

Effects of High Level Nutrition During Mating Period on The Reproductive Hormones and Performance of Goats

Dilek Kor and Murat Demirel
Department of Animal Science, Faculty of Agriculture,
Yuzuncu Yil University, 65080 Van, Turkey

Abstract: The aim of this study was to investigate the effect of feeding above the maintenance requirement throughout the mating period on some hormones and reproduction traits in goats. The animal materials of study were consist of 75 adult hairy goats from 2-4 years old and six hairy bucks. The feeding program was started following the synchronization and continued for 40 days as 20 days prior to mating and 20 days after mating. During the feeding period, the goats in the first group were nourished at level of maintenance energy and protein requirements (1.58 Mcal ME, 61.98 g CP/head/day); the goats in second, third and fourth groups got nourishment matters as 1.25 (1.97 Mcal ME, 77.47 g CP/head/day), 1.50 (2.37 Mcal ME, 92.97 g CP/head/day) and 1.75 (2.76 Mcal ME, 108.46 g CP/head/day) times of the maintenance requirements, respectively. While maintenance level in the all groups was met by meadow hay, above the maintenance requirement was met by barley in the others except the first group. Assessed reproductive efficiency traits showed that differences among groups were not statistically significant. However, the fourth group of goats was found to have a higher rate of twins (29.40%) than the other groups. The mean of estradiol concentration of group four was found to be lower than group one and two ($p < 0.05$). The blood progesterone concentration of fourth group of goats was higher than that of other groups. As a result, it can be said that feeding above the maintenance requirement throughout the mating period did not affect reproduction traits in goats. It can also be said that data were found in this study question the relationships among nutrition, endocrine profile and reproductive performance in goats.

Key words: Hair goat, flushing, estrogen, progesterone, reproductivity, Turkey

INTRODUCTION

In recent years, goat studies discuss the effects of feeding not only on reproductive performance but also activity in ovary, some blood metabolites and/or endocrine mechanism (Tanaka *et al.*, 2003; Meza-Herrera *et al.*, 2004; Paula *et al.*, 2005; Aboelmaaty *et al.*, 2008; Karikari and Blasu, 2009).

It has been reported that negative energy balance in dairy cow prevents developing of corpus luteum and falls progesteron levels. Several studies have reported that decreasing of body weight of undernourished goats suppresses the secretion of LH, estradiol and progesterone (Tanaka *et al.*, 2002, 2004), pressured oestrus behaviours and decreased progesterone levels of fasted goats in oestrus cycle (Al-Azraqi, 2007).

In studies with goats by feeding over of maintenance level are stated conflicting results relation to ovarium activity with hormonal and metabolic profile depend on feed application level, time and oestrus cycle phase

(Haruna *et al.*, 2009; Zabuli *et al.*, 2010). Impact of feeding on fertility is known. However, in recent years it is discussed that how nutritional factors effect hormonal processes.

In this study, reproduction traits, blood estradiol and progesterone concentrations of hair goats fed maintenance energy and protein and its 1.25, 1.50 and 1.75 times during mating period were evaluated.

MATERIALS AND METHODS

Animal material of this study was consisted from 2-4 years of age of 75 heads of female Native Hair goat and 6 heads bucks hairy.

In this study, early cut meadow grass (11.64% CP, 2099 kcal kg⁻¹ DM ME) and crushed barley (11.26% CP, 2801 kcal kg⁻¹ DM ME) during mating period and alfalfa dry hay (13.38 % CP, 2000 kcal kg⁻¹ DM ME) and crushed barley during the last 2 months of pregnancy were used as feed material. While maintenance level in the all groups

Table 1: Metabolic energy and crude protein requirements of experimental goats (LW = 39 kg)

Ration level	Group 1 (M)	Group 2 (M + (M×0.25))	Group 3 (M + (M×0.50))	Group 4 (M + (M×0.75))
Energy and protein amounts (head/day)	1.58 Mcal ME 61.98 g CP	1.97Mcal ME 77.47 g CP	2.37 Mcal ME 92.97 g CP	2.76 Mcal ME 108.46 g CP

Group 1: control, n = 19; Group 2: n = 19; Group 3: n = 19; Group 4: n = 18

was met by meadow hay, above the maintenance requirement was met by barley in the others except the first (control) group during mating period. All goats were synchronized with 2 doses PGF_{2α} (cloprostenol, 0.5 mL/head) 11 days apart before the experiment.

