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GROSS OVARIAN CHANGES IN THE CYCLING AND ANOESTROUS ANGORA GOAT DOE

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OPSOMMING: VERANDERINGE IN DIE OVARIA VAN ANGORABOKOOIE GEDURENDE DIE ESTRUSSIKLUS EN ANESTRUS

Follikelaktiwiteit neem vinnig toe in die ovaria gedurende die eerste 12 dae van die luteale periode om dan 'n tydelike plato-waarde te bereik. 'n Hernude groeigolf neem in die follikels 'n aanvang teen pro-estrus en eindig met ovulasie gedurende laat estrus. Die grootste en tweede grootste follikels in die ovaria van 'n ooi volg nagenoeg dieselfde groeipatroon as die totale follikelaktiwiteit. Die grootste aantal, asook die hoogste gemiddelde follikeldeursnit word net vóór of net ná die aanvang van bronstigheid aangetref. Die periode van anestrus word deur verlaagde follikelaktiwiteit gekenmerk, alhoewel relatiewe groot individuele follikels in die ovaria aanwesig is. Die corpus luteum word deur 'n periode van snelle groei gekenmerk wat tot ongeveer die mid-luteale fase (Dag 12) van die bronstigheidsiklus duur, wanneer maksimum grootte en gewig bereik word. Hierna begin degenerasie in die corpus luteum intree, aanvanklik stadig maar agteruitgang versnel aanmerklik namate die volgende periode van estrus nader. Teen ongeveer 40 dae na die oorspronklike ovulasie, is die ou corpus luteum (corpus albicans) byna nie meer makroskopies sigbaar nie. In 28% van die corpora lutea in bokooie wat vorige normale bronstigheidskringlope vertoon het, word sentrale holtes aangetref met 'n gemiddelde deursnee van 3,7 mm (1,9 tot 8,9 mm).

SUMMARY

Ovarian follicular activity increased sharply during the first 12 days of the luteal period, then ceased temporarily. Renewed follicle growth commenced towards pro-oestrus and terminated in ovulation. Although follicular activity decreased considerably during the period of anoestrus, relative large individual follicles were present in the ovaries. Following a period of active growth the corpus luteum attained maximum size and weight during the mid-luteal phase (Day 12) of the cycle. After Day 12 the corpus luteum began to regress and degeneration accelerated at the time of oestrus. In a large number of corpora lutea (28%) central cavities were observed, ranging in diameter from 1,9 to 8,9 mm (mean 3,7 mm).

Several reports have been published on changes occurring in the ovaries of common domestic animals, especially those changes during the oestrous cycle (Quinlan & Maré, 1931; Grant, 1934; Rajakoski, 1960; Hutchinson & Robertson, 1966). Küper (1928) reported some general morphological observations on the ovaries of some European and South African goat breeds, but a detailed quantitative investigation and time relationships in which changes took place was not carried out. Nor is information available on the cyclic changes occurring in the ovaries of the Angora doe. During the course of a study on the gonadotrophic hormone activity of the anterior pituitary gland in the Angora goat, data were collected on follicular and corpus luteum growth during the ovarian cycle and is the object of this report.

Procedure

Angora does, showing regular oestrous cycles (mean cycle length 20,2 days) were killed during each of the following reproductive stages: Pro-oestrus (Day – 1); early oestrus (Day 0; 4 hr following the onset of behavioural oestrus); late oestrus (Day 1; 36 hr following the onset of oestrus); early luteal phase (Day 6); mid luteal phase (Day 12); late luteal phase (Day 18) and early, mid and late anoestrus (the date of slaughter determined by the onset, middle date and end of the previous anoestrous period). Six does were killed during each stage, except during early and mid anoestrus in which only five animals were slaughtered. Oestrus was detected with the aid of vasectomised teaser rams. The animals were slaughtered at the local abbatoir, situated about 200 m away from the feeding pens. Care was taken not to subject the does to any conditions of stress prior to slaughter.

Both ovaries were removed, dissected free from adherent tissue and fixed in Bouin's fluid for at least 14 days. Each ovary was subsequently cut serially into approximately 1 mm slices with a sharp razor blade. The number and diameter of all macroscopical follicles, corpora lutea and corpora albicantia ≥ 1 mm in diameter was recorded. The diameter of the largest and second largest follicles in the two ovaries was recorded individually. Care was taken not to count or measure the same follicle twice. When a structure was not spherical the mean diameter at rectangles was taken. The corpus luteum was dissected from the serially cut ovarian sections and weighed. The results were analysed according to standard statistical procedures (Snedecor, 1966).

