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TESTICULAR MORPHOMETRY, SPERM PRODUCTION RATE, GONADAL AND EXTRAGONADAL SPERM RESERVES IN THE INDIGENOUS WEST AFRICAN BOAR IN A LOWLAND TROPICAL ENVIRONMENT

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ABSTRACT

Testicular morphometry, sperm production rate, gonadal and extragonadal sperm reserves were evaluated in indigenous West African boars using samples from 12 mature animals. Whereas the weight of the reproductive tract (g), scrotal circumference (cm) paired testes weight (g) and paired epididymal weight (g) were 410.28±48.66, 28.88±1.22, 196.97±25.34 and 45.92±6.17 respectively, paired caput weight(g) paired corpus weight(g), paired cauda weight(g) were 15.99±2.38, 6.46±1.15, 22.74±3.13 and 12.96± 1.97 respectively. The mean length of the epididymis(cm) mean testis density (g/cm^3) and mean epididymal density (g/cm^3) were 13.76±0.47, 1.07±0.05 and 1.00 respectively. Daily sperm production (DSP) averaged 0.29±0.04 x 10^9 while daily sperm production per gram testis (DSP/g) averaged 0.38x10^7. Gonadal sperm reserves (1.27±0.18x10^9) were significantly higher than caput (0.17±0.06x10^9), corpus (0.18±0.07x10^9), cauda (0.21±0.01x10^9) and ductus deferens (0.09±0.008 x 10^9) reserves ($P<0.05$). The contributions of the epididymal segments and the ductus to the total extragonadal sperm reserves were 26.81%, 27.76%, 31.70% and 13.73% respectively. The left and right testes were similar ($P>0.05$) in both morphometric characteristics and sperm reserves.

KEYWORDS: Indigenous boar, Testicular morphometry, sperm production, sperm reserves.

INTRODUCTION

The potential of pigs to supply the much needed protein at affordable cost in the diets of people living in the humid tropics is evident in their relatively short reproductive cycle, high prolificacy, rapid growth rate and high efficiency of feed utilization. After decades of the introduction of exotic breeds of swine in the West African sub-region, the indigenous West African breed still occupies an important place in the livestock economy of people living in the middle but and rain forest zone of Nigeria.

Increased productivity of these animals in their native environment where well-adapted exotic breeds have consistently shown superiority in productivity will depend on a clear understanding of the physiology of reproduction in the male and information on its reproductive potential. Osinowo (1979) reported that the lack of experimental data on the reproductive physiology of the indigenous breeds of our livestock is a constraint to their improvement.

Though Egbunike (1980) reported on the sperm storage capacity of the boars of this breed in Ibadan, it is note worthy that such reports in the lowland Benue region of Nigeria are completely lacking. Climate is however known to influence the physiology of reproduction in male animals and the reproductive capacity of ruminants has been reported to vary in different parts of the country (Lamorde and Weinman, 1972).

This work was designed to provide information on testicular morphometry, sperm production rate, gonadal and extragonadal sperm reserves in the indigenous West African boar with a view to improving this breed in its native environment.

MATERIALS AND METHODS

Location

This study was conducted in Makurdi, located at latitude 7^{0}14N and longitude 8^{0}31E with an annual rain fall ranging from 1270-1397mm and a temperature range of 21^{0}C-42^{0}C.

Sample Collection

Reproductive tracts of adult (mature) indigenous West African boars were obtained *intoto* between 0600 and 0700hours from the Wurukum Abattoir in Makurdi and brought to our laboatroy at the University of Agriculture Makurdi in an isolated ice-box. A total of 12 samples were randomly selected within a period of one month in the rainy season.

Testicular Morphometry

Each reproductive tract was weighed *intoto* after which scrotal circumference was evaluated using a piece of tread placed at the longest diameter and measured on a rule as reported by Osinowo et. al. (1981). The tested were then 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 ductus deferens was also obtained. The volume of the testis was taken after which the tunica albuginea was 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 (Bitto, 1989). All weights were taken using sensitive (digital) balances in our laboratory.

