SEASONAL VARIATIONS IN SEMEN QUALITY OF BUCKS INDIGENOUS TO SAUDI ARABIA

Adel A. Al-Hozab and Ghazi F. Basiouni
Department of Animal Sciences, College of Agricultural and Food Sciences, King Faisal University, P.O. Box 420, Al-Hofuf 31982, Saudi Arabia

ABSTRACT

High environmental temperatures are known to have an adverse effect on the fertility of both male and female goats. The main objective of this study was to examine the effect of seasonal variations in environmental temperature on buck's semen characteristics of a local breed of goats in Saudi Arabia. Semen samples were collected from twelve adult bucks during the month of July and December using an electroejaculator. Semen were examined for its volume (Vol.), sperms mass motility (MM), individual motility (IM), sperms density (D), the percentage of live and abnormal sperms. No significant differences were found in smeen quality of bucks during the month of July compared to that of December. However, the density of sperms was found to be significantly higher ($P < 0.05$) in the semen collected during the month of July (2.5×10^9) compared to that collected in December (1.5×10^9). These results suggest that bucks indigenous to Saudi Arabia are adapted to high environmental temperatures without any noticeable adverse effects on their apparent semen quality.

INTRODUCTION

The rapid expansion in the meat production industry in Saudi Arabia had lead to the introduction of both intensive and semi-intesnive farming systems for all the farm species including goats. The goat industry constitute around 23 per cent of the total livestock market in Saudi Arabia and therefore, contributes considerably towards the meat production in the country. Among others, low fertility in both sexes is a major limiting factor in goat production.

Environmental factors such as high temperatures and daylength had been reported to be implicated in low fertility in the sheep. High environmental temperatures adversely affect the ram sexual activity (Lindsay, 1969) and this adverse effect of high temperatures on semen quality had been demonstrated in the case of both whether the rams were raised during the hotter months of the year with ambient temperature above 32°C (Tiwary and Sahni, 1975) or exposed to higher temmperature (40°C) for a short period of time about 3 hrs (Voglmary, 1971). Even local heating of the testes may cause spermatic damage (Waites and Setchell, 1964). However, Murciano Granadian bucks raised in the mediaterranean area were found to have a better semen quality during late summer and autumn compared to that collected during other periods of the year (Roca *et al.*, 1992).

Apart from high temperatures, daylength is another factors which may affect ram fertility. Rams kept under short day cycle had larger testes compared to those kept under long day cycle (Lincoln *et al.*, 1981), Such an increase (45%) in the testes weight being contributed by comparatively (30%) larger diameter of seminiferous tubules results in almost twice the number of sperms compared to rams exposed to long days (Schanbacher and Ford, 1979). Similarly, bucks exposed to long day periods (non-breeding season) have lower percentage of motile spermatozoa compared to those exposed to short day periods i.e., breeding season (Delgadillo *et al.*, 1992).

In most of the experiments conducted to test the effect of high environmental temperatures on semen quality, the rams used, were either from the regions where they do not experience temperatures more than 30-35°C or such studies were conducted on rams originally taken from temperate regions and tested in areas where temperature of 40°C and more may prevail during the summer months. Environmental temperatures in Saudi Arabia range from 1°C (winter) to 47°C (Summer). Daylength range is 10.5 hours (winter) to 13.5 hours (summer). At the moment it is not clear, how the fertility in bucks is affected by extremes of temperature prevailing in Saudi Arabia. So an experiment was conducted to examine semen quality of bucks of a local breed indigenous to Saudi Arabia during two main period of the year representing summer (July) and winter (December).

