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Effect of Controlled Internal Drug Release Device Treatment Duration and eCG Dose on Reproductive Performance of Seasonally Anestrous Fat-tailed Iranian Ewes

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Abstract: The objectives of this study were to determine the effects of Controlled Internal Drug Release (CIDR) device treatment duration and equine chorionic gonadotropin (eCG) dose on induction of synchronized fertile estrus and pregnancy, lambing and twinning rates and lamb crop in seasonally anestrous fat-tailed ewes. A total of 73 nonlactating fat-tailed Mehraban ewes (2-5 year old) were assigned to 5 randomized treatments including: 1) 7 days CIDR plus 400 IU eCG (n = 10); 2) 7 days CIDR plus 600 IU eCG (n = 10), 3) 12 days CIDR plus 400 IU eCG (n = 10); 4) 12 days CIDR plus 600 IU eCG (n = 10); 5) nor CIDR and neither eCG (control group, n =33). Overall pregnancy rates in hormone-treated groups (1-4) were higher than in control ewes ($p<0.05$). Pregnancy rates from first service period in ewes treated for 7 days were higher than in ewes treated for 12 days ($p<0.05$). The number of estrus to conception and interval from ram introduction to lambing in hormone treated were lower than in control ewes ($p<0.05$), but did not differ among hormone-treated groups ($p<0.05$). The highest lambing rates were observed in ewes treated with 600 IU eCG (groups 2 and 4) ($p<0.05$) compared to the control and other treatment groups. A non-significant increase of twinning rate was observed in groups treated with 600 IU eCG in comparison to other groups. The highest lamb crops were observed in ewes treated with CIDR for 7 days and 600 IU eCG ($p<0.05$).

Key words: Iranian fat-tailed ewe, CIDR, eCG, reproductive performance

INTRODUCTION

Iran has more than fifty million sheep and in this regard ranks fifth in the world. Iranian fat-tailed sheep are seasonal breeder. Breeding behavior of fat-tailed sheep increases when day length decreases. In the sheep industry, efficiency of production can be characterized by the number of lamb weaned per ewe per year (Safranski *et al*., 1992).

Estrus synchronization in goats and sheep is achieved by control of the luteal phase of the estrous cycle, either by providing exogenous progesterone or by inducing premature luteolysis (Wildeus, 2000). Progesterone was first used to synchronize estrus five decades ago (O'Mary *et al*., 1950). The Controlled Internal Drug Release (CIDR) device is an intravaginal pessary containing only the natural hormone progesterone (P_4), which is used for synchronizing estrus in activity of farmed and captive wild ruminant (Wheaton *et al*., 1993). The ability of breeder ewes out of season and also synchronize breeding activity, will provide the opportunity for producers to concentrate efforts at breeding and lambing which enhances the adoption of more advanced sheep production and management (Powell *et al*., 1996; Safranski *et al*., 1992; Burke and Keisler, 1988). Injection of equine chorionic gonadotropin (eCG), after progesterone treatment, increases estrous response, conception rate and percentage of multiple births from the induced ovulation (Knights *et al*., 2001; Leyva *et al*., 1998; Safranski *et al*., 1992). Unfortunately, the optimum duration of progesterone treatment and eCG dose are not absolutely indicated (Safranski *et al*., 1992). The objectives of this study were to determine the optimum duration progesterone treatment and dose of eCG had on induction of out side breeding season and increase the lamb production per ewe per year in fat-tailed Mehraban sheep flocks in Iran.

MATERIALS AND METHODS

This study was conducted from May to July 2004 (out of breeding season) at farm Animal Science in

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Abu-Ali-Sina University, west of Iran. A total number of 73 nonlactating fat-tailed Mehraban ewes (2-5 year old) were used in this study. Ewes were fed on the native grass pastures but were brought into holding lost to initiate treatment as well as the time of synchronized estrus. In addition to pasture grass, each ewe was received 250 g barley per day. Water and mineral licks were available *ad libitum*. At the beginning of the experiment, Body Condition Score (BCS) and Body Weight (BW) of ewes were determined. In the 7th day of the experiment, ewes were assigned to one of the two progesterone treated groups (A and B). Ewes in group A received the CIDR (controlled internal drug release) for 7 days (n = 20) and ewes in group B received the CIDR for 12 days (n = 20). To determine whether different doses of eCG given at the time of CIDR removal would increase prolificacy, each group was divided into two subgroups and four treatments were formed:

Treatment 1: Seven days CIDR and a single I.M. injection of 400 IU eCG (n = 10).