Results

Follicular activity

Ovarian follicular activity, in terms of total follicle volume (mean for two ovaries), increased sharply and highly significantly ($P < 0,01$) during the first part of the luteal period (Day 1 to Day 12) when a plateau value was reached (Fig. 1). This was followed by another short, but intense follicle growth wave towards oestrus, commencing

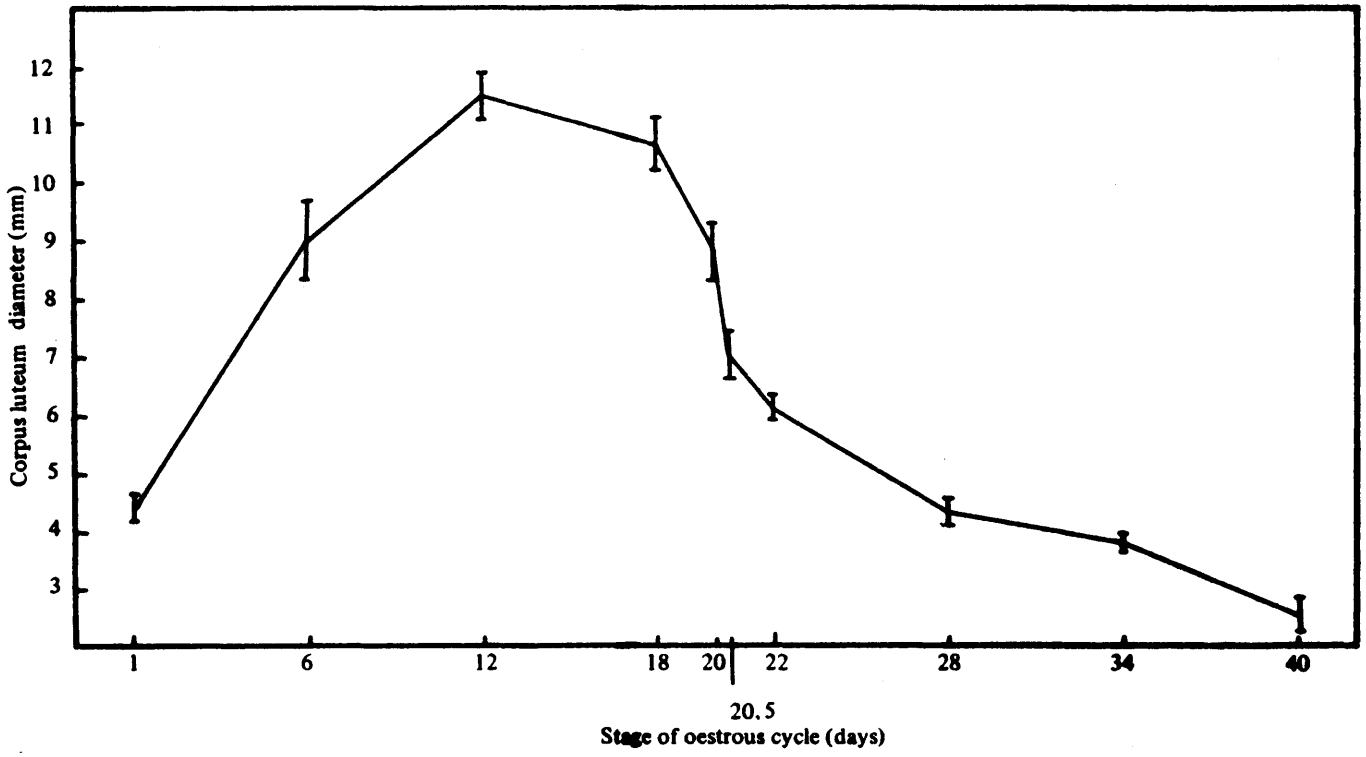

Fig. 1. – *Growth and retrogression of the corpus luteum during the oestrous cycle in Angora goat does (Mean ± S.E.)*

Table 1

Ovarian follicular activity in Angora goat does during different stages of the oestrous cycle and in anoestrus (Mean ± S.E.)

