World Journal of Agricultural Research, 2015, Vol. 3, No. 5, 174-178
Available online at http://pubs.sciepub.com/wjar/3/5/4

DOI:10.12691/wjar-3-5-4

Fertility of Libyan Barbary Sheep Treated with Prostaglandin F2α (PGF2α) in Different Seasons

Aboulgasem Elmarimi*, Najmi Mariol, Jamil Ahmed, Mokhtar.F. Sassi, Abdurraouf Gaja

Department of surgery and Theriogenology, Tripoli University, Tripoli, Libya
*Corresponding author: drelmarimi2005@yahoo.com

Received July 21, 2015; Revised September 01, 2015; Accepted October 08, 2015

Abstract Bearing in mind the objectives of this study to investigate the Barbary sheep fertility under our climatic conditions and to evaluate the efficiency of the prostaglandin F2α (PGF2α) injection in induction of fertile estrus in different seasons. For these objectives some experiments were performed during the period from July 2008 to March 2009. A total number of 300 Libyan Barbary ewes (3 – 6 years old weight 40 – 60 Kg) was used in this experiment. Ewes were kept in privet farms fed and managed similarly. Ewes were divided to four season groups (summer, autumn, winter and spring groups) each season group was divided into treated and control. Animals in the treated groups were injected with double injection of 125µg of prostaglandin F2α intramuscularly (IM) 11days apart. While those in the control groups were injected with two injections of 1.0 ml of 0.9%NaCl saline solution simultaneously with the treated ewes. At the same day (day 11) rams wearing painted sponges on their briskets regions were introduced for natural mating. Treated groups showed shorter estrus response time than control groups in all seasons ($P<0.05$). Estrus duration was longer in winter and spring than in summer and autumn ($P<0.001$) but no difference was found between treated and control groups inside seasons. Treated group showed higher pregnancy rate ($P<0.001$) in winter season than control group. Percentage of ewes lambed in winter was significantly high ($P<0.001$) among treated ewes than control (80% Vs 38%). Lambing rate differed significantly ($P<0.001$) among treated groups in all seasons. Data were collected and calculated statistically using SPSS system for percentages, means, standard deviation (mean ±SD) analyses of variance (ANOVA), Chi squire and Duncan's test were used accordingly. Other values were measured, calculated and analyzed similarly.

Keywords: *fertility, Barbary sheep, PGF2α, seasons*

Cite This Article: Aboulgasem Elmarimi, Najmi Mariol, Jamil Ahmed, Mokhtar. F. Sassi, and Abdurraouf Gaja, “Fertility of Libyan Barbary Sheep Treated with Prostaglandin F2α (PGF2α) in Different Seasons.” *World Journal of Agricultural Research*, vol. 3, no. 5 (2015): 174-178. doi: 10.12691/wjar-3-5-4.

1. Introduction

In small ruminants, estrus synchronization (ES) is affected by the seasonal breeding patterns in most temperate breeds of sheep [15]. Estrus may not only have to be synchronized, but also initiated. Systems requiring the regression of an active corpus luteum will not be effective under these conditions [28].

Estrus Synchronization of ewes has been accomplished using several methods with various degrees of success. The progesterone impregnated intravaginal sponges, left in situ for 12-19 days in the breeding season, is a widely used method. Intravaginal sponges can usually induce inflammation with adherence to vaginal mucosa [18]. Following the withdrawal of the sponge, a rich discharge with unpleasant odour is usually observed.

It is now well established that the injection of prostaglandin (PGF2α) or one of its analogues at any time between Days 5 and 16 of the bovine estrous cycle will result in luteal regression with a consequent return to estrus within 2-3 days [5,14].

