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Oestrus Synchronization by Short and Long-Term Intravaginal Sponge Treatment in Lactating Goats During the Breeding Season: The Effects of GnRH Administrations Immediately after Matings on Fertility

[1]Mustafa Kemal Saribay, [2]Fikret Karaca, [1]Gokhan Dogruer, [1]Yasar Ergun,
[2]Ilker Yavas and [3]Cafer Tayyar Ates
[1]Department of Obstetrics and Gynecology, [2]Department of Reproduction and Artificial Insemination,
[3]Department of Animal Breeding, Faculty of Veterinary Medicine, Mustafa Kemal University,
31040 Hatay, Turkey

Abstract: The present study was aimed at oestrus synchronization by applying progestagen-impregnated intravaginal sponges for either 7 or 12 days to lactating goats during the breeding season and at the determination of the effects of post-mating GnRH injection on fertility. The study was conducted in 80 hair goats aged between 2-5 years. The goats were allocated to two equal groups, one of which was applied short-term intravaginal sponge treatment and the other long-term treatment. The duration of intravaginal sponge treatment was 7 days in the short-term group (ST, n = 40) and 12 days in the long-term group (LT, n = 40). Furthermore, on the day of intravaginal sponge removal, the goats received intramuscular injections of 400 IU of PMSG and 0.075 mg of cloprostenol. In both groups, 12 h after the removal of the vaginal sponges, 10 fertile bucks were introduced into the flock for oestrus detection twice a day and goats which were determined to be in oestrus were hand-mated to the assigned bucks. Immediately after mating, the goats included in each of the ST and LT groups were randomly assigned to two subgroups, referred to as ST1 (n = 18), ST2 (n = 18), LT1 (n = 18) and LT2 (n = 18). The subgroups ST1 and LT1 were maintained as controls whilst the subgroups ST2 and LT2 were administered with 5 mcg of bucerelin acetate immediately after mating. In the present study, the times of oestrus onset and oestrus rates in the ST and LT groups were determined as 33.3±1.4 and 35.0±1.4 h and 94.7 and 97.2%, respectively. The differences observed between the two groups for the time of oestrus onset and oestrus rate were statistically insignificant ($p>0.05$). In the subgroups ST1, ST2, LT1 and LT2, pregnancy rates were determined as 55.5, 50, 50 and 55.5%, respectively whilst the parturition rate of all four subgroups was 100%. Furthermore, litter sizes were detected as 150, 200, 188 and 170% in the subgroups ST1, ST2, LT1 and LT2, respectively. The differences observed between the subgroups for pregnancy rate, parturition rate and litter size were statistically insignificant ($p>0.05$). In conclusion, it was demonstrated in the present study that GnRH administrations immediately after mating to lactating goats in which oestrus synchronization was performed by means of short and long-term intravaginal sponge treatment during the breeding season did not improve pregnancy rate, parturition rate and litter size.

Key words: Oestrus synchronization, goat, fluorogestone acetate, GnRH, pregnancy, rate, Turkey

INTRODUCTION

In small ruminants, intravaginal sponges impregnated with either Fluorogestone Acetate (FGA) or Medroxyprogesterone Acetate (MAP) are applied during the breeding and anoestrus seasons for a period of 6-14 days to induce oestrus synchronization.

A commonly used hormonal synchronization method involves the induction of oestrus and ovulation by means of the administration of Pregnant Mare Serum Gonadotropin (PMSG) and Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) at either the time of intravaginal sponge removal or earlier (Gordon, 1997; Wildeus, 2000; Saribay *et al*., 2008; Karaca *et al*., 2010).

