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Sperm Production Rate, Gonadal and Extragonadal Sperm Reserves of West African Dwarf Rams in the Southern Guinea Savannah of Nigeria

T. Ahemen[1], I. I. Bitto[1] and F.O.I. Anugwa[2]

[1]Department of Animal Breeding and Physiology; [2]Department of Animal Nutrition, University of Agriculture, Makurdi
Author for Correspondence: memberter@yahoo.com

Target Audience: Physiologists, Rabbit Breeders

Abstract

Five healthy West African Dwarf (WAD) rams, 1.5 to 2.5 years of age and weighing between 15 kg to 20 kg were used to determine daily sperm production, gonadal and exra-gonadal sperm reserves. Gonadal and extragonadal sperm reserves were estimated by the haemocytometric method, while the daily sperm production was estimated from the gonadal sperm reserves. Daily sperm production $x10^9$ and daily sperm production per gram testis x 10^7 were 0.60 ± 0.01 and 0.94 ± 0.02 respectively. Mean gonadal sperm reserves x 10^9 was 2.15 ± 0.11; mean caput, corpus, cauda and ductus deferens reserves $x10^8$ were 1.79 ± 0.13, 0.75 ± 0.10, 3.77 ± 0.24 and 0.22 ± 0.06, respectively. The gonadal and extragonadal sperm reserves and daily sperm production values obtained in this study were lower than those reported for exotic breeds. High correlations were found between testis weight and daily sperm production (r = 0.81; P < 0.05), testis and testicular sperm reserves (r = 80; P < 0.05), caput weight and caput sperm reserves (r = 0.66; P < 0.05) corpus weight and corpus sperm reserves (r = 0.54; P < 0.05), cauda weight and cauda sperm reserves (r = 57; P < 0.05). This study has identified several important relationships among testicular characteristics and epididymal reserves that may be of value in improving breeding soundness examination of WAD rams.

Key words: West African Dwarf rams, sperm production, sperm reserves, breeding soundness.

Description of Problem

It is generally reported that knowledge of the reproductive characteristics of any livestock is basic in appreciating the breeding and production potentials, and capabilities of the particular stock [1]. An assessment of the general reproductive characteristics of the native breeds is, therefore, necessary prior to developing strategies aimed at improving meat supplies with these animals.

Several aspects of the physiology of reproduction of rams have been

documented [2,3,4]. Measurable criteria such as scrotal dimension, sperm production rate, gonadal and extragonadal sperm reserves have been extensively studied in some Nigeria breeds [2,3,5]. However, few of such reports are available for the West African Dwarf (WAD) ram; the breed that is abundant in this "harsh" environment and is reputed for being hardy and resistant to some local diseases like trypanosomiasis [6]. Studies on the WAD ram have also not been carried out in the Southern Guinea Savannah zone of Nigeria. It has been observed that the reproductive capacity of ruminants is variable in different parts of the country [7].

The purpose of this study was to obtain base-line data on sperm production rate, gonadal and extragonadal sperm reserves of WAD rams in the Southern Guinea Savannah zone. Such information is essential in the determination of male/female ratio during natural mating and artificial insemination programmes, and also in evaluating male reproductive efficiency of a breed [8].

Materials and Methods

Study location

The study was carried out in the Small Ruminant Unit of the University of Agriculture Makurdi research farm. Makurdi which is situated at latitude 7^{o} 14 N and longitude 8^{o}31 E at a height of 90 meters above sea level [9]. The study location had earlier been reported to have distinct rainy and dry seasons [10]. The rainy season starts in May and ends in October, while the dry season begins in November and ends in April. The annual rainfall ranges from 1270 to 1397 mm and average annual temperature ranges from 22.43^{o} C to 33.41^{o} C. Annual mean relative humidity has a value of 64.58% [9].

Experimental animals

Five mature WAD rams, weighing between 15.0 and 22.0kg aged between 1.5 and 2.5 years were used for this study. The animals were obtained from local sources within and around Makurdi town, and were pre-conditioned for two weeks before the commencement of the experiment. They were released to graze natural pasture between 0900 and 1600 hours daily, and housed in standard goat pens overnight. The predominant grass species were *Andropogon gayanus*, *Andropogon schriensisi, Hyparrhenia involucurata, and Imperata cylindrica.* Grazing was supplemented with maize offals and water was provided ad *libitum.*

Morphometric characteristics of the testes

The rams were slaughtered at the end of two months after taking body weight and scrotal circumference (SC) measurements. The testes were excised, the epididymis separated and divided into caput, corpus and cauda segments.The testis weights, epididymal segment weights and ductus deferens weights were measured.

Gonadal and extragonadal sperm reserves

Gonadal and extragonadal sperm reserves were determined following the homogenized count using a haemocytometer [11].The parenchyma of each testis was sectioned (1 g) and homogenized in 100 ml of normal saline. One gram (1 g) of epididymal segments (caput, corpus, cauda) and ductus deferens were also minced separately in 10 ml of normal saline with a pair of scissors for 5 minutes. The testicular and epididymal homogenates were then filtered through two 2 layers of loosely netted bandage.

The spermatozoa and elongated spermatids numbers in the testicular and epididymal samples were determined using an improved Neubauer Chamber; two counts to each sample were performed, and the mean used in the analysis to obtain the sperm reserves. Daily sperm production (DSP) was estimated from testicular homogenates by dividing the gonadal sperm reserves by a time divisor of 3.56 corresponding to the days of the duration of the seminiferous epithelium cycle [11].