Once prostaglandin (PGF2α) was identified as a uterine luteolytic factor in the estrous cycle of the ewe [6,21], synthetic forms were developed which can be used to induce premature luteolysis. The injection of an analogue of PGF2α to a flock of randomly cyclic ewes is effective to induce luteal regression in most ewes with a consequent return to estrus [5]. However, the responding ewes present a greatly variable interval to estrus and some of the ewes do not respond, which precludes a more extensive use of the product, particularly if ES is used associated with timed artificial insemination. The variability of the response was attributed to differences in ovarian status among the ewes at the time of the treatment. The day of the cycle on which PGF2α was given influences the interval to onset of estrus [17]. Early treatment was followed by shorter intervals to estrus. This was attributed to the different time span necessary to reduce progesterone concentrations to basal level as the luteal phase progresses and corpus luteum (CL) acquires its full endocrine functionality [17,29]. The variation in the interval between PGF2α administration and ovulation could also be attributed to the wave giving origin to the ovulatory follicle [27]. The changes which occur in plasma concentrations of LH and progesterone at the induced estrous cycle immediately following treatment with PGF2α is more closely resemble those occurring during a natural estrous than do those obtained when ovulation is synchronized by progestagen treatment [7].

In the subtropics, sheep is almost cyclic throughout the year. Season affects mainly the luteal functions with little influences on follicular characteristics [8]. Subtropical fat-tailed sheep possess the ability to breed more than once per year. Producing a lamb crop every 8 months resulted in increases of 33-49% in the number of lambs born per ewe per year [1,3].

Prostaglandin-based ES systems control the estrous cycle by terminating the luteal phase through regression of the CL. This approach is only applicable in cyclic females and hence prostaglandin-based systems are restricted for use during the breeding season in sheep. There are many products of PGF2α analogues used in this field for such purpose, and because not all stages of the estrous cycle are similarly receptive to treatment, a double injection system 11 days apart is the most widely used approach in sheep and goats [10,15,28].

There is no previous study which has investigated the fertility of Libyan Barbary ewes in different seasons after the treatment with PGF2α under Libyan conditions. The present study was conducted to investigate the seasonality of Barbary sheep under Libyan conditions and evaluate the efficacy of PGF2α in induction of fertile estrus in relation to season.

2. Materials and Methods

In the present study we used 300 fertile, healthy fatty tailed Libyan Barbary ewes. All ewes were 40-60 kg body weight and 3 – 6 years old, and all ewes were fed and managed the same way and handled similarly, they were kept in sheep farms in Al-Zawia area (45 – 60 km) west to Tripoli.

All animals were left in herds grazing together the whole day during autumn, winter, spring and summer. In general, animals were managed under natural condition in typical manner of Al-Zawia commercial flocks which mostly depend on grazing.

The experiment was conducted during the period from July, 2008 and continued till March, 2009. Ewes were divided into four groups according to the seasons. One hundred (100) ewes were considered as summer group (S.GP), 50 for treated and 50 for control. Thirty treated and 25 control ewes were subjected for autumn group (A.GP) during September, 2009. For winter group (W.GP) we used 50 ewes for treated and 50 for control during December, 2009. For spring season (SP.GP) 45 ewes divided into 25 as treated and the other 20 for control group during March, 2009.

All the animals in the treated groups were injected with double injections of 125μg prostaglandin F2α ((PGF2α, cloprostenol. V.M.D., Belgium) intramusculary (IM) 11 days apart.

Ewes in the control groups were received two injections of 1 ml of 0.9 NaCL (placebo) 11 days apart simultaneously to that of PGF2α injections to the treated ewes. In the same day (day 11) the rams were introduced for natural mating, painted sponges were fixed on the chests (brisket regions) of the rams before introduction to mark the ewes being mounted by them.

Parameters that were of importance to our experiment were assessed which included; estrus response in percentages (%), estrus duration (hr), non return rate (NRR) (non return rate as those ewes mated and did not come back to estrus from the first mating), pregnancy rate, percentage of ewes lambed (%), lambing rate, number of lambs and the litter size of each season group in both treated and control ewes. The parameters were chosen after the work done by other authors [9,10,11,23].