Greyling and van Niekerk (1990) reported that in goats, ovulations occurred within a broader time interval, compared to other animal species and indicated that the LH surge to ovulation interval on average was 24.7 h. Furthermore, Chemineau (1991) ascertained that ovulations occurred 20-24 h after the preovulatory LH surge. In goats, ovulations have been reported to occur 48 h after the onset of oestrus by Rao and

Corresponding Author: Mustafa Kemal Saribay, Department of Obstetrics and Gynecology, Faculty of Veterinary Medicine, Mustafa Kemal University, 31040 Hatay, Turkey

Bhattacharyya (1980), towards the end of oestrus by Van der Westhuysen *et al.* (1985) and immediately after the end of oestrus by Whitley and Jackson (2004). On the other hand, Jainudeen *et al.* (2000) determined that ovulations occurred spontaneously, 24-36 h after the onset of oestrus and that on average, 2-3 oocytes could be ovulated during each cycle.

It has been reported that the combined use of Gonadotropin Releasing Hormone (GnRH) and its analogues with other hormones in synchronization programmes of farm animals, elevates LH levels in the peripheral blood within 3-5 h and that this increase contributes not only to the LH surge but also to the synchronization and induction of ovulation (Tamanini *et al.*, 1985; Cameron *et al.*, 1988; Thatcher *et al.*, 1993). It is indicated that GnRH injection to goats during both the breeding and anoestrus seasons induces the LH surge within a period of 2 h (Rubianes *et al.*, 1997a, b). Synchronization studies conducted in goats have demonstrated that GnRH administration to goats in oestrus shortens the LH surge interval, regulates the occurrence of the LH surge and shortens the period from sponge removal to ovulation thereby increasing the rate of ovulation (Leboeuf *et al.*, 2003; Pierson *et al.* 2003). It has been stated that in ewes, GnRH injection at an appropriate timing after the removal of intravaginal sponges, shortens the time period within which ovulation occurs but goats not increase fertility (Walker *et al.*, 1989; Eppleston *et al.*, 1991). Cameron *et al.* (1988) reported that in goats, to which 50 mcg of GnRH (Gonadorelin) was administered 20 h after sponge removal during the breeding season, the rate of ovulation was 91% whilst in animals spared from this treatment; the same rate was only 64%. Furthermore, it was indicated that the ovulations generally occurred between 36-48 h. In a study conducted by Akinlosotu and Wilder (1993) in which anoestrous goats were applied ear implants containing norgestomete for 9 days and were administered with 300 mcg of Luteinizing Hormone-Releasing Hormone (LHRH) by intravenous route 24 and 48 h after the removal of the implants, it was reported that the fertility rate was 72.1 and 64.35% in the LHRH group and control group, respectively.

The knowledge in the cited literatures varied about the effect of GnRH administrations on induction of ovulation in cattle. While, Archbald *et al.* (1993) reported that GnRH administrations did not affect the pregnancy rates, some others (Peters *et al.*, 1992; Srivastava and Kharche, 2002; Kharche and Srivastava, 2007) reported to increase the pregnancy rates also some researchers (Chenault, 1990; Alan *et al.*, 1998) stated to decrease the pregnancy rates in cattle. Nonetheless, to the researchers' knowledge, no previous study exists on oestrus synchronization and GnRH administration at the time of mating in goats.

The present study was carried out during the breeding season in lactating hair goats in which oestrus was synchronized by the combined use of intravaginal sponges for 7 or 12 days and PMSG and $PGF_{2\alpha}$ administration and in which the effects of immediately after mating GnRH administration on fertility were investigated.

MATERIALS AND METHODS

The research was carried out in September in Hatay province, located in the eastern Mediterranean region of Turkey which has the geographic coordinates of 35°52' and 37°04'N latitude and 35°40' and 36°35'E longitude. Throughout the study, the average annual temperature was 28°C during the day and 19°C during the night. The area is known to receive an average annual precipitation of 570-1160 mm^3.

The study was performed in 80 healthy hair goats, aged 2-5 years which had no previously reported fertility related problem. Throughout the study period, the animals were milked once daily in the morning, grazed on the pasture between 08.00-18.00 h and provided with 150 g of concentrate feed per animal in the evening. Mineral salt and water were offered *ad libitum*.

