 13(1.2) | 0(0) | 17(1.5) | 04(0.4) | 07(0.6) | 28(2.6) | 12(1.1) | 01(0.1) | 35(3.2) | 07(0.6) | 124(11.4) | 214(19.6) | 338(31.0) |
| CORPUS | 07(0.6) | 0(0) | 11(1.0) | 09(0.8) | 05(0.4) | 29(2.7) | 22(2.0) | 00(0) | 25(2.3) | 04(0.4) | 112(10.3) | 229(21.0) | 341(31.3) |
| CAUDA | 06(0.5) | 0(0) | 06(0.5) | 07(0.6) | 02(0.2) | 3(2.7) | 19(1.7) | 00(0) | 20(1.8) | 10(0.9) | 100(9.2) | 311(28.5) | 411(37.7) |
| TOTAL | 26(0.5) | 0(0) | 34(3.1) | 20(1.8) | 14(1.3) | 87(8.0) | 53(4.9) | 01(0.1) | 80(7.3) | 21(1.9) | 336(30.8) | 754 (69.2) | 1090(100) |
| X±SEM | 8.7±3.1 | 0(0) | 11.3±4.5 | 6.7±2.0 | 4.7±2.0 | 29±0.8 | 17.7±4.2 | 0.3±0.5 | 26.7±6.2 | 7.0±2.4 | 112.0±9.8 | 251.3±42.5 | 363±33.7 |
| 4—5 Years | | | | | | | | | | | | | |
| CAPUT | 14(1.2) | 0(0) | 25(2.2) | 0(0) | 11(1.0) | 42(3.7) | 04(0.3) | 07(0.6) | 18(1.6) | 14(1.2) | 135(12.0) | 210(18.7) | 345(0.8) |
| CORPUS | 11(1.0) | 0(0) | 11(1.0) | 06(0.5) | 07(0.6) | 25(2.2) | 11(1.0) | 09(0.8) | 20(1.8) | 17(1.5) | 137(12.2) | 244(21.8) | 381(34.0) |
| CAUDA | 07(0.6) | 0(0) | 07(0.6) | 04(0.3) | 0.6(0.5) | 112(1.1) | 14(1.2) | 11(1.0) | 21(1.9) | 18(1.6) | 100(8.9) | 284(26.2) | 394(35.2) |
| TOTAL | 32(2.8) | 0(0) | 43(3.8) | 10(0.9) | 24(2.1) | 79(7.0) | 29(2.6) | 27(2.4) | 59(5.3) | 49(4.4) | 372(33.2) | 748(66.8) | 1120(100) |
| X±SEM | 10.7±2.9 | 0 | 14.3±7.7 | 3.3±2.5 | 8.0±2.2 | 26.3±12.2 | 9.7±4.2 | 9.0±1.6 | 19.7±1.2 | 16.3±1.7 | 124.0±17.0 | 249.3±34.5 | 373.3±20.7 |

Value in Parenthesis Indicate Percentages

age group as presented in Table 1.

The distal cytoplasmic droplets increased from the caput to corpus but lower in the caudal epididymis in all age groups. The occurrence of the proximal cytoplasmic droplets (PCD) was significantly higher ($P<0.05$) than that of distal cytoplasmic droplets (DCP) (Table 1).

Age group 1-2 years had higher percentage of abnormal sperm head (2.1%) in caudal epididymis than caput (0.6%) and corpus(0.4%) , the differences differed significantly ($P<0.05$). The other age groups had caput having higher percentages for 2½-3½ age group caput had 1.2%, corpus 0.6% and caudal 0.5% while in 4-5 age group caput had 1.2% corpus 1.0% and caudal 0.6%.

The 1-2 years group had significantly higher mean value of abnormal sperm head of 11.7± 6.2 in the epididymis compared to 2½-3½ years group with 8.7 ± 3.1which in turn is significantly lower ($P<0.05$) than 4-5 years' group with 10.7 ±2.9. Abnormal mid-piece observed in the epididymis of all the ages did not differ significantly ($P>0.05$). In the 1-2 and 2½-3½ years groups, the caudal epididymis had higher detached sperm heads than other parts while caput epididymis had significantly higher ($P<0.05$) percentage (3.7%) than corpus (2.2%)and caudal (1.1%) in 4-5 years age group.

The incidence of bent tail is higher in most cases in the corpus and caudal than in the caput epididymis. As the age of the animals increases , the mean percentage of tail abnormalities increases. The total abnormalities observed in this study shows that as the age of animal increases, the mean percentage of abnormalities increases. The mean values of testicular parameters observed in this study did not differ significantly ($P>0.05$) irrespective of age of the animals under study (Table 2).