Treatment 2: Seven days CIDR and a single I.M. injection of 600 IU eCG (n = 10).

Treatment 3: Twelve days CIDR and a single I.M. injection of 400 IU eCG (n = 10).

Treatment 4: Twelve days CIDR and a single I.M. injection of 600 IU eCG (n = 10)

Simultaneously with CIDR removal, BCS and BW were record. Fat-tailed Mehraban intact rams were introduced to all ewes at CIDR removal in which one ram was considered for seven ewes. The remaining 33 ewes received neither CIDR nor I.M. injection of eCG and rams were introduced in the 19th day of the experiment (control group). For three weeks after ram introduction, ewes were fed by barley. There after ewes were fed native grass pastures until last the two months of pregnancy. Subsequently 250 g barley added to their ration until parturition. Weight, number of lambs per ewe, BCS of ewe and date of lambing were recorded. Also, lamb production per ewe per kg, lambing rate per each ewe, number of estrous periods leading to pregnancy, time of ram introduction upto parturition and rate of twin lambing per ewe lambing were recorded in each group.

Data were analyzed, using the General Linear Model (GLM) procedures of Statistical Analysis System (SAS) by completely randomize design. Variable included sex of lambs, ewes' BCS at time of mating and parturition and ewes age to adjust their effects in experiment.

RESULTS AND DISCUSSION

The results of this study are presented in Table 1. Pregnancy rate in four groups which treated with progesterone and eCG was significantly ($p<0.05$) higher than control group in first, second and third estrus after ram introduction (Table 1) which is in agreement with other studies (Safranski *et al*., 1992; Powell *et al*., 1996; Knights *et al*., 2001). This was properly due to increased follicle production and higher ovulatory rate in ewes treated with progesterone outside the breeding season (Leyva *et al*., 1998; Knights *et al*., 2001). Leyva *et al*. (1998) have shown that eCG + progesterone treatment causes more normal activation of corpus luteum after ovulation at the time of ewes' seasonal anestrus. It may reduce embryo mortality and result in increased pregnancy rate. Seven days progesterone treatment compared to 12 days significantly increased pregnancy rate in first estrus after ram introduction ($p<0.05$), but in second and third estrus period, this difference was not significant ($p>0.05$). Powell *et al.* (1996) reported that progesterone treatment was more effective for 8 days compared to 11 and 14 days in non-breeding season. Knights *et al.* (2001) have shown that progesterone treatment for 5 days compared to 12 days could increase estrous and ovulation rate as well. Higher progesterone concentration in ewes' blood through progesterone treatment can explain this increase. In this study, increased eCG did not affect the pregnancy rate ($p<0.05$) (Table 1). In the study by Wheaton *et al.* (1992), if progesterone was paused at abrupt ram introduction in non-breeding season, gonadotropin is not required for induction of estrous with ovulation. However, progesterone is necessary to increase hypothalamus sensitivity to estrogen (Fabre-Nys *et al*., 1991) and to effect progesterone feedback of estrogen for onset of preovulatory GnRH surge (Caraty *et al*., 1999). On the other hand, abrupt ram introduction without progesterone treatment increased plasma estrogen concentration, but neither the sensitivity to estrogen nor the estrus induction with ovulation (Signoret, 1990). Mean number of estrus period leading to pregnancy and duration of ram introduction until parturition among progesterone and eCG treated ewes was significantly less than in control ewes ($p<0.05$); but this difference was not significant within four groups treated with progesterone. This is in agreement with Knights *et al.* (2001).

