Efficiency of short time protocols based on combined FGA, PGF2α, GnRH and eCG treatments on oestrus synchronization and reproductive performance of kermani ewes during the breeding season

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ABSTRACT

The objectives of the present study were to determine the efficiency of short time protocols based on combined FGA, PGF2α, GnRH and eCG treatments on oestrus synchronization and reproductive performance of kermani ewes during the breeding season. Seventy-five multiparous non-lactating kermani ewes weighing 45 ± 0.5 kg with a body condition score (3.6 ± 0.1) were allocated into five groups. The treatment are shown in article body. The ewes were checked for oestrus by teaser rams at 8 h intervals. The ewes were hand-mated (male to female ratio 1:5) at the beginning of oestrus and subsequently 12 h intervals until the end of oestrus. The percentages of female in estrus and the interval to oestrus (h after treatment), fertility and prolificacy rate were recorded. The obtained data were analyzed using the GLM procedure of SAS system. Treatments had no significant effect on incidence of oestrus, however, ewes received T4 tended to show a lower oestrus. Hormonal treatments significantly affected the interval to oestrus which was earlier in treated control ewes than in T4 and T2 (P < 0.05). Fertility rate tended to be higher in T4 and T2 groups compared to that of control group also Prolificacy rate was higher in T4 group. Results of the present study showed that PGF2α–FGA–eCG as well as FGA–PGF2α–eCG short term 5-day treatments is effective in synchronizing oestrus in ewes during the breeding season. Also GnRH–PGF2α–eCG 5-day treatment has been found effective to provide high level of oestrus followed by acceptable levels of fertility after natural mating.

1. Introduction

Estrus synchronization or the induction of estrus is a valuable management tool for increasing the pregnancy rate in ewes [1]. Modern sheep husbandry has improved the efficiency of extensive production and controlled the reproductive process for intensive production [2]. The most economically important trait in sheep production is reproduction and it can be manipulated using hormonal treatments [3]. Several techniques have been developed to induce out of season estrus in sheep, allowing farmers to raise and provide the market lambs year round. Intravaginal devices containing different types of progestagens, maintained in situ during 12–14 days, associated with gonadotrophin administration is the most widely used. An extension of the lifespan of the ovulatory follicle, as a consequence of low concentrations of progesterone, may be associated with a low viability of the ovulated oocyte [4]. The fertility of the ewe is affected in a dose dependent manner by fluorogestone acetate [5] or progesterone in intravaginal devices [6]. 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, 8]. It has been shown that the 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 [9]. 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 are actively cycling, estrus can be synchronized with PGF2α or one of its analogues, such as cloprostenol [10]; however, the number of observations in different breeds is still insufficient for allowing firm conclusions [11]. The most extensively researched method [12] is the use of vaginal sponges impregnated with 40 to 50 mg of fluogestone acetate FGA. [13] showed that induction of estrus in indigenous Damascus goats, outside the breeding season by using medroxyprogesterone acetate (MAP) plus injection of eCG (equine chorionic gonadotropin) at the time of sponge removal resulted in estrous response of 100%; conception rate and fecundity were 65.8% and 195.2% respectively. Estrus and ovulation synchronization technologies in ewes are mainly based on the control of corpora lutea lifespan with prostaglandin or using progestagen/progesterone treatments plus equine chorionic gonadotropin (eCG) for 12–14 days [10, 14]. Prostaglandin alone does not provide an acceptable synchrony of oestrus, which depends on the stage at the time of the oestrus cycle when prostaglandin-induced luteolysis [15, 16]. Moreover, this method is only applicable in cyclic females. Progestagen treatment systems are quite long and do not meet the expectations of dairy ewe farmers because products (milk and derived cheeses) cannot be used during the treatment period. Therefore, in order to shorten the treatment period, a luteolytic dose of PGF2α can be injected at the end or 24–48 h before the end of progestagen treatment [6, 14]. However, such methods have resulted in a high fertility rate variability. Improved knowledge of ovarian dynamics [17, 18] and wave-like patterns with the presence of follicular dominance [19, 20, 21] indicate possibilities to control follicular development by synchronization of the follicular wave that gives rise to the preovulatory follicle, and synchronize oestrus and ovulation. In cattle, GnRH injections promote LH release thus inducing either ovulation or atresia of the dominant follicle followed by the appearance of a new follicular wave in a synchronous way [22, 23]. Treatments with a combination of GnRH plus PGF2α have been used to control ovarian follicular and luteal function and increase the precision of oestrus and ovulation synchronization in reproductive management programs [24]. Therefore, the present investigation was conducted to compare the efficiency of combined progestagen, PGF2α, GnRH and eCG treatments in order to develop a short time protocol for synchronizing oestrus in kermani ewes before mating during the breeding season.

