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Seasonal variation in semen quality of Gorno Altai cashmere goats and South African indigenous goats

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Abstract

Seasonal effects on semen quality of Gorno Altai cashmere goats and South African indigenous goats were studied in this experiment. A definite breeding season for the two breeds was determined. Semen quality parameters that were quantified include semen volume, sperm concentration, sperm motility, percentage live sperm, dead sperm and scrotal circumference. Scrotal circumference, semen volume, concentration and sperm concentration of the two breeds followed a seasonal pattern. These seasonal variations were significantly affected by changes in photoperiod, with subsequent effects on sperm production. The results suggest that environmental temperature plays a secondary role in terms of semen production compared to seasonal differences in photoperiod.

Keywords: Indigenous goats, Gorno Altai, semen quality, seasonal effects
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Introduction

In South Africa, goats comprise a large portion of the livestock in possession of small-scale farmers. Over the decades the use of goats as a means to generate an income has been limited mainly because of being utilized for traditional purposes. Another drawback is that the reproduction potential of goats was never realized and not well researched to date. Some studies have indicated that in temperate environments, semen production is influenced by seasonal changes (Loubser & Van Niekerk, 1983). In addition, South African indigenous goats produce a small amount of cashmere, but crossbreeding with the Gorno Altai could improve cashmere production and contribute substantially to the income of small-scale goat farmers. Gorno Altai goats are typical short day breeders, while previous studies suggest that South African indigenous goats tend to breed all year round (Greyling, 1988; Webb *et al*., 1998). The aim of the present study was to evaluate the effect of season on the semen quality of Gorno Altai cashmere bucks and South African indigenous bucks, to facilitate crossbreeding programs.

Materials and Methods

The experiment was conducted at the ARC-Irene (25º55` S; 28º12' E), South Africa. The location is in the highveld climate, at an altitude of 1525 m above sea level. The climatic conditions ranged from hot days and cool nights in summer to moderate winter days with cool nights. Two goat breeds were studied in this experiment, namely six Gorno Altai bucks (an imported cashmere breed) and six indigenous bucks that were donated to the ARC. The Gorno Altai and indigenous goats varied in age between 4 and 5 years and the two breeds weighed between 45 to 65 kg respectively. All animals were housed in enclosed pens with roofing and an open–air area. Every morning the bucks were fed lucerne and grass hay, while water and a mineral lick were provided *ad libitum*. During the day bucks were allowed free access to open paddocks.

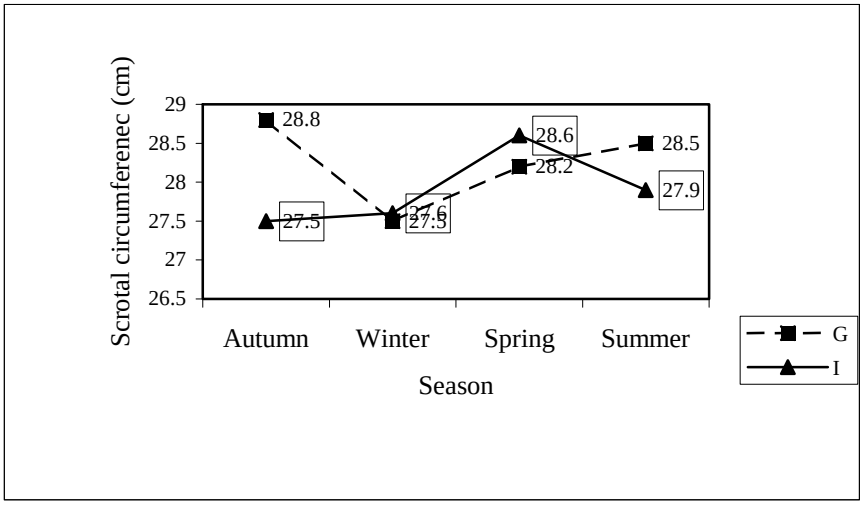
Monthly ambient temperatures were obtained from the South African Weather Services and the average daily ambient temperatures were calculated according to the method of Loubser *et al.* (1983). Semen was collected on a monthly basis during 2002 by means of an electro-ejaculator, consisting of a bipolar electrode and variable source of alternating electrical current. Prior to the rectal insertion of the probe, the electrode was lubricated with KY-jelly to ease insertion and improve contact. Before semen collection commenced, preputial hair was clipped and the preputial orifice was thoroughly cleansed.