With an aim to induce and synchronize oestrus, all goats were applied intravaginal sponges impregnated with 30 mg of Fluorogestone Acetate (FGA) (Crono-gest, Intervet, Istanbul, Turkey). The goats were assigned to two groups such that one (n = 40) was subjected to short-term and the other (n = 40) to long-term intravaginal sponge treatment. The duration of intravaginal sponge treatment was 7 days in the Short-Term (ST) group and 12 days in the Long-Term (LT) group. Furthermore, on the day of sponge removal, the goats received intramuscular injections of 400 IU of PMSG (Cronogest PMSG, Intervet, Istanbul, Turkey) and 0.075 mg of cloprostenol (Dalmazin, Vetas, Turkey).

In both groups with an aim to detect oestrus and achieve mating as from the 12th h after sponge removal, 10 fertile bucks were introduced into the flock in the morning (06:00-07:00 h) and evening (18:00-19:00 h). At the time of mating, the goats included in the ST and LT groups were randomly allocated to two equal subgroups, hereafter referred to as ST1 (n = 18), ST2 (n = 18), LT1 (n = 18) and LT2 (n = 18). The subgroups ST1 and LT1 were maintained as controls whilst the subgroups ST2 and LT2 were administered with 5 mcg of bucerelin acetate

(Receptal, Intervet, Istanbul, Turkey) immediately after mating. The reproductive parameters were evaluated according to the formulations:

Time of oestrus onset: The time from sponge removal to the acceptance of mating.

Oestrus rate: (Goats in oestrus/goats in the group)×100.

Pregnancy rate: (Goats pregnant/goats in the group)×100.

Parturition rate: (Goats exhibiting parturition/goats pregnant)×100.

Litter size: (Number of kids/exhibiting parturition)×100.

In all groups, pregnancy was diagnosed using a B-mode (Pie Medical, Scanner 100 LC, VET) sector array 5-7.5 mHz ultrasonography device via the abdominal wall 50 days after mating.

The times of oestrus onset and oestrous rates of the groups were analysed by one-way ANOVA whilst pregnancy rates, parturition rates and litter sizes were assessed using the Chi-square (χ^2) test. The time of matings and pregnancy rates were analysed using the Fisher's exact χ^2-test.

RESULTS AND DISCUSSION

During the study period, it was determined that in the short-term treatment group, intravaginal sponges were lost in 2 goats (5%) whilst in the long-term treatment group, intravaginal sponges were lost in 3 (7.5%) goats. These goats were excluded from the study.

In the ST and LT groups, the time of oestrus onset was 33.3±1.4 and 35.0±1.4 h, respectively. The groups did not differ from each other significantly shown at Table 1 (p>0.05).

In the group which was applied short-term vaginal sponge treatment (n = 38), the number of goats showing oestrus after the removal of the sponges was 13 (36.1%) between the 24-25th h, 18 (50.0%) between the 36-37th h and 5 (13.9%) between the 48-49th h, amounting to a total number of 36 (94.7%) (Fig. 1). On the other hand in the group which was applied long-term intravaginal sponge treatment, the number of goats showing oestrus after the removal of the sponges was 10 (27.8%) between the 24-25th h, 20 (55.5%) between the 36-37th h and 6 (16.7%) between the 48-49th h, amounting to a total number of 36 (97.2%) (Fig. 1). The two groups did not differ from each other significantly for oestrus rate (p>0.05).

The analyses performed in the present study demonstrated that the pregnancy rates were 55.5, 50, 50 and 55.5% and the litter sizes were 150, 200, 188 and 170% in the subgroups ST1, ST2, LT1 and LT2, respectively (Table 2). The parturition rate was determined to be 100% in all of the subgroups. The groups did not differ significantly for pregnancy rate, parturition rate and litter size (p>0.05).

