Seasonal variation in seminal and testicular characteristics of Brazilian Somali rams in the hot semi-arid climate of tropical northeast Brazil

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Summary. The seasons in the 1 year study were classified as rainy, transitional rainy–dry, dry, and transitional dry–rainy. Semen pH and the consistency of the testes did not vary between seasons or among rams. All other characteristics of semen and testis varied between rams. Significant seasonal differences were observed for ejaculate volume, mass, % motility, forward motility score and concentration of spermatozoa, and linear testis measurements. The total number of spermatozoa per ejaculate did not vary seasonally. The magnitude of the seasonal effects was not sufficient to prevent the rams being used for breeding throughout the year.

Introduction

Hairy breeds constitute a sizeable proportion of sheep population of Brazil and are being studied for their potential in the hot tropical climate (Figueiredo, Simplicio & Pant, 1982). The Brazilian Somali breed (Mason, 1980; Shelton & Figueiredo, 1981) is a much modified and locally adapted version of the original import. Virtually no information is available on the reproductive behaviour of sheep in this region and an attempt has therefore been made to study seasonal variation in the characteristics of the semen and in the shape and size of the testes.

Materials and Methods

This experiment was carried out for 1 year with 5 rams of the Brazilian Somali breed which were 16–24 months of age at the beginning. All the rams were clinically examined once every 15 days for any symptoms of disease in general and of the genital organs in particular. The rams were already donating semen when the experiment started and for this study one ejaculate was collected once a week, between 08:00 and 09:00 h, using a short artificial vagina (Mies Filho, 1975). In all, there were 52 collections from each of 4 rams and 49 from the fifth.

Immediately after collection, the tube containing semen was placed in a water bath and brought to the laboratory. No precautions were necessary to avoid cold shock. The ejaculate volume was read in 0.1 ml units. Semen colour and consistency was graded from 1 to 5 (turbid to thick creamy). Other seminal characteristics were measured according to standard methods. The proportion of unstained spermatozoa was estimated by differential staining using separate solutions of nigrosin and eosin.

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Vernier callipers were used to measure the scrotal skin thickness (Hahn, Foote & Seidel, 1969) and the length and the anterior-posterior breadth of the testis. The testis shape index was calculated by multiplying the two linear measurements. Testicular circumference was measured with a tape and scrotal volume was determined by water displacement. The testes were graded on a 1–5 scale according to flaccidity or firmness. The procedure of least-squares analysis for general linear models (Barr, Goodnight, Sall & Helwig, 1976) was used in the interpretation of the data.

Results

The seasonal variation in environmental temperature, rainfall and humidity is presented in Table 1. There was little variation in the temperature throughout the year but rainfall was concentrated in the months of January–April. The seasons were therefore classified as rainy (February–April), transitional rainy–dry (May–July), dry (August–October), and transitional dry–rainy (November–January), and the results are given in Table 1.

Table 1. Least-squares means (s.e.) of seminal and testicular characteristics of Brazilian Somali rams and meteorological data in different seasons in tropical northeast Brazil

Characteristics	Seasons			
	Rainy	Transitional rainy–dry	Dry	Transitional dry–rainy
Ejaculate vol. (ml)	0.669 (0.041) ^a	0.776 (0.025) ^b	0.685 (0.028) ^a	0.632 (0.024) ^a
Colour–consistency of semen (score 1–5)	3.166 (0.135) ^a	3.600 (0.084) ^b	3.667 (0.093) ^b	3.671 (0.079) ^b
Mass motility (score 1–5)	3.875 (0.087) ^b	3.993 (0.054) ^b	3.880 (0.059) ^b	3.561 (0.051) ^a
% individual sperm motility	67.65 (1.24) ^{ab}	68.42 (0.77) ^b	65.97 (0.85) ^a	65.01 (0.72) ^a
Forward sperm motility score (1–5)	3.968 (0.075) ^b	3.934 (0.047) ^b	3.879 (0.052) ^b	3.684 (0.044) ^a
Sperm conc. ($\times 10^4/\text{mm}^3$)	242.55 (13.82) ^a	248.77 (8.55) ^a	278.18 (9.49) ^b	278.80 (8.04) ^b
Total sperm no. ejaculate ($\times 10^4$)	167.24 (15.14) ^a	202.61 (9.37) ^a	194.55 (10.39) ^a	177.31 (8.80) ^a
% stained sperm.	19.8 (1.43) ^a	20.3 (0.89) ^a	23.50 (0.98) ^b	21.4 (0.83) ^{ab}
Semen pH	7.11 (0.21) ^a	7.01 (0.08) ^a	6.79 (0.09) ^a	6.87 (0.10) ^a
Testis volume (ml)	434.7 (13.9) ^{ab}	443.2 (8.2) ^b	427.1 (9.0) ^{ab}	408.9 (8.1) ^a
Testis consistency (score 1–5)	2.99 (0.14) ^a	3.00 (0.08) ^a	3.15 (0.09) ^a	3.00 (0.08) ^a
Average length of testis (cm) (A)	8.22 (0.05) ^{bc}	8.09 (0.03) ^a	8.30 (0.03) ^c	8.19 (0.03) ^b
Average diam. (breadth) of testis (cm) (B)	5.86 (0.06) ^c	5.56 (0.04) ^a	5.78 (0.04) ^{bc}	5.69 (0.03) ^b
Testis shape (A $\times$ B)	48.29 (0.71) ^c	45.09 (0.42) ^a	48.21 (0.46) ^c	46.74 (0.41) ^b
Circumference of testes (cm)	27.64 (0.21) ^{bc}	27.99 (0.12) ^c	27.27 (0.14) ^{ab}	27.08 (0.12) ^a
Months	Feb.–Mar.–Apr.	May.–Jun.–Jul.	Aug.–Sep.–Oct.	Nov.–Dec.–Jan.
Mean maximum temp. (°C)	32.03	34.50	35.77	35.13
Mean minimum temp. (°C)	23.20	22.50	23.40	23.97
Mean daytime temp. (°C)	26.87	27.83	28.33	28.40
Mean relative humidity (%)	77.00	61.00	55.00	58.67
Total precipitation (mm)	476.70	33.30	0.40	84.40