Reproductive stage	Total follicle number	Mean follicle diameter (mm)	Frequency distribution of follicles						
			≤ 1 (mm)	1,1–2,0 (mm)	2,1–3,0 (mm)	3,1–4,0 (mm)	4,1–5,0 (mm)	5,1–6,0 (mm)	> 6,1 (mm)
Oestrous cycle									
Pro-oestrus (Day–1)	22,3 ± 2,2	1,6 ± 0,1	9,9 ± 2,0	7,5 ± 0,9	2,5 ± 0,5	0,8 ± 0,7	0,5 ± 0,2	0,7 ± 0,2	0,7 ± 0,1
Early oestrus (Day 0)	26,4 ± 5,4	1,7 ± 0,1	10,6 ± 3,2	8,2 ± 0,9	5,8 ± 1,8	0,7 ± 0,7	0,2 ± 0,1	0,3 ± 0,1	0,8 ± 0,2
Late oestrus (Day 1)	19,2 ± 1,6	1,6 ± 0,1	6,8 ± 0,6	7,0 ± 0,5	4,0 ± 0,6	0,9 ± 0,2	0,5 ± 0,2	0,1 ± 0,1	–
Early luteal phase (Day 6)	19,1 ± 2,1	1,4 ± 0,1	9,3 ± 1,1	6,4 ± 0,8	1,8 ± 0,5	0,3 ± 0,1	0,3 ± 0,1	0,3 ± 0,1	0,6 ± 0,1
Mid luteal phase (Day 12)	18,4 ± 2,5	1,8 ± 0,1	8,5 ± 1,5	5,4 ± 1,3	1,7 ± 0,5	0,8 ± 0,2	0,7 ± 0,2	0,6 ± 0,2	0,8 ± 0,3
Late luteal phase (Day 18)	25,0 ± 3,3	2,0 ± 0,2	9,0 ± 1,7	8,8 ± 1,4	4,8 ± 0,9	1,9 ± 0,6	0,8 ± 0,2	0,2 ± 0,2	0,8 ± 0,3
Anoestrus									
Early anoestrus	25,0 ± 3,6	1,6 ± 0,1	7,3 ± 1,7	12,2 ± 2,1	3,6 ± 0,7	1,0 ± 0,2	0,5 ± 0,2	0,2 ± 0,1	0,3 ± 0,2
Mid anoestrus	19,6 ± 2,1	1,9 ± 0,2	5,5 ± 1,1	6,0 ± 1,1	6,1 ± 0,5	0,9 ± 0,3	0,6 ± 0,2	0,5 ± 0,2	0,1 ± 0,1
Late anoestrus	13,5 ± 2,0	1,9 ± 0,2	3,8 ± 0,7	4,8 ± 1,0	3,1 ± 0,7	0,7 ± 0,2	0,4 ± 0,2	0,4 ± 0,2	0,3 ± 0,1

at about pro-oestrus, which terminated in ovulation.

The largest follicle in the ovaries of a doe followed almost the same growth pattern as that recorded for mean total follicle volume. The second largest follicle also grew rapidly in size ($P<0,01$) during the early luteal phase of the cycle. However, from Day 12 until early oestrus of the next cycle a slight but continuous decrease in size of this follicle occurred (Fig. 1).

During the period of anoestrus ovarian follicular activity equalled that recorded during the early stages of the di-oestrous period in cycling females. Nevertheless, the data in Fig. 1 illustrates that relatively large individual follicles were present in the ovaries of anoestrous does. An average diameter of 6,0 mm was recorded for the largest follicle during this period of sexual quiescence.

The largest number of follicles was recorded just prior to and following the onset of oestrus. Mean follicle diameter was also higher around the time of occurrence of oestrus compared to the rest of the di-oestrous period (Table 1). The incidence of large and medium sized follicles varied with the stage of the cycle, as proved by the frequency distribution of follicles in Table 1, but never exceeded 15% of the total number of ovarian follicles.

A relatively large number of follicles were present in the ovaries of does killed at the onset of anoestrus, but declined as the period of anoestrus advanced. However, mean follicle diameter remained fairly high during the period of sexual quiescence, due to the presence of large individual follicles in the ovaries (Table 1).

Corpus luteum growth and retrogression

Following ovulation the newly formed corpus luteum increased rapidly in size and weight ($P < 0,01$) during the first 12 days of the luteal period (Fig. 2 and Table 2). After maximum size and weight was attained at Day 12, the corpus luteum began to regress. Enhanced retrogression set in around the time the following oestrous period was due. At the time the next heat period has commenced, the corpus luteum had already decreased some 35% in size and 76% in weight ($P<0,01$). This retrogression continued during the rest of the luteal period until the old corpus luteum (corpus albicans) was hardly discernible macroscopically in the ovarian stromal tissue at Day 40 (two cycles from the original ovulation). In 28% of the corpora lutea from normally cycling does central cavities were recorded. These cavities ranging in diameter from 1,9 to 8,9 mm with a mean diameter of 3,7 mm.

Discussion

The cyclic changes in the ovarian follicular system of the Angora goat agree well with the general ovarian changes described by Küpfer (1928) and the follicular changes reported on by Harrison (1948) in other goat breeds. In the bovine female, Rajakoski (1960) observed also two waves of follicular growth during the oestrous cycle. Quinlan & Maré (1931), Marincowitz (1964) and Hutchinson & Robertson (1966) reported cyclic ovarian follicular changes in sheep which correspond in general to those recorded in the present study. However, Grant (1934) and Kammlade, Welch, Nalbandov & Norton (1952) presented evidence of a steady, but continuous increase in ovarian

