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Comparison of Reproductive Performance in Raieni Goats Following Different Estrous Synchronization Methods and Subsequent ECG Treatment During the Natural Breeding Season

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Abstract: This experiment was performed to determine the effectiveness of different synchronization methods and one dose of eCG treatment on the reproductive performance in adult Raieni goats. In this experiment, 96 goats were allocated into three groups, treated with fluorogestone acetate (FGA) sponges or controlled internal drug release (CIDR) for 14 days and two injections (250 µg) cloprostenol with 13 interval. The goats in groups 1 and 2 were injected intramuscularly with 350 IU eCG (Intervet, The Netherlands) at the time of progestagen removal from the vagina on day 14. The second injection of cloprostenol in group 3 coincides with the injection of eCG at the time of CIDR and sponge removal in groups 1 and 2. The interval to onset of estrus was detected by using five aproned bucks. The estrous synchronized after heat detection was artificially inseminated with diluted semen of fertile bucks. Twenty one days after insemination, blood samples were taken from jugular vein in 10-ml vacuum tubes (venoject) for pregnancy diagnosis. No significant difference was observed for the interval between the end of the synchronization protocol and the standing heat amongst treatments. Blood serum progesterone level (overall mean: 4.90 ± 0.41 ng/ml; SEM), non-return rate to estrus and the kidding rate were not significantly affected by the synchronization methods. Prolificacy and fecundity were not significantly affected by the synchronization methods; however, cloprostenol method was found to be more convenient and economical under the conditions of this experiment.

Key words: Raieni goat · eCG · Intravaginal Sponge · $PGF_2\alpha$

INTRODUCTION

The most economically important trait in sheep production is reproduction and it can be manipulated using hormonal treatments [1]. Several techniques have been developed to induce out-of-season estrus in goat, allowing farmers to raise and provide the market kids year round. Intravaginal devices containing different types of progestogens, maintained in situ during 12–14 days, associated with gonadotrophin administration is the most widely were used. In herds of goats, artificial insemination(AI) could be used for increasing desirable production traits and number of offspring produced per sire per year, grading-up to a new strain or genotype, hastening genetic progress, increasing efficiency of breeding and controlling disease by using diluted or frozen semen of superior bucks [2, 3]. The use of AI is facilitated after estrous synchronization programs which induce tight estrus during a short period of time and improve pregnancy and prolificacy rates. During the breeding season, when goats and ewes are actively cycling, estrus can be synchronized with $PGF_2\alpha$ or one of its analogues, such as cloprostenol [4, 5]; however, the number of observations in different breeds is still insufficient for allowing firm conclusions. The most extensively researched method [6] is the use of vaginal sponges impregnated with 40 to 50 mg of fluogestone acetate (FGA). Treatment with intravaginal sponge impregnated with FGA for a period of 10-16 days and intramuscular injection of PMSG at intravaginal device removal, have been successfully used to improved the reproductive performance in ewes [7- 9]. Motlomelo *et al.*

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[10] showed that several progestagen treatments, including MAP, FGA and controlled internal drug releasing device (CIDR) were equally efficient for estrous induction and synchronization of Boer and African indigenous goats; no significant differences were found in pregnancy rates 40 days after AI. Administration of gonadotropins such as equine chorionic gonadotropin (eCG) stimulates follicular growth and increases ovulation rate and fertility and induces a tighter synchrony of ovulation in both anestrous and cycling sheep [11, 12]. Injection of eCG after progesterone treatment increases estrus response, conception rate and percentage of multiple births from the induced ovulation. In Iranian fat-tailed ewes, injection of eCG, especially in high dosage (500 vs. 350 IU at the time of CIDR removal) increases twinning and lambing rates [13, 14]. There are about 25 million goats in Iran and goat production has a significant economical role for Iranian farmers. Flocks have been established aimed at preserving and breeding Iranian native goats. Raieni goats have been included in this program. The Raieni goats is one of the important native breeds, are raised mostly for fiber (with the fiber yield of about 2 kg per year). It also presents a good carcass conformation and stands out as being very fertile, precocious and resistant to gastrointestinal parasites and produce valuable Kashmir hair [15]. The goat herds are raised on natural vegetations during most parts of the year, except for approximately 30 days during winter when they are stablefed. As a part of a nationwide program for preservation and genetic improvement of the native livestock, several Raieni goat herds have also been established which are bred by artificial insemination after estrus synchronization. Various methods of estrous synchronization are practiced in several goat flocks in Iran, but no research has been conducted concerning the efficacy of these methods in the Raieni goats. Therefore, main objective of this experiment was to study the effect of CIDR, fluogestone acetate sponges and cloprostenol with eCG treatments on reproductive performance of mature Raieni goats during the breeding season.