Semen quality parameters that were quantified monthly from January to December 2002 were semen volume, sperm concentration, sperm motility, percentage live sperm, dead sperm as well as scrotal

circumference. Immediately after collection, semen samples were placed in a water bath at 35 ºC and each ejaculate was examined for volume, % motility and sperm concentration. Semen volume was estimated in a calibrated semen collection tube. Sperm concentration and motility were determined on a warm stage (35 ºC) under a light microscope. Motility rate was determined under a light microscope and a scale ranging from 0 to 5 was applied with five showing very turbulent movement. Semen concentration was determined by means of a Neubauer haemocytometer under a 400 X magnification. Percentages live and dead sperm were determined by eosine-negrosin staining on a glass slide (Vilakazi & Webb, 2004).

Results and Discussions

Scrotal circumference data are presented in Figure 1. Seasonal changes in scrotal circumference occurred in the Gorno Altai breed with the most significant ($P < 0.05$) increase occurring during March, which is similar to the findings of Folch (1984). During the natural breeding season, Gorno Altai goats recorded a larger scrotal circumference (29.3 ± 1.4 cm) compared to indigenous bucks (27.8 ± 0.8 cm). The mean values and seasonal variations in scrotal circumference obtained for indigenous bucks in this study agree with that reported by Webb *et al.* (1998). The increase in scrotal circumference in the Gorno Altai was associated with a marked decrease in photoperiod, which triggered sexual activeness towards the end of autumn (Figure 1). In the other seasons scrotal circumference did not differ between these breeds and tended to decrease during the non-breeding season in both breeds. Body weight did not affect the scrotal circumference of indigenous (55.95 ± 6.4 kg) or Gorno Altai (56.83 ± 6.3 kg) bucks which is in agreement with the results of Tegegne *et al.* (1994). Although the scrotal circumference of the Gorno Altai was higher, indigenous bucks recorded higher semen volumes in the hot summer months of December (1.9 ± 0.4 mL) and January (1.57 ± 0.35 mL) and higher semen motility, compared to the Gorno Altai.



G = Gorno Altai; I = South African indigenous goats

Figure 1 Seasonal effects on the scrotum circumference of South African indigenous and Gorno Altai goats

Although the semen volume (1.77 ± 0.3 mL) of indigenous bucks was marginally higher compared to the Gorno Altai, sperm concentration was higher ($P < 0.05$; Figure 2) in Gorno Altai (161.3 ± 83.6 x 10^6 sperm/mL) than in indigenous bucks (126.5 ± 73.2 x 10^6 sperm/mL) particularly during winter and early spring.

It was also evident that the sperm concentration in the Gorno Altai bucks recorded highest values in the breeding season, which agrees with the findings of Roca *et al.* (1992), while less variation was noted for indigenous goats. Semen concentrations tended to increase in both breeds at the end of winter and onset of spring and decreased again in summer (Figure 2).

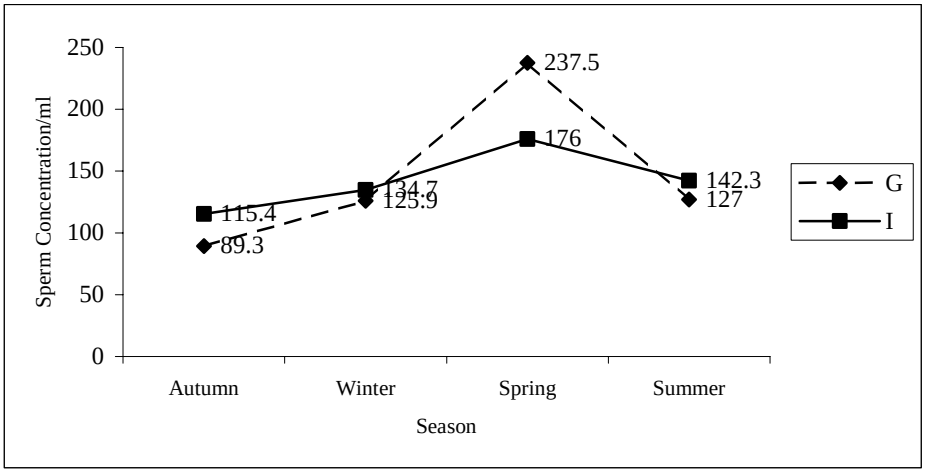
Semen volume in May (mid autumn) and August (end of winter) differed significantly ($P < 0.05$) between the Gorno Altai (2 ± 0.52 mL and 1.55 ± 0.24 mL) and indigenous bucks (1.43 ± 0.4 mL and 1.32 ± 0.15 mL) (Figure 3). In September (spring), when the environmental temperature started to increase, the

semen volume of indigenous bucks was higher (1.77 ± 0.3 mL; P < 0.05) compared to the Gorno Altai (1.28 ± 0.25 mL).

