

The Effect of Time of Equine Chorionic Gonadotrophin and Prostaglandin F_{2α} Administration on Fertility Parameters in Akkaraman Yearlings Treated by Medroxyprogesterone Acetate in Non-breeding Season

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Yearlings, estrus synchronization, eCG, PGF_{2α}, different application times

Abstract

The aim of this study was to determine the effect of the administration of eCG and PGF_{2α} at different times on some fertility parameters in Akkaraman yearlings aged 10-12 months synchronized with medroxyprogesterone acetate in the out-of-breeding season. A total of 75 Akkaraman yearlings were divided into two groups at random. Intravaginal sponges containing 60 mg of medroxyprogesterone acetate (MPA) were kept in the vagina for 9 days for estrus synchronizations. Group 1 and Group 2 received 500 IU eCG and 125 mcg d-cloprostenol 48 hours before sponge removal. Group 2 received the same treatment at sponge removal. The rams joined the herd for an hour twice a day 24 hours after the sponge withdrawal. Pregnancy examinations of the sheep were performed via transabdominal ultrasonography with 6-8 MHz real-time ultrasound probe (Falco, Pie Medical, Netherlands) 50 days after mating. Estrus onset times were 49.63 ± 7.67 and 50 ± 7.64 h in Group (I) and Group (II), respectively. Estrus, pregnancy, and conception rates were % 64.70, and %66.66; % 44.11, and % 52.77, % 68.18, and % 79.16 in group (I) and group (II), respectively. There was no statistical difference between the groups in terms of estrus onset times, estrus, pregnancy, and conception rates (p>0.05). In conclusion, eCG and PGF_{2α} treatment at progesterone removal was considered more advantageous in terms of labour. Also, it was seen that earlier matings can be obtained with the estrus synchronization protocols used without waiting for the breeding season.

Üreme Sezonu Dışında MPA ile Senkronize Edilen Akkaraman Irkı Şişeklerde eCG ve Pgf_{2α}'nın Farklı Zamanlarda Uygulanmasının Fertilité Parametreleri Üzerine Etkisi

Özet

Bu çalışmanın amacı üreme sezonu dışında medroksiprogesteron asetat (MPA) ile östrüsleri senkronize edilen ve yaşları 10-12 ay arasında değişen Akkaraman ırkı şişeklerde eCG ve PGF_{2α}'nın farklı zamanlarda uygulanmasının bazı fertilité parametreleri üzerine olan etkisinin ortaya konmasıdır. Çalışmada bulunan toplam 75 adet Akkaraman ırkı şişek rastgele iki gruba ayrıldı. Grup 1 ve Grup 2'deki şişeklere östrüslerin senkronizasyonu amacıyla 60 mg MPA içeren intravaginal süngerler vaginaya yerleştirildi ve süngerler 9 gün süreyle vaginada tutuldu. Grup 1'deki şişeklere süngerlerin çıkarılmasından 48 saat önce, Grup 2'deki şişeklere ise süngerlerin çıkarıldığı anda 500 IU eCG ve 125 mcg d-kloprostenol kas içi yolla enjekte edildi. Sünger çıkartıldıktan 24 saat sonra koç katımı yapıldı. Şişeklerin gebelik muayeneleri aşımından 50 gün sonra, 6-8 MHz problu real-time ultrason cihazı (Falco, Pie Medical, Netherlands) ile transabdominal olarak yapıldı. Grup (I) ve Grup (II)'de östrüs başlangıç zamanları sırasıyla 49.63 ± 7.67, 50 ± 7.64 saat, östrüs, gebelik ve konsepsiyon oranları ise sırasıyla % 64.70 ve %66.66, % 44.11 ve % 52.77, % 68.18 ve % 79.16 olarak tespit edildi. Gruplar arasında östrüs başlangıç zamanları, östrüs oranları, gebelik oranları ve konsepsiyon oranlarında istatistiki olarak bir fark tespit edilmedi (p>0.05). Sonuç olarak Akkaraman ırkı şişeklerde üreme sezonu dışında gerçekleştirilen östrüs senkronizasyonları çalışmalarında süngerlerin çıkarıldığı anda uygulanan eCG ve PGF_{2α} enjeksiyonlarının işgücü yönünden avantaj sağlayacağı kanısına varıldı ve kullanılan yöntemlerle şişeklerde üreme sezonunu beklemeden aşımaların öne alınabileceği görüldü.

Introduction

Akkaraman sheep are a fat-tail sheep breed that was mainly bred in the Middle-Anatolian region and account for nearly 40% of the sheep population of Turkey (Akcapınar, 1994). They have the capability of benefiting low-quality pastures and a mean litter size of 1.2 (Akcapınar, 1994). Photoperiod, age, body weight, and season affect the time of puberty. Most of the sheep reach puberty at 50-70% of the adult body weight and are 9-15 months old. In puberty, the inhibiting effect of the gonadal steroids decreases, thereby activating the hypothalamus to secrete the gonadotropins. This cascade stimulates gonadal functions such as gametogenesis and sex steroidogenesis (Jainudeen et al., 2008; Canoğlu and Sarıbay, 2015).