MATERIALS AND METHODS

Location and Animals: This experiment was conducted on Raieni goat Breeding Station in Baft city which is located in southeast of Kerman province (2250 meters above the sea level, 92°17 N latitude and 56°36 E longitude and 220 mm annual rainfall) during the breeding season from September to February 2010. The average ambient temperature during experiment was 25 to 30°C. The animals were submitted to examination for general clinical condition, sanitary and reproductive health. Goats weighing (40±2.5 kg) with a standard body condition score between 3 and 3.5 on a scale of 1 to 5. Does grazing on native pastures plus received barley (150–180 gr) per day. Ninety six adult Raieni goats were randomly divided into three groups and were synchronized by either the CIDR (EAZI-BREED, New Zealand) containing 0.3 g of progesterone for 14 days (n=32), intravaginal sponges impregnated with 30 mg of FGA (Cronolone, Intervet, The Netherlands) for 14 days (n=32), or injections 250 µg cloprostenol (Estrumate, ICI Pharma, Canada) 13 days apart (n=32). The goats in groups 1 and 2 were injected intramuscularly with 350 IU eCG (Intervet, The Netherlands) at the time of progestagen removal from the vagina on day 14. The second injection of cloprostenol in group 3 coincides with the injection of eCG at the time of CIDR and sponge removal in groups 1 and 2. The interval to onset of estrus was detected by using five aproned bucks. The estrous synchronized after heat detection was artificially inseminated with diluted semen of fertile bucks. Twenty one days after insemination, blood samples were taken from jugular vein in 10-ml vacuum tubes (venoject) for pregnancy diagnosis. Serum was recovered by centrifugation (10 minutes at 3000 rpm) and stored at -20°C until assayed for Serum progesterone concentrations using commercially available ELISA kit (Demeditec Diagnostics GmbH, Kiel, Germany). Serum progesterone level of greater than 1.4 ng per ml was taken as an indication of pregnancy. All does becoming pregnant following insemination at the first synchronized estrus kidded successfully, therefore, the number of kids born per female kidded (fecundity) and the number of kids born per estrous female inseminated (prolificacy) were identical.

Statistical Analysis: Frequencies of estrus and the proportion becoming pregnant were compared by x^2-test. The interval from device withdrawal to estrus onset was compared using a mathematical model that included fixed effect due to intravaginal devices and residual error. Gestation length and serum progesterone were analyzed by use of repeated measures test. Prolificacy (number of kids born per estrous female inseminated) were assessed by Chi-squared analysis.

RESULTS

There was no significant effect of the synchronization method on estrous response, time of onset of estrus, estrous duration, serum progesterone concentration at 21 days after insemination, kidding rate, gestation length and fecundity rate (Table 1 and Figure 1).

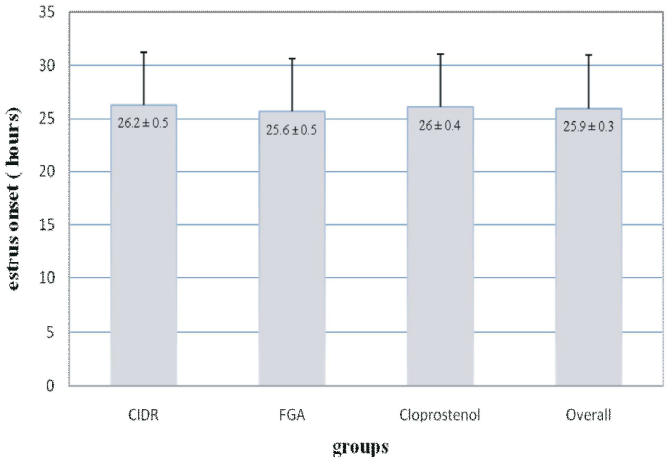

Fig. 1: Time to the onset of estrus in goats treated with different synchronization methods

Table 1: Effect of three synchronization methods on reproductive performance of Raieni goats (means±SEM)

parameter	CIDR	FGA Sponge	Cloprostenol	Overall
Goats in estrus (%)	94 (30)	97 (31)	97 (31)	96 (92)
Duration of estrus (h)	21.7±0.4	22.0±0.3	21.9±0.5	21.8±0.4
Serum P 4 level (ng/ml)	5.2±0.8	5.0±0.9	4.8±0.6	4.9±0.4
Kidding rate [a] (%)	60	55	57	57
Gestation length (days)	148.6±0.8	146.3±0.7	150.5±0.9	149.4±0.5
Fecundity rate [a] (%)	122	133	127	113
Litter size	1.35±0.1	1.35±0.2	1.44±0.2	1.38±0.8

[a]All does becoming pregnant following insemination at the first synchronized estrus kidded successfully, therefore, the number of kids born per female kidded (fecundity) were identical.