2. Materials and Methods

This experiment was conducted on Rezvan junior college farm in kerman provinces (latitude 300 18 / N, longitude 570 7/ E, altitude 1755 m) during the breeding season from September to February 2010. The average ambient temperature during experiment was 30 to 35°C. The annual rainfall in this region ranges from 140 to 155 mm, with an erratic distribution throughout the year. The animals were submitted to examination for general clinical condition, sanitary and reproductive health. This experiment aimed at evaluating the efficiency of short time protocols based on combined FGA, PGF2α, GnRH and eCG treatments on oestrus synchronization and reproductive performance following natural service. Seventy-five multiparous non-lactating kermani ewes weighing 45 ± 0.5 kg with a body condition score (3.6 ± 0.1) were allocated into five groups (Fig. 1).

Fig. 1. Experimental design and timeline for treatment administration.

The groups are subsequently defined by letters represented the sequence and combination of treatments used: (T1) control = FGA (fluorogestone acetate intravaginal sponges, 40 mg, Intervet, Milano, Italy) for 14 days + eCG (Ciclogonina, Intervet, Milano), 200 IU i.m. at sponge removal (s.r.). (T2) = FGA (40 mg, 5 days) + PGF2α (Cloprostenol, ICI, Estrumate, Schering-Plough, Milano) 100µg i.m. s.r. (Day 5) + eCG (200 IU i.m. s.r., Day 5). (T3) = PGF2α (100µg ICI, Day 0) + FGA (40 mg, 5 days) + eCG (200 IU i.m. s.r., Day 5). (T4) = PGF2α (100µg ICI, Day 0) + GnRH (a GnRH analogue, Fertagyl, Intervet, Milano, Italy, 100µg given i.m. 30 h after s.r.). (T5) = GnRH (100µg i.m., Day 0) + PGF2α (100µg ICI, Day 5) + eCG (200 IU i.m., Day 5). The ewes were checked for oestrus by teaser rams at 8h intervals. The ewes were hand
-mated (male to female ratio 1:5) at the beginning of oestrus and subsequently 12 h intervals until the end of oestrus. At lambing, fertility (number ewes lambing/number ewes treated) and prolificacy (number lambs born/number ewes lambing) were recorded. Results of experiments were analyzed using the GLM procedure of the SAS system [25]. Differences among treatments in the interval between FGA or PGF2α injection and oestrus and ovulation time were analyzed by least-squares analysis of variance, and the differences between the treatment groups were compared by Student’s t-test. Percentages of animals in oestrus, fertility and prolificacy were compared by using the chi-square test.

3. Results and discussion

Seven ewes were excluded from the data due to the loss of intravaginal sponges (N= 7) or accidental trauma (N= 3 ewes). Treatments did not differ in the incidence of ewes in oestrus (Table 1) although (T4) ewes tended (P < 0.10) to show a lower incidence of ewes in oestrus (71.4%, 10/14) compared to treatment Groups and control Groups (Table 1). Hormonal treatments affected (P < 0.05) the interval to oestrus which was earlier in treated control ewes (30.3±4.4 h) than in T4 (36.3±4.0 h; P < 0.05) and T2 (43.6±8.1 h; P < 0.01) (Table 1). Fertility rate tended (P < 0.10) to be higher in T3 (93.3%) and T2 (87.5%) Groups, if compared with the control Group (T1). Prolificacy rate was higher in T4 Group (173%; P > 0.05) (Table 2).

Table 1: Influence of synchronization treatments on oestral responses of adult kermani ewes.