The main target of sheep breeding is to have two lambings per year or three lambings in two years. However, due to the seasonal characteristic of the reproduction in the sheep, long anestrous periods prevent sheep breeding from being sustainable and profitable (Alacam, 2007). Therefore, estrus synchronizations are a widely accepted strategy to overcome the challenges related to seasonal breeding patterns (Ataman et al., 2006; Özar et al., 2022; Özbilek et al., 2022). Estrus synchronizations have many advantages such as synchronizing the estrus, ovulation, and parturitions in a short period. In addition, more feasible farm management can be made with estrus synchronizations (Alacam, 2007).

There are many methods such as flushing, photoperiod, and hormonal treatment for estrus synchronizations in ewes. Hormonal treatments include progesterone, gonadotropins, and prostaglandins (Wildeus, 2000; Alacam, 2007). The primary reason for progesterone use in estrus synchronization is to inhibit estrus, luteinizing hormone (LH) peak and ovulation during the

progesterone administration. Progesterone can be applied for different lengths (5-11 days), and usually, estrus can be observed within 24-48 hours after progesterone withdrawal (Wildeus, 2000; Menchaca and Rubianes, 2004; Kuru et al., 2022). While equine chorionic gonadotrophin (eCG) is also used to increase ovulation rates (Wildeus, 2000), prostaglandin $F_{2\alpha}$ is administered to induce luteolysis and follicular phase with ovulation (Abecia et al., 2012).

In estrus synchronization in ewes, eCG and $PGF_{2\alpha}$ treatment can be applied at the progesterone removal or before the progesterone removal (Quintero-Elisea et al., 2011; Özar et al., 2022; Özbilek et al., 2022). eCG treatment applied 48 hours before progesterone removal caused earlier preovulatory LH peak and ovulations (Ritar et al., 1984). When the eCG treatment was made before progesterone removal, increased estrus response, a shorter estrus onset time, and estrus duration were observed (Zepek et al., 2005; Quintero-Elisea et al., 2011).

This study aimed to determine the effect of the administrations of eCG and $PGF_{2\alpha}$ at different times on some fertility parameters in the Akkaraman yearlings in the out-of-breeding season.

Material and Method

Material

The study material comprised 75 Akkaraman yearlings, which were aged 10-12 months years, weighed 40-45 kg, and were raised at a sheep holding located in the Tokat province during the second half of February in 2023. The study location, namely, the Zile district of the Tokat province, is located in the central Blacksea region of Turkey (latitude 40° 90' N, longitude 35° 49' E). Throughout the study period, the average day and night lengths were 11 h and 13 h, respectively.

Method

Akkaraman yearlings (n=75) were randomly divided into two groups. Intravaginal sponges (MPA, Espanjovet, HIPRA®, Spain) containing 60 mg of medroxyprogesterone acetate (MPA) were administered to each of the 75 Akkaraman yearlings. Intravaginal sponges were kept in the vagina for 9 days for estrus synchronizations. Group 1 (n=34) received 500 IU equine chorionic gonadotrophin (eCG) (Oviser, HIPRA®, Spain) and 125 mcg d-cloprostenol (Estrumate®, Intervet, Istanbul, Turkey) 48 hours before progesterone removal. Group 2 (n=36) received the same treatment at progesterone removal. Estrus detection was performed with five rams for one hour twice a day after 24 hours after progesterone withdrawal. Rams were introduced to the herd, and matings were noted. Yearlings mated after estrus detection were separated from the herd.

Pregnancy examinations of the sheep were performed via transabdominal ultrasonography (Falco, Pie Medical, Netherlands) 50 days after mating. The presence of the fetuses, placentomes, and fetal heartbeat was evaluated as pregnancy positive.

The fertility parameters assessed in this study were calculated with the formulae indicated below.

Estrus onset time: The period from sponge withdrawal to acceptance of mating (hours)

Estrus rate: (Number of ewes in estrus/Number of ewes treated for estrus synchronization) x 100

Pregnancy rate: (Number of pregnant ewes/Number of ewes in the group) x 100

Conception rate: (Number of pregnant ewes/Number of naturally mated ewes) x 100

Statistical analyses

In the present study, pregnancy, estrus, and conception rates between the groups were evaluated with the Chi-Square test, and estrus onset times were evaluated by T-test in the SPSS 11.00 package program. The $P < 0.05$ was considered significant.

Results

In the present study, three yearlings with misplaced sponges in Group I and two with misplaced sponges in Group II were excluded and not evaluated. None of the yearlings showed signs of estrus throughout the period during which the intravaginal sponges were maintained. The estrus onset times of Group I and Group II were determined to be 49.63 ± 7.67 h and 50 ± 7.64 h, respectively. No significant difference was detected between the two study groups (Table 1, $p > 0.05$). The estrus, pregnancy, and conception rates in Group I were determined as 64.70%, 44.11%, and 68.18%, respectively, and in Group II, 66.66%, 52.77%, and 79.16% respectively. No statistically significant difference was observed between the groups for these parameters (Table 1, $P > 0.05$).

