Nig. J. Anim. Prod. 2005, 32(2):327 - 334
©2005 Nigerian Society for Animal Production

Effect of breed and season on semen quality and fertility of bucks in a humid tropical environment.

N. Nwoko and S. N . Ibe[1]

Department of Non- Ruminant Animal Production, Michael Okpara University of Agriculture, Umudike, P.M.B. 7267 Umuahia, Abia State, Nigeria.

[1]Corresponding Author

Abstract

A breeding programme, which spanned over four seasons (early dry, late dry, early rainy and late rainy), was carried out with one West African Dwarf (WAD) buck, one Red Sokoto (RS) buck, eight WAD does and eight RS does. The bucks were subjected to electrical stimulation with an electro-ejaculator and their semen was collected and analysed. Fertility rate was significantly ($P<0.05$) higher in WAD than in RS in the early dry season. There was no significant effect ($P>0.05$) of season on fertility of WAD. Fertility was least in the early dry season in RS and the difference from other seasons was significant ($P<0.05$). The effect of season on both semen volume and concentration was significant ($P<0.05$). There was a progressive increase in both parameters from early dry to late rainy season. However, RS showed superiority over WAD in both parameters in all the seasons. There were no significant effects of breed or season on all other parameters studied. The indication is that both breeds could be used for all-year-round breeding with adequate feeding in the zone. However, for purposes of artificial insemination, RS bucks, which produce larger quantities of semen with higher concentration, should be preferred.

Key words: Breed, season, semen quality, fertility, bucks

Introduction

Evaluation of the ejaculate is an important aspect of the determination of the reproductive status of male animals. The level of reproductive performance in domestic animals depends on the interaction of genetic and environmental factors, including climate, nutrition, management and disease.

Studies have been carried out on the concentration, volume and motility of semen (Hafez, 1987; Plachot *et al.*,1984; Segerson *et al.*, 1981). Hafez (1987) reported the minimal standard for classification of a "probable fertile" semen in a bull to be 500 million spermatozoa per ml, more than 50% of motile sperm to make a forward progression and more than 80% of the spermatozoa to conform to normal morphology.

If any of these criteria is not met, particularly with samples of three or more ejaculates, the bull is rendered infertile (Hafez,1987). Peter and Leslie (1980) also stated that the evaluation of the male for breeding soundness must be based on scrotal circumference, motility and morphology of semen.

Available information has revealed that season of the year has no significant effect on age, body weight and scrotal circumference (Niba *et al.*, 1998). However, changes in scrotal circumference occur as age advances (Adedeji and Gbadamosi, 1999). It has also been shown that young animals and those smaller in size within a species produce smaller volume of semen and frequent ejaculation results in lower average volume (Hafez 1987; Oyeyemi *et al.*, 1996).

The main objective of this study was to determine the effect of breed and season on semen quality and fertility of bucks. The result would enable appropriate recommendation to farmers in the zone on the breed of buck with desirable semen quality and fertility and the season when these parameters are optimum.

Materials and Methods

Location

The study was carried out at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, located at latitude 5°29' N and longitude 7°32' E and an altitude of 122 m above sea level. The maximum daily temperature in the zone is about 33°C. The annual rainfall ranges from 2100 to 2500 mm and the relative humidity is about 85%, although daily values are subject to variation.

Experimental animals and their management

Sixteen animals, comprising eight West Africa Dwarf (WAD) does and eight Red Sokoto (RS) does, and two bucks, one of each breed, were randomly selected from the flock in the farm and were used for the experiment. Routine management of daily cleaning of pens and normal cut-and-carry feeding system of confined animals were applied. Also their feed was supplemented with concentrate feed three times a week. Deworming was done with Livaget® injection three times during the course of the experiment. The animals were vaccinated against *Pestes de petit ruminant* (PPR) with tissue culture rinderpest vaccine (TCRV).

Mating and experimental design

A buck belonging to a particular breed (WAD or RS) was test-mated with two different does (one WAD and one RS) in each of four seasons, namely early dry, late dry, early rainy and late rainy. Non-return rates of the mated does were determined.

