



## Effects of Progestagen and Pmsg on Estrous Synchronization and Fertility in Kivircik Ewes during Natural Breeding Season

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**ABSTRACT** : An experiment was conducted using indigenous Kivircik ewes to evaluate the effect of intravaginal progestagen sponges, containing 30 mg of fluorogestone acetate (FGA), followed by administration of pregnant mare serum gonadotrophin (PMSG) on inducing synchronized oestrus in the season and fertility. Three times of PMSG administration relative to sponge withdrawal (24 h before ( $n = 30$ ), at ( $n = 29$ ) or 24 h after ( $n = 29$ )) and two routes of PMSG administration (intramuscular ( $n = 46$ ) and subcutaneous ( $n = 42$ )) were compared for estrous response, number of multiple births and fecundity rates. There were no significant differences in terms of estrous response, due to differences in the time and route of PMSG administration. Lambing percentage, proportion of multiple births and fecundity were 75.6, 51.6 and 114.6%, respectively. The administration had a significant effect on lambing ( $p < 0.05$ ), multiple birth and fecundity rates ( $p < 0.01$ ). The subcutaneous administration of PMSG resulted in a significantly higher lambing rate ( $p < 0.05$ ) and fecundity rate ( $p < 0.01$ ), compared to the intramuscular injection of the PMSG. (**Key Words** : Kivircik Ewe, Synchronization, PMSG, Progestagen, Fertility)

### INTRODUCTION

Estrous synchronization is a valuable management tool which has been successfully employed to enhance reproductive efficiency, particularly in ruminants (Kusina et al., 2000). In small ruminants, estrous synchronization is achieved either by reducing the length of the luteal phase of the estrous cycle with prostaglandin  $F_{2\alpha}$  or by extending the cycle artificially with exogenous progesterone or more potent progestagens (Evans and Maxwell, 1986; Jainudeen et al., 2000; Kusina et al., 2000). As prostaglandin treatment is limited to the breeding season, different protocols of estrous synchronization using progestins have been introduced (Ainsworth and Wolynetz, 1982; Godfrey et al., 1997; Rosado et al., 1998).

Two pharmacological agents are frequently used to synchronize estrus in small ruminants during the breeding season: luteolytic drugs (Thimonier, 1981) and progesterone or its analog progestagen (Gordon, 1975). Both progesterone and its synthetics, when administered orally, by implantation or by means of intravaginal sponges, exert negative feedback on LH secretion so that the endocrine

events that lead to the maturation of ovarian preovulatory follicles and their subsequent ovulation are inhibited (Hansel and Convey, 1983). Therefore, when progestagen impregnated sponges are withdrawn, follicular growth, estrus and ovulation occur within 2-8 days (Gordon, 1975; Hansel and Convey, 1983).

Progesterone-impregnated vaginal sponges have been widely used for estrous synchronization of ewes during the breeding and non-breeding seasons. Breeding season of sheep shows regional changes. The breeding estrus term in Turkey is the end of summer and months of fall, when daytime begins to shorten and sunlight begins to reduce its effectiveness.

The Kivircik is the exclusive breed of sheep in the Thracian part of Turkey; it is also raised in the southern and eastern provinces of Marmara Region and in some Aegean provinces. Mating of Kivircik ewes takes place in June and July in the southern Marmara Region and in July and August in Thrace (Yalcin, 1986).

Oestrus in the ewe is a less obvious event than in other ruminants (Ptaszynska, 2001). Hence, a detailed detection of estrous stages becomes crucial in this species, particularly in hand-mating or AI. Synchronization of oestrus has been used to increase reproductive efficiency in most animals including ewes. The aim of PMSG use in the

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present study was to determine that the majority of ewes lambed over a short period of time (2 weeks). This study aimed at evaluating the effect of route and time of PMSG administration relative to sponge removal on the efficiency of estrous synchronization and overall fertility in Kivircik ewes during the breeding season.

## MATERIALS AND METHODS

The experiment was conducted at the Application and Research farm of the College of Agriculture, Uludag University, Bursa province (southern Marmara Region). The site is situated at 28° 50' E longitude and 40° 13' N latitude and at an altitude of 100 m above sea level. The yearly absolute minimum and maximum temperatures in the area average -16.4°C (February) and 43.8°C (July), respectively, with a mean annual rainfall of 706.0 mm.