MATERIALS AND METHODS

Throughout the experiment, twelve adult local bucks indigenous to Saudi Arabia aged two years were housed under conditions of natural daylength and temperature, and fed concentrates and hay with free access to water. Semen was collected from bucks using an electroejaculator (Western Instrument Company, Denver, Colorado, U.S.A) during July and December. The volume of each ejaculate was recorded using a graduated test tube. Sperm density was then evaluated in a haemocytometer after diluting an aliquote of semen with normal saline (1:400 diluting rate). Mass motility (MM), percentage and individual motility (IM) were assessed at a scale of 0-5 under the microscope as described by Evans and Maxwell (1987), whereas nigrosin-eosin staining technique was used to calculate the percentage of live and dead sperms as described by Hancock (1951). The percentage of abnormal sperms (tailless, enlarged head, small head, coiled tail, tapered head, broken at neck, broken at midpiece and abnormal acrosomes) was also determined.

The maximum and minimum temperature during the month of July were 47°C and 26.4°C whereas during the month of December these were 31.2°C and 0.8°C, respectively. The maximum relative humidity during July and December were 38 and 99 per cent, respectively. The maximum daylength during July and December was 13.5 and 10.5 hours, respectively.

Analysis of variance (SAS, 1985) was used to examine the effect of month on different parameters used to determine the semen quality.

RESULTS

Statistical analysis on different parameters tested in this study showed that no significant differences were found in the ejaculate volume, mass motility, individual motility, the percentage of live and abnormal sperms between July and December (Table 1). However, significant differences ($P<0.05$) was observed in the density of sperms in samples taken during the month of July ($2.5 \times 10^9 \pm 0.28$) compared to that taken during the month of December ($1.5 \times 10^9 \pm 0.20$) (Table 1).

DISCUSSION

The absence of any significant differences in the ejaculate volume, mass motility, individual motility percentage and the percentage of live or abnormal sperms in the semen collected from the bucks during the summer (July) compared to that collected during the winter (December) indicates that local bucks are well adapted to the extremes of the local environment and the extreme environment does not result in any noticeable apparent deterioration in semen characteristics. This breed, in general, is well known for its ability to survive with little protection from the enviornment. Nevertheless, the significant increase observed in sperm density in the semen of bucks collected during July compared to that of December is not only consistent with some previous findings observed for Awassi rams (Juma and Dessouky, 1969) but also indicates that enviornment may affect some of the semen characteristics. Similar results have also been reported in the case of Najdi rams of Saudi Arabia in which sperm concentration was found to increase as summer approaches and then decline to low values as winter progress (October, November, December) (Galil *et al.*, 1984). In Billy goats, sperm concentrations were highest in the spring and early summer (7×10^9 spermatozoa/mL) compared to those in winter (4×10^9 spermtozoa/mL) (Corteel, 1977). One possible explanation for such an increase in sperm concentrations may be the hormonal support received by the testes during this time of the year as a result of seasonal changes in daylight length. In the ram, both the content and concentrations of the pituitary

Table 1: Mean±SE of bucks semen characteristics during the month of July and December

Characteristics	July	December
Volume of semen (mL)	0.71±0.08a	0.75±0.12a
Mass motility (MM)	4.50±0.14a	4.90±0.10a
% individual motility (IM)	63.80±2.23a	60.00±2.02a
Density ($X10^9$)	2.50±0.28a	1.50±0.20b
% live sperm	56.30±5.18a	58.80±2.83a
% abnormal sperms	5.70±1.31a	3.60±0.73a

Mean values within the same row with different values are significantly different ($P<0.05$)

leutinizing hormone is higher during the period of June-November compared to that between December and May. Similarly a higher follicular stimulating hormone activity was observed in rams during the month of July and February (Pelletier and Ortavant, 1967). An increase in the testosterone levels in the Alpine billy goat bucks was also found to occur 45 days after the longest day and then decreased before the shortest day (Saumande and Rouger, 1972). It is possible, therefore, that the significant increase in sperm production observed in the present experiment which occurred during the month of July was at a time when daylength has just started to decrease and may therefore, reflect long day photorefractoriness, rather than due to the short days per se.