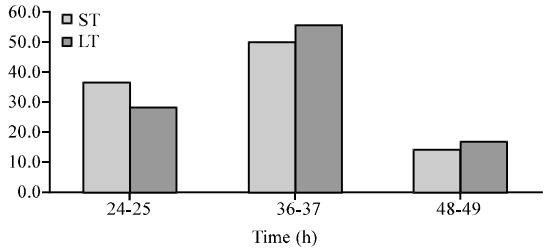

Fig. 1: The oestrous rates in ST and LT groups at 24-25, 36-37 and 48-49th h

Table 1: Time of oestrus onset and oestrus rates determined in the groups which received short and long-term intravaginal sponge treatment

Parameters	ST (n = 36)	LT (n = 36)
Time of oestrus onset (h)	33.3±1.4	35.0±1.4
Oestrus rate (%)	94.7	97.2

(p>0.05)

Table 2: Pregnancy rates, parturition rates and litter sizes in the ST1, ST2, LT1, LT2 groups

Parameters (%)	ST1 (n = 18)	ST2 (n = 18)	LT1 (n = 18)	LT2 (n = 18)
Pregnancy rate	55.5 (10/18)	50 (9/18)	50.0 (9/18)	55.5 (10/18)
Parturition rate	100 (10/10)	100 (10/10)	100 (9/9)	100 (10/10)
Litter size	150	200	188	170

(p>0.05)

Table 3: The time of matings and pregnancy rates in ST1, ST2, LT1 and LT2 groups

Time of matings (h)	Pregnancy rates of subgroups (%) (n = 18)			
	ST1	ST2	LT1	LT2
24	75.0 (6/8)	40.0 (2/5)	50.0 (3/6)	50.0 (2/4)
36	42.9 (3/7)	54.5 (6/11)	55.6 (5/9)	63.6 (7/11)
48	33.3 (1/3)	50.0 (1/2)	33.3 (1/3)	33.3 (1/3)

(p>0.05)

In this research, the pregnancy rates of the goats mated in 24, 36 and 48th h in the ST1 and LT1 groups were 75.0 and 50.0, 42.9 and 55.6, 33.3 and 33.3%, respectively. Also the pregnancy rates of the goats mated in 24, 36 and 48th h in the ST2 and LT2 groups were 40.0 and 50.0, 54.5 and 63.6, 50.0 and 33.3%, respectively (Table 3).

In the present study, the times of oestrus onset determined for the groups subjected to short and long term intravaginal sponge treatment were 33.33±1.36 and 35.00±1.38 h, respectively (Table 1). It was ascertained that the two groups did not differ from each other significantly (p>0.05). In a study, in which goats were applied intravaginal sponges impregnated with 45 mg of FGA for a period of 11 days and were administered with 400 IU of PMSG and 50 μg of $PGF_{2\alpha}$ 48 h prior to sponge removal, Freitas *et al.* (1997) reported that the time of oestrus onset was 33.0+6.6 h. In another study conducted

by Blaszczyk *et al.* (2004) in which animals were applied intravaginal sponges (40 mg, FGA) for 12 days in autumn (October) and were administered with 500 IU of PMSG on the day of sponge removal, the time of oestrus onset was determined as 32.0±3.4 h. Furthermore, Romano (2004) reported that the application of intravaginal sponges impregnated with 30 mg of FGA during the breeding season for 13 days to goats, resulted in an oestrus onset time of 32.9±9.7 h. On the other hand, in another study in which goats were applied FGA-impregnated intravaginal sponges for 11 days during the breeding season and were administered with 500 IU of PMSG and 125 mcg of cloprostenol at the time of sponge removal, Dogan *et al.* (2005) reported the mean time of oestrus onset as 18.0±1.9 h. The times of oestrus onset determined in the present study are in agreement with the results reported by Freitas *et al.* (1997), Blaszczyk *et al.* (2004) and Romano (2004) and are longer than that reported by Dogan *et al.* (2005). This difference may have arisen from geographical region, type of feeding, animal breed and season. Karaca *et al.* (2010) reported that when hair goats were applied intravaginal sponges (30 mg, FGA) for 8 and 14 days at the beginning of the breeding season, the times of oestrus onset were 28.8±1.1 and 28.0±1.0 h, respectively. These researchers also indicated that the two groups which were applied vaginal sponge treatment for different time periods did not differ from each other significantly.