The experiment was a 2 x 4 factorial in a completely randomized design. There were two breeds of buck (WAD and RS) and four seasons. The statistical model is given in Expression (1).

$$Y_{ijk} = i + B_i + S_j + (BS)_{ij} + e_{ijk} \quad \ldots\ldots (1)$$

where Y_{ijk} = the k^{th} observation of the i^{th} breed of buck in the j^{th} season

i = overall mean

B_i = effect of breed of buck ($i = 1, 2$)

S_j = effect of season ($j = 1, \ldots, 4$)

$(BS)_{ij}$ = effect of interaction between breed of buck and season

e_{ijk} = random error, assumed to be independently and identically normally distributed with zero mean and constant variance, i.e. iind(0, δ^2)

Fertility determination

Fertility of bucks both in the dry and rainy seasons was determined by the non-return rates of does, following test mating, as earlier indicated.

Semen collection

Semen was obtained from each buck by electrical stimulation with an electro-ejaculator twice a week for the period of each season. Before the commencement of the ejaculation exercise in the farm, all the materials needed for the exercise were thoroughly washed with water and rinsed with distilled water.The animals were stimulated with the electro-ejaculator by inserting the probe, which was lubricated with petroleum jelly, gently into the rectum. Current was then gently applied at the rate of one volt every seven seconds (Cameron, 1977) until stimulation occurred in the animal. Ejaculation finally occurred at a voltage of five and the ejaculate was collected with a glass funnel and graduated test-tube. The volume of each ejaculate was read off immediately.

Semen evaluation

In the laboratory, spermacid or sperm fluid was prepared by dissolving 2.9 g of hydrated tri-sodium citrate ($C_6H_5Na_3O_7.2H_2O$) in 100 ml of distilled water and shaking thoroughly. Semen motility was determined immediately after collection, as follows: a drop of semen was placed on a microscopic slide, heated by rubbing it at the back of the hand and covered with a cover slip warmed in the same manner; the slide was then viewed over a light microscope at 10 x 10 magnification and readings were taken. Thereafter, a drop of semen was mixed with Nigrosine-Eosin stain (Hancock, 1952) and a thin smear of semen was made with a cover slide, dried and kept for viewing at convenience in the laboratory.

Sperm concentration/count was determined in the laboratory by diluting one part of the semen in 199 parts of spermacid or sperm fluid in a blood pipette. Three drops of the mixture were then put in the smaller chamber of a Neubauer haemocytometer according to Zaneveld and Polakoski (1977), covered with a cover slip and read with a light microscope. The reason for adding the spermacid solution was to kill the sperm cells for easy counting in the squares of the Neubauer chambers. Within the smaller squares of the chambers, counting was taken from the top left and right, bottom left and right and then the centre. Readings of sperm number within these squares were only noted. Also only head regions of the sperm cells within the squares were taken (Arthur, 1977). After counting, average of the numbers counted was taken and the semen concentration/count was calculated by multiplying the result with a dilution factor of 200 and the multiplication factor of 50,000 (Zaneveld and Polakoski, 1977).

The films of semen prepared in the farm were observed for semen morphology with the light microscope at a 10 x 10 magnification. Some primary sperm abnormalities like bent tails, tail-less and headless as well as sperm precursors were observed and recorded.

Such other semen characteristics as semen colour, odour, volume and viscosity were also observed and recorded.

Statistical analysis

Data on semen quality characteristics and fertility of bucks were subjected to analysis of variance appropriate for a factorial experiment in a completely randomized design. Significant means were separated using the Least Significant Difference (LSD) method.

Table 1: Fertility rates (%) of bucks in the different seasons

Season	Breed of buck	
	West African Dwarf	Red Sokoto
Early dry	100[a]	50[b]
Late Dry	100	100[a]
Early rainy	100	100[a]
Late rainy	100	100[a]

[a,b] Values for breeds in the early dry season are significantly different (P<0.05)
Values within the Red Sokoto breed with different superscripts are significantly different (P<0.05)

Table 2: Semen characteristics of the West African Dwarf buck in the different seasons