Table 2: Compared Progesterone level (ng/ml) between does coming to estrus and not returned to estrus

	No. of does	Progesterone level (ng/ml)
Returned to estrus	37	2.9±0.3[a]
Not returned toestrus	55	5.7±0.5[b]

[a,b]significantly different (P<0.01)

The mean intervals to onset of estrus were 26.2±0.5, 25.6±0.5 and 26±0.4 in CIDR, FGA sponge and cloprostenol respectively. The mean onset of estrus in CIDR group was higher than other groups but this difference was not statistically significant (Fig. 1). The mean duration of estrus ± SD was 21.7±0.4, 22.0±0.3 and 21.9±0.5 in CIDR, FGA and Cloprostenol group respectively (Table 1).

Overall, 96% of the does were in estrus within 26 h and 57% were pregnant following a single intracervical insemination of does at first detected estrus, as determined by ultrasonography on day 78, which kidded successfully. Of the 92 does that kidded, 78 had singltons, 12 had twins and two of them delivered triplets. At 21 days after AI, had a serum progesterone concentration (mean±SEM) of 5.2±0.8, 5.0±0.9 and 4.8±0.6 ng/ml, In CIDR, FGA sponge and cloprostenol synchronization methods respectively. The litter size estimated for the different synchronization method are shown table (1). The overall mean number of kids born per female kidded was 1.38+0.8. No significant differences were observed between treatments (CIDR: 1.35±0.1, FGA: 1.35+0.2 and Cloprostenol: 1.44±0.2) respectively. Results of the present study showed that the kidding rate of Raieni goats, after a single insemination into the beginning of cervix, was 60%, 55% and 57% in treatment groups respectively. The gestation length (146 to 150 days) was not significantly different between treatments (Table 1).

Serum progesterone concentration on day 21 was significantly lower in those goats that returned to estrus after AI (Table 2).

DISCUSSION

The three synchronization methods employed resulted in estrous response in 94 to 97% of the treated goats (Table 1). Standing heat was observed between 23 and 35 hours (mean of 26 h) after the end of synchronization protocol with no significant differences between the treatment groups. From the 96 Raieni goats used in the trial, 92 goats exhibited signs of estrus during the 120 hour observation period, which group one are (94%), group two (97%) and group three is (97%) are shown in table (1).

The percentage of goats exhibiting estrus in this trial was comparable to values reported in the literature [16, 11]. While Dogan [11] reported 88,9% estrus response by using 60 mg of MAP and 500 IU of PMSG during non-breeding season, 80.87% estrus response have been obtained by Simonetti *et al*. [16] who used 60 mg MAP. Higher estrus responses (100%) have been reported by Hashemi *et al.* [17] in studies involving the use 500 PMSG in Karakul ewes outside of the breeding season. The slight differences between the results obtained in the current study and those of the proceed researchers may be due to differences in the breed of goats used and the seasons in which the studies were executed.

The results were also comparable to the findings of Amarantidis *et al.* [18] in three groups of indigenous Greek goats (*Capra prisca*) treated with FGA, $PGF_2\alpha$ and FGA/ $PGF_2\alpha$ (overall 98%) and Lehloenya *et al.* [19] in Boer and Nguni goats treated with MAP/eCG (overall 95.5%), during the breeding season; and to the findings of Blaszczyk *et al.* [20] in Anglo-Nubian goats treated with FGA/eCG (100%), outside the breeding season. Intravaginal sponges containing 40 mg progestagen were effective in inducing estrus in 70% of the Sudanese Nubian goats. Intravaginal sponges containing FGA and CIDR devices were equally effective for the control of ovulation in Lory ewes when combined with eCG injection [13]. Researchers have also tried to determine the optimum dose of cloprostenol for estrous synchronization. Greyling and Van der Westhuysen [21] found that with 125 µg doses of cloprostenol, only 80% of their ewes came into estrus, as compared with 100% at the 250 µg dose level. On the other hand, doses of 125 µg were highly effective (100%) in inducing estrous synchrony in Sudanese Nubian goats [22]. Cloprostenol seems to be very effective for rapid lysis of the caprine corpora lutea and subsequent falling of progesterone levels during the breeding season when does are cycling; however, progesterone can be used for estrous synchronization whether a corpus luteum is present on the ovaries or not. Onset of estrus between three application methods were not significantly different. The time to estrus onset was slightly longer (26.2 h) in the groups treated with CIDR for 14 days compared to the other groups (25.6 and 26 h). The time of estrus onset results of the current trial no agreement with the previous findings of Greyling and Van der Nest [23] the time of onset (50.7±26.3 h) and with Dogan [11] 30 and 60 hour. Also Amer and Hazzaa [24] noted the time from sponge withdrawal to the onset of estrus to be later in ewes treated with FGA for 12 days. Simonetti *et al*. [16] recorded estrus to occur 55.94, 56.74 and 57.7 hours after using sponges impregnated with 40,50,60 mg progesterone respectively.

