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https://dx.doi.org/10.4314/nvj.v39i1.4 **ORIGINAL ARTICLE**

Effect of Season on Reproduction in West African Dwarf Bucks

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SUMMARY

This study was conducted to determine effects of season on some reproductive parameters of WAD bucks. Nine apparently healthy WAD bucks, aged between 18 and 24 months and weighing 8-15 Kg, were used to evaluate the effect of seasonal variations on Live-Weight (LW), Rectal Temperature (RT) and Scrotal Circumference (SC) between January and December, 2013. Semen was collected monthly by electro-ejaculation method and evaluated for spermiogram using standard techniques. Results were compared between and within groups using analysis of variance for repeated measures. Values are significant at $p < 0.05$. Seasonal variation significantly ($p < 0.05$) affected RT and SC except total sperm morphological abnormalities. Means for the total sperm morphological abnormalities were 7.42 ± 3.21% (late dry), 3.42 ± 0.36% (early rainy), 6.33 ± 0.33% (late rainy) and 7.25 ± 1.18% (early dry). The total morphologically abnormal spermatozoa reported for the seasonal study was 6.10%. It was thus concluded that seasons does not have significant effect on the spermiogram of WAD buck, however, they appeared to be most fertile during the early and late rainy seasons and least potentially fertile during early and late dry seasons.

Key words: Spermiogram, Season, Buck, Rectal temperature, Reproduction.

INTRODUCTION

Goat keeping is popular because no section of the community discriminates against its rearing whether on the basis of religion, social or cultural beliefs. Goats that are reared in the Northern Sudan zone, where there are adverse environmental conditions, have marked foraging and browsing abilities, which enable them to multiply and survive (Kurtze, 1982; Ajani *et al*., 2015). The dwarf breeds in the forest zones are trypanotolerant (Osaer *et al*., 1994; Dhollander *et al*., 2005) which explains their wide distribution in this region (Osuagwuh and Akpokodje, 1981; Ugwu, 2009).

West African Dwarf (WAD) goat is the most prevalent of small ruminants in southern Nigeria. They are hardy, small, early maturing, prolific, non-seasonal breeder (Osuagwuh and Akpokodje, 1981) and plump, measuring less than 50 cm in height and weighing between 20 and 25 kg (Ozoje, 2002). It has been observed that WAD goats possess the widest margin for adaptation amongst the ruminants (Oni, 2003) and have quite specific physiological properties that made acclimatization possible.

The goat is valued mainly for its meat and milk. As a milk producer, the goat is inevitably more efficient where the available fodder is of such low quality that a cow can barely thrive (Mackenzie, 1980; Okoli *et al*., 2005).

Taylor and Bogart (1988) reported that high ambient temperature increased the scrotal temperature in male and consequently caused a decline in semen quality due to elevated subcutaneous scrotal temperature. Heat has been found to be a major constraint on animal productivity in the tropical belt and arid areas (Silanikove, 1992). Also, solar radiation in the tropics has been shown to considerably increase thermal load on the animal grazing during the day (Adedeji, 2012).

It is known that domestic animals are homeotherms and the most common index of heat tolerance in mammal is core body temperature as measured by rectal temperature (Liu, 1989; Silanikove, 1992).

Baker (1989) reported that the ability to regulate temperature is an evolutionary adaptation that allows homeotherms to function in spite of variation in ambient temperature. Oladimeji *et al*. (1996) opined that changes in rectal temperature have often been used as index of physiological adaptation to tropical environment.

It has also been documented that high ambient temperature depresses body activities and such heat creates physiological stress that could invariably affect production by promoting an unfavourable endocrine balance metabolism or by reducing feed intake. Thus, heat stress affects livestock productivity most especially milk production, body growth, prenatal growth, postnatal growth, wool growth and reproduction (Adedeji, 2012). Monterio *et al.* (2011) posited that season, nutrition, genetics and disease could influence morphological characteristics of spermatozoa.

The body's failure to maintain lower testicular temperature such as that resulting from high ambient temperature, high fever, and retention of testes within the abdominal cavity invariably affect seminal quality (Kennedy *et al.*, 2002). In view of the afore-stated reports,

this study was conducted to determine effects of season on some reproductive parameters of WAD bucks.

MATERIALS AND METHODS

Study location

The study was carried out at the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta (FUNAAB).

Experimental animals

Nine (9) WAD bucks were used for this study. The animals were aged by dentition (Williamson and Payne, 1984). The ages of the experimental animals were between 18 and 24 months and the live weight ranged from 8.0 to 15.0 Kg. They were acquired from the local markets (Odeda, Olodo and Olugbo) and housed in fly-proof pens in the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta.

