



## The Estrous Cycle of the Markhoz Goat in Iran

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**ABSTRACT :** The purpose of the present study was to determine the onset of breeding season, the occurrence of silent and true heats and the duration of estrus in female Markhoz goats of the Kurdistan province in Iran. Ten, 3 years-old Markhoz does with an average weight of  $34.05 \pm 2.62$  kg and with one kidding record, were used. The goats were maintained in an open barn under constant nutritional levels and natural photoperiod. One aproned buck was used twice a day every 12 h to detect estrus from mid August to early January. For the determination of the onset of reproductive activity as well as occurrence of silent heat, blood samples were collected every 10 days, from the beginning of the experiment. After 2<sup>nd</sup> standing heat, blood samples were obtained twice a week in order to assess luteal activity and the length of estrous cycles. In this study, estrous behavior was observed including sniffing, vocal exchange, following courtship, flehman, standing heat and mounting. The results of the progesterone assay indicated that in this goat silent heats occur mostly in the early breeding season. The first standing heat was observed in mid-October which was considered as the onset of the breeding season. Duration of the estrous cycle and estrus was recorded as being  $20.93 \pm 1.56$  days and  $38.86 \pm 15.19$  h, respectively. The correlation coefficient between length of daylight and occurrence of estrus was negative ( $r = -0.470$ ) but not significant ( $p > 0.05$ ). The data showed that there was no significant effect of body weight on estrous cycles (first, second and third) and estrous periods (first, second, third and fourth). Progesterone levels were not significantly different in the first, second and third estrous cycles at days 0, 4, 10, 12, 14 and 19. The results of progesterone assay during the estrous cycle indicate that follicular and luteal phases last 4-5 and 14-15 days, respectively and the concentration of serum progesterone in these phases was  $0.88 \pm 0.08$  and  $7.44 \pm 0.26$  ng/ml, respectively. The study concluded that Markhoz does could be considered as a breed with a short breeding season and an optimal estrous activity in autumn. (**Key Words :** Breeding Season, Estrous Cycle, Silent Heat, Progesterone, Markhoz Goat)

### INTRODUCTION

Today around 25,000 Markhoz (Angora) goats are raised in Kurdistan province of Iran and produce 20 ton of mohair annually. The mohair obtained from these animals has important cultural role and uses for making of local clothes in Kurdistan and they also provide a major source of red meat in Iran (102,000 ton per year). These small ruminants are easy to handle, withstand harsh conditions (Zarkawi and Soukouti, 2001) and are found in many arid and semi-arid areas where they are used as multipurpose animals for the production of milk, meat, hair and hide (Amoah et al., 1996; Rashidi, 2000; Zarkawi and Al-Masri, 2002).

Knowledge of the breeding season of these animals is important in flock management (Bathaei, 1996), and in

order to determine the reproductive and productive potential of the Markhoz goats, a thorough knowledge of the reproduction physiology is essential. There has been no systemic study of seasonal trends in reproductive patterns of Markhoz goats in Iran and this information is needed if optimum breeding programs are to be developed.

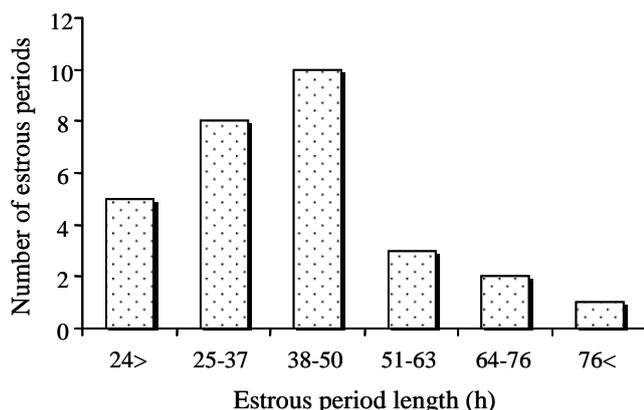
In general the breeding season appears to extend over the whole year but at latitudes greater than 35° S or 40° N it is reduced to the early autumn/late winter. Although the photoperiod is considered as the primary environmental cue, a wide range of periods of breeding activity in this species have been observed under similar photoperiodic cues (Santiago-Moreno et al., 2006). In goats the reproductive patterns reflect the expression of a self-sustained endogenous rhythm which is synchronized or entrained by the photoperiod (Chemineau et al., 1992b; Rivera et al., 2003). However, other environmental stimuli, such as availability of food and social interactions (Restall, 1992; Restall et al., 1995), should not be discarded as potential regulators of seasonal reproduction.

