Seasonal changes in sexual activity and semen quality in the Angora ram. 2. Semen volume, quality and freezability

P.G. Loubser and C.H. van Niekerk
Department of Human and Animal Physiology, University of Stellenbosch

Seasonal changes in semen volume and quality in the Angora ram were investigated. Semen was collected by means of an artificial vagina and criteria such as ejaculate volume, semen pH, sperm concentration, sperm motility, percentage live and normal sperm and survival of sperm after freezing and thawing were monitored.

The Angora ram was found to be a seasonal breeder (late summer through autumn) and produced semen only during this period. Semen volume differed highly significantly ($p \leq 0,01$) between months, with the highest production in autumn and the lowest in summer. Semen pH increased linearly from autumn through spring, being significantly lower early (February) and late (August) in the breeding season. Sperm concentration did not change significantly during the intervening period. No significant seasonal variation in sperm motility, percentage live sperm and survival of sperm after freezing and thawing was found during the breeding season. The percentage normal sperm was significantly higher during winter than in summer and autumn.

S. Afr. J. Anim. Sci. 1983, 13: 161–163

Volwasse Angorabokramme is gebruik om die seisoenale veranderinge in semenvolume en -kwaliteit te ondersoek. Die semen is twee-weekliks met behulp van 'n kunsvagina vir 'n tydperk van agt maande (somer, herfs en winter) opgevang. Die kwaliteitsparameters wat bepaal was, is pH, spermkonsentrasie, spermbeweeglikheid, persentasie lewendige en normale sperme en spermoorlewing na bevriesing en ontdooiing. Semenbevriesing was uitgevoer met 'n melk en eiergeel-verdunningsmiddel en in plastiekstrooitjies in vloeibare stikstof gevries en gestoor.

Dit is gevind dat die Angorabokram slegs tydens 'n beperkte tyd (vanaf laat somer tot vroeg lente) geslagsaktief is. Semenvolume het hoogs-betekenisvol ($p \leq 0,01$) tussen maande verskil, met die grootste volume gedurende herfs en die laagste in die somer. Gedurende die lente kon geen semen opgevang word nie. Semen pH het vanaf herfs tot lente liniêr toegeneem. Spermkonsentrasie het tussen maande nie betekenisvol verskil nie, hoewel die gemiddelde spermkonsentrasie vroeg in die teelseisoen en aan die einde van die teelseisoen betekenisvol laer was as gedurende die res van die teelseisoen. Geen betekenisvolle variasie in spermbeweeglikheid, persentasie lewendige sperme en spermoorlewing na bevriesing en ontdooiing is gedurende die teelseisoen ondervind nie. Die persentasie normale sperme per ejakulaat was hoër in die winter as in die somer en herfs.

S.-Afr. Tydskr. Veek. 1983, 13: 161–163

Keywords: Semen characteristics, seasonal variation, freezability

Part of thesis accepted for the M.Sc.-degree in Animal Physiology, Dept. of Human and Animal Physiology, University of Stellenbosch.

C.H. van Niekerk
Department of Human and Animal Physiology,
University of Stellenbosch, Stellenbosch, 7600
Republic of South Africa
P.G. Loubser*
Present address: Le Chasseur, Eversdal Road, Stellenberg,
Durbanville, 7550 Republic of South Africa
*To whom correspondence should be addressed

Received 17 August 1982

Introduction

Several studies have indicated that semen production is influenced by seasonal changes (Corteel, 1978; Colas & Brice, 1976; Jennings, 1976; Skinner & Van Heerden, 1971). It has been stated that the fertilizing ability of frozen semen is improved when collected during the active breeding season as compared to semen collected during the period of sexual quiescence (Colas & Brice, 1976; Courot, 1976).

This study was carried out to determine the seasonal variation in production, quality and freezability of Angora goat semen.

Material and Methods

The semen of twelve mature Angora goat rams was collected fortnightly by means of an artificial vagina, from late summer through winter. Semen production was monitored as the volume of semen delivered by each ram during semen collection.

Semen quality parameters quantitated were: pH, sperm concentration, sperm motility, percentage live and normal sperm per ejaculate and sperm survival post-thawing.

Merck pH paper (pH 6,0 – pH 8,0) was used to determine semen pH. The procedure used to determine sperm concentration was as follows: A drop of semen diluted 1:200 in a gentian violet-alcohol mixture (1:50 m/v), was put into the counting chamber of a haemocytometer. Using the five squares in the centre of the counting chamber, the sperm were counted under a light microscope. The concentration of the sperm (sperm/cm^3) was then calculated using the formula:

$$\text{sperm counted in five squares} \times 10^7.$$

During this counting procedure, the percentage normal sperm per ejaculate was also determined.