Means within rows with the same superscript letter are not significantly different ($P > 0.05$).

The pH of semen and the consistency score of the testes did not vary between rams or between seasons. All other measurements varied between rams. Differences were observed between seasons for ejaculate volume, percentage of motile spermatozoa and forward motility score, sperm concentration and the linear measurements of the testes. The seasonal variations in colour and

consistency of semen, proportion of dead spermatozoa and scrotal volume were of smaller magnitude and the total number of spermatozoa in the ejaculate did not vary between seasons. There was a large difference in semen mass motility between the transitional dry-rainy and the other 3 seasons, the former showing a much reduced value. The forward motility score showed a similar trend. The concentration of spermatozoa in the semen was significantly lower in the rainy and the subsequent transitional rainy-dry seasons. There was some indication of ram $\times$ period interaction in ejaculate volume, various motility scores and the length of the testes.

During the year, the rams showed marked changes in body weight, and this was used as a covariate in the analysis. Body weight was closely related to all the testis measurements and the forward motility score for spermatozoa, but no association was found with other characteristics of semen.

Discussion

When sheep breeds are imported from temperate regions to tropical areas, they suffer from seminal degeneration during very hot parts of the year, resulting in 'summer sterility' (Sahni & Roy, 1967). The magnitude of such effects may vary with the breed (Mittal & Ghosh, 1979). The Brazilian Somali breed is a more or less adapted type, the foundation stock coming from near-tropical areas in East Africa. Therefore, the pattern of seasonal variation in semen quality is expected to be different from that observed in temperate breeds exposed to severe hot climates. The results showed that the seasonal variation, although significant, was much less than has been observed by other workers (Dutt & Bush, 1955; Sahni & Roy, 1967; Tiwari & Sahni, 1975) and semen was usable throughout the year. Mittal & Ghosh (1979) have stated that, in the very hot seasons of arid regions of India, imported Corriedale rams donated semen of usable quality and this was ascribed to the very low humidity and large diurnal variation in environmental temperature which was always low during the night. The role of low night temperatures in arid regions has also been discussed by Hafez, Badreldin & Darwish (1955) and Amir & Volcani (1965) and seasonal variation had little influence on semen quality of rams (Amir & Volcani, 1965; Galal, El-Gamal, Aboul-Naga & El-Fouly, 1978; Chiboka, 1980).

The ejaculate volume and motility scores had higher values during the rainy and the subsequent transitional season. Although several studies, including those of Kaushish & Sahni (1976) and Riveros & Corvalán (1979), show no association between nutrition and semen characteristics, in the present study this effect perhaps has more to do with the availability of green fodder during the rainy and in subsequent transitional period, resulting in a general improvement in the condition of the rams. The level of feeding has been shown to influence sperm production of rams (Salamon, 1964; Braden, Turnbull, Mattner & Moule, 1974).

Rams vary greatly in testicular size and the rate of sperm production per unit of testis weight is constant (Lino, 1972; Gherardi, Lindsay & Oldham, 1980). Gherardi *et al.* (1980) showed that improved feeding resulted in increased size of testes and such rams were capable of mating with a larger number of ewes. Braden *et al.* (1974) also showed that the testis size was influenced by the protein and energy levels in the diet. In the present study, there was a marked seasonal difference in all testis measurements, except consistency score. Similar seasonal variation was also reported by Islam & Land (1977). In this study, all testis measurements were related to body size. Land & Sales (1977) and Abdelhakeam, El-Alamy, Tony & Yassen (1978) also reported similar associations. The ram $\times$ season interaction was significant for testis length, but not for other testis measurements. Thus, testis measurements showed almost uniform variation in the seasons in all the rams. A significant breed $\times$ season interaction in testis size was reported by Islam & Land (1977).

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