All the data were analyzed statistically by SPSS (statistical system, WIN.Version 16/2007) using analysis of variance (ANOVA) for parameters of multiple comparisons, differences considered significant at the level (P≤0.05).

3. Results

The percentages of estrus response as estrus response rates were found to be higher in treated group than in control group (P≤0.05) inside different seasons, but there was no significance (P≥0.05) among season groups within the same group, the percentage of estrus response rate was 84 vs.60% in summer, 86.7 vs. 60 % in autumn (fall) 86 vs. 52 % in winter and 84 vs. 55% in spring for treatment and control groups respectively (Table 1).

Estrus duration (hr) (Mean±SD) was found to be almost equal with no significant values between the treated and control groups inside each season. The duration was 26.60±0.89 vs. 26.40±0.89 hr summer, 26.8±1.30 vs. 26.20±1.79 hr in autumn, 31.60±1.14 vs. 31.0±1.0 hr in winter and it was 30.20±084 vs. 31.40±0.55 hr in spring. But it was highly significant (P≤0.001) between the values of summer and autumn from one side and winter and spring, since the duration was longer in winter and spring than those in summer and autumn (Table 1).

Table 1. Effect of PGF2α on estrus response rate and estrus duration.

Season	Group	No.of ewes	Estrus rate (%)	Estrus duration (hr)
Summer	T	50	42/50 84 a	26.60±0.89^{a}
	C	50	30/50 60 b	26.40±0.89^{a}
Autumn	T	30	26/30 86.7 a	26.80±1.30^{a}
	C	25	15/25 60 b	26.20±1.79^{a}
Winter	T	50	43/50 86 a	31.60±1.14^{b}
	C	50	26/50 52 b	31±1^{b}
Spring	T	25	21/25 84 a	30.20±0.84^{b}
	C	20	11/20 55 b	31.40±0.55^{b}

The values with different supscripts were significantly different (P≤0.001).

In regard to the non return rates (%) during different seasons, there was no significant difference between treated and control groups; 97.62 % vs. 93.33 % in summer, 96.15 % vs. 93.33 % in autumn, 95.35 % vs. 88.46 % in winter and 90.48 % vs. 90.91 % in spring. Also there was no significant difference among seasons (Table 2).

Pregnancy rate (%) inside the different season between the treated and control group were significantly different (P<0.05). the difference was highly significant (P≤0.001) in winter season. The percentage was higher in treated group than in control group in summer it was 78% vs. 52% and it was 83.3% vs. 56% in autumn, in winter season it was 80 vs. 40 % and it was 68 vs. 35 % in spring season. There was no significant difference among the season groups (Table 2).

Table 2. Effect of PGF2α on non- return rate (%) and pregnancy rate (%)

Season	Group	No.of ewes	Non return rate (%)	Pregnancy rate (%)
Summer	T	50	41/42 97.62	78 % (39) a *
	C	50	28/32 93.33	52 % (26) b
Autumn	T	30	25/26 96.15	83.33 % (25) a *
	C	25	14/15 93.33	56 % (14) b
Winter	T	50	41/43 95.35	80 % (40) a **
	C	50	23/26 88.46	40 % (20) b
Spring	T	25	19/21 90.48	68 % (17) a *
	C	20	10/11 90.91	35 % (7) b

The values with different superscripts were significantly different (* = P<0.05, ** = P<0.001).

In regard to percentage of ewes lambed we found the value (80%) was in treated ewes in both autumn and winter and the lowest value was during spring season (64%). There was a significant level (P≤0.05) between the treated and control groups in all seasons, the highest significance (P≤0.001) was found in winter season between the treated and control groups (80 vs. 38 %). There was no significant difference neither among treated nor control group in different seasons (Table 3).

For the lambing rate, values in the treated and control groups differed significantly (P≤0.05) among different seasons. The percentage in the treated groups were higher than those in control groups; 76% vs. 48%, 83.3 vs. 56%, 80 vs. 42% and 64 vs. 35% in different seasons respectively. There was no significant difference among seasons in both treated and control groups (Table 3).