Management and feeding of experimental animals

Upon arrival, the experimental animals were tagged for ease of identification and screened for both ecto- and endoparasites (blood and faecal examinations). They were acclimatized for a period of eight weeks during which time they were treated prophylactically with Albendazole (Shanuzole®, Jawa International Limited, Nigeria) at a dose rate of 10 mg/Kg body weight; Ivermectin injection at recommended dosage of 1 ml/50Kg Bodyweight); Oxytetracycline LA (Tetranor® Jubaili Company) at a dose rate of 20 mg/Kg bodyweight; Diminazene aceturate (Nozomil®, Kepro B.V., Holland) at a dose rate of 7.0 mg/Kg bodyweight and Cypermethrin (Ectocyp Pour on®, Kepro B.V., Holland) at a dose rate of 60 mg/Kg bodyweight. The treatments instituted were to take care of worm infestation, bacterial, haemoparasitic and ectoparasitic infections respectively.

They were intensively maintained on grass (zero-grazing), dry cassava peels, concentrate feed (Growers mash, Rainbow feed®, Nigeria). Salt licks and water *ad libitum* were provided throughout the duration of the experiment. The animals were vaccinated against *Peste des Petits Ruminants* (PPR) using PPR vaccine produced by National Research Institute, NVRI, Vom, Nigeria.

Experimental protocol

Based on the observations made at the Meteorological Station of the Federal University of Agriculture, Abeokuta, the year of the study was divided into four seasons, viz.: Late Dry (January - March), Early Rainy (April - June), Late Rainy (July - September) and Early Dry (October - December).

Nine WAD bucks were used to study the effect of seasons on live weight, rectal temperature, scrotal circumference and spermiogram.

Data generation

Live weight: Each buck was weighed weekly between 0800 and 1000 hours in a sac suspended on a hanging weighing scale (Pocket balance [0-100kg or 0-224lbs], Germany)

Rectal temperature: This was measured using a digital mercury-in-glass thermometer that was inserted into the rectum and tilted against the rectal wall for 60 seconds. The temperature was read and recorded in degree Celsius (°C).

Scrotal circumference: The scrotum was transversely measured at the widest point of paired testes once weekly to get the circumference, using a flexible tape as described by Noakes *et al.* (2001).

Semen evaluation / spermiogram: The scrotum and its contents were palpated and semen collected weekly by electro ejaculation method (Noakes *et al.*, 2001; Memon *et al*., 2007).

The ejaculated semen was evaluated for volume, colour, mass activity, motility, sperm concentration, livability and sperm morphological abnormalities according to the method described (Zemjanis, 1977; Sekoni, 1992; 1993).

Data analysis

Data collation and management was done on Microsoft® Excel while IBM® Statistical Package for Social Sciences (Version 21.0) was used for statistical analysis of the data obtained from the study at 95% level of significance ($p < 0.05$).

RESULTS

Table 1 show the result for the live weight changes. No significant relation was observed. Also, the information on seasonal variation in rectal temperature of WAD bucks is presented in Table 1. There was no significant difference ($p > 0.05$) within the various seasons investigated though season I recorded the highest value. The scrotal circumference of the WAD bucks evaluated for the various groups is shown in Table 1. There were significant differences ($p < 0.05$) between the various seasons investigated. Lowest value was recorded during season I.

Table 2 show the result of ejaculate characteristics for the various seasons investigated. Semen volume obtained did not

TABLE 1: Effect of Seasons on measured Parameters of WAD bucks for the year 2013

Parameters	Seasons			
	I (n=9)	II (n=9)	III (n=9)	IV (n=9)
Live weight (kg) mean ± SEM	11.67^{a} ± 0.17	13.11^{a}± 0.16	13.34^{a} ± 0.22	12.06^{a} ± 0.21
Rectal temperature (^{o}c) mean ± SEM	38.59^{b} ± 0.04	38.20^{ab} ± 0.07	37.93^{a} ± 0.06	38.01^{ab} ± 0.04
Scrotal circumference (cm) mean ± SEM	16.28^{a} ± 0.11	16.71^{ab} ± 0.10	17.19^{b} ± 0.20	16.87^{b} ± 0.14

n= number of experimental animals
Means with different superscripts within the same row are statistically significant at $p < 0.05$
Season I- Late dry (LD)
Season II- Early rainy (ER)
Season III- Late rainy (LR)
Season IV- Early dry (ED)

TABLE 2: Effect of Seasons on Seminal Characteristics (Mean ± SEM) of experimental WAD bucks

