PRELIMINARY QUANTIFICATION OF SPERMATOGENESIS (DAILY SPERM PRODUCTION) AND EPIDIDYMAL SPERM RESERVE IN THE CAMEL *(CAMELUS DROMEDARIUS)* IN NIGERIA

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ABSTRACT

The scrotal contents of 109 camels (Camelus dromedarius) aged between 3-8 years were secured from abattoirs over a 12 month period and examined in Northern Nigeria. At slaughter, testes and epididymes were immediately collected, examined for gross lesions and evaluated for paired testes weight (PTW), epididymal weight (EPW), daily sperm production (DSP) and epididymal sperm reserve (ESR).

The mean weight of testes and epidydymes were 87.32 ± 3.9g and 15.22 ± 3.12g respectively. The mean (±SD) DSP per gram of testicular parenchyma was 5.42 ± 1.08 million cells and DSP per PTW averaged 4.80 ± 1.74 billion sperm cells.

The results of this study indicated that 1) prediction equations could be established for DSP and ESR, 2) the inter-correlations between PTW, DSP and ESR could be of special clinical significance in the prediction of reproductive potential of the one humped camel.

Key words: *Spermatogenesis, Daily Sperm Production, Epididymal Sperm Reserve, Camel*

INTRODUCTION

The domestic camel is employed primarily as a working animal in most tropical regions of the world. However its secondary role as a source of animal protein is becoming more important as human population and meat demands keep on increasing. Camel husbandry is mostly under nomadic husbandry system which is less productive. The camel as a supplementary source of animal protein needs to be given serious attention. Camels suffer from fewer diseases than other domestic livestock [12,16] and epidemics rare. Most African camels are raised and survive under harsh conditions of limited natural vegetation. The food requirement of the dromedary are modest and under drought conditions the animal can decrease its food intake and metabolism (8). With the degraded environment of the Northern sector of Ghana where cattle and small ruminant production further worsens this situation, camel production could help reactivate the vegatation. In degraded environments with few shrubs and neem trees, the dromedary adjusts by adopting highly extensive, dispersed and continuous grazing habits even during the heat of the day and consume more thorny and highly fibrous plants. [4]

Leupold [12] is of the view that males attain sexual maturity at 3 years, however Khatami (6) indicated that both the Iranian female and male camels reach sexual maturity at the age of 5 years. Camel stallions can breed three females per day at the peak of the breeding season although higher levels are possible. These parameters indicate the limited capability of the stallion to breed mares.

The present work focused on the biometric studies of the scrotal contents, the rate of daily sperm production, and epididymal sperm reserves of the camel *(Camelus dromedarius).*

MATERIALS AND METHODS

Source of specimen

The scrotal contents of 109 camels, aged 3-8 years, were secured from local abattoirs in Kaduna, in the Kaduna State of Northern Nigeria. Samples were

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collected for 12 months from January to December 1986. Animals were examined physically prior to slaughter for genital pathology and diseased animals were eliminated from the study. At slaughter the testes and epididymes were immediately excised, examined for gross lesions, and evaluated for paired testes weight (PTW), epididymal weight (EPW) daily sperm production (DSP), and epididymal sperm reserves (ESR).

DSP and ESR

Daily sperm production was determined by the procedure described by Amnan and Almquist [1], using a time divisor of 5.31, which equalled the number of days of sperm production represented by homogenization resistant spermatids [7,16]. Haemocytometric counts were performed in duplicates by two individuals, allowing a 10 percent variability. Epididymal sperm reserves were determined from epidiymal homogenates according to the procedure adopted by Amnan and Almquist [1] with the following modifications:

a) Between 20 and 30 g of testicular parenchyma were removed from the equatorial segment of each testis for homogenization,

b) Segments of each epididymis - head, body and tail, were homogenized separately, and

c) The homogenizing solution for all the homogenates was made up of 0.125% Triton X-100 and 0.9% NaC1 solution.

Epididymal sperm morphology

Fluid from the three different segments of the epididymis were drawn with micropipette, or milked out, into 0.5 - 1.0 ml BFS (buffered formal saline) for sperm morphologic and biometric studies. Wet smears from BFS were made for midpiece and tail abnormalities and Nigrosin - Eosine stains were prepared for the study of head abnormalities, using the same BFS-preserved sample. The slides were prewarmed on a slide warmer. Sperm morphology was studied using a phase contrast microscope under oil immersion magnification at X 1000. For each slide a total of 100 sperm cells were counted, and the percentage of the various sperm abnormalities was quantified. For the physical dimensions, the lengths of the heads and tails of 20 straight sperm cells per slide were measured with standard calibrated ocular graticule, Leitz micrometer (E Leitz, Wetglar, West Germanv).

Data were subjected to statistical analysis using a computerised statistical package, which included analysis of variance and multiple regression analysis [14].

RESULTS

The mean (±S.D) weight of each testes was 87.32 ± 3.9g, and ranged from 35.72 ± 1.63g to 138.90 ± 9.71g for the 109 camels *(Table 1)*. The difference in testicular weight between individual animals ($p < .01$) and the various age groups ($P > 0.05$) was significant. The mean (±SD) total weight of the epididymis was 15.22 ± 3.12g, with a range from 8.30g to 18.75g. The ratio of head:body:tail of the epididymis was 1:1.5:1.2, with the body portion being significantly bigger ($P < .05$) than either the tail or the body.

The estimation of DSP and ESR yielded good precision between the two counters/technicians, with average correlation coefficients of 9.3% and 23.5% for DSP/gm and ESR respectively. The mean (±SD) DSP per g of testicular parenchyma was 5.42 ± 1.08 million cells, and DSP per PTW averaged 4.80 ± 1.74 billion sperm cells *(Table 2)*. The mean (±SD) ESR was 8.88 ± 2.01 billion. The sperm cell reserves in the head, body and tail of the epididymis were in the ratio of 1:3.6:4.73, with significant difference ($P < .01$) between the three segments.

