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Studies on follicular dynamics and endocrine profile in cyclic non-descript goats

T. SARATH[1], S. MEHROTRA[2†] S.K. AGARWAL[3], V.P. VARSHNEY[4], M. HOQUE[5], UMA SHANKAR[6] AND S.K. SINGH[7]

Animal Reproduction Division
Indian Veterinary Research Institute, Izatnagar - 243 122 (UP)

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ABSTRACT

The present investigation was conducted to study the follicular dynamics and endocrine profiles in seven non-descript cyclic goats. Follicular population, dimension and corpus luteum development was studied through real time B-mode transrectal ultrasonography. Serum endocrine estrogen, progesterone, tri-iodo-thyronine and thyroxine concentrations were estimated by Radioimmunoassay. It was recorded that the medium sized and total follicular population was significantly higher on day 12 when compared to day 0, 4, 8, 16 and 20 of the cycle. There was no appreciable difference in follicular diameter between different days. However, the diameter of the large follicle was maximum on day of estrus. The diameter of the corpus luteum was found to increase from day 8 reaching maximum by day 16 and was undetected on day 20 of the cycle. Findings revealed that the peak values of serum estrogen. T3 and T4 concentrations observed on day of estrus were significantly higher as compared to day 4, 8, 12, 16 and 20 of the cycle. The progesterone level started to increase from day 4, attaining peak on day 16, thereafter started declining and reached basal values on day 20 of the cycle.

Key words : Follicular dynamics, endocrine profiles, cyclic, goats

Goat, an important economic livestock species, contributes greatly to agrarian Indian economy. It received more importance mainly on account of their short generation interval, higher rates of prolificacy, readily adaptability to almost any climatic condition and the ease with which they can be marketed. It provides a dependable source of livelihood to rural population below the poverty line in India and to many who do not possess any land.

The understanding of the dynamics and regulation of follicular development in the goat has increased in recent years with the use of ultrasonography. However, the applications of this technique for ovarian studies in small ruminants were delayed for about 10 years compared to its use in large animals.(Adams, 1999). The follicular development is still not properly understood in this species and needs further investigations. Keeping this is consideration the present study was undertaken to record the follicular dynamics and serum endocrine profiles in normal cyclic non-descript goats.

MATERIALS AND METHODS

Seven cyclic non-descript female adult goats of 2-3 years of age maintained at experimental animal shed of Animal Reproduction Division, were taken as the experimental animals for the study. The does were selected on the basis of detection of estrus twice daily (morning and evening) using apronized buck and observation of estrus signs as described by Jainudeen and Hafez (1994). The goats were maintained under uniform feeding and managemental conditions. The animals were kept in intensive system and fed with concentrate mixture @ 300 g/animal/day in addition to green fodder and water *ad libitum*.

All the animals were subjected to twice in a week (day 0, 4, 8, 12, 16 and 20) ultrasonographic scanning of ovaries using real time B-mode scanner equipped with 6.0 MHz linear array transducer (Pie Medical, Netherlands) to examine follicular and luteal development. The goats were prepared for transrectal ultrasonography. They were kept off feed 12 hrs prior to scanning. Animals were restrained in the standing position and faecal pellets

[1]Ph.D. Scholar
[2]Senior Scientist
[3,6]Principal Scientist
[4]Principal Scientist, Physiology & Climatology Division
[5]Senior Scientist, Surgery Division
[7]Scientist

[†]Corresponding author

were removed from rectum digitally. As a coupling medium carboxymethyl cellulose gel was applied over transducer and manipulated in rectum to view the urinary bladder, cervix and caudal uterus. After the cervix and uterus are found the transducer was rotated 45-90° clockwise and anticlockwise to locate the ovaries. Follicles were counted, measured and classified according to Khan (2001) as small (<3.0 mm), medium (3-4 mm) and large (>4.0 mm). The diameter as well as number of corpus luteum (CL) was also measured in similar way. Both the ovaries were scanned one by one.

