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Technical note

GnRH agonist treatment on day 12 post-mating to improve reproductive performance in goats

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Abstract

Reproductive performance was determined in GnRH (4 μg synthetic GnRH agonist, buserelin, receptal; *n*=37) and saline (control, *n*=38) treated (i.m.) does on day 12 post-mating during the breeding season. Kidding rate was higher in the GnRH treated group (87%) compared to the control (68%) group ($P<0.05$). The does in the GnRH group had more twins ($P<0.01$) and consequently a higher total number of kids born and a larger litter size was recorded. Administration of GnRH on day 12 post-mating did not affect birth weight of kids. In conclusion, GnRH administration improved the reproductive performance of goats when administered on day 12 post-mating although the financial implications need to be evaluated.

Author Keywords: Author Keywords: Goat; GnRH; Reproductive performance

Article Outline

1. Introduction

Embryonic mortality during early pregnancy causes a significant reduction in the reproductive performance of farm animals. During the first 3 weeks of pregnancy, 30–40% of fertilized eggs are lost in sheep and goats (Bolet, 1986; Nancarrow, 1994 and Michels et al., 1998). Of this total loss, 70–80% occur between days 8 and 16 after insemination (Sreenan et al., 1996). Few studies have focused on the cause of embryonic mortalities in goats, while factors influencing embryonic survival have been studied mostly in cattle and sheep. One of the major causes of embryonic loss is thought to be inadequate luteal function (Nancarrow, 1994). In attempts to reduce embryonic mortality and hence to improve reproductive performance, progesterone supplementation after breeding, administration of hCG or GnRH before the time of maternal recognition of pregnancy have been employed to compensate for possible luteal insufficiency or to stimulate embryo development in order to amplify the embryonic signal during early pregnancy in dairy and beef cattle, and sheep (Beck et al., 1994; Nephew et al., 1994; Sreenan et al., 1996; Thatcher et al., 2001 and Cam et al., 2002).

The administration of GnRH to sheep result in an increase in plasma LH concentration and hence systemic progesterone (Sreenan et al., 1996 and Cam et al., 2002) and much of this rise in serum progesterone is due to the induction of accessory corpora lutea (Beck et al., 1996 and Cam et al., 2002). Studies in cattle and sheep showed that the timing of GnRH or hCG administration post-mating seems to be important (Beck et al., 1994; Nephew et al., 1994; Peters, 1996; Thatcher et al., 2001 and Cam et al., 2002). The administration on day 12 post-mating is the critical period for maternal recognition of pregnancy which coincides with the beginning of regression of the corpus luteum (CL) in the natural estrous cycle (Bazer et al., 1998). Hormonal induction of progesterone production after day 12 may increase interferon-τ production (Thatcher et al., 1995), which in turn might prevent luteolysis by inhibiting $PGF_{2\alpha}$ secretion (Bazer et al., 1998). Administration of GnRH on day 12 post-mating has been shown to improve early embryo survival (Beck et al., 1994 and Cam et al., 2002), pregnancy rate (Beck et al., 1994 and Cam et al., 2002) and litter size (Cam et al., 2002) in sheep. Enhanced luteal function and/or conceptus growth, hence improved the reproductive performance by GnRH administration post-mating have also been reported in cattle (Rettmer et al., 1992; Sheldon and Dobson, 1993 and Drew and Peters, 1994). However some studies have reported that GnRH administration to have no effect on reproductive performance in cattle and sheep (Ryan et al., 1994 and Tefera et al., 2001). Currently, there is little information available on the effect of GnRH administration on reproductive performance of goats. The objective of the present study was therefore to investigate whether a single injection of GnRH on day 12 post-mating during the breeding season has a beneficial effect on reproductive performance of goats.

2. Material and methods

2.1. Animals and treatments

The experiment was conducted at Ondokuz Mayis University, Samsun field station (41.2°N), Turkey, during the breeding season and a total of 75 Akkeci does (Saanen × (Saanen × Kilis) crossbreds, 2- to 3-year-old, 35.4±0.8 kg live weight) were used. Does in natural estrus were randomly allocated into two treatment groups. Both treatment groups were mated during late autumn season to two fertile Akkeci bucks. Estrus was detected with the aid of teaser bucks. Does in estrus were mated naturally during November. On day 12, post-mating (day of ESTRUS = 0), the does in one group (n=37) were given an i. m. injection of 4 μg of synthetic GnRH agonist (GnRH group; buserelin, receptal, Topkim, Istanbul, Turkey) and the other group (n=38) was given a saline (i.m.) injection (control group). Does returning to service were recorded to calculate non-return rate. The does were maintained on pastures during the day

and supplemented with hay and concentrates during pregnancy. At kidding, the date of birth, number, sex and weight of each kid were recorded.

2.2. Statistical analysis

Differences between treatment groups were analyzed by χ^2-analysis for non-return rate, kidding rate and fecundity, while analysis of variance was used to compare gestation length and birth weight (SAS, 1990).