**Table 2: Testicular parameters in different ages of WAD bucks.**

| Parameters | 1— 2 years | $2^1/_2$— $3^1/_2$ years | 4 — 5 years |
|---|---|---|---|
| Weight of testes +Epididymis (g) | 49.8+11.0 | 50.5±9.3 | 50.7±7.3 |
| Weight of testes (g) | 46.6±6.4 | 47.9±9.4 | 47.9±7.1 |
| Weight of Epididymis(g) | 2.2±1.0 | 2.6±0.8 | 2.8±0.7 |
| Length of Epididymis(cm) | 11.3±0.9 | 11.8±1.3 | 11.8±1.7 |
| Length of testes (cm) | 6.4±0.7 | 6.9±0.6 | 6.9±0.8 |
| Circumference of testes (cm) | 10.8±1.0 | 11.0±0.9 | 11.2±1.1 |
| Scrotal circumference (cm) | 18.5±2.2 | 18.8±1.7 | 18.8±1.8 |

The rated value of the mass activity in testes and epididymis agreed with earlier scientific reports (14, 15, 16). Progressive motility was observed in the testes, but progressive motility of 8-10% was observed in the caput as compared to zero reported by Chandhurry and Majunder (16) in Black Bengal goats. The

motility of sperm cell from the corpus epididymis, was 20-30%, which is a weak motility this increased to 40% in caudal epididymis. These observations agreed with the findings of Young (17) and Van Demark and Free (2).

The reduction in the proportion of spermatozoa carrying the proximal cystoplasmic droplet (PCD) along the epididymis appeared to be a useful indicator for assessing the functional state of testis and epididymis. The same trend was observed in all age groups. This observation conforms with valid scientific findings(18, 19, 20). It also agrees with other workers (9, 21) that proximal cystoplasmic droplet decreases from the testis down to the caudal epididymis. However, high incidence of proximal droplets indicate sperm immaturity which is normally observed to be high in the caput epididymis. In this study the 1-2years group had significantly higher ($P<0.05$) mean value of PCD than other age groups. These observations conformed with the findings of other scientists (21,22). The distal cytoplasmic droplet (DCD) had the highest mean value in the corpus than the rest of the epididymal segments. This is the indication of the morphorlogical changes that occur when sperm cells migrate along different segment of the epididymis (23).

In all the age groups, there was no abnormal acrosome observed in any segment of the epididymis. This suggests a high fertility rate in all the groups. The simple bent tail is significantly higher ($P<0.05$) in the caudal and corpus than that of caput epididymis in all the age groups (19). There was a significant difference ($P<0.05$) in the mean percentage values of tail coiled around the head, looped tail when compared with different segments of the epididymis. The caput had the lowest value while the caudal has the highest value.

The incidence of primary abnormalities, abnormal acrosome and tail abnormalities were less than the upper limit of 20%, 5%, 25% respectively reported for bulls (14). However, the incidence of total abnormal forms were lowest in the corpus epididymis (11.4%) in 1-2 years group compared to (12.9%) in caput and (14,9%) in the caudal epididymis in same age group. In the 2½-3½ years group the mean percentage of abnormal forms in caudal (9.2%) is significantly lower ($P<0.05$) compared to corpus (10.3%) and 11.4% in caput epididymis. This observation follow a definite pattern, the value decreased from caput to caudal epididymis. This observation was also seen in 4-5 years group, where the caudal epididymis had 8.9%, caput 12.2% and corpus epididymis 12.2%.This observation agrees with the findings of (24) that less morphorlogical abnormalities were observed in caudal epididymis irrespective of age, due to development of the spermatozoa.

There was a high correlation ($P<0.05$) between the testicular weight and scrotal circumference irrespective of the age group. This result conforms with the observation of Willet and Ohm (25). There was a non significant increase ($P>0.05$) in the testicular weight with corresponding increase in age of the

bucks (5), this indicate that the testicular weight in bucks increases with age. There was a correlation ($P<0.05$) between the testicular circumference and testicular weight in the analysis of testicular and epididymal parameters and this coincides with the report of Land and Car (26).

Similar to the observation of Bongso et al (27) that there was a rapid increase in the size of the testis in ages between 5-12 months and after which the size begin to increase gradually, the findings in this study show a gradual increase in weight of testis with age. (1-2 years 46.6 $\pm$ 6.45g 2½-3½ years 47.9 + 9.4g and 4-5 years 47.9 + 7.1g (Table 2). All other parameters follow this pattern of increase.

## CONCLUSIONS AND APPLICATION

1. The changes which spermatozoa undergo during their movement in the epididymis is very important in the study of andrology and artificial insemination.
2. No doubt, animals obtained from the commercial goat market can be used for natural breeding and artificial insemination purposes.
3. It can also be seen that age after attaining puberty does not have adverse effect on the testicular parameters and as the bucks advance in age, more defective spermatozoa are observed. Major sperm defects known to cause impaired fertility and or sterility were not observed in the bucks under study irrespective of their ages.

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