Blood samples from the experimental goats were collected through jugular venepuncture in a sterilized vial on the day of ultrasonographic scanning. Serum was separated and stored at -20°C until analysis. Serum estrogen, progesterone, Tri-iodo-thyronine (T3) and thyroxine (T4) estimations were carried out by Radioimmunoassay (RIA) using the diagnostic I^{125} kits supplied by Immunotech, France. The data was analysed statistically using paired `t' test (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

The average number of small, medium, large and total follicles varied between 2.1±0.23 to 2.9±0.17, 4.1±0.24 to 5.6±0.32, 3.0±0.29 to 5.5±0.00 and 10.1±0.24 to 12.6±0.32 respectively, during different days of estrous cycle (Table 1). The medium sized and total follicle populations on day 12 were significantly higher ($P < 0.01$) indicating that the follicular turnover increases as the luteal phase progresses, which might be due to the higher progesterone levels during luteal phase. Progesterone promotes the follicular development and decreases duration of interweave-interval of the cycle (Ginther and Kot, 1994; de Castro *et al.*, 1999).

As depicted in Table 2, the mean diameter of medium and large follicles ranged between 3.5±0.02 to 3.6±0.04 and 4.3±0.39 to 4.7±0.14, respectively. There was no appreciable difference in the follicular diameter between different days of estrous cycle. However, the diameter of large follicle was maximum (4.7±0.14) on day of estrus which is in agreement with Ginther and Kot (1994) and de Castro *et al.* (1999). The phenomenon of follicular dominance is poorly defined in caprine estrous cycle (Ginther and Kot, 1994), which could be a reason for finding minor variation in the large follicle diameter under present study.

Corpus luteum development : Ultrasonographic scanning revealed that diameter of CL was 5.5±0.10 mm on day 8 followed by further increase on day 12 (6.07±0.16 mm) attaining maximum diameter on day 16 (6.8±0.20). CL was undetected on day 20 of the estrous cycle. The findings are in accordance with Ginther and Kot (1994), deCastro *et al.* (1999) and Medan *et al.* (2003). Mean dimension of

Table 1. Follicular population on different days of estrous cycle in goats (Mean±SE)

Category of follicles	Days					
	0	4	8	12	16	20
Small (<3.0 mm)	2.1±0.23	2.7±0.34	2.7±0.18*	2.9±0.17**	2.8±0.49	2.2±0.14
Medium (3-4 mm)	4.1±0.24	4.3±0.28	4.5±0.28	5.6**±0.32	4.6±0.48	4.9±0.20*
Large (>4.0 mm)	5.5±0.00	4.3±0.40*	4.0±0.38**	3.9±0.3**	3.5±0.59*	3.0±0.29*
Total	11.7±0.29	11.3±0.44	11.2±0.42	12.6**±0.32	10.9±0.65	10.1±0.24*

Means bearing superscripts(*) indicates significant difference from day 0 mean values ($P < 0.05$)
Means bearing superscripts (**) indicates significant difference from day 0 mean values ($P < 0.01$)

Table 2. Diameter of medium and large size follicles on different days of estrous cycle in goats (Mean±SE)

Category of follicles	Days					
	0	4	8	12	16	20
Medium (3-4 mm)	3.5±0.02	3.5±0.02	3.6±0.03	3.5±0.04	3.5±0.02	3.6±0.04
Large (>4.0 mm)	4.7±0.14	4.6±0.09	4.4±0.07*	4.5±0.07	4.6±0.04	4.3±0.06

Means bearing superscripts (**) indicates significant difference from day 0 mean values ($P < 0.05$)

Table 3. Serum estrogen (pg/ml) and progesterone (ng/ml) concentrations on different days of estrous cycle in goats (Mean±SE)

Hormones	Days					
	0	4	8	12	16	20
Estrogen	26.32±1.02	3.60±0.38**	11.11±0.34**	3.07±0.22**	2.50±0.09**	25.62±0.25**
Progesterone	0.55±0.16	1.60±0.21**	4.40±0.62*	4.08±0.66**	4.79±0.84**	0.42±0.07

Means bearing superscripts (*) indicates significant difference from day 0 mean values (P < 0.05)
Means bearing superscripts (**) indicates significant difference from day 0 mean values (P < 0.01)

CL recorded in our study on day 8 and 12 are corresponding with Khan (2001). Mean no. of CL recorded in present study was higher (1.42±0.20); compared to 1.28±0.18 (Khan, 2001) which could be due to breed, individual or seasonal variability in CL morphometry.