Other researchers (Tegegne *et al.*, 1984; Roca *et al.*, 1992) reported a strong correlation between body weight and scrotal circumference, but no significant correlation was obtained between body weight and scrotal circumference in this study, probably since all goats were well fed and in a good condition (Table 1) and because the number of animals was rather small. Negative correlations were recorded between body weight and the % live sperm and semen colour. Positive correlations were found between semen volume and semen concentration (r = 0.27) and % live sperm (r = 0.22).

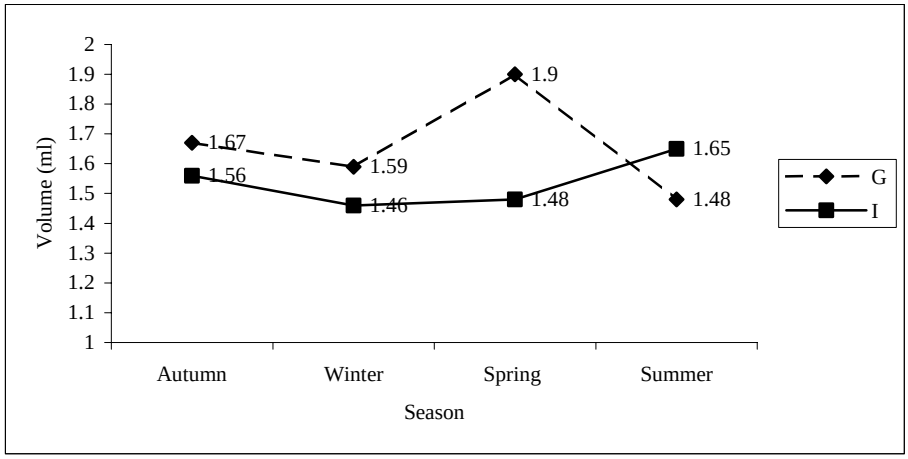
Table 1 Correlations between body weight, semen volume, sperm concentration, % live sperm, semen colour and scrotal circumference (SC)

		Weight	Volume	Concentration	% Live sperm
Weight	Person correlation	1			
(kg)	Significance (P < F)	0.0			
	n	152			
Volume	Person correlation	0.067	1		
(mL)	Significance (P < F)	0.413	0.0		
	n	152	152		
Concentration	Person correlation	0.089	**0.274**	1	
(x 10^6 sperm/mL)	Significance (P < F)	0.278	**0.001**	0.0	
	n	152	152	152	
% Live sperm	Person correlation	**-0.242**	**0.220**	**0.323**	1
	Significance (P < F)	**0.003**	**0.006**	**0.000**	0.0
	n	152	152	152	152
Semen colour	Person correlation	**-0.327**	0.139	**0.323**	**0.411**
	Significance (P < F)	**0.000**	0.088	**0.000**	**0.000**
	n	152	152	152	152
SC	Person correlation	0.098	-0.020	-0.107	-0.101
(cm)	Significance (P < F)	0.230	0.810	0.188	0.216
	n	152	152	152	152



G = Gorno Altai; I = South African indigenous goats

Figure 2 Seasonal trends in sperm concentration of South African indigenous and Gorno Altai goats



G = Gorno Altai; I = South African indigenous goats

Figure 3 Seasonal effects on the semen volume of South African indigenous and Gorno Altai goats

Conclusions

It is concluded that seasonal variations in semen quality of goats are evident in temperate environments. Season significantly affected the semen quality of both Gorno Altai and South African indigenous goats. Gorno Altai bucks exhibited significant seasonal variation in semen production, with the best quality semen being produced during the breeding season. Semen quality was less affected by seasonal changes in the environmental temperature in indigenous bucks, which suggests a higher level of adaptability in subtropical environments. The semen characteristics of the Gorno Altai bucks were more favourable than those of indigenous bucks during the natural breeding season. This information could be of importance in an artificial insemination programme. It appears that the extent of these seasonal effects on the semen quality of the Gorno Altai is not so severe that it cannot be used for breeding purposes throughout the year, compared to indigenous goats.

Acknowledgements

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