Table 1. Fertility parameters of Group I and Group II

Parameters	Group I (n=34)	Group II (n=36)	P
Estrus onset time (h)	49.63 ± 7.67	50.00 ± 7.64	
Estrus rates (%)	% 64.70 (22/34)	%66.66 (24/36)	P>0.05
Pregnancy rates (%)	% 44.11 (15/34)	% 52.77 (19/36)	
Conception rates (%)	% 68.18 (15/22)	% 79.16 (19/24)	

Discussion

In the current study, the effect of different times of eCG and PGF_{2a} treatment in the estrus synchronization protocol on fertility parameters in Akkaraman yearlings in the out-of-breeding season was investigated. While group I received eCG and PGF_{2a} 48 hours before the progesterone removal, group II received eCG and PGF_{2a} at progesterone removal. According to the results obtained, there was no difference in pregnancy, conception, estrus rates, and estrus onset times between the two groups (Table 1).

Equine chorionic gonadotrophin (eCG) can be administered either at progesterone removal or before progesterone removal and the main reason for eCG use in the estrus synchronization is to increase the multiple ovulation rates (Ritar et al., 1984; Wildeus, 2000; Zeleke et al., 2005; Quintero-Elisea et al., 2011). When the eCG treatment was applied before progesterone removal, the number of small follicles decreased, and middle and large-sized follicles increased. Also, treatment of the eCG before the progesterone removal reduces estrus duration and causes earlier preovulatory LH peak and ovulations (Ritar et al., 1984; Zeleke et al., 2005; Quintero-Elisea et al., 2011). Doğan and Nur (2006) stated that 500 IU eCG treatment 48 hours before the progesterone removal results in 41.2%

pregnancy rates. Doğruer et al. (2015) reported that 400 IU eCG treatment 48 hours before the progesterone removal results in 76% pregnancy rates. In the present study, the pregnancy rates of Group (I) are higher than those of Doğan and Nur (2006), and there were no statistical differences between the two groups in terms of pregnancy rate. The results of our study were similar to previous studies (Eppleston et al., 1991; Quintero-Elisea et al., 2011).

The current study has found that eCG treatment applied at different times has no statistical effect on the estrus rate in the Akkaraman yearlings (Table 1). It has been reported that eCG treatment at progesterone removal or before progesterone removal has no effect on the estrus rates. However, it caused the reduction of progesterone removal-estrus onset and ovulations (Zeleke et al., 2005; Ali, 2007).

In the current study, there was no difference in terms of the estrus onset following the progesterone removal between the two groups. Estrus onset times depend on the time of eCG treatment (Ali, 2007) and the dose of eCG (Quintero-Elisea et al., 2011). Al-Merestani et al. (1999) reported that matings occurred within 36-48 hours after progesterone withdrawal in the Awassi yearlings. In our study, the mean estrus onset was around 49-50 hours. Our results

showed that mean estrus onset was longer in the Akkaraman yearlings (Table 1).

Due to the low ovulation rates (Kleeman and Walker, 2005) and increased single lambing (Kilgour, 1992), the reproductive performance of the yearlings is lower than adult ewes. In addition to that, delaying the matings until the breeding season can result in economic loss in the yearlings. Therefore, early breeding of the yearlings without waiting for the breeding season can be advantageous in terms of reproductive performance (Steffan et al., 1983; Al-Merestani et al., 1999). Ozbilek et al. (2022) stated that Awassi yearlings treated with vaginal sponges for 7 days followed by 500 IU eCG had pregnancy rates of 67.2-72.1% in the out-of-breeding season. In the current study, pregnancy rates were between 44-52%. Although pregnancy rates in our study are lower than those of Ozbilek et al. (2022), it is worthwhile to mention that early breeding of the Akkaraman yearlings can be advantageous in terms of reproductive performance. Because the breeding season commences in September-October in the Tokat region in Turkey (Kaya, 1996). Delaying the matings until breeding season would cause an almost seven-month time loss for breeding. Therefore, it was considered that estrus synchronization treatments used in the current study can be applied to the Akkaraman yearlings during the non-breeding season.

In the current study, there was no significant difference between the two groups statistically ($p>0.05$) (Table 1). The conception rates vary between 70-85% in sheep (Gordon, 1997, Ungerfeld and Rubianes, 1999, Ataman et al., 2006; Doğruer et al., 2015). The results of the present study are in line with the previous studies (Gordon, 1997, Ungerfeld and Rubianes, 1999, Ataman et al., 2006; Doğruer et al., 2015).

In conclusion, the administration of the eCG and PGF_{2a} treatment at different times in the estrus synchronization has no statistical effect on pregnancy, conception, estrus onset time, and the estrus rates of the Akkaraman yearlings in the out-of-breeding season. It has been concluded that eCG treatment before progesterone removal is labour-intensive and does not affect reproductive parameters. Therefore, eCG treatment at progesterone removal is considered more feasible regarding herd management and advantageous for reducing labour. In addition, early breeding of the yearlings without waiting for the breeding season can be advantageous in terms of reproductive performance.

Ethical approval

This study was approved by Hatay Mustafa Kemal University Animal Experiments Local Ethics Committee on 16/12/2022 with decision numbered 2022/08-03.

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