The present study was conducted to determine the

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**Figure 1.** Frequency distribution of estrous duration in Markhoz does.

normal incidence of estrous cycles in Markhoz does in Iran so that more efficient breeding programs could be developed.

## MATERIAL AND METHODS

### Animal and management

This experiment was performed at the testing station, located in Sanandaj, 35° 20' N latitude and 47° E longitude and lasted from mid-August to early January. The experiment was carried out on ten, 3 year old does with a mean weight of 34.05±2.62 kg and with one kidding record. The animals were kept under natural photoperiod, and nutritional levels were adjusted to meet maintenance requirements (NRC, 1981). Goats were fed twice a day with a diet of 530 gr alfalfa hay, 190 gr barley straw and 300 gr concentrates. They had free access to water and mineral blocks. In addition, animals were dewormed (Albendazole, Sigma, USA) at the beginning of experiment.

Live weight was recorded at monthly intervals during the experiment. For determination of the onset of reproductive activity as well as occurrence of silent heats, blood samples were collected at 8 a.m every 10 days, using syringes without anticoagulant. Following the onset of breeding season and observation of the 2<sup>nd</sup> standing heat, blood samples were collected twice a week in order to determine luteal activity and the length of estrous cycles.

Blood samples were centrifuged within 1 h of collection at approximately 3,500 rpm for 15 min and serum stored at -20°C for later progesterone assay. Estrous detection was carried out twice a day for 1 h (a.m and p.m) using an aproned buck which was kept in a separate barn. Does that exhibited a tail-flagging response and stood for mounting were considered to be in estrus (Jarrell and Dziuk, 1991).

### Progesterone assay

The progesterone concentration was determined in

serum using a progesterone (RIA) kit for ovine (Immunotech, Abbeckman Coulter company-France). The intra- and inter-assay coefficients of variation were 5.8% and 9% respectively, with an analytical sensitivity for assay of 0.05 ng/ml.

Duration of behavioral estrus was defined as the time elapsed between the first and the last detection of behavioral estrus during the same estrous period while estrous cycle duration was defined as the number of days between the onsets of two consecutive estrous periods (Chemineau et al., 1992a). In estimating the duration of the estrous period, it was assumed that its onset and cessation were half-way between observations, this period of time being added to the interval between the first and last detection (Bathaei, 1996).

Estrous cycles length were classified according to Chemineau et al. (1992a) as short (<17 days), normal (17-25 days) or long (>25 days). Estrous period length was classified according to distribution of times: 12-36 h, 37-61 h and 62-86 h. When an increase in serum progesterone levels above 1.0 ng/ml in at least two consecutive samples was not preceded by detected estrous behavior, it considered to be a silent heat (Rivera et al., 2003).

### Statistical analysis

Estrous characteristics and duration were recorded by visual observation and data were analyzed using ANOVA (SAS), and Duncan's new multiple range test to compare between means. Correlation coefficients between the characteristics were determined in the breeding season. Progesterone concentrations during the first, second and third cycles were compared using Duncan's new multiple range test.

## RESULTS

This study of Markhoz goat does reveals a breeding season commencing in mid-October. Early estrous cycles were of short duration and ranged from 3-12 days with an average of 6.51±3.49 days. These animals were designated in the short estrous cycle group. The majority of cycles in goats (73.68%) were 20.93±1.56 days. All of the goats (100%) exhibited one or more silent heats during the experiment. The mean duration of estrus in the Markhoz goats was 38.86±15.19 h, with a range between 17.5 and 78 h. The numbers of estrous events were classified according to their length. The duration of more estrous periods varied from 25 to 50 h (Figure 1). Figure 2 shows the silent and true heats and photoperiod changes throughout the experimental period. The photoperiod length was decreased from August to January. With decrease in photoperiod length the number of silent and true heats were decreased and increased, respectively.