A total of 123 Kivircik ewes, ranging in age from 2 to 4 years and weighing 38 to 64 kg, were used in the trial. The experimental flock was maintained under standard farm management practices. The ewes were grazed daily for 8-10 h on a pasture consisting of a mixture of common vetch (*Vicia sativa* L), Hungarian vetch (*Vicia pannonica* L), alfalfa (*Medicago sativa*) and sainfoin (*Onobrychis sativa*). In addition, the ewes received 200 g concentrate (wheat 75%, sunflower oilcake 23%, limestone 1.4%, salt 0.5% and premix 0.1%)/head/day during the entire period of study.

Animals were routinely drenched for fluke and roundworm, and vaccinated for pasteurellosis and clostridia infections. Clean water was available throughout the study period.

The treatments included two routes of 500 IU PMSG administration (intramuscular or subcutaneous); three times of PMSG treatment (24 h prior to sponge withdrawals, at sponge withdrawal or 24 h after sponge withdrawal). The intravaginal progestagen sponges (FGA 30 mg) remained *in situ* for a period of 14 days in all ewes. All ewes were checked twice daily (morning and evening) to ensure that sponges remained in place during the treatment period. At the end of the treatment period with intravaginal progestagen sponges, animals were randomly allotted to four groups of 30, 29, 29, and 35 animals, respectively. The 1<sup>st</sup>, the 2<sup>nd</sup> and the 3<sup>rd</sup> groups were treated with 500 IU PMSG 24 h prior to sponge withdrawal, at sponge withdrawal and 24 h after sponge withdrawal, respectively. The fourth groups of ewes served as a control (no PMSG treatment). Among ewes administered PMSG 46 were injected intramuscularly while 42 were injected subcutaneously. Fertile Kivircik rams were placed with all the ewes 24 h post-sponge withdrawals for estrous detection and ewes in estrous were hand-mated.

The following traits were evaluated in each of the treated and control groups:

Estrous response: (percentage of ewes showing estrous/total ewes treated), lambing rate: (percentage of ewes lambing/total ewes mated), multiple birth rate: (percentage of multiple lambing/total lambing), fecundity: (percentage of lambs born/total ewes mated).

Data regarding the onset, end and duration of estrus were analyzed using the General Linear Models (GLM) procedure of SAS (1991). A chi-square test was used to analyze the estrous response, fecundity, lambing and multiple birth rates among the groups at the 5% and 1% level of significance.

## RESULTS

From the 123 ewes used in the trial, 118 (96.0%) exhibited overt signs of estrous during the 48-72 h observation period. No significant difference in percentage of ewes exhibiting estrous was recorded with time and route of PMSG administration.

The overall lambing, multiple birth and fecundity rates recorded following estrous synchronization was 75.6, 51.6 and 114.6%, respectively. No significant difference in terms of multiple birth rates was recorded between routes of PMSG administration. The time of PMSG administration relative to the time of sponge withdrawal had a significant effect on lambing ( $p < 0.05$ ), multiple birth and fecundity rates ( $p < 0.01$ ). The highest lambing, multiple birth and fecundity rates were recorded in ewes receiving PMSG 24 h prior to sponge withdrawal or at sponge withdrawal, compared to ewes given PMSG 24 h after sponge withdrawal or the control animals (Table 1). Furthermore, the subcutaneous administration of PMSG resulted in a significantly higher lambing rate ( $p < 0.05$ ) and fecundity rate ( $p < 0.01$ ), compared to the intramuscular injection of PMSG.

## DISCUSSION

Increasing Kivircik sheep productivity by increasing lambing frequency and fecundity is considered important in the development of Kivircik sheep production in Turkey. On the other hand, increasing rate of fecundity in sheep offers the best opportunity to increase the efficiency of lamb meat production. In the present study, estrous was induced in 96.0% of the ewes, 48-72 h after sponge withdrawal. This technique (FGA+PMSG) has an estrous response similar to the 97.0% obtained by Zeleke et al. (2005) in Dorper ewes, but higher than the 66.0% obtained with Romney Marsh ewes (Gatica and Correa, 1993), and lower than the 100% reported in Karakul ewes (Hashemi et al.,

**Table 1.** Effect of time and route of PMSG administration on estrous response, lambing, multiple birth and fecundity rates in Kivircik ewes