Ejaculate Characteristics	Seasons			
	I (n=9)	II (n=9)	III (n=9)	IV (n=9)
Semen Volume (ml)	0.20 ±0.06^{a}	0.33 ±0.07^{a}	0.23 ±0.03^{a}	0.27 ±0.07^{a}
% Progressive Motility	71.7±1.68^{a}	78.3 ±4.41^{ab}	83.3 ±1.67^{b}	75.0±2.89^{ab}
% Livability	70.0±0.00^{a}	86.7±4.41^{b}	87.3±3.71^{b}	80.0 ±2.89^{ab}
Sperm Concentration (x 10^{6} sperm cells/ml)	1666.7 ±492^{ab}	2840±381^{b}	2194 ±503^{ab}	1290±46^{a}

n= number of experimental animals
Values with different superscripts within the same row are statistically significant at $p< 0.05$
Season I- Late dry (LD)
Season II- Early rainy (ER)
Season III- Late rainy (LR)
Season IV- Early dry (ED)

differ significantly ($p < 0.05$), although it increased from season I to II, decreased from II to III and gradually increased from season III to IV. Percentage progressive motility of spermatozoa was significantly higher during season III. Percentage livability of the ejaculated spermatozoa showed significant difference ($p < 0.05$) during season III. Sperm cell concentration of the ejaculated semen increased significantly ($p < 0.05$) during season II. Lowest value was recorded during season IV. Table 3 show the result obtained for percentage spermatozoa morphological abnormalities of the ejaculated semen of WAD bucks during the various seasons under investigation. Sperm morphological abnormalities observed included those of the Head, Proximal cytoplasmic droplet (PCD), distal cytoplasmic droplets (DCD) and sperm tail. The mean sperm head abnormality was significant ($p < 0.05$) at season I. Also, there were highly significant monthly variations which ranged from highest mean of 10.75 % in January to the lowest mean of 1.0 % in March (Figure 1).

The mean percentage value of acrosome abnormalities was zero throughout the period of investigation.

TABLE 3: Mean percentage seasonal values of sperm morphological abnormalities of wad bucks in 2013

	SEASONS			
	I **(n=9)**	II **(n=9)**	III **(n=9)**	IV **(n=9)**
Acrosome	0.00	0.00	0.00	0.00
Sperm head	$2.83^{b}\pm1.42$	$0.00^{a}\pm0.00$	$0.08^{a}\pm0.08$	$1.25^{ab}\pm0.66$
Proximal Cytoplasmic Droplets	$1.33^{a}\pm0.67$	$0.17^{a}\pm0.08$	$0.25^{a}\pm0.14$	$1.00^{a}\pm0.29$
Distal Cytoplasmic droplets	$1.17^{a}\pm0.60$	$0.25^{a}\pm0.14$	$0.08^{a}\pm0.08$	$0.92^{a}\pm0.30$
Detached heads	$0.08^{a}\pm0.08$	$0.75^{a}\pm0.14$	$1.83^{b}\pm0.33$	$0.75^{a}\pm0.38$
Sperm tail	$2.08^{a}\pm0.68$	$2.25^{a}\pm0.43$	$4.08^{b}\pm0.30$	$3.33^{ab}\pm0.33$
Middle piece	0.00	0.00	0.00	0.00
Total Abnormalities	$7.42^{a}\pm3.21$	$3.42^{a}\pm0.36$	$6.33^{a}\pm0.33$	$7.25^{a}\pm1.18$

Means with different superscripts within the same row are statistically significant at $p < 0.05$

Highest mean value for proximal cytoplasmic droplets was recorded in season I which differed from seasons II and III significantly ($p < 0.05$). There were significant monthly variations which ranged from 2 % in January and February to 0 % in March, April and July (Figure 1). For the distal cytoplasmic droplets, season I had the highest mean while season III had the lowest. There was no significant difference ($p > 0.05$) in the mean values of

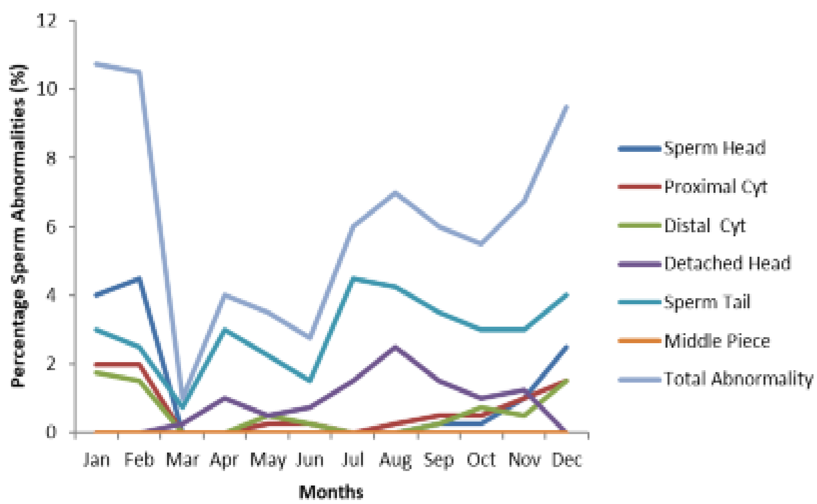

Figure 1: Monthly variations of some sperm morphological abnormalities in the semen of WAD Bucks (January-December)