Gonadal and extragonadal sperm reserves

Estimates of testicular and epididynal sperm reserves were determined by the homogenization technique of Amann and Almquist (1962) and Amann (1970) as also reported by Egbunike (1980) . Known weights of the left and right testes were homogenized in 100ml/g of 0.154m NaCl in clean beakers 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 glass test tubes. Sperm counts were then made from the homogenates using an improved Neubauer haemocytometer.

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Daily sperm production (DSP) and Daily sperm production/g testis (DSP/g)
Daily sperm production was estimated from the testicular homogenates by dividing the gonadal sperm reserves by a time divisor of 4.37 proposed by Amann et. al. (1976) for pigs.

Statistical analysis
Data were subjected to the student't' test, one way analysis of variance (ANOVA) and correlation analysis (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

A summary of the morphometric characteristics of the reproductive organs and their derivations is presented in Tables 1 and 2, respectively. Testicular morphometric characteristics obtained in this study are in close agreement with the report of Egbunike (1980) for pubertal boars, but much lower in all cases than values reported by the same author for adult boars of the same breed in Ibadan; which were in turn lower than corresponding values for exotic boars. These differences may probably be due to nutrition and management as the boars in Egbunike's (1980) study were intensively raised on a standard breeders ration containing 19% crude protein. The animals in the present study were on the other hand reared extensively, being allowed to roam and scavenge.

Table 1: The morphometric characteristics of the reproductive organs of the indigenous West African boar (means ± s.e.m.)

Parameter	Left	Right	Paired
Weight of reproductive tract (g)	-	-	410.28 ± 48.66
Scrotal circumference (cm)	-	-	28.88 ± 1.22
Scrotal sac. Weight (g)	-	-	107.94 ± 16.35
Testis weight (g)	98.24 ± 12.43	98.73 ± 12.91	196.97 ± 25.34
Epididymal weight (g)	22.68 ± 3.04	23.24 ± 3.13	45.92 ± 6.17
Ductus deferens weight (g)	1.12 ± 0.18	1.17 ± 0.17	2.29 ± 0.35
Tunica albuginea weight(g)	6.38 ± 0.96	6.58 ± 1.01	12.96 ± 1.97
Caput weight (g)	7.86 ± 1.12	8.13 ± 1.11	15.99 ± 2.38
Corpus weight (g)	3.10 ± 0.54	3.36 ± 0.61	6.46 ± 1.15
Cauda weight (g)	18.18 ± 1.50	11.56 ± 1.63	22.74 ± 3.13
Epididymal length (cm)	13.75 ± 0.49	13.76 ± 0.44	13.76 ± 0.47*
Testis density (g/cm^3)	1.07 ± 0.06	1.07 ± 0.04	1.07 ± 0.05*
Epididymal density (g/cm^3)	1.00 ± 0.02	0.99 ± 0.01	1.00± 0.00*
*=mean. s.e.m. =Standard error of mean			

Table 2: Some derivations from testicular morphometry in the indigenous West African boar (means ± s.e.m)

Parameters	Values
Paired testes weight /weight of reproductive tract (%)	47.45 ± 2.16
Paired tunic weight/ weight of reproductive tract (%)	3.17 ± 0.46
Paired epididymal weight/ weight of reproductive tract (%)	11.00 ± 0.66
Paired ductus weight/ weight of reproductive tract (%)	0.54 ± 0.04
Paired tunic weight /paired testes weight (%)	6.79 ± 0.54
Paired epididymal weight/ paired testis weight (%)	23.56 ± 1.67
Paired ductus weight/ paired testes weight	1.17 ± 0.11
Paired carput weight/ Paired epididymal weight (%)	34.88 ± 1.35
Paired corpus weight/ Paired epididymal weight (%)	14.36 ± 0.83
Paired canda weight / Paired epididymal weight (%)	49.36 ± 1.56

s.e.m = Standard error of mean

Table 3: Ratios of left to right organs in testicular morphometry in the indigenous West African boar