Litter size did not differ significantly neither among treated groups nor among control groups in the different seasons. The values were; 1.05±0.23 vs. 1.0 in summer, 1.04±0.20 vs. 1.08±0.28 in autumn, 1.0 vs. 1.05±0.23 in winter and 1.0 vs. 1.0 in spring (Table 3).

Table 3. Effect of PGF2α on percentage of ewes lambed (%), number of lambs, lambing rate and litter size.

Season	G	No Ewe	Percentage of ewes lambed (%)	No. of lambs	Lambing Rate	Litter size
Summer	T	50	72 % (36) a *	38	76%^{a}	1.05 ±0.23
	C	50	48 % (24) b	24	48% ^{b}	1
Autumn	T	30	80 % (24) a *	25	83.3%^{a}	1.04 ±0.20
	C	25	52 % (13) b	14	56%^{b}	1.08±0.28
Winter	T	50	80 % (40) a**	40	80% ^{a}	1
	C	50	38 % (19) b	21	42%^{b}	1.05± 0.23
Spring	T	25	64 % (16) a *	16	64%^{a}	1
	C	20	35 % (7) b	7	35 %^{a}	1

The values with different superscripts were significantly different (* = P<0.05, ** = P<0.001).

4. Discussion

Knowing that sheep is a seasonal polyestrous species and breeding will be in specific season only, this experiment aims to bring sheep into estrus in different seasons in order to breed them throughout the year. In this experiment it is clear that double injections of PGF2α given randomly to cyclic flock of Libyan Barbary ewes during different seasons gave 84 – 86.7% as estrus response rate from the synchronized ewes. This result showed significant difference in regard to the percentage of ewes exhibited estrus signs. It was higher in treated groups in all seasons versus the control groups. However, there was no significant difference among the treated groups in all seasons. These results were in agreement with other workers [4] who conducted their work on two breeds in the same time (Karacounco and Serres breeds). They were in agreement with Das, et.al, 1999 [12]. Humida, et.al, 2009 [16] worked on Naeimi Awassi ewes and Yavuzer,et.al. 2010 [30] worked on Awassi breed during breeding season with two injection of 10 days apart resulted in similar results to ours. Safdarian, et.al. 2007 [25] working on Karakul ewes using different protocols of estrus synchronization outside breeding season resulted in lower estrus response than ours.

Variations in estrus response rate in the mentioned studies and the discrepancies between the results could be attributed to the difference in the breed variations, nutrition, seasonality effect, climatic and environment factors, in addition to the ovarian status or ovarian cyclicity [11,12,13,17,22].

Estrus duration did not differ between treated and control groups when estrus occurred at summer or autumn seasons however, it was significantly longer (P≤0.001) during winter and spring seasons for both treated and control groups. This result is in agreement with studies of Rosa and Bryant 2003[24] who attributed this finding to the little effect of photoperiod length on estrus signs and sexual behavior of ewes which are more pronounced during late autumn, winter and early spring seasons (short period of photoperiodism). The most likely explanation for the estrus length variation is due to breed variation and the tendency of estrus to be shorter during the beginning and at the end of breeding season [2,3,15].

The non return rate (NNR) does not show significant difference in all seasons among treated and control groups. The percentage of non return rate (NNR) among treated group ranged from 97.62% to 90% while it ranged between 93.33% to 88.46% in control group. These results were in agreement with Makawi and Manahil 2007 [20] and with Sozabilir, et.al. 2006 [26], Atman and Akoz 2006 [10]. But they were less than the results which reviewed by Wildeus 2000 [28] who found higher results using a combination of PGF2α and progestagen for estrus synchronization in ewes.