The oestrus rates determined for the ST (94.7%) and LT (97.2%) groups in the present study did not display any statistically significant difference ($p>0.05$). Oestrus rates determined in previously conducted studies in which goats were applied vaginal sponges impregnated with progestagens have been reported as 85.7% by Dogan *et al.* (2005), 98.1% by Baril *et al.* (1993), 97.1% by Freitas *et al.* (1997) and 100% by Karaca *et al.* (2010) and Amarantidis *et al.* (2004). The oestrus rates determined in the present study are higher than that reported by Dogan *et al.* (2005), similar to those reported by Baril *et al.* (1993) and Freitas *et al.* (1997) and lower than those reported by Karaca *et al.* (2010) and Amarantidis *et al.* (2004).

In the present study, pregnancy rates were determined to be 55.5, 50, 50 and 55.5% in the groups ST1, ST2, LT1 and LT2, respectively (Table 2). The groups did not differ from each other significantly ($p>0.05$). In previous studies conducted on the use of PMSG for oestrus synchronization in goats, it has been reported that the administration of GnRH 24-44 h after sponge removal increased the synchronization of ovulations but did not increase pregnancy rates (Walker *et al.*, 1989; Eppleston *et al.*, 1991). Khan *et al.* (2003) reported that in a study in which ewes were applied progestagen impregnated intravaginal sponges for 12 days and were administered with 250 IU of PMSG on the day of sponge removal and 150 IU of human Chorionic Gonadotropin (hCG) at the time of mating, pregnancy rates did not differ between the control group (50%) and the group that received hCG (54%). Furthermore, Saribay *et al.* (2008) determined that when goats were applied intravaginal sponges impregnated with 30 mg of FGA for 14 days during the anoestrus season and were administered with 500 IU of PMSG and 0.075 mg of cloprostenol 48 h prior to sponge withdrawal with one of the groups being administered with 5 mcg of GnRH 48 h after sponge withdrawal, the pregnancy rates did not differ between the GnRH-treated group (38.9%) and the control group (33.3%).

In a study carried out by Walker *et al.* (1989) in which ewes were applied intravaginal sponges (60 mg MAP) for 12 days and were administered with GnRH 24 and 36 h after sponge removal, the pregnancy rates of the two groups that received GnRH at different times were determined as 37.1 and 65.9%, respectively. These researchers explained the pregnancy rate of the group administered with GnRH 24 h after sponge removal being lower by early ovulations resulting in weaker embryonic development. In the present study, GnRH injection 24 h after sponge removal in the ST2 and LT2 groups resulted in pregnancy rates of 40.0 and 50.0%, respectively whilst GnRH injection 36 h after sponge removal resulted in pregnancy rates of 54.5 and 63.6%, respectively ($p>0.05$) (Table 3).

In a study, in which goats were administered with GnRH 24 and 36 h after intravaginal sponge removal, Baldassarre reported that in the group that received GnRH 24 h after sponge removal, 34% of the embryos were in the pronuclear stage. These researchers determined that at the 36th h after sponge removal the rate of embryos in the pronuclear stage increased to 90%. Pierson *et al.* (2003) have reported that GnRH administration should be performed shortly before the endogenous LH surge which occurs after sponge removal and have suggested that the most appropriate timing during the breeding season would be 36 h after the removal of intravaginal sponges.

CONCLUSION

It was demonstrated in the present study that GnRH administrations immediately after mating to lactating goats, in which oestrus synchronization was performed by means of short and long-term intravaginal sponge treatment during the breeding season did not improve pregnancy rate, parturition rate and litter size.

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