In current experiment the duration of estrus was within the normal range of 21 to 22 h, but it was less variable than that reported by Emady *et al.* [25] for Abadeh goats (another Iranian indigenous goat) during the breeding season. Mean duration of estrus was not significantly different amongst the treatment groups (overall mean=21.8 h). duration of estrus was slightly longer (22.0±0.3) in the FGA group for 14 days compared to other groups (21.7±0.4 and 21.9±0.5 h). The results of our study could be the shorter compared to previous studies Hashemi *at el.* [17] who reported that the duration of estrus were between 18 and 72 hours with an average around 36 hours and the duration of estrus to be 22.11±3.4 by using MAP with 500IU eCG out-breeding season. Similarly Ahmed *et al.* [22] did not find any significant difference in mean estrous duration (52 h) for the Nubian goats treated with cloprostenol or intravaginal progesterone sponges followed by eCG injection. It is believed that estrous synchronization using two prostaglandin injections, 11 days apart, has no adverse effect on pregnancy rate in goats [5]. In the present study kidding rate, fecundity rate were not significantly affected by the synchronization methods. Similarly, reproductive performance of Sudanese Nubian goats were not significantly different for the does that were synchronized by intravaginal sponges or cloprostenol [22]. While some studies have reported that fertilization and lambing rates were decreased in the ewes bred by artificial insemination at the prostaglandin controlled estrus, others have not found an adverse effect of prostaglandins on the ewe fertility [5]. The kidding rate of dairy goats injected with 100 µg cloprostenol, at an interval of 10 days and inseminated with frozen semen at a predetermined time after treatment, was reported to be 10%, 44.7% and 21.4%

for a single insemination at 60, 72 and 84 h respectively after the second cloprostenol injection [26]. The gestation length (146 to 150 days) was not significantly different between treatments (Table 1) and was within the normal range of 140 to 155 days. In the present study and study of Amarantidis *et al.* [18], the gestation length was not affected by the litter size but Lehloenya *et al.* [19] reported a significantly shorter gestation length in does with quadruplets. In our study only two of the goat had triplets and no quadruplet gestations were recorded. The mean litter size in the CIDR groups were estimated to be 1.35 compared to 1.35±0.2 and 1.44±0.2 for the goats treated with FGA and cloprostenol respectively; therefore, there was no significant difference in litter size rates between the groups. This results were agreement with Pollott and Gootwine [27], they reported that the mean litter size in Assaf breed to be 1.57, although increased PMSG doses should increase the number of follicular growth and so to increase twining rate and litter size, the results of the present study did not show any significant differences between three groups. However, in the present study there was noticeably increase in the litter size in cloprostenol injection group treated with 350 I.U, opposing the phenomena of gonadotropin effects on ovulation rate, gonadotropin hormones function to increase litter size and twining rate. Researchers reported that the using of 400 I.U PMSG increased the litter size when compared to ewes injected with 200 or 300 I.U. PMSG [28, 29].

The mean serum progesterone concentration during the 21 day after insemination were 5.2±0.8, 5.0±0.9 and 4.8±0.6 ng/ml in the groups treated with CIDR, FGA and cloprostenol injection respectively. No significant differences were found between the mean P_4 concentration when administration 350 IU of eCG hormone. This not comparable with Amer and Hazzaa [24] who reported that P_4 concentration tend to increase gradually and reach maximum between day 11 and 20 days when PMSG administrated with high doses. Based on the number of kids delivered and measurement of P_4 concentration 21 days after insemination a strong, positive, linear between blood P_4 concentration and the number of kids delivered was found. The blood P_4 concentration values in ewes carrying single or twin fetuses are comparable to those reported by other researchers [23, 30]. According to these results measurement of P_4 concentration during pregnancy can be used to diagnose pregnancy with single or multiple fetuses.

In conclusion this study has shown that reproductive performance of the Raieni goats was not significantly affected by the estrous synchronization methods used, but cloprostenol injection was found to be more convenient and economical under the conditions of this experiment during the breeding season.

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