Pregnancy rate were higher in the treated groups than those of the control groups in different seasons (P≤0.05) ond (P≤0.001) but there was no significant difference among each group (P>0.05). these results were in agreement with those reported by Sozbilir, et.al 2006 [26], Makawi and Manahil 2007 [20] who worked with two injection protocols, Madani, et.al 1984 [19] working with Libyain fatty tailed ewes with double injection protocol found similar results to ours. The highest results gained by Yavuzer, et al. 2010 [30] who used double injection of PGF2α, 10 days apart with or without injection of recombinant follicular stimulating hormones (rFSH) gave 100 and 95% respectively.

The percentage of ewes lambed in the present study was significantly higher in treated groups than control groups (P≤0.05) the results show that treated ewes lambed in autumn and winter gave higher lambing rates (P≤0.001) and more lambs given by treated group in summer season. It is no wonder since ewes mated at winter or early spring considered as breeding season for sheep in Libya. These results were in agreement with Zunturlu, et.al. 2009 [31] using the two PGF2α injection protocol with 10 days apart. But Safdarian, et.al. 2007 [25] using the same protocol (2 PGF2α injections with 10 days apart) resulted in lesser percentage. The highest result was obtained by Madani, et.al 1984 [19] working with Libyan fatty tailed ewes, using double injections of PGF2α 10 days apart with PMSG (91%) or without PMSG (80%), which may indicate that this high percentage could be of breed factor in Barbary fatty tailed ewes in Libya, and we explain our result due to the presence of rams with ewes for about 35 days after treatment which may gave more time for contact and mating.

In regard to lambing rate, it was found that the treated group gave significantly higher results (P≤0.001), but there was no difference between groups within different seasons. This result indicates that season does not affect the lambing rate but it is the treatment with PGF2α which resulted in higher rate than the control one. The lambing rate in this experiment ranged between 64 – 83.3 % vs. 35 – 56 % in the treated and control groups respectively. These results were in agreement with Ataman and Akoz 2006 [10] with almost the same rates to our results. It is in agreement with the work of Sozbilir, et.al 2006 [26]. In the meantime Madani, et,al. 1984 [19] got higher rates than ours (91%) working with same the breed.

In regard to the litter size this experiment revealed no significant difference between treated or control groups. It is normal to get similar litter size in both treated and control groups since it is breed genetic factor when all other factor are the same for both groups. This result was achieved by Madani, et.al 1984 [19] who worked on Libyan fatty tailed ewes under the same conditions. Other workers conducted similar work on different breeds (Farfar local breed) which were subjected to the same work by Ali, et.al. 2009 [8] gave bigger litter size. Atman and Akoz 2006 [10] also found bigger litter size than we had in our experiment. We attributed the difference to the breed variation.

The present study described for the first time the reproductive performance of Libyan Barbray ewes under the effect of injected PGF2α during different seasons of the year, in order to evaluate the fertility of our breed and to investigate whether there is tendency for seasonal estrus activity and breeding under this protocol of estrus synchronization. Animals treated with 2 injections of PGF2α 11 days apart resulted in successful responses in different evaluated parameters which prove that Libyan fatty tailed ewes (Barbary ewes) responded successfully to the PGF2α injections, exhibited fertile estrus and yielded acceptable level of lambing rate through different seasons of the year. These results suggested that the Libyan fatty tailed ewes are polyestrous animals and not seasonal polyestrous. The other point which we can consider it as a useful result is to recommend PGF2α injections 11 days apart to assure almost all animals will be in the mid luteal phase at the second dose and will respond with estrus behavior and ovulation.

Acknowledgement

We thank Mr. Ali Dreeby the owner of the privet farm where sheep were kept during the experiment for his assistance.

References

[1] Aboul-Ela, M.B. and A.M. Aboul-Naga, Improving Fecundity in Subtropical Fat-Tailed Sheep. New Techniques in Sheep Production1987: London, UK. p. 163-171.

[2] Aboul-Naga, A., M. Aboul-Ela and F. Hassan, Manipulation of Reproductive Activity in Subtropical Sheep. Small Ruminant Research, 7(2): p. 151-160. 1992.