Parameter	Left	Right
Testis weight	100.00 ± 0.00	100.50 ± 1.79
Epididymal weight	100.00 ± 0.00	102.25 ± 1.25
Ductus def. weight	100.00 ± 0.00	104.46 ± 6.39

Even though the live weights of the animals could not be obtained before slaughter at the abattoir, the paired testis, paired epididymal and paired ductus weights relative to the weight of the reproductive tract as well as the weights of the tunic, epididymis and ductus deferens, relative to the paired testes weight and the epididymal sections relative to the epididymis, all showed a normal pattern of development in these animals (Dyce et. al.,2003). One would therefore expect the paired testes weight expressed on a per kg live weight basis to be high in these boars.

With regard to sperm production rate (Table 4), both DSP and DSP/g values obtained in the present study are lower than values reported for both adult and pubertal exotic boars raised in Ibadan (Egbunike, 1995). These differences are expected as sperm production rates are a function of testes size and are determined by the kinetics of spermatogenesis with obvious advantages of the exotic breeds over the indigenous breed including the plane of nutrition.

Table 4: Daily sperm production (DSP) and daily sperm production per gram testis (DSP/g) in the indigenous West African Boar (means±s.e.m)

Parameters	Left	Right	Paired	Level of significance
DSP ($X10^9$)	0.15±0.02	0.14±0.02	0.29±0.02	ns
DSP/($X10^7$)	0.20±0.04	0.18±0.03	0.38±0.03	ns

s.e.m=Standard error of mean, ns=not significant (P>0.05).

Sperm reserves in the indigenous bear in the present study (Table 5) were comparable to only corpus reserves in both pubertal and adult boars of the same breed in Ibadan (Egbunike,1980). Sperm reserves in all other regions of the reproductive tract in the present study were lower than corresponding valves reported by Egbunike (1980).

Table 5: Gonadal and extragonadal sperm reserves in the indigenous West African boar (Means ± **s.e.m)**

	Parameters	Values ($x10^9$)	Level of significance
1	Testis: Left Right Paired	0.65 ± 0.08 0.62 ± 0.92 1.27 ± 0.18[b]	ns
2	Caput: Left Right Paired % contribution of paired caput:	0.09 ± 0.01 0.08 ± 0.01 0.17 ± 0.06[a] 26.81%	ns
3	Corpus: Left Right Paired % contribution of paired corpus:	0.083 ± 0.01 0.093 ± 0.01 0.177 ± 0.07[a] 27.76%	ns
4	Cauda: Left Right Paired % contribution of paired cauda	0.097 ± 0.012 0.104 ± 0.01 0.205 ± 0.01[a] 31.70%	ns
5	Ductus deferens: Left Right Paired % contribution of paired ductus	0.038 ± 0.01 0.049 ± 0.01 0.87 ± 0.05 13.73%	ns

s.e.m. = Standard error of mean
a,b = paired values of epididymal sections bearing different superscripts are significantly different (P<0.01),
ns = Not significant (P>0.05) (between left and right organs)

These results would be expected going by the low values of the morphometric characteristics of the reproductive organs as earlier explained. The similarities between the left and right organs in testicular morphometry, and sperm storage capacity (Tables 3, 6 and 7) confirm earlier reports in the same breed (Egbunike, 1980) and in exotic breeds (Egbunike and Elemo, 1978).

