CHAPTER 1

PROJECT THEME: Reproductive management of the domestic animals.

TITLE: Seasonal effect on semen production of Gorno Altai and the South African indigenous goats.

AIM: Quantification of the effect of season on the quality of semen in Gorno Altai and the South African indigenous bucks.

MOTIVATION: Indigenous goats in the rural areas of South Africa are only utilized for traditional and sacrificial purposes. The recent importance of the commercialisation of goats through value adding to meat, milk, skins and fibre make improved reproduction an integral part of the economic viability of commercialisation. It is assumed that the low fertility of goats observed during summer is linked primarily to the quality of the sperm produced during that period and not necessarily to the decrease in fertility of the doe. Periods of low sperm motility have also been noted to be correlated to periods of low fertility, suggesting that the fertilizing capacity of viable spermatozoa becomes drastically reduced for certain months of each year, especially during the non-breeding season. The resource-poor rural farmers do not necessarily have to replace their already existing animals, as they are perceived to be inferior. Gaining access to superior genetic material is thus of great importance, and access to such material is limited due to large financial constraint that stud animals impose on the resource poor farmer. As a first step, it is imperative to characterize the reproductive seasonality of the indigenous and Gorno Altai male goats. It is postulated that the success rate of artificial insemination can also be improved if the semen is processed and frozen at the most viable time, which is season related.

INTRODUCTION

Semen of good quality is essential for the success of an artificial insemination programme. Sperm production rates and epididymal storage capacity have been documented for bulls, boars, rams and rabbits. Knowledge on sperm production rates would be useful in any animal breeding programme which aims at exploiting males with superior genetic potential. However reports on sperm production rates of the caprine specie are scanty.

Morphological evaluation of spermatozoa must be conducted in order to ensure semen of high quality (Roca *et al,* 1992). A high proportion of abnormal spermatozoa adversely affect the fertility of domestic animals. Semen quality of indigenous goats is reported to be acceptable all year round, as the proportion of abnormal spermatozoa is well within the accepted range for normal fertility. It has also been postulated that the quality of semen in goats varies according to the breed, geographical location and the season of the year. The type or occurrence of sperm abnormalities showed great variation during the experimental period (Eaton and Simon, 1953, Corteel, 1981).

A significant season X ejaculate interaction on sperm density and number was reported. Amir *et al* (1986) also recorded sperm density to be lower in June and August to September, compared to November to December. It was also postulated that the percentage of abnormal spermatozoa (mainly coiled tails, acrosomic defects and protoplasmic droplets), was significantly higher in March than in June and August to September. In addition it was found that 75 % of the abnormal spermatozoa were those with coiled tails in March, 60 % of the abnormal spermatozoa had acrosome defects in June, while the prevailing abnormality in August to September was the presence of protoplasmic droplets. In November to December, 80 % of the abnormal spermatozoa were evenly distributed between coiled tails and protoplasmic droplets. Motility has been said to be lower in March, than in the other months. Semen volume was found to decrease significantly corresponding to the decrease in sperm density and sperm number which was found to be significantly greater in March, June and November-December than in

August to September (Amir *et al*, 1986). Thus the literature on seasonality of semen quality is conflicting.

The effects of frequent ejaculation and of season on the semen characteristics of rams have been studied by several workers. In these studies it was reported that successive ejaculation affected the quantity, but not the quality of spermatozoa. It was also stated that the effect of season on sperm quality in the trials was characterized by a significant increase in the percentage of abnormal cells and a decreased motility in ejaculates during March and by an increased number of ejaculated spermatozoa in November-December (Salamon, 1962; 1964; Amir and Volcani, 1965; Amir, 1966; Lightfoot, 1968; Jennings and McWeeney, 1976; Tomkins and Bryant, 1976).

Colas (1983) and Amir and Volcani (1965) reported similar effects in Ile-de-France and Awassi rams. The morphological evaluation of spermatozoa is the most accurate test available to test the quality of the ejaculate. The incidence of the highest percentage of abnormal spermatozoa and the lowest conception rate in March may be indicative of the role that rams play in the lower fertility obtained in ewes during this month.

Fulkerson *et al* (1982) have indicated that a single artificial insemination requires twice as many spermatozoa for conception equivalent to natural mating. Assuming that semen of equal quality is used, the only difference between artificial and natural mating appears to be the absence of normal courtship behaviour of the ewe and the stress associated with handling and strange surroundings, when A.I is used. During natural service, rams often deposit fewer spermatozoa per service that are adequate for conception.

Conception becomes related to the number of times a ewe is served or the more rams with which the ewe mates, this can possibly be explained on the basis that inadequate numbers of spermatozoa are deposited in a single insemination (Mattner and Braden, 1967; Knight and Lindsay, 1973).

Scrotal circumference has a great role to play, as it influences the quantity of spermatozoa that can be produced by the intact ram. Scrotal circumference is positively correlated to the testicular weight. The colour of semen is indicative of the concentration of the ejaculate. Testicle measurements are used as indicators of both reproductive status and spermatogenic capacity of small ruminants, for example in rams and bucks (Bongso *et al,* 1982).