At the beginning of the experiment, average live weight of flock was determined as 39 kg and maintenance energy and protein requirements calculated by depending on this average weight. Metabolic live weight value was considered as 15.60 kg ($W^{0.75} = 39^{0.75}$).

After the second dose PGF_{2α} injection, goats were divided into four groups at 39 kg average live weight of each group. Experimental groups were constituted as a model of NRC (1981); the first group (control): maintenance (M) level, the second group: maintenance + low activity, the third group: maintenance + moderate activity and the fourth group: maintenance + high activity, respectively. Goats were fed by giving rations containing different levels of energy and protein depending on their groups, continued for total of 40 days experiment period which were 20 days prior to mating and 20 days after mating. The calculated requirements for 39 kg of live weight are shown in Table 1.

Blood samples were collected from 10 goats which were randomly selected of each group every other day, twice a day: morning and evening during the feeding period. Approximately 5-6 cc of blood were taken from vena jugularis of each animal and were centrifuged for 5000 rev/15 min. Hormon (estradiol and progesterone) analysis was fully automated macro Elisa (Roch Elecsys 2010-Hitachi) device. Catalog number of UBB 4015630917693 of estradiol and catalog number of UBB 4015630914258 of progesterone kits were used for this experiment.

Data were analyzed by using one-way analysis of variance according to the following model (Winer *et al.*, 1991):

$$y_{ijm} = \mu + \alpha_i + \pi_{m(i)} + \beta_j + \alpha\beta_{ij} + \beta\pi_{jm(i)} + \epsilon_{ijm}$$

Where:

- Y_{ijm} = An individual observation
- μ = The overall mean of population
- α_i = The i group effect
- $\pi_{m(i)}$ = The m goat effect in i group
- β_j = The j day factor level effect
- $\alpha\beta_{ij}$ = Group x day interaction effect
- $\beta\pi_{jm(i)}$ = The day and goat between interaction effect in I group
- ϵ_{ijm} = The residual error

RESULTS AND DISCUSSION

The morning and evening estradiol concentration graphics of goats in mating period are shown in Fig. 1. There were no significant differences among research groups for daily blood estradiol concentrations.

When a general evaluation during mating period, blood estradiol concentrations were determined as 64.08±1.25 pg mL⁻¹ for the first group, 63.69±1.76 pg mL⁻¹ for the second group, 61.75±1.38 pg mL⁻¹ for the third group and 58.46±1.38 pg mL⁻¹ for the fourth group. The estradiol concentrations of the first, second and third groups were similar but the fourth group's concentration was lower than the other groups (p<0.05). Especially, estradiol concentrations of groups were similar until 29th day of mating period but from that day forth this level started to decline in all groups, distinctly in 4th group.

The blood hormone concentrations of different goat breeds in mating period were reported in many studies and these levels were varied by depending on ages and physiological stages of animals, hormone applications in order to ensure superovulation, matingm, etc. many different factors (Kumar *et al.*, 2003; Selvaraju *et al.*, 2003; Yu *et al.*, 2005; Khanum *et al.*, 2008). Obtained estradiol values in this study were higher than some earlier studies due to the above mentioned factors.

