Seasonal changes in sexual activity and semen quality in the Angora ram. 1. Libido and male hormone concentrations

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

The seasonal changes in libido and peripheral venous plasma concentrations of testosterone and luteinizing hormone of the Angora ram were investigated. A definite breeding season from March to the end of July was determined. Libido, as well as the levels of testosterone and luteinizing hormone followed a seasonal pattern with a change in photoperiod being the main stimulus for the seasonal sexual variations.
S. Afr. J. Anim. Sci. 1983, 13: 131 – 133

Die seisoenale veranderinge in geslagsdrif en manlike hormoonkonsentrasies in die perifere bloedplasma by Angoraramme was tydens hierdie studie ondersoek. Daar was gevind dat die Angoraram 'n seisoenale teler is met die verandering in sonliglengte die hoofstimulus vir veranderde geslagsdrif en manlike hormoonkonsentrasies. Die geslagsdrif van die Angoraramme het 'n piek bereik vanaf Maart tot Julie, met daarvoor en daarna 'n tydperk van relatiewe geslagsonaktiwiteit. Die konsentrasies van testosteroon en luteïniserende hormoon in die perifere bloedplasma van die Angoraram het ook 'n seisoenale patroon gevolg.
S.-Afr. Tydskr. Veek. 1983, 13: 131 – 133

Keywords: Season, photoperiod, environmental temperature, libido, testosterone, luteinizing hormone

From a thesis accepted for the M.Sc. degree by the Dept. of Human & Animal Physiology, University of Stellenbosch (1981)

P.G. Loubser*, C.H. van Niekerk and L.J.J. Botha*
Department of Human and Animal Physiology, University of Stellenbosch, Stellenbosch 7600, Republic of South Africa

*Present address: Agricultural Research Institute of the Karoo Region, Private Bag X 529, Middelburg 5900, Cape Province, Republic of South Africa

Received 10 May 1982

Introduction

Seasonal sexual quiescence of the Angora doe (van der Westhuysen, 1976) initiated the question of whether similar activity occurs in the Angora ram. Interactions between seasonal changes in photoperiod, environmental temperature and hypophyseal activity cause seasonal changes in male sexual activities (Jennings, 1976; Lincoln, Peet & Cunningham, 1977; Marais, 1968; Sanford, Palmer & Howland, 1977).

A seasonal variation in the levels of testosterone, luteinizing hormone, and to a lesser extent follicle stimulating hormone, in the peripheral venous plasma were detected in male pygmy goats (Muduuli, Sanford, Palmer & Howland, 1979) and in sheep (Falvo, Buhl, Reimers, Foxcroft, Dunn & Dzuik, 1975; Gomes & Joyce, 1975; Sanford *et al.*, 1977). The 'modulating effect' of changes in photoperiod on hypothalamo-hypophyseal activity may be responsible for these seasonal changes in testosterone and luteinizing hormone levels in the blood plasma (Pelletier & Ortavant, 1975).

This study was performed to determine the effect of seasonal changes in photoperiod and temperature on sexual activity and plasma testosterone and luteinizing hormone levels in the Angora ram.

Material and Methods

Seasonal changes in photoperiod and environmental temperature

The daily photoperiod (h/24 h) was measured and converted to a monthly average. The average daily temperature (°C) was calculated by means of the formula,

$$\text{average daily temperature (°C)} = \frac{\text{maximum temperature} + \text{minimum temperature}}{2},$$

and converted to a monthly average.

Sexual activity (libido)

Twelve Angora rams were tested weekly for libido for one year by recording their sexual interest and mating urge when introduced to a sexually active Angora doe. Libido was determined using the following index:

5: the doe is mounted and mating and ejaculation occur
3: the doe is mounted but ejaculation does not take place

1: the ram shows only slight interest in the doe
0: the ram ignores the doe
The average monthly libido index of the Angora rams was thus calculated.

Seasonal hormonal variation

During the breeding season peripheral venous plasma was taken weekly and thereafter every two weeks at a predetermined time of day (11h 00). The blood plasma was separated, frozen and stored at −12°C. The following assays were carried out:

Testosterone

Total venous plasma testosterone concentration was determined by radio-immuno-assay with a testosteronedihydrotestosterone RIA kit (TRK 600, Radiochemical centre, Amersham, England). A 5α dihydro (1, 2, 4, 5, 6, 7 -^{3}H) testosterone isotope with a total radio-activity of 4 μCi was used. The antiserum was specific for both testosterone and dihydrotestosterone and the radio-activity was measured with a Beckman (LS − 315OT) liquid scintillation counter.

Luteinizing hormone

Luteinizing hormone (LH) concentration was determined by the method of Dierkse (1978). Anti-LH-antiserum and anti-rabbit-gamma-globulin (ARGG) were produced locally.