Among the important factors in the evaluation of male reproductive capacity, is sexual behaviour particularly in artificial insemination programmes where an artificial vagina is used to collect semen. In small ruminants living at high and mid-latitudes, reproductive factors appear to be influenced by environmental conditions throughout the year particularly day length and ambient temperature (Almeida & Pelletier, 1988; Langford *et al*, 1989). Simplicio *et al* (1982) postulated that in Brazilian Somali rams, significant seasonal differences were observed for ejaculate volume, % mass motility, progressive motility score and concentration of spermatozoa. All other characteristics of semen and testes varied between rams. It was also stated that the total number of spermatozoa per ejaculate did not vary according to season, and the magnitude of the seasonal effect was not sufficient to prevent the rams being used for breeding throughout the year. The seasonal variation in the colour and consistency of semen, proportion of dead spermatozoa and the scrotal volume were of smaller magnitude and the total number spermatozoa in the ejaculate did not differ between seasons. According to these findings, rams showed marked changes in the body weight and it was related to all testes measurements and the motility score of the spermatozoa.

There is an increase in the percentage of abnormal spermatozoa and a decrease in motility with increasing duration of heat. This also reflected an increase in both volume and density. The percentage abnormalities in semen starts with the coiling of the tail, followed by the appearance of tailless heads. Reaction time has been said to be the longest in animals that are exposed to high ambient temperatures for a long period of time. In a trial by Karagiannidis *et al* (1999), five Chios and five Friesian rams were used to study the effect of season on semen production. It was found that the best quality semen was produced mainly during autumn and the worst quality during spring. It was

also stated that the magnitude of these seasonal effects was not sufficient to prevent rams from being used for breeding throughout the year.

However, the existence of differences among rams within and between each breed in semen quality and quantity, makes it necessary to perform a semen evaluation in order to select the best males before being used for breeding. Significant differences were not recorded between the two breeds in any trait. Season affected both the quantity as well as the quality of semen. Semen volume was lower during spring, compared to summer, autumn and winter. During a transitional period, the percentage of motile spermatozoa was lower during summer, compared to autumn, winter and spring. A gradual increase motile sperm was observed with the highest value being recorded during autumn. Semen characteristics were generally higher during summer (onset of improvement) and autumn (peak of improvement), compared to during winter (onset of decline) and spring (lowest quality).

When considering that summer and autumn are seasons of decreasing day length (breeding season) and winter and spring are seasons with increasing day length (the non-breeding season), it is obvious that bucks are sensitive to photoperiodism. Ibrahim (1997) in a similar study with Chios and cross-bred rams raised in the United Arab Emirates, reported that semen characteristics were improved mainly during the winter. The variation of quantitative and qualitative sperm production, as well as the time of the year in which the unfavourable effect of photoperiodism occurs, varies between several latitudes and between breeds. It was also confirmed that breeds used for industrial crossing appear to be more sensitive to photoperiodism than the hardy breeds.

Contrary to the general consideration that semen quality is higher during the breeding season, it was also found that progressive motility of sperm was lower in summer, compared to the other three seasons of the year. According to Mandiki *et al* (1998), semen motility does not vary greatly over seasons, while a sporadic decrease is observed during spring. Colas (1983) suggested that photoperiod has an effect on the sperm motility. Karaginnidis *et al* (1999), concluded that semen characteristics of rams showed

a significant seasonal variation in semen quantity and quality and best semen is produced during late summer and autumn (breeding season).

In another study by Perez and Mateos (1996) with Verata and Malaguena bucks, it was postulated that there were differences between the breeds in semen characteristics, with higher semen production and better semen quality being observed in the Malaguena bucks. The influence of the photoperiod on both semen quantity and quality was observed in the Verata breeds, with a noticeable improvement in all semen characteristics during the periods of decreasing photoperiod. Differences were also observed in bucks of both breeds with regards to semen production, but only in the Malaguenna bucks with regards to semen quality. Perez *et al* (1996) cited significant differences between breeds in almost all seminal characteristics. The Malaguenna bucks gave higher semen volumes, higher total sperm per ejaculate, higher percentage of normal acrosomes and lower percentage of abnormal acrosomes, than Verata bucks. These bucks presented a higher concentration than the Malaguenna breeds. Variations in semen production caused by photoperiod are more or less marked, depending on the latitude.

In studies performed in zones above 40°, these variations are very marked with significant increases in semen production during periods of decreasing photoperiod (Corteel, 1981). Greyling and Grobbelaar (1983) reported that, in latitudes between 30° and 40°, there are seasonal, but not very marked variations with a higher production during summer and autumn. In zones below 30°, bucks do not present seasonal variation in sperm production. It was also recorded that Verata breeds undergo a seasonal increase in testosterone secretion, which is greater than that of the Malaguenna breed. This difference in sensitivity to photoperiod between breeds may be due to the different latitudes. As a consequence of their testicular size, Malaguenna bucks have a higher seminal production due, possibly to their being less sensitive to photoperiod. This seminal production was more consistent throughout the year than that of Verata breed. Perez and Mateos (1996) concluded that photoperiod did not have the same effect on semen characteristics in the two breeds studied. Delgadillo and Chemineau (1992) confirmed that goat bucks show seasonal variation in semen quality, mainly influenced

by the photoperiodic changes. These results differ from results from other researchers, in that the minimum percentage of motile sperm cells and movement occurs during spring and summer. It is thus clear that studies inn other species, as well as some studies with goats have alluded to the effect of photoperiod, season, breed, geographic location, frequent ejaculation, scrotal circumference (which is directly correlated to nutrition), sexual behaviour and temperature of the environment, as factors that can affect semen quality.

The objective of this study is thus to observe the effect of some of these factors on the semen quality of two breeds of goats (one breed exotic and one breed indigenous to South Africa) over a 1 year period in South Africa. This will provide information that may be used in subsequent semen freezing and artificial insemination programmes.