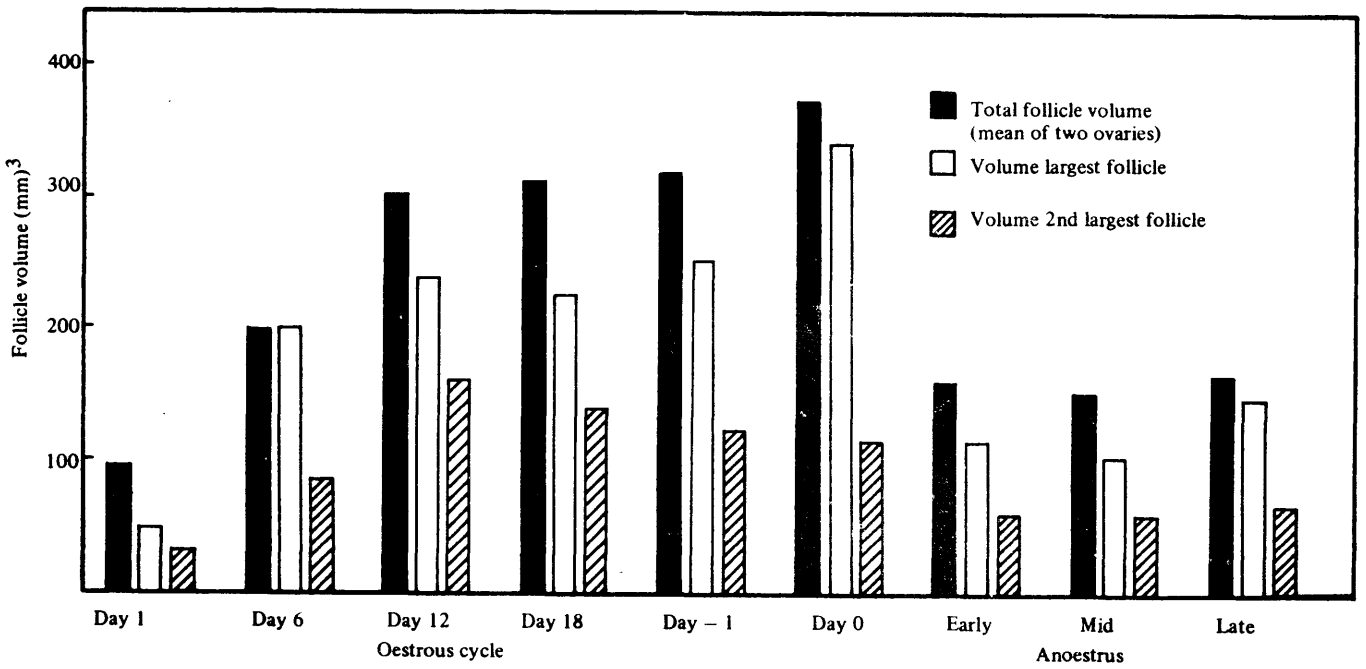

Fig. 2. – *Changes in ovarian follicle volume during different stages of the oestrous cycle and anoestrus in Angora goat does*

follicular activity during the whole oestrous cycle in the ewe.

Table 2

Weight of the corpus luteum in Angora goat does during different stages of the oestrous cycle (Mean ± S.E.)

Stage of cycle	Age of C.L. (Days)	Weight (mg)
Late oestrus	1	42,2 ± 3,1
Early luteal phase	6	378,8 ± 72,3
Mid luteal phase	12	835,3 ± 67,8
Late luteal phase	18	616,7 ± 56,3
*Pro-oestrus	20	377,3 ± 46,8
*Early oestrus	20,5	203,3 ± 28,7
*Late oestrus	22	168,8 ± 23,4

*Stages of subsequent oestrous cycle.

Although ovarian follicular activity is low during the period of anoestrus, large individual follicles were recorded in the ovaries of anoestrous does. However, these follicles did not ovulate during this period of sexual quiescence. Similar observations were reported on the ovaries of anoestrous ewes by Kammlade *et al.* (1952) and Hutchinson & Robertson (1966). It appears that the large follicles which had developed during the active breeding season were maintained in some way during the period of anoestrus.

The growth and retrogressional changes in the cyclic corpus luteum of the Angora doe was similar to other goat breeds (Harrison, 1948) and sheep (Restall, 1964; Deane, Hay, Moore, Rowson & Short, 1966; Hutchinson & Robertson, 1966). The corpus luteum of the doe attained maximum size and weight somewhat later than that of the ewe (Day 12 cf. Day 10), due to the longer oestrous cycle in the doe.

The presence of central cavities in a large number of corpora lutea in normally cycling does posed the question whether such corpora lutea should be regarded as cystic. However, according to Donaldson & Hansel (1968) such corpora lutea cannot simply be regarded as pathological unless substantial evidence can be produced associating cystic corpora lutea with reproductive disorders. The records on regularity in periodicity of oestrus of the does in the present study certainly excluded such a possibility. Luteinisation was probably retarded in such animals.

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