distal cytoplasmic droplets among the four seasons investigated. Also, the result of detached free head abnormality shows that season I had the lowest mean while season III had the highest. There were highly significant ($p < 0.05$) seasonal variations in the incidence of detached free heads (Figure 1). Both the seasonal and monthly means of sperm tail abnormalities were significantly different ($p < 0.05$). The highest monthly value was 4.5% in July and the lowest of 0.75% in March (Figure 1). Zero values were recorded for mid-piece abnormalities during the 4 seasons investigated. Seasonal variations for total sperm abnormalities were highly significant ($p < 0.05$). The highest mean was in January with 10.75 % and the lowest was in March with 1.0 % (Figure 1). The mean percentage of total sperm morphological abnormalities found in the 9

WAD bucks during the year under investigation was 6.10 %. Season I had the highest mean which differed significantly ($p<0.05$) from seasons II and III. Season II also differed significantly from seasons III and IV ($p < 0.05$) respectively. There were significant monthly variations ($p < 0.05$) in the incidence of total sperm morphological abnormalities. The highest total sperm morphological abnormalities of 7.42 ± 3.21% were recorded in the late dry (LD) season closely followed by 7.25 ± 1.18% of the early dry (ED) season. Both early rainy (ER) and late rainy (LR) seasons recorded 3.42 ± 0.36% and 6.33 ± 0.33% respectively.

DISCUSSION

It was observed that as the live weight of the animals increased, the scrotal circumference also increased. This is similar to the observation made by Raji and Njidda (2014). The values obtained for scrotal circumference of WAD bucks were consistent with results obtained for normal WAD bucks (Oyeyemi, 2002; Inegedu, 2004).

A significant difference in the rectal temperature findings showed variation with seasons. This is in agreement with similar observations made by Butswat *et al*. (2000), Marai *et al.* (2007) and Sanusi (2008). They all reported higher rectal temperature during the late dry season. The increase is due to high ambient temperature and relative humidity which characterize the late dry season whereas the lowest rectal temperature recorded in early and late rainy seasons is as a result of lower ambient temperature.

In 2013, season I was the hottest period of the year and there were more total sperm abnormalities than the remaining 3 seasons which were the early rainy, late rainy and early dry periods of the year. The lowest sperm abnormalities were recorded during the early rainy season apparently due to clement weather conditions and availability of grasses. Season I findings in this study could be attributed to heat stress as supported by reports of Machado *et al*. (2000) and Coeldho *et al.* (2006) in bucks.

The value for total morphologically abnormal spermatozoa in the 9 WAD bucks studied in 2013 was 6.10% which falls below the maximum range of 15-20 % that Evans and Maxwell (1987) found in the semen of fertile bucks for optimal productivity. Thus, the mean total sperm morphological abnormalities in the semen of the bucks in this study were within the range for fertile bucks.

The decline in ejaculate characteristics were due to the elevated ambient temperature with the attendant increase in spermatozoa abnormalities. High ambient temperature causes a sharp reduction in semen quality with the presence of many abnormal sperm cells (Skinner and Louw, 1966; Daramola and Adeloye, 2010; Adedeji *et al*., 2011; Valle *et al*., 2005; Catunda *et al*., 2011). Elevated body temperature during periods of high ambient temperature or pyrexia from disease has been reported to lead to testicular degeneration and reduce percentage of normal and fertile spermatozoa in the ejaculate (Hafez, 1993).

Influence of season on sperm morphology was significant in this study. This is in agreement with the findings of Roca *et al*. (1992) who revealed that bucks showed lower reproductive activity during high ambient temperature. Similar observations were made by Skalet *et al*. (1988) and Karagiannidis *et al*. (2000). This is one of the reasons why mating is done either early in the morning or late in the evening, a period characterised by low ambient temperature.

The lowest incidence for the season and months coincided with the early rainy and wet period of the year, while the higher incidence which could be attributed to heat stress occurred during the hottest period of the year (January to March). The results agree with the findings of many other researchers like Hultnas, 1959; Igboeli and

Rakha, 1971; Sekoni, 1978; Fayemi and Adegbite, 1982 in bulls that is comparable to those in bucks (Valle *et al.,* 2005; Catunda *et al.*, 2011).

The practical implication of 6.10 % abnormal spermatozoa from this investigation is that WAD bucks can be ejaculated during any month of the year and such semen can be utilized for artificial insemination of the does thereby resulting in improved productivity. The bucks can also be used for natural mating during any season of the year.

Conclusion

It was concluded that season does not have significant effect on the spermiogram of WAD buck, however, they appeared to be most fertile during the early and late rainy seasons and least potentially fertile during early and late dry seasons.

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