Results

Table 1 and Figure 1 summarize the average monthly environmental temperatures and photoperiods. The seasonal

Table 1 Seasonal changes in environmental temperature and photoperiod

Month	Average Temperature (°C)	± Deviation	Average photoperiod (24h)	± Deviation
January	21,3	+ 1,4	10,3	+ 0,2
February	20,6	− 1,3	9,8	− 0,1
March	20,8	+ 0,7	9,5	+ 0,8
April	17,1	− 1,0	6,4	− 0,8
May	13,9	− 1,0	6,0	+ 0,5
June	13,2	− 0,4	5,0	+ 0,2
July	13,7	+ 1,6	5,6	+ 0,4
August	13,9	+ 1,8	5,7	+ 0,1
September	14,2	+ 0,9	7,2	+ 0,8
October	15,8	+ 0,2	8,8	+ 1,2
November	16,8	− 1,2	6,8	− 2,3
December	21,1	+ 1,7	10,8	+ 1,8

changes in environmental temperature and photoperiod correlate significantly ($P \leq 0,05$). A maximum environmental temperature of ± 20,9°C occurred during the months of January to March, thereafter decreasing to a minimum value of 13,2°C in June. It then increased gradually until September and then drastically to reach 21,1°C in December.

Daily photoperiod followed a seasonal pattern, related to environmental temperature, with the longest days from December to March (± 10 hours sunlight) and the shortest days in June (5 hours sunlight).

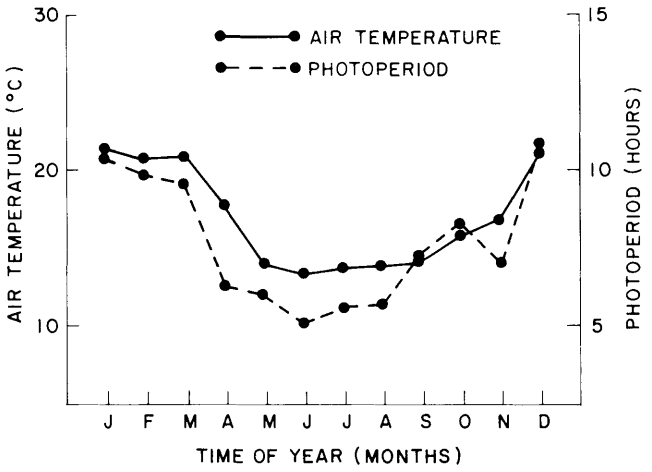

Figure 1 Variation in environmental (air) temperature and photoperiod

The average monthly libido index of the Angora rams is shown in Table 2 and Figure 2. The Angora ram was found to be sexually inactive during January, followed by a steep increase in sexual activity which reached a maximum of 4,8 in April. Sexual activity decreased from June to September reaching a period of sexual quiescence from September to December. Libido of the rams was significantly higher ($P \leq 0,05$) from March to June than in other months of the year. The seasonal variation of the plasma testosterone concentrations of the Angora ram is shown in Figure 3. During the first week of February the testosterone concentration was 5,13 ng/ml and thereafter a sharp increase was measured. A peak concentration of 10,9 ng/ml was determined at the beginning of March, denoting the onset of the active breeding season of the Angora ram. Fluctuations in the testosterone concentration occurred between the beginning of March and April and were followed by a decrease to a minimum level of 0,3 ng/ml at the end of August. This relatively low level of testosterone concentration was maintained until November whereafter a gradual increase occurred up to 7,34 ng/ml during February the next year.

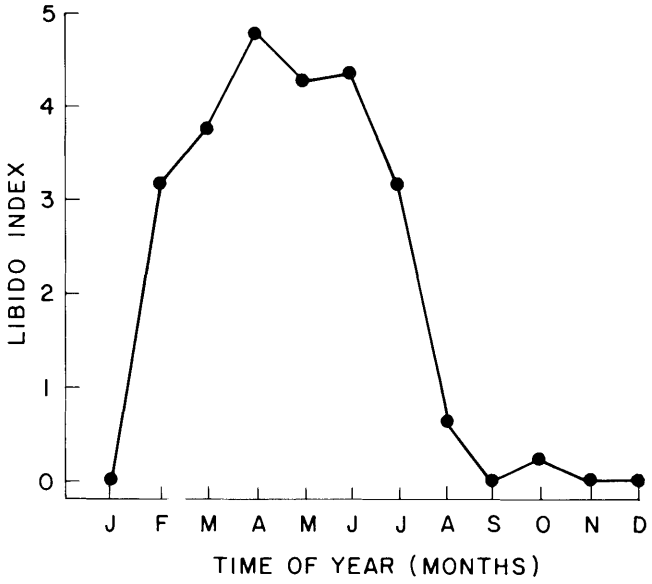

Figure 2 The effect of season on the libido of the Angora rams.