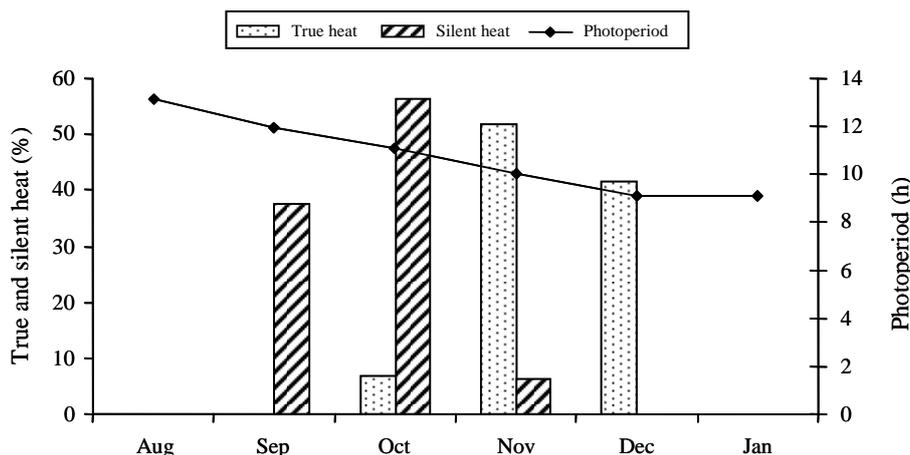


Figure 2. Photoperiod changes and distribution of true and silent heats in Markhoz does.

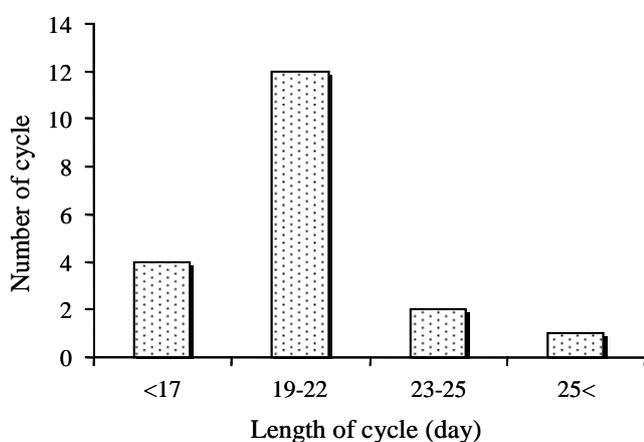


Figure 3. Frequency distribution of estrous cycle length in Markhoz does.

Mean live weight of the goats was 34.05±2.62 kg, and remained unchanged throughout the experiment (p>0.05). The correlation coefficients between live weight, estrous period and estrous cycle duration were positive (r = +0.355) and negative (r = -0.199), respectively, but not significant (p>0.05). Likewise the correlation coefficients between length of photoperiod and occurrence of estrus was negative (r = -0.470) but not significant (p>0.05). Figure 3 shows the frequency distribution of estrous cycle length throughout the experimental period. Estrous cycles with length of 19 to

22 and more than 25 days had higher and lower number, respectively. Activity of the corpus luteum (progesterone) was the basis for classification of two phases of the estrous cycle:

*Luteal phase* : The length of this phase was 14-15 days with a mean progesterone level of 7.44±0.26 ng/ml (range 2.24-10.95 ng/ml). Maximum level of progesterone during this phase was 10.95 ng/ml and was observed on day 14 of the estrous cycle.

*Follicular phase* : This phase lasted 4-5 days, with a mean progesterone level of 0.88±0.08 ng/ml (range 0.09-1.87 ng/ml). The progesterone concentration ranged from 0.53±0.07 to 0.9±0.09 ng/ml on the day of estrus. On days 0 to 4 of the cycle the progesterone concentration was 0.09 to 4.15 ng/ml. Progesterone levels increased (p<0.05) progressively until reaching a maximum of 9.16 to 10.95 ng/ml on day 14 of the cycle. Thereafter it dropped rapidly to values of 2.35 to 0.63 on days 19. Progesterone concentrations during the first, second and third cycle (Table 1) did not differ significantly (p>0.05) between the cycles, on days 0, 4, 10, 12, 14 and 19.