The morning and evening progesterone concentration graphics of goats in mating period are shown in Fig. 2. The progesterone levels were found about 0-2 ng mL⁻¹ until 29th day of mating period but a rapid increase of progesterone releasing was observed in all groups after 29th day of mating period (p<0.05). In Fig. 2, progesterone levels are shown to reach the peak in 37 and 39th days in all groups. It was conspicuous that progesterone levels of fourth group goats were higher than the other groups. Hence, it can be said that increasing in nutrient content of the ration is positive impact on corpus luteum functions in goats. As from 29th day of mating period, simultaneous changes of progesterone and estradiol levels can be a result of ovulation. In some studies, positive impact of additional feeding on reproductive performance was reported.

However, in the same studies, it was stated that estradiol and progesterone levels were not affected by this feeding (Karikari and Blas, 2009; Haruna *et al.*, 2009; Zabuli *et al.*, 2010).

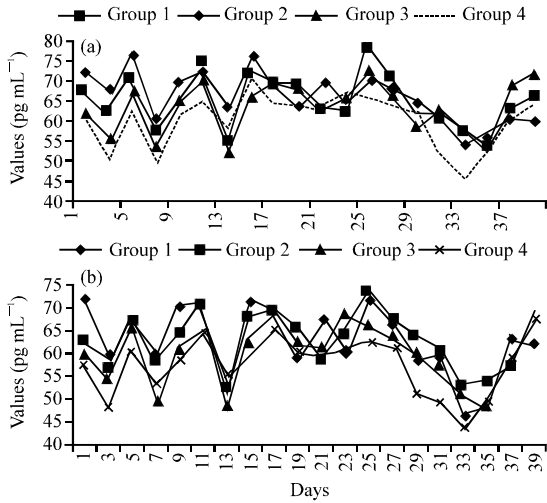


Fig. 1: a) The morning and b) evening estradiol concentrations of goats in mating period

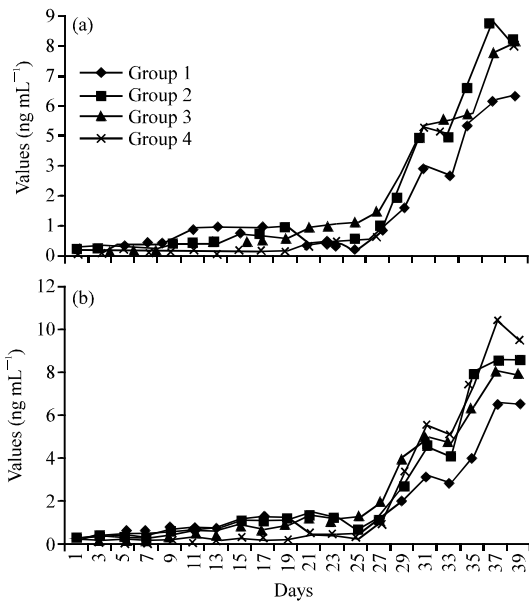


Fig. 2: The morning and evening progesterone concentrations of goats in mating period

Progesterone levels in this study were similar to some earlier studies (Gaafar *et al.*, 2005; Khanum *et al.*, 2007; Alvarez *et al.*, 2010; Al-Sobaiyl, 2010). Nevertheless, progesterone values of this study were lower than values of some researches (Zarkawi and Al-Masri, 2002) while they were higher than other some researches (Kacar *et al.*, 2004).

Distribution of birth types (single and twin) and birth rates according to the experimental groups are given in Table 2.