Semen characteristic	Season			
	Early Dry	Late Dry	Early Rainy	Late Rainy
Av. Semen volume (ml)	0.10[a]	0.40[b]	0.35[b]	0.50[c]
Colour	- white	milky white	milky -	
Viscosity	-	non-viscous	non-viscous	-
Odour	-	Nil	-	-
Av. semen conc/count (ml)1.	$26x10^{8a}$	$1.43x10^{8b}$	$2.35x10^{8c}$	$2.38x10^{8c}$
Av. semen motility (%)	72	70	75	80
Av. semen morphology (%)	87	80	85	81
Live/Dead ratio (%)	75	78.5	83	76
Av. abnormalities (%)	10	13	13	16
Precursors (%)	3	7	2	3

[a-c] Values in a row with different superscripts are significantly different (P<0.05)

Results and Discussion

The fertility rates of the two breeds of bucks and in the different seasons are given in Table 1. Fertility was significantly higher (P<0.05) in WAD than in RS in the early dry season in the early dry season. There was no significant effect (P>0.05) of season on fertility of WAD. However, fertility was significantly (P < 0.05) lowest in early dry season compared with other seasons in RS. The indication is that WAD should be preferred to RS for breeding during the early dry season and that, within RS themselves, breeding during

late dry and rainy seasons is preferred to breeding during the early dry season.. Krishnan and Lal (1997) reported that, of all farm animals, the goat has no breeding problem, but rather that fertility is occasionally impaired by deficiency in feeding and improper management technique. Topps (1977) reported that severe undernutrition in animals is a major cause of low fertility and low level of production. The generally high fertility rate obtained in this study could be attributed to the high nutritional regime administrated to the experimental animals.

Tables 2 and 3 show the semen characteristics of the WAD and RS bucks, respectively in the different seasons. The semen volume (0.01 ml) of WAD buck was lowest in the early dry season, but progressively increased to 0.50 in the late rainy season. The value in the late rainy season was significantly ($P < 0.05$) higher than in other seasons. However, there was no significant difference ($P > 0.05$) between late dry and early rainy seasons. The volume obtained in the early dry season was lower than 0.31 ml reported by Oyeyemi *et al.* (1996), but the volumes of 0.40 ml and 0.35 ml recorded in the late dry and early rainy seasons, respectively are in agreement with their report of 0.38 and 0.35 ml, respectively. The volume obtained in the late rainy season in this study is higher than that reported by Oyeyemi *et al.* (1996).

A similar trend was observed for RS buck, that is, a progressive increase from early dry to late rainy season. There was no significant difference ($P > 0.05$) in semen volume between the two dry season periods and between the two rainy season periods. However, significantly higher ($P < 0.05$) semen volumes were obtained in the rainy than in the dry seasons. The value of 0.65 ml in the early dry season for this breed is similar to that reported by Eaton and Simmon (1952) when

Table 3: Semen characteristics of the Red Sokoto buck in the different seasons

Semen characteristics	Season			
	Early dry	Late dry	Early rainy	Late rainy
Av. Semen Volume (ml) 0	.65[a]	0.68[a]	0.75[b]	0.80[b]
Colour	Creamy yellow	Creamy yellow	Creamy yellow	Creamy yellow
Viscosity	Non-Viscous v	Non-iscous	Non-viscous	Non-viscous
Odour	Nil	Nil	Nil	Nil
Av. semen conc./count (ml)	$2.12x10^{8a}$	$2.4x10^{8a}$	$2.86x10^{8b}$	$3.86x10^{8c}$
Av. semen motility (%)	75	79.2	80	83
Av. semen morphology (%)	80	82	88	78
Live/ Dead ratio (%)	77	80	78	80
Av. abnormalities (%)	16	12	10	21
Precursors (%)	4	6	2	1

[a-c] Values in a row with different superscripts are significantly different ($P<0.05$)

artificial vagina was used. However, the value of 0.75 ml obtained in the early rainy season is in agreement with the value reported by Mann (1980) with electro-ejaculator. The indication is that level of feeding influences semen volume, since feed is usually more abundant during the rainy season.