### DISCUSSION

It was concluded that the breeding season of the Markhoz goats used in this study commenced in autumn a

Table 1. Mean±SEM serum progesterone concentration (ng/ml) in different stages of the estrous cycle

Day	Cycle		
	First cycle	Second cycle	Third cycle
0 (Estrous day)	0.51±0.10 <sup>d</sup>	0.79±0.14 <sup>bc</sup>	0.50±0.11 <sup>c</sup>
4	3.76±0.30 <sup>c</sup>	4.58±0.41 <sup>abc</sup>	4.26±0.49 <sup>b</sup>
10	8.41±1.34 <sup>b</sup>	9.14±1.00 <sup>ab</sup>	8.32±1.40 <sup>a</sup>
12	8.34±0.81 <sup>b</sup>	10.75±0.41 <sup>a</sup>	10.40±0.40 <sup>a</sup>
14	10.72±0.71 <sup>a</sup>	10.52±0.59 <sup>a</sup>	10.34±0.59 <sup>a</sup>
19	1.55±0.12 <sup>d</sup>	0.63±0.19 <sup>c</sup>	1.43±0.29 <sup>c</sup>

<sup>a-d</sup> Values with different superscripts in the same column are significantly different (p<0.05).

pattern also reported by Chemineau et al. (1992b) and Rivera et al. (2003), but in contrasting with the report of Amoah et al. (1996) where high environmental temperatures in summer may have delayed onset of the breeding season. The results here are in general agreement with those reported by Amoah et al. (1996) for American Alpine, French Alpine, Nubian, Pygmy, Saanen, Toggenburg and dairy crossbred goats in northern hemisphere, but are not consistent with observation by Restall (1992) in Australian goats in the southern latitude. These differences maybe attributed to the amplitude of changes in photoperiod or to differences in genetics background.

The present study has shown that silent heats occurs in Markhoz does around the onset of the breeding season as reported for other breeds (Thompson et al., 1983). It is readily apparent that true heats were entrained by a decreasing photoperiod, and that maximal sexual activity was achieved around the late October to late November. In contrast, the increasing photoperiod was associated with decreasing sexual activity and increase silent heats. Elevation in serum progesterone for period of 1-3 days suggests that ovulation has occurred but without estrus. One abnormally short estrous cycle is followed by a series of normal length inter-estrous intervals. Short or abbreviated cycles have been observed in does following parturition, after prostaglandin  $F_{2\alpha}$  induced abortion, and following super ovulation and are associated with premature regression of luteal function (Camp et al., 1983).

Estrous duration in the goats is known to vary depending on the breed. Thompson et al. (1983) for Nubian goats, Greyling (2000) for Boer goats, Zarkawi and Soukouti (2001) for Damascus goats reported a  $21.7\pm 0.7$ ,  $20.7\pm 0.7$  and  $21.2\pm 1.5$  day cycle length, respectively but can range from 18 h to 4 day. Estrous duration is influenced by breed, age and season (Romano and Abella, 1997). Greyling (2000) for Boer goats and Romano and Abella (1997) for Nubian goats reported  $36.4\pm 8.6$  and  $36.0\pm 8$  h estrus, respectively. In the present study the normal mean duration of the Markhoz breed estrous cycle and estrous period was  $20.93\pm 1.56$  days and  $23.82\pm 12.3$  h, respectively and are in general agreement with values reported for other breeds.

In this experiment, the progesterone level in estrous day was below 1.0 ng/ml. According to Bauernfeind and Holtz (1991) progesterone levels below 1.0 ng/ml around estrus suggest that in goats the corpora lutea constitute the major source of progesterone. Individual differences in progesterone level during the luteal phase may be associated with different numbers and function of corpora lutea as indicated by Chemineau et al. (1982).

The changes in progesterone levels from day 4 to 19 after the onset of estrus in Markhoz does are well

accompanied with physiological events in goats. The average progesterone level and cyclic pattern reported in this experiment correspond with findings reported by Braun et al. (1988) for Nubian, Alpine and mixed Alpine, Jarrell and Dziuk (1991) for mixed breeds and Leyva-Ocariz et al. (1995) for native and crossbred ANN (Alpine $\times$ Nubian $\times$ Native) goats.

## CONCLUSION

These findings show that Markhoz does in Iran commence their breeding season begins late in summer with the maximum estrous activity occurring in November. Seventy three percent of estrous cycles were normal (17-25 days) and 34.48% of estrous periods were of normal duration (38-50 h). It seems that under natural photoperiod and weather conditions, Kurdistan Markhoz does can be considered as a breed with short seasonal breeding.

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