[3] Aboul-Naga, A., H. Mansour, M. Aboul-Ela, M. Mousa, F. Hassan and F. El-Hommosi, Oestrous Activity in Three Subtropical Sheep Breeds in Upper Egypt and Response to Long-Day Light Treatment. The Journal of Agricultural Science, 116(01): p. 139-143. 2009.

[4] Acritopoulou-Fourcroy, S., V. Pappas, G. Peclaris, N. Zervas and V. SKOUFIS, Synchronization of Œstrus in Ewes with Provera Sponges/Pmsg, Prostaglandin F2 or the Prostaglandin Analogue, Ici 80996, and Fertility Following Natural Mating or Artificial Insemination. Reproduction Nutrition Développement, 22(2): p. 345-354. 1982.

[5] Acritopoulou, S. and W. Haresign, Response of Ewes to a Single Injection of an Analogue of Pgf-2 {Alpha} Given at Different Stages of the Oestrous Cycle. Reproduction, 58(1): p. 219. 1980.

[6] Acritopoulou, S., W. Haresign, J. Foster and G. Lamming, Plasma Progesterone and Lh Concentrations in Ewes after Injection of an Analogue of Prostaglandin F-2 {Alpha}. Reproduction, 49(2): p. 337. 1977.

[7] Acritopoulou, S., W. Haresign and G. Lamming, Time of Ovulation in Ewes after Treatment with a Prostaglandin F-2 {Alpha} Analogue. Reproduction, 54(1): p. 189. 1978.

[8] Ali, A., M. Hayder and R. Derar, Reproductive Performance of Farafra Ewes in the Subtropics. Animal reproduction science, 114(4): p. 356-361. 2009.

[9] Alkass, J.E., T.A. Abdulkareem and S.M. Al-Mjamei, Reproductive Performance of Iraqi Awassi Ewes in Response to Treatment with Equine Chorionic Gondortropin. Department of Animal Resources, College of Agriculture, Universityof Baghdad, Abou-Ghraib, Baghdad, Iraq, 2: p. 74-77. 2004.

[10] Ataman, M.B. and M. Akoz, Gnrh-Pgf2 and Pgf2 -Pgf2 Synchronization in Akkaraman Cross-Bred Sheep in the Breeding Season. Bull Vet Inst Pulawy, 50: p. 101-104. 2006.

[11] Contreras-Solis, I., B. Vasquez, T. Diaz, C. Letelier, A. Lopez-Sebastian and A. Gonzalez-Bulnes, Efficiency of Estrous Synchronization in Tropical Sheep by Combining Short-Interval Cloprostenol-Based Protocols and “Male Effect”. Theriogenology, 71(6): p. 1018-1025. 2009.

[12] Das, G.K., S.M.K. Naqvi, R. Gulyani, A. Joshi and J.P. Mittal, Effect of Two Protocols of Pgf2 [Alpha] Treatment for Synchronization of Estrus in a Tropical Sheep. Theriogenology, 51(1): p. 283. 1999.

[13] Dogan, I. and Z. Nur, Different Estrous Induction Methods During the Non-Breeding Season in Kivircik Ewes. Vet. Med, 51(4): p. 133-138. 2006.

[14] Elmarimi, A., C. Gibson, D. Morrow, J. Marteniuk, B. Gerloff and J. Melancon, Use of Prostaglandin F2 Alpha in the Treatment of Unobserved Estrus in Lactating Dairy Cattle. American journal of veterinary research, 44(6): p. 1081. 1983.

[15] Hafez, B. and E.S.E. Hafez, Reproduction in Farm Animals. 7th ed., 2000: Lippincott Williams & Wilkins.

[16] Homeida, A., A. AL-Mubarak and Y. AL-Yousef, Synchronization of Estrus in Naeimi Ewes Following Treatment with Progestagens or Prostaglandin F2. Scientific Journal of King Faisal University (Basic and Applied Sciences), 10(2): p. 1430. 2009.