Semen from the WAD buck maintained a constant milky white colouration throughout the period of study (Table 2), whereas semen from RS buck was creamy yellow (Table 3). Arthur (1977) reported a creamy white colour for most breeds. However, Ali and Mustapha (1986) and Bearden and Fuquary (1992) reported creamy yellow semen in their bucks. Oyeyemi *et al.* (1996) noted that a change from creamy white to milky white colouration indicates an increase in ejaculation. This agrees with the observations of Okere *et al.* (1986) and Anderson (1945). The milky white colouration maintained by the WAD buck in this study is an indication of increase in ejaculation and hence high fertility. Oyeyemi *et al.* (1996) also reported that frequent ejaculation could lead to change in colour from creamy white to milky white, perhaps because the animals were kept exclusively for experimental purposes and with less number of females. The increase in ejaculation could be attributed to adequate nutrition and less frequent use.

Tables 2 and 3 also present the semen odour and viscosity of the bucks' semen. The semen had no odour and was not viscous.The semen concentrations/counts of WAD and RS bucks are presented in Tables 2 and 3, respectively. Red Sokoto buck was superior to WAD buck in semen concentration in all the seasons. Semen concentration was significantly ($P < 0.05$) higher in the rainy seasons than in the dry seasons in both breeds. Like semen volume, semen concentration increased progressively from early dry to late rainy season, indicating that season also influences concentration, probably through its effect on availability of feed. Austin *et al.* (1968) reported that semen samples obtained by means of the artificial vagina tended to have a higher sperm concentration than those obtained by electro-ejaculation. This may be the reason for the differences in sperm concentration obtained in this study and those reported by previous workers, who used artificial vagina.

The average sperm motility of WAD and RS is presented in Tables 2 and 3, respectively. Motility of semen from WAD ranged between 70 and 80%, whereas that of RS ranged between 75 and 83%. The values fall within the range of values reported by Okeke *et al.* (1986) and Niba *et al.* (1998) for dry and wet seasons, respectively. However, the motility obtained for the RS buck is lower than that reported by Akpa (2000) for the same breed of buck. Hafez (1987) described sperm motility as essential for fertility but not indicative of fertilizing capacity. It is, however, crucial in facilitating passage through the cervix and utero-tubal junction. Certain endogenous and exogenous factors have been described as affecting sperm motility (Hafez, 1987). Such factors as age and sperm maturation are endogenous while physiological as well as stimulating and inhibiting factors are exogenous.

An average semen morphology of 80-87% (Table 2) and 78-88% (Tables 3) was obtained for the WAD and RS bucks, respectively. The result agrees with values reported by Niba *et al.* (1998) for dry and wet seasons and supports their argument that seasonal effects on sperm quality do not appear strong enough to prevent normal breeding throughout the seasons.

Results in Tables 2 and 3 also indicate a 75-83% live/dead ratio for the WAD buck and 77-80% for the RS buck. This is lower than 96.57%

reported by Oyeyemi *et al.* (1996) but is similar to that reported by Okeke *et al.* (1986). Percentage abnormalities ranged from10 to 16% (Table 2) and from 10 to 21% (Table 3) for WAD and RS bucks, respectively. These values are lower than that reported by Arthur (1977) as primary abnormalities. Also, sperm precursors ranged from 2 to 7% in the WAD buck and 1 to 6% in the RS buck. Oyeyemi *et al.* (1996) reported that an increase in frequency of ejaculation increases sperm abnormalities. This may be due to depletion of the epididymal reserve, which, in turn, releases immature sperm cells into the ejaculate. Sperm precursors could arise due to disturbances of spermatogenesis and can increase constantly with increase in frequent ejaculation.

Conclusion

The result obtained in this study indicates that bucks of both WAD and RS breeds maintained high fertility and acceptable levels of the various semen characteristics studied in all seasons. There was a progressive increase in both semen volume and concentration from early dry to late rainy season, indicating that season influences both parameters, probably through its effect on feed availability. With adequate feeding, the indication is that both breeds could be used for all-year-round breeding, although constant breeding should be avoided to prevent high incidence of sperm abnormalities. The results presented here may be regarded as preliminary because of the small number of bucks used. Further studies using a larger number of bucks are recommended.

References

Adedeji, O.S. and Gbadamosi, A.J. 1999. Relationship of scrotal circumference to age, body weight and the right and left scrotal length in the Red Sokoto (Maradi) goat. *Proceedings of 26th Annual NSAP Conference*, Ilorin, Nigeria. Pp. 307-308.