Estimation of DSP by means of regression formula for DSP on PTW yielded the following prediction equation for DSP:

$$DSP = 0.489 + 0.039PTW;$$ where DSP x billion, PTW in g.

A similar prediction equation for the estimation of ESR from PTW using the same regression analysis was:

$$ESR = 719PTW - 21.53;$$ ESR x billion, and PTW in g.

In the prediction of DSP, PTW was found to be the single most significant parameter. There were significant correlations between PTW and DSP ($r = .91$, $P < 001$), PTW and EPW ($r = .63$, $P < .01$), ESR and EPW ($r = .7$, $P < .01$) and SER and PTW ($r = .61$, $P < .01$).

On the average 12.7 4.6% of all spermatozoa showed some morphologic abnormalities (Table 2), with significant ($P < .05$) individual differences. The following specific abnormalities were identified: head defects, 2.56 ± .91; midpiece, 13.28 ± 3.98; proximal droplets, 9.28 ± 2.11; tail defects, 74.88 ± 13.45. The inter- and intra-age group differences were sig-

nificant ($P < .01$), with more abnormalities in the younger animals. The midpiece defects were mostly of the swollen and abaxial type while abnormal tails were predominantly bent and returned.

The mean (±SD) length of the head of the sperm cell was 5.39 ± 1.60 microns, and the entire length of the sperm cells measured 48.97 ± 12.21 microns. There was no significant correlation between the physical dimensions of sperm and age of the camels.

DISCUSSION

The mean testicular and epididymal weights were significantly different between and within the age groups. However, there was positive effect of age on testicular growth on young animals. This relationship seemed to disappear after six years of age. It is possible that testicular growth peaks between six and seven years, after which, age has no significant correlation with testicular size. However, individual differences in testicular weight continued to be significant. This observation is in agreement with previous reports in bulls [18,19]. In bulls and other domestic animals, significant correlations between PTW and body weight have been reported [1,8]. Under the circumstances in which the present studies were conducted, it was not possible to weight the animals investigated.

The mean DSP per gram of testicular parenchyma and mean ESR have not been previously reported for Nigerian camels. However, the values obtained were in agreement with similar studies reported [7]. It is of interest to note that, in all cases, the body of the epididymis is the biggest/heaviest of the three epididymal segments which is in contrast to the heaviest caudal epididymis for other domestic animals [2]. The accessory glands; ampulla, and seminal vesicles do not exist in the camel [14,18]. The epididymis has been reported as the major storehouse for sperm cells in other domestic male animals [11,13,14,17]. Therefore, it is inevitable that under normal physiological conditions the size of the epididymis and rate of DSP would greatly influence semen concentration (sperm output per ejaculation). The significant inter-correlations between PTW, EPW, DSP and ESR were independent of age group. Similar correlations have been reported for other domestic animals [4,17].

The mean percent sperm morphologic abnormalities were within acceptable limits for normal fertility [5,7]. The significantly higher percentage of abnormal sperms observed in the relatively younger age group (<4 yr) could be associated with levels of sexual maturity.

CONCLUSION

The results of this study indicated,

1) that predictive equations could allow prediction of DSP and ESR with a fair degree of accuracy, and

2) that the inter-correlations between PTW, DSP and ESR could be of special clinical significance in the prediction of reproductive potential of the camel for screening in camel breeding.

Further work needs to be done to include scrotal circumference measurement and its significance in the assessment of breeding potential of the young male camel.

ACKNOWLEDGEMENTS

This study was made possible by grants from Ahmadu Bello University, Ziara, Nigeria. The assistance of the staff at the Kaduna State abattoir at Kaduna city, is highly appreciated.

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Table 1*The mean (±SD) values of the scrotal contents of 109 camels in relation to five age groups.

Age group (Yrs)	No. of Camels	Mean Wt (+S.D, g) of: Testis*	Epididymis
3 - <4	21	49.61 ± 13.11[a]	14.05 ± 1.34[a]
4 - <5	17	65.40 ± 9.14[b]	14.84 ± 1.89[b]
5 - <6	30	85.90 ± 11.30[c]	15.94 ± 2.37[c]
6 - <7	23	104.23 ± 19.67[d]	16.91 ± 6.50[d]
7 - 8	18	121.45 ± 17.83[d]	16.01 ± 9.29[d]
Total/Mean	109	85.32 ± 14.72	18.36 ± 5.33

* Numbers with different superscripts within a column are significantly different (P <.01).

Table 2* The mean (±SD) values of DSP, ESR and total percent of abnormal sperm cells in 109 mature camels in Nigeria.

Age group (Yrs)	No. of Camels	DSP/Camel (x billion)	ESR (x billion)	Total % Abn. sperm
3 - <4	21	2.49 ± 0.45[a]	7.81 ± 1.24[a]	19.35 ± 2.61[a]
4 - <5	17	3.39 ± 0.18[b]	8.52 ± 1.93[b]	14.37 ± 3.81[b]
5 - <6	30	4.91 ± 1.17[c]	8.81 ± 2.41[b]	10.73 ± 1.19[c]
6 - <7	23	6.12 ± 1.93[d]	9.98 ± 4.53[c]	9.91 ± 1.63[d]
7-8	18	7.08 ± 3.12[d]	9.27 ± 3.78[c]	9.11 ± 2.27[d]
Total/Mean	109	4.80 ± .1.44	8.88 ± 2.01	12.69 ± 4.57

* Within columns, numbers with different superscripts are significantly different (P <.01).