Table 2 Seasonal changes in libido of the Angora ram

Month	Libido index	S.D.	n
January	0,0	0,0	48
February	3,16[b]	2,04	24
March	3,75[a]	1,62	48
April	4,77[a]	0,65	60
May	4,29[a]	1,34	48
June	4,33[a]	0,96	24
July	3,14[b]	1,94	36
August	0,63[b]	1,69	24
September	0,0	0,0	24
October	0,26[c]	0,58	24
November	0,0	0,0	24
December	0,0	0,0	12

Values with the same superscript do no differ significantly ($P \leq 0,05$)

The seasonal changes in luteinizing hormone concentration are shown in Figure 3. The luteinizing hormone concentration was approximately 2,7 ng/ml during February and increased to a level of 5,24 ng/ml at the end of April. A peak of 7,58 ng/ml was reached at the beginning of June and a relatively high level of luteinizing hormone was maintained until October, whereafter the level decreased to a minimum of 2,27 ng/ml in December. By February, the following year, the luteinizing hormone concentration had increased to 3,84 ng/ml.

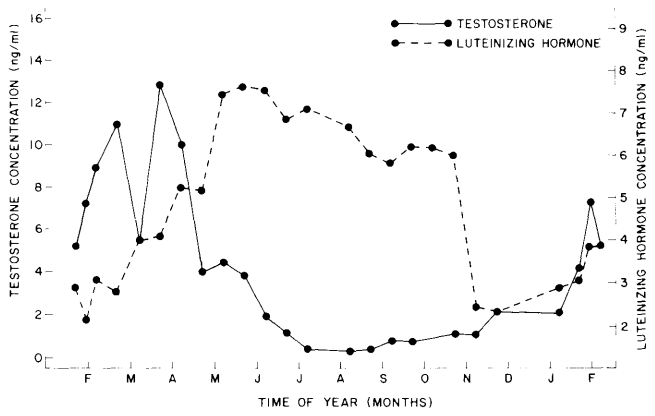

Figure 3 Monthly variations in venous plasma testosterone and luteinizing hormone concentrations of the Angora ram.

Discussion

A maximum average photoperiod of 10,8 h/24 h and a minimum of 5,0 h/24 h were found in December and June respectively. A significant ($P \leq 0,05$) correlation between photoperiod and environmental temperature was found.

Relating this to similar characteristics in sheep breeds (Jennings, 1976; Lincoln *et al.*, 1977 and Sanford *et al.*, 1977), a negative relationship between photoperiod and male sexual activity was found in the Angora ram. The Angora ram thus has a definite breeding season, from March to the end of July, with a period of sexual quiescence from August to the beginning of February.

Corresponding with the findings of Muduuli *et al.* (1979) in pygmy goat rams, plasma testosterone and luteinizing hormone concentrations of the Angora ram also showed a seasonal pattern. A maximum testosterone concentration of 15,86 ng/ml in April and a minimum of 1,17 ng/ml in September were recorded. The luteinizing hormone concentration yielded a maximum of 8,18 ng/ml in May and a minimum of 1,86 and 1,75 ng/ml in February and December respectively. Although both the testosterone and luteinizing hormone concentrations varied seasonally, little or no relationship was found between them.

References

DIERKSE, E., 1978. Verandering in serum progesteroon en luteïniserende hormoon peile na sinkronisasie van estrus by skape. M.Sc. (Agric.) thesis, Univ. of Stellenbosch.

FALVO, R.E., BUHL, A.E., REIMERS, T.J., FOXCROFT, G.R., DUNN, M.H. & DZUIK, P.J., 1975. Diurnal fluctuations of testosterone and LH in the ram: Effect of HCG and gonadotrophic-releasing hormone. *J. Reprod. Fert.* 42, 503.

GOMES, W.R. & JOYCE, M.C., 1975. Seasonal changes in serum testosterone in adult rams. *J. Anim. Sci.* 41, 1373.

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

LINCOLN, G.A., PEET, M.J. & CUNNINGHAM, R.A., 1977. Seasonal and circadian changes in episodic release of FSH, LH and testosterone in rams exposed to artificial photoperiods. *J. Endocrin.* 72, 337.

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

MUDUULI, D.S., SANFORD, L.M., PALMER, W.M. & HOWLAND, B.E., 1979. Secretory patterns and circadian and seasonal changes in luteinizing hormone, follicle stimulating hormone, prolactin and testosterone in the male pygmy goat. *J. Anim. Sci.* 49, 543.

PELLETIER, J. & ORTAVANT, R., 1975. Photoperiodic control of LH release in the ram. *Acta Endocr. (Kbh.)* 78, 435.

SANFORD, L.M., PALMER, W.M. & HOWLAND, B.E., 1977. Changes in the profiles of serum LH, FSH and testosterone, and in mating performance and ejaculate volume in the ram during the ovine breeding season. *J. Anim. Sci.* 45, 6.

VAN DER WESTHUYSEN, J.M., 1976. Induction of breeding activity in anoestrus Angora goat does: Effect of progestagens, PMSG and teasing. *Agroanimalia* 8, 165.