Akpa, G.N. 2000. Factors affecting growth and body measurements of traditionally managed Red Sokoto goats. *Proceedings of NSAP Annual Conference*, Umudike, Nigeria. Pp. 262-263.

Ali, B.H. and Mustapha, A.I. 1986. Semen characteristics of Nubian goats in the Sudan. *Animal Production Science* 12:63-68.

Arthur, G.H. 1977. *Veterinary Reproduction and Obstetrics*. 4th Edition, ELBS & Bailliere Tindall, London.

Anderson, J. 1945. The semen of animals and its use for A.I. *Tech. Comm. Imp. Rum. Anim. Breeding and Genetics*, Edinburgh. Pp. 1-9.

Austin, J.W., Leidy, R.B., Krise, G.M. and Hupp, E.W. 1968: Normal values of semen collected from Spanish goats by two methods. *Journal of Applied Physiology* 24:339-372.

Bearden, H.J. and Fuquary, J.W. 1992. Semen evaluation. In: *Applied Animal Reproduction*. 3rd Ed. Prentice Hall, Englewood Cliffs, New Jersey. Pp. 163-176.

Cameron, R.D.A. 1977. Semen collection and evaluation in the ram. The effect of method of stimulation on response to electro ejaculation. In: *Veterinary Reproduction and Obstetrics*. G. H.

Arthur (Ed.). ELBS and Bailliere, Trindall, London. Pp. 438-442.

Eaton, O.N. and Simmon, V.L. 1952. A semen study in goats. *Anim. J. Vet. Res.*13: 537-544.

Hafez, E.S.E. 1987. *Reproduction in Farm Animals*. 5th edition. Lea and Febiger, Philadelphia.

Hancock, J.L. 1952. Procedures for preparation, collection, evaluation and insemination of bovine semen. *Journal of Experimental Biology* 29:445-448.

Krishnan, C.A. and Lal, G.M.M. 1997. *Livestock and poultry enterprises for rural development*. 4th edition. McGraw Hill Book Company, London. Pp. 546-547.

Mann, T. 1980. Effects of nutrition on male accessory organs. In: *Male accessory sex organs*. D. Branches (Ed.). Academic Press, New York.

Niba, A.T., Butswat, I.S.R., Shehu, L.M. and Kudi, A.C.1998. Seasonal variation in semen characteristics of Red Sokoto bucks in the semi-arid zone of Nigeria. *Proceedings of Silver Anniversary Conference of NSAP/WASAP Inaugural Conference*, Abeokuta, Nigeria. Pp. 294-295.

Okere, C., Chiboka, O. and Montsma, G. 1986. Effect of frequent ejaculation of WAD goats on semen characteristics. *Anim. Reprod. Sci.* 11:249-258.

Oyeyemi, M.O., Akusu, M.O., Olaoye, M.O. and Omobowale, O.T. 1996. Effect of frequent ejaculation on the semen characteristics of WAD bucks. *Journal of Tropical Vet.* 14:71-75.

Peter, J.C. and Leslie, B.1980. Thermal characteristics of the testis and epididymis of the boar. In: *Current therapy in theriogenology*. D. Marrow (Ed.), W.B. Sanders Co., Philadelphia. Pp. 330-335.

Plachot, M., Mandelbaum, J. and Junca, A. 1984. Acrosome reaction of human sperm used for *in vitro* fertilization. *Fertil. Steril.* 42:418-423.

Segerson, E.C., Getz, W.R. and Johnson, B.H. 1981. Selenium and reproductive function in boars fed a low selenium diet. *J. Anim. Sci.* 53:1360-1367.

Topps, J.H. 1977. The relationship between reproduction and under nutrition in beef cattle. *World Review of Animal Prod.* X111: 43-49.

Zaneveld, L.J.D and Polakoski, K.L. 1977. Collection and physical examination of the ejaculate. In: *Techniques of Human Andrology*. E.S.E. Hafez (Ed.), Elsevier, Amsterdam, The Netherlands.

(Received 17 February 2003; Accepted 22 November 2004).