Sperm motility was estimated on a warm stage (34°C) under a light microscope by means of the hanging-droplet method. A semen droplet was stained with a nigrosin and eosin mixture (2:1), to determine the percentage live sperm per ejaculate (Van Rensburg, 1974).

To determine the survival rate of sperm following freezing and thawing, an estimation of the degree of linear spermatic movement of fresh and thawed semen was made. Semen was artificially collected, the seminal

plasma aspirated following centrifugation (200 G for 10 minutes), the semen reconstituted with a milk and egg yolk diluent and then frozen in liquid nitrogen vapour for six hours (Van der Westhuysen, Wentzel, Viljoen & Loubser, 1980). Prior to freezing, the semen was aspirated into plastic straws (0,5 cm^3). The semen-filled straws were then stored in liquid nitrogen. Three semen straws per ram per batch were thawed after freezing and a further estimation of the degree of linear movement made. The decline of linear movement prior to deep freezing (LMF) and following thawing (LMT) was calculated, using the formula:

$$\frac{LMF - LMT}{LMF} \times 100$$

and thus expressed as the percentage of sperm surviving the deep freezing process.

Results and Discussion

Figure 1 illustrates the seasonal changes in semen production and quality.

Semen production, as indicated by the volume of semen delivered during the collection process, differed highly significantly ($p \leq 0,01$) between months. The Angora rams, because of their sexual inactivity and lack of libido during the anoestrous period (spring and early summer), only mounted the ewes during the active breeding season i.e. February through August (Loubser & Van Niekerk, 1983), and thus only delivered semen during these months. The volume of semen delivered during the breeding season increased from February to reach a peak from March to July and then declined until August when an abrupt cessation of semen output took place. According to Table 1, the average volume of semen per ejaculation was 1,06 ml, with a maximum 1,2 ml in March and a minimum 0,57 ml in February.

Semen pH increased linearly ($p \leq 0,01$) from February to reach a peak of 7,06 in June. The minimum pH of 6,18 was recorded in February and a plateau was reached in June and maintained until August (Figure 1). Although the average pH of 6,81 (Table 1) was higher than the average of 6,63 reported by Hulet, Foote & Blackwell (1964), this gradual increase corresponds to the findings of Hulet & Ercanbrack (1962) and may be a result of the decline in semen quality late in the breeding season.

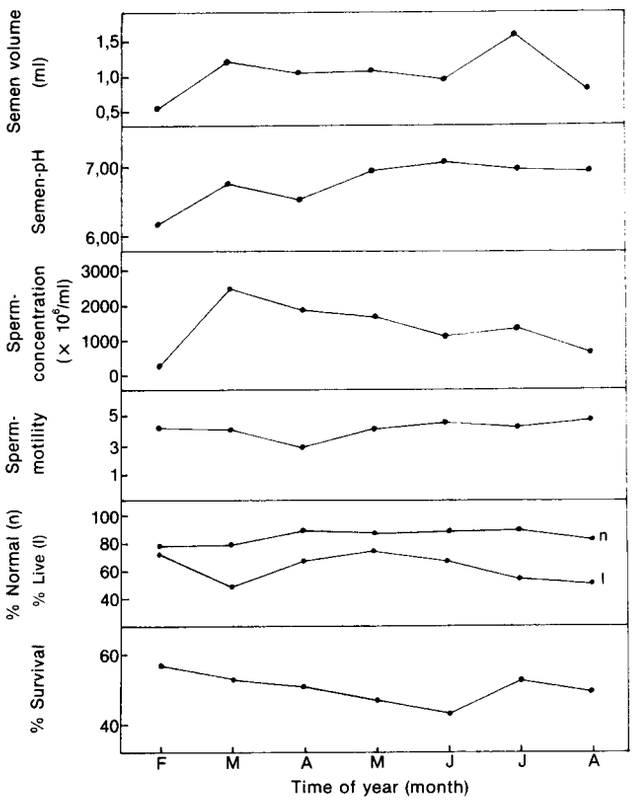

Figure 1 Seasonal changes in semen production and semen quality.

An average sperm concentration per ejaculate of 1865,2 × 10^6 sperm/ml was determined (Table 1). Although the sperm concentration in February and August was significantly ($p \leq 0,05$) lower (Figure 1), no significant change in sperm concentration for the months March through July could be detected. Sperm motility scored an average of 3,25 (Table 1) with no significant difference between seasons.