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>Treated ewes</th>
<th>Ewes in oestrus</th>
<th>Onset of estrus</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Control)</td>
<td>16</td>
<td>15</td>
<td>30.3 ± 4.4Ac</td>
</tr>
<tr>
<td>T2</td>
<td>16</td>
<td>14</td>
<td>43.6 ± 8.1Bb</td>
</tr>
<tr>
<td>T3</td>
<td>15</td>
<td>14</td>
<td>35.0 ± 8.0d</td>
</tr>
<tr>
<td>T4</td>
<td>14</td>
<td>10</td>
<td>36.3 ± 4.0d</td>
</tr>
<tr>
<td>T5</td>
<td>14</td>
<td>13</td>
<td>33.9 ± 8.4a</td>
</tr>
</tbody>
</table>

The results of this study indicate that the incidence of females in oestrus following PGF2α–FGA–eCG, GnRH–PGF2α–eCG or FGA–PGF2α–eCG short time treatments was similar to that of FGA–eCG long term control regimen. Mean interval to oestrus delayed in T, treated ewes. The efficiency in synchronizing estrus of T, 5-day protocol is given by the fact that progestagen prevents new corpora lutea formation [6, 14, 26] while PGF2α ensures the luteolysis 5 days later and eCG improves the synchronization. Incidence of oestrus in T, treated ewes found in this study (87.5%) is similar to those obtained in other studies following longer control treatments [27] and a long term traditional control treatment [16].

Table 2 : Influence of synchronization treatments on reproductive performance of adult kermani ewes

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>Treated ewes</th>
<th>Fertility Rate %</th>
<th>Prolificacy %</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Control)</td>
<td>16</td>
<td>10/16</td>
<td>62.5</td>
</tr>
<tr>
<td>T2</td>
<td>16</td>
<td>14/16</td>
<td>87.5</td>
</tr>
<tr>
<td>T3</td>
<td>15</td>
<td>14/15</td>
<td>93.3</td>
</tr>
<tr>
<td>T4</td>
<td>14</td>
<td>6/14</td>
<td>42.8</td>
</tr>
<tr>
<td>T5</td>
<td>14</td>
<td>10/14</td>
<td>71.4</td>
</tr>
</tbody>
</table>

Different superscripts in columns differ significantly; P<0.05.
The delayed interval to oestrus observed in (T2) might be attributed to the status of corpora lutea at the time of induced PGF2α luteolysis as well as to the stage of follicular development at the time of prostaglandin administration. Previous studies have demonstrated a great variability in the occurrence of oestrus related to the stage or the day of the cycle at which PGF2α was given [15, 16]. In this study, the efficiency of (T2) in inducing a high level of synchronization is comparable to that observed in goats [28], where a PGF2α injection at the time of the CIDR device insertion for 5 days promotes the growth of a large follicle, which is aged about 5 days at end of treatment. This treatment resulted into a pregnancy rate of 80% after natural service [28], similar to the fertility rate observed in the present study (87.5%). In the current study fertility rates after natural mating following short term 5 days (T2) and (T3) protocols were similar and higher than in long-time (14 days) treatment control group, despite its high percentage of ewes in oestrus. The reasons for this maybe might be attributable in the sub-luteal spong progesterone concentration observed at the end of the long term treatment with progestogen [4]. Ungerfeld and Rubianes [6] showed that high levels of short time progestagen priming (6 days), followed by low doses of eCG, are able to control follicular turnover and to determine good levels of fertility. It is likely that the induction of luteolysis by PGF2α injected at the time of the insertion of FGA sponges (T2) ensured high levels of progestagen during the short term progestagen priming. Moreover, an improving oestrus synchronization has been observed by synchronizing the follicular wave to luteolysis [29], with subsequent good fertility, as probably happened for the most of T2 and T1 treated ewes in this trial. The efficiency of GnRH–PGF2α–eCG treatments in inducing a high level of oestrus (91.7%) matches the results of [30] in Welsh Halbred ewes treated with a combination of buserelin and PGF2α (90.9%) or those of in GnRH–PGF2α – eCG Akkaram cross breed treated ewes (93.7%). This outcome also corresponds to the results (85%) obtained in cattle by using a combined buserelin-PGF2α treatment [31]. Again, the level of synchronization is comparable with that obtained with progestagen pessaries observed in this study (control Group) and in others [15]. GnRH injection at random stages of the oestrus cycle, promoting LH surge, generally induces ovulation/luteinisation of the dominant follicle followed by a new follicular wave and a derived new dominant follicle with the best oocyte quality [32]. Moreover it has been shown that the corpora lutea is responsive to PGF2α since Day 3 of the oestrus cycle [28]. The overall results of this study suggest that GnRH injection is able to ensure the most animals to be responsive to PGF2α administration and subsequent eCG treatments observed in this study (87.5%) ensured high levels of fertility after natural mating. This short time method is more advantageous for its reduced costs, furthermore it is less laborious because it does not require the use of progestagen sponges and avoids potential pathological diseases (pessary retention, vaginitis).

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5. References