Twin birth rates of third and fourth groups fed high energy and protein were higher than first and second

Table 2: Distribution of birth types and birth rates

Groups	Number (%)	Single	Twin	Total
1	n	16.00	3.00	19
	%	84.20	15.80	100
2	n	16.00	3.00	19
	%	84.20	15.80	100
3	n	14.00	4.00	18
	%	77.80	22.20	100
4	n	12.00	5.00	17
	%	70.60	29.40	100
5	n	58.00	15.00	73
Total	%	79.46	20.54	100

Table 3: Some reproductive performances of goats

Reproductive traits	Group 1	Group 2	Group 3	Group 4
Mated goat number (n)	19.00	19.00	19.00	18.00
Pregnancy rate (%)	100.00	100.00	94.74	94.44
Parturient goat number (n)	19.00	19.00	18.00	17.00
Infertile goat number (n)	0.00	0.00	1.00	1.00
Infertility rate (%)	0.00	0.00	5.26	5.56
Born kid (buck under) (n)	1.16	1.16	1.16	1.22
Litter size (n)	1.16	1.16	1.22	1.29
Weaning survival rate (%)	86.36	95.45	90.91	100.00

groups although it was not significant statistically. In this way, it is possible to increase kid number of native hair goats which have low fertility by means of good management and feeding conditions.

Some traits of reproductive performances of experimental goats are given in Table 3. There were no significant differences statistically among groups for reproductive performances of goats.

As well as in this study, in some studies investigating effect of feeding on different genotypes were determined that applications of additional feeding in mating period increased some reproductive traits although there were no significant differences statistically (Acero-Camelo *et al.*, 2008; Karikari and Blasus, 2009; Kharrat and Bocquier, 2010).

CONCLUSION

When the groups were compared in terms of the daily level of estradiol in mating period, there were not significant differences statistically but the estradiol levels of group fed on 1.75 times of maintenance were lower than the other groups fed on maintenance and its 1.25 times, significantly ($p < 0.05$). There were not significant differences among groups with regard to progesterone levels which were obtained at the same day and general of feeding period. However, when group ($M \times 1.75$) given the highest energy and protein in mating period was considered, the important point appears that progesterone level and twice rate of this group were higher than the others. This situation can be questioned relationships among feeding level, hormonal profile and reproduction on goats.