Treatment	n	Estrous response (%)	Lambing rate (%)	Multiple birth rate (%)	Fecundity (%)
Time of PMSG administration		ns	*	**	**
24 h before sponge withdrawal	30	96.7	76.7 <sup>b</sup>	73.9 <sup>a</sup>	132.0 <sup>a</sup>
At sponge withdrawal	29	95.9	86.2 <sup>a</sup>	61.9 <sup>a</sup>	127.6 <sup>a</sup>
24 h after sponge withdrawal	29	96.9	72.4 <sup>b</sup>	44.0 <sup>b</sup>	120.7 <sup>a</sup>
Control	35	94.8	68.6 <sup>b</sup>	29.2 <sup>b</sup>	71.4 <sup>b</sup>
Route of PMSG administration		ns	*	ns	**
Intramuscular	46	95.1	73.9 <sup>b</sup>	55.9	117.4 <sup>b</sup>
Subcutaneous	42	97.3	83.3 <sup>a</sup>	62.9	147.6 <sup>a</sup>
Overall	123	96.0	75.6	51.6	114.6

Means in the same column with different superscripts are significantly different.

\*  $p < 0.05$ , \*\*  $p < 0.01$ . ns = Not significant.

2006). The slight discrepancy between the results obtained in the current study and those of Greyling et al. (1994) may be due to differences in the breed of sheep used and the season in which the studies were executed.

The overall lambing, multiple birth and fecundity rates recorded in this study (Table 1) are comparable to results obtained by Zeleke et al. (2005) in Dorper ewes. Lambing rate in the treated ewes was 75.6%. This is similar to 80% reported by Zarkawi et al. (1999), higher than 64.3% (Alkass et al., 1989) and lower than 90% reported by Crosby and O'Callaghan (1991) in ewes fitted with intravaginal sponges followed by PMSG injection.

The multiple birth rate in Kivircik sheep is low and averages 10-20% (Kaymakci, 2006). Hormonal treatment increased multiple births overall by 51.6%. Increased lambing rate is very economical and sought-after by sheep holders in semi-intensive production systems. It has been observed that in semi-intensive sheep production systems, rams are able to mate ewes at almost any time of the year. PMSG injection is required to stimulate follicular growth, leading to a higher ovulation rate by an estrous animal outside the breeding season (Greyling and van Niekerk, 1991).

Many researchers have indicated the importance of administering PMSG to obtain a more predictable and compact estrous or ovulation, even though cyclic ewes or does are expected to demonstrate oestrus shortly after intravaginal progestagen withdrawal without administration of PMSG (Zhang and Yuan, 1988; Knight et al., 1992; Artiningsih et al., 1996; Cordova et al., 1999; Cline et al., 2001). The lower lambing, multiple birth and fecundity rates in ewes which did not receive any PMSG, compared to those injected with PMSG in the present study indicates the importance of administering PMSG to achieve better fertility. Besides the mere administration of PMSG, the time of administration relative to intravaginal progestagen withdrawal and the route of administration were observed in this study to be essential to improve reproductive

performance. A similar study done by Zeleke et al. (2005) also indicated an increase in fertility when PMSG was administered 24 h prior to sponge removal. However, the results in the present trial were not in agreement with the findings of Eppleston et al. (1991) which indicated that the time of PMSG treatment did not yield a constant improvement in fertility, except for shortening the time to ovulation.

Attainment of significantly higher lambing rates ( $p < 0.05$ ) and fecundity ( $p < 0.01$ ) in ewes given 500 IU PMSG subcutaneously, compared to ewes given PMSG intramuscularly, demonstrates the advantage of this administration route. The reason for this difference is vague, and the work of Greyling and van Niekerk (1989) suggested the pre-ovulatory LH surge to be significantly shorter in subcutaneously-injected does, compared to intramuscularly-treated animals. This may be due to the difference in the rate of absorption and metabolism of PMSG between subcutaneous and intramuscular administration (Zeleke et al., 2005).

## CONCLUSION

The study was designed to determine estrous response in Kivircik ewes synchronized with different protocols of progesterone during the natural breeding season. The results suggest that it is possible to induce synchronization of estrous and fertile estrous and successful pregnancy and lambing, to improve fecundity. Administration of PMSG preferably 24 h prior to or at progestagen sponge withdrawal is essential to obtain better fertility rates. The subcutaneous administration of PMSG is preferable to intramuscular administration as it resulted in higher lambing, multiple birth and fecundity rates.

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