Results and Discussion

Table 1. Shows the result of some morphometric characteristics of the testis in West African Dwarf (WAD) rams. Mean values of scrotal circumference, weights of the testis and epididymis obtained in this study were much lower than values reported for other Nigerian breeds at similar ages by [5], [2] and [3] in Yankasa, Uda and Balami rams respectively. This could be attributed to the size of the WAD rams. The WAD rams had been described as the smallest in size of all the indigenous breeds of sheep in Nigeria [12].

Table 1. Body weight and some morphometric characteristics of the testis in mature West African Dwarf rams (mean ± sem).

Parameters	No of rams	mean±sem
Body weight (kg)	5	17.40 ± 0.81
Scrotal circumference (cm)	5	21.50 ± 0.61
Paired testes weight (g)	5	134.48 ± 2.28
Paired epididymides (g)	5	19.12 ± 0.21
Paired caput weight (g)	5	7.00 ± 0.06
Paired corpus weight (g)	5	3.24 ± 0.31
Paired caudal (g)	5	7.44 ± 0.10
Paired ductus deferens weight (g)	5	1.40 ± 0.14

Weight distribution in the epididymides obtained in this study were similar to values reported by [3] in Balami rams, with the cauda epididymis accounting for more of the total epididymal weight, closely followed by the caput and the corpus, respectively.

Table. 2. shows the estimated sperm production rate, gonadal and extragonadal sperm reserves and relative epididymal sperm distribution of WAD rams. The daily sperm production (DSP) value of 0.60 x 10^9 and daily sperm production per gram testis (DSPG) value of 0.94 x 10^7 obtained in this study were lower than 5.29 x 10^9 and 2.7 x 10^7 for DSP and DSPG respectively reported by [13] in temperate breeds. This could be attributed to testicular size, nutrition and genotype.

Table 2. Sperm production rate, gonadal and extragonadal sperm reserves in West African Dwarf rams (mean ± sem).

Parameters	No. of rams	mean ± sem
Daily sperm production (x10^9)	5	0.60 ± 0.01
Daily sperm production /gram testis (x10^7)	5	0.94 ± 0.02
Gonadal sperm reserves (x10^9)	5	2.15 ± 0.05
Caput sperm reserves (x10^8)	5	1.79 ± 0.05
Corpus sperm reserves (x10^8)	5	0.75 ± 0.04
Caudal sperm reserves (x10^8)	5	3.77 ± 0.12
Ductus deferens sperm reserves (x10^8)	5	0.22 ± 0.02
Relative epididymal sperm distribution (%)		
Caput 28.43		
Corpus 11.84		
Caudal 59.75		

The sperm reserves of the caput epididymis represented 28.43% of the total reserves of the organ while the corpus and cauda accounted for 11, 87 and 59.75%, respectively. The distribution of epididymal reserves in this study is similar to what has been reported for other Nigerian sheep breeds [3,4] in the country. The result agrees with the report that the cauda epididymis contains most of epididymal sperm reserves and hence is the major site of sperm storage [3,4,5].

The gonadal and extragonadal sperm reserve values obtained in this study were lower than 18.8 ± 1.1 x 10^9 for gonadal and 14.1 ± 0.4 x 10^8 for extragonadal reserves, reported by [3] in Balami rams. This could be attributed to genotype,

testicular size and probably technique of estimation.

Table.3. shows correlation coefficients between testicular morphometry, sperm production rate, gonadal and extra gonadal sperm reserves. High correlations were found between testis weight and daily sperm production ($r = 0.81$; $P < 0.05$), testis and testicular sperm reserves $r = 80$; $P < 0.05$, caput weight and caput sperm reserves ($r = 0.66$; $P < 0.05$) corpus weight and corpus sperm reserves ($r = 0.54$; $P < 0.05$), cauda weight and cauda sperm reserves ($r = 57$; $P < 0.05$). These results agree with the findings of [14] who reported high and positive correlation ($r = 0.6$; $P < 0.05$) between testis weight and testicular sperm reserves for the Borno white bucks. The high and positive correlations observed are suggestive of high spermatozoa reserve per unit mass of the testis and epididymal segments.

Table 3. Correlation coefficients between testicular morphometry, sperm production rate, gonadal and extragonadal sperm reserves in West African Dwarf rams (n=5)

	DSP	CauSR	CorSR	CapSP	TSR	CauWt	CorWt	CapWt	TWt
TWt	-.10	.81**	.11	.64*	.82**	.80**	.73**	.90**	.82**
CapWt	-.27	.55*	-.30	.31	.66*	.54	.24	.89**	-
CorWt	-.16	.63**	-.22	.54*	.55*	.64	.56*	-	
CauWt	.05	.55*	.57*	.88**	.48*	.55*	-		
TSR	.56*	.10	.06	.20	.84**	-			
CapSP	.20	.85**	.21	.31	-				
CorSR	.43	.21	.64**	-					
CauSR	-	.50	-						
DSP	.75*	-							

DSP=Daily sperm production CauSR=Cauda sperm reserves CorSR=Corpus sperm reserves CapSR=Caput sperm reserves TSR=Testicular sperm reserves CauWt=Cauda weight Cor Wt=Corpus weight CapWt=Caput weight

*Significant ($P<0.05$) correlation

** Highly significant ($P<0.01$) correlation

Conclusion and Application

This study revealed the reproductive potentials of West African Dwarf (WAD) rams in the Southern Guinea Savannah ecological zone of Nigeria. The high and positive correlation between the scrotal circumference (SC) and other parameters indicate that measurement of SC could be used to estimate testis weight, gonadal and extragonadal sperm reserves, and sperm production rate in WAD rams. This could be useful in evaluation of rams for breeding soundness that may bring about genetic improvement of this breed in the zone.

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