An average of 50,7% live sperm cells per ejaculate was determined (Table 1) with minor changes between months (Figure 1), while Rossouw (1974) reported a slightly higher percentage of viable sperm in the Boer goat. Although not significant, an increase in the percentage live sperm per ejaculation was monitored from March through August (autumn and winter).

The percentage normal sperm per ejaculation was higher ($p \leq 0,05$) during autumn and winter than in summer — with an average of 80,1% (Table 1). Marais (1968)

Table 1 The average semen volume and semen quality parameters of Angora goat rams collected with the artificial vagina from late summer through winter

Parameter	n	Average	S.D.	C.V. (%)	Range
Semen volume (ml)	60	1,09	0,24	21,53	0,4–2,2
pH	45	6,81	0,29	4,19	5,11–7,20
Sperm concentration (× 10^6/ml)	35	1865,2	830,8	38,53	170,0–4030,0
Sperm motility	57	3,25	1,75	54,00	0,0–5,0
Percentage live sperm	76	50,78	27,72	54,60	0,0–96,0
Percentage normal sperm	55	80,16	18,04	22,50	0,0–99,0
Sperm survival rate post thawing (%)	59	46,62	15,80	33,89	6,25–62,50

n: number of determinations. S.D.: standard deviation. C.V.: coefficient of variance.

speculated that collection of sperm from the male genital tract during the inactive breeding season may result in a lower percentage of normal sperm cells per ejaculation early in the breeding season. An average of 46,6% of sperm survived the deepfreezing process (Table 1). A non-significant correlation (r = 0,06) between sperm survival and seasons was recorded.

It can thus be seen that the Angora ram is a seasonal breeder with a definite period of sexual activity. Only during this period (late summer through winter) will the ram produce semen, with the semen production (or output) varying ($p \leq 0,01$) between seasons.

Semen pH increased ($p \leq 0,01$) from February (late summer) to August (winter) but with no seasonal changes in sperm concentration and sperm motility. The percentage live and normal sperm per ejaculate did not change significantly between seasons. The sperm survival rate following thawing averaged 46,6% during the active season and yielded no seasonal pattern.

Seasonal variations in semen production were observed in the Angora ram with minor variations in semen quality between seasons.

References

COLAS, G. & BRICE, G., 1976. Seasonal variations of the fertilizing capacity of the deep-frozen ram semen. *Proc. VIIIth Int. Cong. Anim. Reprod. and A.I.* Cracow.

CORTEEL, J.M., 1978. Seasonal variations in motility and fertilising ability of goat spermatozoa. *Anim. Breed. Abstr.* 46, 41.

COUROT, M., 1976. Semen quality and quantity in the ram. *Proc. Int. Sheep Br. Cong.* Muresk.

HULET, C.V. & ERCANBRACK, S.K., 1962. A fertility index for rams. *J. Anim. Sci.* 21, 489.

HULET, C.V., FOOTE, W.C. & BLACKWELL, R.L., 1964. Effects of natural and electrical ejaculation on predicting fertility in the ram. *J. Anim. Sci.* 23, 418.

JENNINGS, J.J., 1976. Effect of season and mating frequency on semen characteristics in rams. *Proc. VIII th Int. Cong. Anim. Reprod. & A.I.* Cracow.

LOUBSER, P.G. & VAN NIEKERK, C.H., 1983. Seasonal changes in sexual activity and semen quality in the Angora ram. 1. Libido and male hormone concentrations. *S. Afr. J. Anim. Sci.* 13, 131.

MARAIS, J.F.K., 1968. Aspekte van die vroeë embrioniese ontwikkeling by die Angorabok en die invloed van voeding daarop. M.Sc. (Agric.) Thesis, University of Stellenbosch.

ROSSOUW, A.F., 1974. 'n Voorlopige mededeling oor die bevriesing van boerboksemen. *S. Afr. J. Anim. Sci.* 4, 165.

SKINNER, J.D. & VAN HEERDEN, J.A.H., 1971. The effect of daylength on the reproductive tract of the merino ram. *S. Afr. J. Anim. Sci.* 1, 77.

VAN DER WESTHUYSEN, J.M., WENTZEL, D., VILJOEN, K.S. & LOUBSER, P.G., 1980. Conception rates of Angora ewes inseminated with deep frozen semen. *S. Afr. J. Anim. Sci.* 10, 237.

VAN RENSBURG, S.W.J., 1974. In: "Breeding problems and artificial insemination". J.L. van Schaik (Ltd.), Pretoria.