[17] Houghton, J.A., N. Liberati, F.N. Schrick, E.C. Townsend, R.A. Dailey and E.K. Inskeep, Day of Estrous Cycle Affects Follicular Dynamics after Induced Luteolysis in Ewes. Journal of Animal Science, 73(7): p. 2094. 1995.

[18] Larsson, B., A. Gustafsson, A. Nasholm and L. Bjurström, A Programme for Oestrus Synchronization and Embryotransfer in Sheep. Reprod. Dom. Anim., 26: p. 301-308. 1991.

[19] Madani, M.O.K., T.M. Ali, B.A. Yagoub and M.T. Zawia, The Influence of Prostaglandin Analogue and Pms Treatment on the Lambing Performance of Libyan Fat-Tailed Ewes. British Veterinary Journal, 140(1): p. 27-33. 1984.

[20] Makawi, S. and Z. Manahil, Fertility Response of Desert Ewes to Hormonal Oestrous Synchronization and Artificial Insemination Using Fresh Diluted Semen. Journal of Animal and Veterinary Advances, 6(3): p. 385-391. 2007.

[21] McCracken, J.A., J.C. Carlsson, M.E. Glew, J.R. Goding, D.T. Baird, K. Green and B. Samuelson, Prostaglandin F2alpha Identified as a Luteolytic Hormone in Sheep. Nature (238, 129). 1972.

[22] Oyediji, G., M. Akusu and G. Egbunike, Comparative Studies on the Effectiveness of Estrus Implants, Veramix Sheep Sponges and Prostaglandin F2 [Alpha] in Synchronizing Estrus in West African Dwarf Sheep. Theriogenology, 34(3): p. 613-618. 1990.

[23] Ozyurtlu, N., I. Kucukaslan and Y. Cetin, Characterization of Oestrous Induction Response, Oestrous Duration, Fecundity and Fertility in Awassi Ewes During the Non-Breeding Season Utilizing Both Cidr and Intravaginal Sponge Treatments, in Reproduction in Domestic Animals. 2008, John Wiley & Sons. p. 464-467.

[24] Rosa, H.J.D. and M.J. Bryant, Seasonality of Reproduction in Sheep. Small Ruminant Research, 48(3): p. 155-171. 2003.

[25] Safdarian, M., M. Kafi and M. Hashemi, Reproductive Performance of Karakul Ewes Following Different Oestrous Synchronisation Treatments Outside the Natural Breeding Season. South African Journal of Animal Science, 36(4): p. 229. 2007.

[26] Sozbilir, N., S. Marasli, Y. Ozturkler and O. Ucar, Effects of Double Injections of Pgf2 at Different Intervals on Some Reproductive Traits in Tuj Ewes. Turk J Vet Anim Sci, 30: p. 207-211. 2006.

[27] Violes, C. and E. Rubianes, Origin of the Preovulatory Follicle after Induced Luteolysis During the Early Luteal Phase in Ewes. Canadian Journal of Animal Science, 78(3): p. 429-431. 1998.

[28] Wildeus, S., Current Concepts in Synchronization of Estrus: Sheep and Goats. J. Anim. Sci, 77: p. 1-14. 2000.

[29] Wiley, T.M., H. Cardenas and W.F. Pope, Effect of the Rate of Progesterone Decline at Luteolysis on the Ovulatory Follicles and Subsequent Estrous Cycle Length in Ewes. Animal Reproduction Science, 46: p. 79-87. 1997.

[30] Yavuzer, U., A. Zonturlu and F. Aral, Effect of Recombinant Follicle Stimulating Hormone (Rfsh) on Some Fertility Parameters in Awassi Ewes Synchronized with Pgf2 in the Breeding Season. Ankara Üniv. Vet. Fak. Derg., 57: p. 241-245. 2010.

[31] Zonturlu, A., F. Aral and U. Yavuzer, Effect of Different Method Gnrh-Pgf2 Treatment on Induced of Estrus and Pregnancy in Breeding Season in Awassi Ewes. Medwell Journal of Animal and Veterinary Advances, 8(4): p. 660-663. 2009.