In the present study, lambing rate among the four groups treated with progesterone and eCG was higher than that of the control group (Table 1). Lambing rate in two groups that received 600 IU eCG, was the highest ($p<0.05$) (Table 1). Ainsworth and Shrestha (1985) reported that reproductive performance among

Table 1: Effect of duration of CIDR device treatment and eCG dose (Mean±SE) on reproductive performance of Mehraban fat-tailed ewes bred outside the breeding season

Treatment	1	2	3	4	Control
Pregnancy rate after ram introduction in:					
First estrus (%)	70±4.8^{a*}	70±4.8^{a}	55.5±5.3^{ab}	37.5±5.2^{b}	2.9±1.8^{c}
Second estrus (%)	90±3.1^{a}	100±0.0^{a}	77.7±4.4^{a}	100±0.0^{a}	5.8±2.4^{b}
Second estrus (%)	100±0.0^{a}	100±0.0^{a}	88.8±3.3^{a}	100±0.0^{a}	32±4.7^{b}
Number of estrous due to pregnancy	1.4±0.3^{b}	1.3±0.2^{b}	1.5±0.25^{b}	1.63±0.1^{b}	2.7±0.2^{a}
Ram introduction to parturition (day)	155±13.7^{b}	154±10.1^{b}	157±14.1^{b}	158±9.19^{b}	171±11^{a}
Lambing rate (%)	110±3.1^{ab}	130±4.8^{a}	88.8±3.3^{b}	125±4.6^{a}	35±5.4^{c}
Twinning rate (%)	10±3.1^{b}	30±4.8^{a}	0±0.0^{c}	25±4.6^{ab}	9.1±3.1^{b}
Lamb production/ewe/kg	5.1±0.4^{ab}	5.65±0.7^{a}	3.92±0.6^{b}	5±0.5a^{b}	1.4±0.2^{c}

*Means with different superscript are significantly different ($p<0.05$)

progesterone treated ewes with 250 or 500 IU eCG was not significant. Gonadotropin administration (FSH<55 mg) could increase number of follicles larger than 3 mm ($p<0.05$); but ovulation rate was not significantly increased. This effect was more intensive among ewes that received a shorter exposure to progesterone treatment (Knights *et al.*, 2001). Leyva *et al.* (1998) showed that plasma progesterone concentration was higher in shorter duration of progesterone treatment in which progesterone increased follicular growth and ovulation rate by upregulation of gonadotropin receptors on granulosa cells of follicles. Ewes that received lower dose of progesterone had higher plasma estrogen concentration and earlier heat in which the time between CIDR removal and LH surge was lower (Johnson *et al.*, 1996; Van Cleeff *et al.*, 1998). Progesterone increase during the treatment had an inhibitory effect on follicle growth in response to estrogen (Van Cleeff *et al.*, 1998), also disorder in sperm transport (Quinlivan *et al.*, 1967) and fertilization (Allison and Robinson, 1970).

In nonbreeding season without progesterone treatment, even if ovulation is occurred, mostly formed corpus luteum be involved early regression and fertility rate will be very low (Leyva *et al.*, 1998). Paradoxically, progesterone treatment and increased plasma progesterone concentration caused delayed ovulation time and LH surge, this provide more opportunity for follicular growth and larger and better follicles will ovulate and consequently created corpus luteum will be larger and more permanent (Leyva *et al.*, 1998; Caraty and Skinner, 1999). In this study, progesterone treated ewes in duration of 7 days with 600 IU eCG were produced the highest lamb per kg per ewe compared with control ewes (Table 1) ($p<0.05$).

In the non-breeding season, the increase of estrus and fertility rates are lower compared to those of the breeding season (Safranski *et al.*, 1992). Breeding outside the normal breeding season may also have an adverse effect in the male, leading to lower sperm fertility of the rams (Fitzgerald and Stellflug, 1991).

This investigation proved that maximum production and reproduction rates in fat-tailed Mehraban ewes mated outside the normal breeding season were obtained when progesterone was administrated for 7 days together with a single injection of 600 IU eCG.

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