The higher percentage of abnormal sperms during July although not significant, was consistent with those of previous studies (Tiwary and Sahni, 1975; Dutt and Hamm, 1957; Waites and Setchell, 1964). Such an increase in the percentage of abnormal sperms, however may not affect semen fertility when combined with the significant increase observed in total sperm density at that time of the year. Nevertheless, it is quite interesting that the percentage of abnormal spermtozoa increases at the time of supposedly better hormonal support. However, larger group of animals may need to be examined before firm conclusions could be drawn.

In conclusion, it appears that bucks native to the enviornment of Saudi Arabia may be very well adapted to the increases in environmental temperatures during the summer months such that it does not affect their semen quality.

REFERENCES

Corteel, J.M., 1977. Production, storage and insemination of goat semen. In management of Reproduction in sheep and Gaots. University of Wisconsin, Madison. pp: 41-57.

Delgadillo, J.A., B. Leboeuf and P. Chemineau, 1992. Abolition of seasonal variations in semen quality and maintenance of sperm fertilizing ability by photoperiodic cycles in goat bucks. Small Ruminant Res., 1: 47-59.

Dutt, R.H. and P.T. Hamm, 1957. Effect of exposure to high environmental temperature and shearing on semen production of rams in winter. J. Anim. Sci., 16: 328-334.

Evans, G. and W.M.C. Maxwell, 1987. Handling and Examination of semen. In: Salmon's Artificial Insemination of Sheep and Goats. Butterworths, Sydney. pp: 93-107.

Galil, A.K.A., H.M. Elhadi, M.M. Elmann and A. Tigani, 1984. Reproduction in sheep. King Abdulaziz City for Science and Technology (KACST), Final Report Project No. AR-2-012, Riyadh, Saudi Arabia.

Hancock, J.L., 1951. A staining technique for the study of temperature shock in semen. Nature (London), 167: 323.

Juma, K.H. and F. Dessouky, 1969. Semen characteristics of Awassi rams. J. Agri. Sci., 73: 311-314.

Lincoln, G.A., O.F.X. Almeida and J. Arendt, 1981. Role of melatonin and circadian rhythms in seasonal reproduction in rams. J. Reprod. Fert. Suppl., 30: 23-31.

Lindsay, D.R., 1969. Sexual activity and semen production in rms at high temperatures. J. Reprrod. Fert., 18: 1-8.

Pelletier, J. and R. Ortavant, 1967. Influence du photoperiodisme sur les activities sexuelle, hypophysaire et hypothalamic du belier lle de France: In La photoregulation chez les Oiseaux et les Mammiferes, Y. Assenmacher and J. Benoit, C.N.R.S., Paris. pp: 483-495.

Roca, J.E. Martinez, J.M. Vazques and P. Copy, 1992. Characteristics and seasonal variations in the semen of Murciano-Granadina goats in the Mediterranean Area. Anim. Reprod. Sci., 29 (3-4): 255-262.

SAS Institute, 1995. SAS User's Guide: Statistics (Version 6.11 Edi.). SAS Institute Inc., Cary, NC.

Saumande, J. and Y. Rougher, 1972. Variations saisonnieres des taux d'androgenes dans le plasma peripherique chez le Bouc. C.R. hebd. Seanc. Acad. Sci., Paris D. 274, 89-92.

Schanbacher, E.D. and J.J. Ford, 1979. Photoperiodic regulation of ovine spermatogenesis: Relationship to serum hormones. Biol. Reprod., 20: 719-726.

Tiwary, S.B. and K.L. Sahni, 1975. Semen quality of Rambouillet rams and their crosses (with the native) during hotter part of the year. Indian Vet. J., 52: 614-619.

Voglmayr, J.K., E.P. Setchell and I.G. White, 1971. The effects of heat on the metabolism and ultrastructure of ram testicular spermatozoa. J. Reprod. Fert., 24: 71-80.

Waites, G.M.H. and E.P. Setchell, 1964. Effect of local heating on blood flow and metabolism in the testes of the conscious ram. J. Reprod. Fert., 8: 339-349.