3. Results

Reproductive performance of does in the control and GnRH treated (day 12 post-mating) groups are presented in Table 1. The number of does returning to estrus and non-return rate did not differ between treatment groups. GnRH administration on day 12 post-mating increased the kidding rate ($P<0.05$), when compared to the control group with the kidding rate being 19% higher in does in the GnRH administered group.

Table 1. Reproductive performance of does in control and GnRH treatment (on day 12 post-mating) groups

View Table (<1K)

Superscripts within rows with different letters differ significantly ($^{a,b}P<0.05$; $^{c,d}P<0.01$).

The does in GnRH administered group had more twins ($P<0.01$) and consequently had a higher total number of kids born and a larger litter size than those in control group. Twinning rate was 49% in GnRH group, while only 12% in the control group. There was no difference between control and GnRH administered does in terms of gestation length (Table 2). Similarly, the administration of GnRH on day 12 post-mating did not affect birth weight of kids.

Table 2. Mean (±S.E.M.) gestation length of does and birth weight of kids in control and GnRH treatment groups

View Table (4K)

4. Discussion

The results of the present study show that administration of a GnRH agonist on day 12 post-mating during the breeding season improves litter size and number of kids born in goats. Kidding rate and twinning rate in GnRH administered does were 19 and 37% higher than control doe, which resulted in a higher total number of kids born and an improved reproductive performance when administered on day 12 post-mating. These results are in agreement with the previous reports in sheep and cattle where GnRH administration on day 12 post-mating improves reproductive performance (Beck et al., 1994; Drew and Peters, 1994 and Cam et al., 2002).

Alacam et al. (1999) studied the effect of gonadorelin (a GnRH analogue) administered on day 12 post-mating in a small number of Angora goats and reported that GnRH administration increased pregnancy

rate, kidding rate and litter size. The results of the present study are in agreement with these findings. Administration of GnRH resulted in a rapid increase in plasma LH concentration and also in an increase in plasma progesterone concentrations in sheep (Beck et al., 1994 and Cam et al., 2002). The number of accessory CLs is increased with the administration of GnRH (Beck et al., 1994 and Cam et al., 2002). The stimulatory effect of GnRH administration on luteal activity has been reported to be detectable on day 45 of pregnancy in sheep (Cam et al., 2002). Although plasma LH and progesterone concentration and the number of accessory CLs was not determined in the present study, the effect of GnRH on embryo survival in does may occur through GnRH-stimulated LH surge stimulating production of progesterone by the CL and/or causing ovulation and the formation of accessory CLs. There was no difference between GnRH administered and control does in terms of the non-return rate, while the number of does kidding was higher in the GnRH treated does. The results indicate that the embryos may have been lost after day 20 in the control group. GnRH administration stimulates luteal activity in sheep observed on day 45 of pregnancy (Cam et al., 2002), which may result in a stronger embryonic signal and/or a higher embryonic development in GnRH administered does, and hence results in pregnancies of embryos, which would otherwise degenerate. GnRH administration to sheep has been reported to increase the non-return rate (Cam et al., 2002). This effect of GnRH may be attributed to its effect on early embryo survival. Ashworth (1995) reported that embryonic mortality rate is similar between days 2 and 12, and days 12 and 30. Therefore, such differences in embryonic mortalities between sheep and goats may be due to the species difference. Another significant difference between sheep and goats is that in goats maintenance of pregnancy is solely dependent on luteal activity by the corpus luteum (Bolet, 1986).

There was no difference between birth weights of kids from GnRH treated and the control groups in the present study. It has been reported that progesterone supplementation increases subsequent fetal growth (Garrett et al., 1988 and Kleemann et al., 1994). Therefore, it is possible that GnRH administration may also stimulate subsequent fetal growth through enhanced luteal activity. However, in our laboratory, it was demonstrated that GnRH administration does not affect fetal growth in sheep, which is similar to the observations in goats in the present study (Cam et al., 2002).

The pregnancy rate recorded in the control group in the present study was approximately 70%, which is lower than reported by Alacam et al. (1999). The effects of hormonal treatments in improving reproductive performance of does may be more profound under such conditions. The low pregnancy rate in control group may reflect the breed differences on embryonic mortality (Nancarrow, 1994). There is no information in the literature available by regarding the reproductive performance of the Akkeci breed used in this trial. Twinning rate in the GnRH treated does was 37% higher than the control doe which resulted in a higher total number of kids born. It is well known that the chance of embryo survival decreases as the litter size increases (Nancarrow, 1994 and Ashworth, 1995). It is thus possible that GnRH administration in the present study prevented the decease of the twin embryos by enhanced luteal activity which resulted in an increased number of twins at birth which otherwise would not have survived.

5. Conclusion

The results of the present study show that GnRH agonist administration improves reproductive performance of goats when administered on day 12 post-mating. Increased pregnancy rate and litter size in GnRH administered goats are thought to be the results of GnRH effect on increasing embryo survival through enhanced luteal function.

Acknowledgements

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