Endocrine profiles

Estrogen : The serum estrogen level during different days of estrous cycle has been depicted in Table 3. Concentrations varied between 2.50±0.09 pg/ml to 26.32±1.02 pg/ml. The peak values of estrogen observed on day of estrus (26.32±1.02 pg/ml) were significantly higher (P < 0.01) as compared to day 4, 8, 12, 16 and day 20 of the cycle. Higher level of estrogen (15.10 - 60.11 Vs 4.16 - 10.95 pg/ml) has been recorded in goats having larger (5-8 mm diameter) than medium (2-3 mm diameter size follicles and the circulatory level of estrogen attains peak (11-16 pg/ml) on the day of estrus (Jain and Madan, 1986). It declines gradually following estrus and fluctuates at basal level (3-5 ng/ml), resembling the findings of the present study.

de Castro *et al.* (1999) demonstrated that serum estrogen concentrations increased from day of ovulation to day 2-3 post ovulation and then decreased to basal levels on day 12. After this early rise, the concentrations remained low until a sharp increase that occurred in coincidence with declining progesterone concentration (luteolysis). These findings also confers the observation recorded in the present study, as the early rise in estrogen concentration between day 4 and 8 (3.60 to 11.11 pg/ml) and late increase between day 16 and 20 corresponding to luteolysis (2.50 to 25.62 pg/ml) has been noticed. The large follicles that grow during the mid luteal phase do not produce higher level of estrogen probably due to high concentration of progesterone, which inhibits pulsatile LH secretion, leading to lower levels of stimulation to the follicles (Rubians and Menchaca, 2003).

Progesterone : The serum progesterone concentrations varied between 0.42±0.07 ng/ml to 4.79±0.84 ng/ml (Table 3). The progesterone level started to increase from day 4 onwards and reaching peak on day 16 thereafter declined to basal values on day 20. Concentrations were significantly higher (P < 0.01) on day 4, 8, 12 and day 16 of estrous cycle as compared to day 0 and day 20

Similar trend of progesterone levels was reported in goats by de Castro *et al.* (1999) and Medan *et al.* (2003). The serum progesterone concentrations are positively correlated with size of CL. Kastelic *et al.* (1990) reported a parallel change in plasma progesterone in heifers with change in ultrasonic cross sectional area of CL. The higher progesterone values (ranging between 0.13±0.01 to 7.64±0.24) has been obtained by Chandra (2004) compared to our study.

Thyroid hormone : The serum T_3 and T_4 concentrations on different observation days were ranging between

Table 4. Serum Tri-iodo thyronine and thyroxine concentrations (ng/ml) on different days of estrous cycle in goats (Mean±SE)

Hormones	Days					
	0	4	8	12	16	20
Tri-iodo-thyronine	1.37±0.13	0.96±0.06*	1.06±0.23	0.85±0.10*	0.71±0.06**	0.88±0.17**
Thyroxine	85.98±6.55	65.38±4.14*	72.57±4.56*	62.72±5.14	56.92±4.49*	61.42±0.29*

Means bearing superscripts (*) indicates significant difference from day 0 mean values (P < 0.05)
Means bearing superscripts (**) indicates significant difference from day 0 mean values (P < 0.01)

0.71±0.06 to 1.37±0.13 ng/ml and 56.92±4.49 to 85.98±6.55 ng/ml, respectively (Table 4).

The corresponding values of T_3 and T_4 on day 4, 8, 12, 16 and 20 were recorded lower than the values on day of estrus. The concentrations of T_3 and T_4 on day of estrus are in close conformity with the findings of Bhattacharya *et al.* (1994), who opined that the higher values of T_3 and T_4 during estrus may possibly be associated with the increase in estrogenic activity of body. Administration of estrogen on androgen causes alteration in the binding of thyroid hormones in plasma and elevation of T_3 and T_4 concentration in blood might be due to the increased concentration of thyroid binding globulin as a result of high estrogen level (Williams, 1974).

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