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REFERENCES

- Aboelmaaty, A.M., M.M. Mansour, O.H. Ezzo and A.M. Hamam, 2008. Some productive and metabolic responses to food restriction and re-feeding in Egyptian native goats. *Global Vet.*, 2: 225-232.
- Acero-Camelo, A., E. Valencia, A. Rodriguez and P.F. Randel, 2008. Effects of flushing with two energy levels on goat reproductive performance. *Livest. Res. Rural Dev.*, Vol. 20.
- Al-Azraqi, A.A., 2007. Effect of fasting on luteal function, leptin and steroids concentration during oestrus cycle of the goat in natural photo-status. *Anim. Reprod. Sci.*, 98: 343-349.
- Al-Sobaiyl, K.A., 2010. Effect of breeding season and pregnancy status on serum progesterone, sodium, potassium, copper and iron of estrous synchronized Aradi goat does. *Saudi J. Biolog. Sci.*, 17: 259-263.
- Alvarez, L., R.R. Arvizu, J.A. Luna and L.A. Zarco, 2010. Social ranking and plasma progesterone levels in goats. *Small Rumin. Res.*, 90: 161-164.
- Gaafar, K.M., M.K. Gabr and D.F. Teleb, 2005. The hormonal profile during the oestrus cycle and gestation in Damascus goats. *Small Rumin. Res.*, 57: 85-93.
- Haruna, S., T. Kuroiwa, W. Lu, J. Zabuli, T. Tanaka and H. Kamomae, 2009. The effects of short-term nutritional stimulus before and after the luteolysis on metabolic status, reproductive hormones and ovarian activity in goats. *J. Reprod. Develop.*, 55: 39-44.
- Kacar, C., N. Ozyurtlu, H.C. Macun, A.K. Zonturlu, E. Saban and S. Aslan, 2004. The pregnancy definition by using servical mucus boiling test in breeds of Akkaraman sheep and Angora goat. *J. Vet. Faculty Ankara Univ.*, 51: 199-204.
- Karikari, P.K. and E.Y. Blasu, 2009. Influence of nutritional flushing prior to mating on the performance of West African Dwarf goats mated in the rainy season. *Pak. J. Nutr.*, 8: 1068-1073.
- Khanum, S.A., M. Hussain and R. Kausar, 2007. Assessment of reproductive parameters in female Dwarf goat (*Capra hircus*) on the basis of progesterone profiles. *Animal Rep. Sci.*, 102: 267-275.
- Khanum, S.A., M. Hussain and R. Kausar, 2008. Progesterone and estradiol profiles during estrous cycle and gestation in dwarf goats (*Capra hircus*). *Pak. Vet. J.*, 28: 1-4.
- Kharrat, M. and F. Bocquier, 2010. Impact of indoor feeding at late lactation stage on body reserves recovery and reproductive performances of Baladi dairy goats fed on pastoral system. *Small Rumin. Res.*, 90: 127-134.
- Kumar, P.S., D. Saravanan, R.C. Rajasundaram, M. Selvaraju and D. Kathiresan, 2003. Serum oestradiol and progesterone profiles and their relationship with superovulatory responses in Tellicherry goats treated with eCG and FSH. *Small Rumin. Res.*, 49: 69-77.
- Meza-Herrera, C.A., J.M. Sanchez, J.G. Chavez-Perches, H. Salinas and M. Mellado, 2004. Protein supplementation, body condition and ovarian activity in goats Pre-ovulatory serum profile of insulin. *South African J. Anim. Sci.*, 34: 223-226.
- NRC, 1981. Nutrient Requirements of Goats. National Academy Press, Washington DC., USA., Pages: 91.
- Paula, N.R.O., G. Galeati, D.I.A. Teixeira, E.S. Lopes Junior, V.J.F. Freitas and D. Rondina, 2005. Responsiveness to progestagen-eCG-cloprostenol treatment in goat food restricted for long period and refed. *Reprod. Domestic Anim.*, 40: 108-110.
- Selvaraju, S., S.K. Agarwal, S.D. Karche and A.C. Majumdar, 2003. Ovarian response, embryo production and hormonal profile in superovulated goats treated with insulin. *Theriogenology*, 59: 1459-1468.
- Tanaka, T., K. Fujiwara, S. Kim, H. Kamomae and Y. Kaneda, 2004. Ovarian and hormonal responses to a progesterone-releasing controlled internal drug releasing treatment in dietary-restricted goats. *Anim. Reprod. Sci.*, 84: 135-146.
- Tanaka, T., N. Akaboshi, Y. Inoue, H. Kamomae and Y. Kaneda, 2002. Fasting-induced suppression of pulsatile luteinizing hormone secretion is related to body energy status in ovariectomized goats. *Anim. Reprod. Sci.*, 72: 185-196.
- Tanaka, T., T. Yamaguchi, H. Kamomae and Y. Kaneda, 2003. Nutritionally induced body weight loss and ovarian quiescence in Shiba goats. *J. Reprod. Develop.*, 49: 113-119.

- Winer, B.J., D.R. Brown and K.M. Michels, 1991. Statistical Principles in Experimental Design. 3rd Edn., McGraw-Hill, New York, Pages: 902.
- Yu, Y.S., M.J. Luo, Z.B. Han, W. Li, H.S. Sui and J.H. Tan, 2005. Serum and follicular fluid steroid levels as related to follicular development and granulosa cell apoptosis during the estrous cycle of goats. *Small Rumin. Res.*, 57: 57-65.
- Zabuli, J., T. Tanaka, W. Lu and H. Kamomae, 2010. Intermittent nutritional stimulus by short-term treatment of high-energy diet promotes ovarian performance together with increases in blood levels of glucose and insulin in cycling goats. *Anim. Reprod. Sci.*, 122: 288-293.
- Zarkawi, M. and M.R. Al-Masri, 2002. Use of Radioimmunoassay to measure progesterone levels during different reproductive stages in female Damascus goats. *Trop. Anim. Health Prod.*, 34: 535-539.