Table 6: Ratios of left to right organs in gonadal and extragonadal sperm reserves in the indigenous West African boar(Means ± s.e.m)

	Means ± s.e.m.	
Parameter	Left	Right
Testes	100.00 ± 0.00	95.39 ± 8.87
Caput	100.00 ± 0.00	91.81 ± 9.66
Corpus	100.00 ± 0.00	112.05 ± 11.12
Cauda	100.00 ± 0.00	107.22 ± 9.66
Ductus deferens	100.00 ± 0.00	128.95 ± 19.76

s.e.m. = Standard error of mean

Table 7: The correlation matrix showing the relationships between testicular morphometry, sperm production and sperm storage in the indigenous West African boar

	12	11	10	9	8	7	6	5	4	3	2	1
1	-0.97***	0.31	0.89***	0.94***	0.31	0.17	0.99***	1.0***	0.97***	1.0***	0.96***	-
2	-0.56*	0.23	0.69*	0.65*	0.23	0.21	0.86**	0.88***	0.88***	0.86**	-	
3	-0.66*	0.39	-0.34	0.52*	0.39	-0.05	0.78**	0.96***	0.74**	-		
4	-0.58*	0.04	0.73**	0.62**	0.004	0.17	0.83**	0.88***	-			
5	-0.66*	0.3	0.51*	0.59*	0.3	-0.03	0.79**	-				
6	-0.8	-0.15	0.72**	0.54*	-0.15	0.34	-					
7	-0.47	-0.59*	0.72**	0.1	-0.59	-						
8	-0.33	1.0***	-033	0.16	-							
9	-0.59*	0.64*	0.57*	-								
10	-0.55*	-0.33*	-									
11	0.76*	-										
12	-											

1. weight of reproductive tract *intoto*
2. scrotal circumference
3. paired testes weight
4. paired tunica albuginea weight
5. mean testes volume
6. paired epididymal weight
7. caput epididymal sperm reserve
8. corpus epididymal sperm
9. cauda epididymal sperm reserve
10. gonadal sperm reserve
11. daily sperm production
12. daily sperm production per gram testis

* = P <0.05, ** = P<0.01, *** = P<0.001

With regard to the linear relationships, as shown in Table 7, the weight of the reproductive tract was (as expected) highly positively related to scrotal circumference(r=0.96;P<0.001), paired testes weight(r=1.00;p<0.001),paired tunic weight(r=0.97;p<0.001),paired epididymal weight(r=0.99;p<0.001) and mean testes volume(r=1.00;p<0.001). The weight of the reproductive tract was also highly positively related to cauda epididymal reserves(r=0.94;p<0.001) and gonadal sperm reserves(r=0.89;p<0.001).Scrotal circumference was similarly highly positively related to paired testes weight(r=0.86,p<0.01), paired tunic weight(r=0.88;p<0.001) and mean testes volume(r=0.88;p<0.001).The relationships of scrotal circumference with cauda epididymal reserves(r=0.65;p<0.05) and gonadal sperm reserves(r=0.69;p<0.05) were all good. Paired testes weight was likewise positively, closely related to paired tunic weight(r=0.74; p<0.01), paired epididymal weight(r=0.78; p<0.01) and mean testes volume(r=0.96.;p<0.001).Whereas gonadal sperm reserves were significantly positively related to caput epididymal sperm reserves(r=0.72;p<0.01) and cauda epididymal sperm reserves(r=0.57;p<0.05),the relationship with corpus epididymal reserves was not significant. This could be related to the sperm transit time which would be dependent on a number of factors including the frequency of ejaculation which could not be obtained in this study as the samples were obtained from animals slaughtered at a public abattoir. The high positive correlations obtained between the morphometric characteristics of the reproductive organs and sperm production rate as well as sperm reserves in the present study are similar to what was earlier reported in bulls in the tropics (Osinowo et. al. ,1981) and lend ground for the prediction of sperm production from testicular measurements.

We conclude that the base line information on the reproductive potential of the indigenous West African boar provided in this study will be useful in the determination of male/female ratio at natural mating and artificial insemination (Igboeli and Rakha, 1971; Wildeus and Entwistle, 1982) The evidence of the normal physiology of reproduction shown by these animal in spite of their nutritional limitations in extensive management also suggests that sires could be obtained at our abattoirs and managed intensively for breeding and improvement programmes in this breed in its native lowland tropical environment.

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