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Seasonal changes of some reproductive traits in Farafra ewes under Egyptian environmental condition

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Abstract

Thirty Egyptian Farafra ewes were used to study the effect of seasonal variations on reproductive cycle and ovarian activity. Estrus was detected twice daily throughout the year. Percentages of ewes showing estrus monthly, number of estrous cycle/ewe/season, estrous cycle length and heat duration were measured throughout different seasons of the year. Changes in ovarian activity were examined using Laparoscopy technique. Percentage of ovulated ewes, ovulation rate and number of large and small follicles were recorded over different seasons. The obtained results revealed that the highest active cycles were observed in autumn and summer (87.1 and 84%), while the lowest was observed in spring (64.3%). Percentages of ewes that exhibited normal estrous cycle length during winter, spring; summer and autumn were 73.3, 47.0, 64.0, and 44.5%, respectively. While, the percentage of the short estrous cycle length was high in autumn (37.0%). During spring, summer and winter, the percentages of the long cycle length were 25.0, 20.0 and 20.0 %, respectively. The percentages of ewes showed normal heat duration during autumn was 63.0%, summer (56.0%) and spring (46.4%), while the percentage of ewes exhibited short heat duration were in spring (53.6%) and winter (50%). During autumn, ewes recorded the longest ($p<0.01$) heat duration (64.7 hrs). Ovulation rate was the highest ($P< 0.01$) in autumn (1.75) and the lowest in winter (0.82). Incidence of large follicles ($2.76 \geq 3$ mm^3) in diameter were significantly higher ($P<0.05$) in winter. Plasma progesterone concentration was always the lowest at the onset of estrous, increased gradually to a maximum level in day 8 and remained until day 14 (luteal phase), then declined in day 16 in winter, spring and summer and at day 18 in autumn. In conclusion, subtropical Farafra ewes were almost cyclic throughout the year. Reproductive performance of Farafra ewes still need more studies to reveal the strength and potential of this breed.

Keywords: Farafa ewes, Season, Estrous cycle, Progesterone

Introduction

The environmental temperature, photoperiod, geographical location and nutritional cues are the major factors controlling reproductive activity in sheep (Kleeman and Walker, 2005 and Marai et al., 2007). The combined effect of these factors on ewe fertility has been described in the temperate breeds (Notter and Mc Claugherty, 1991 and Lewis et al., 1996). In the subtropical sheep, ewes are almost cyclic throughout the year. Season affects mainly the luteal functions with little influences on follicular characteristics (Ali et al., 2006).

Studying seasonality of reproductive activity for subtropical breeds is important to determine the best breeding season (Ali et al., 2006). It has been widely reported that the temperate breeds of sheep are seasonally polyestrous, while those originating from tropical areas, showed estrous and breeding activity all the year round (Bartlewski *et al*., 1998). Reports on estrous and breeding activity of fat-tailed subtropical sheep vary greatly, with a general agreement of non-consistent estrous activity all over the year (Aboul-Naga *et al*., 1991, Omaima *et al.*, 1993 and Hafez, 1993). The length of the reproductive season varies with day length, breed and nutrition (Jainudeen and Hafez, 1993). In Egypt, a high level of cycling activity in local

sheep breeds is maintained throughout most of the year, with a pronounced drop during spring months (Aboul-Ela and Chemineau, 1989). The endocrine changes in the secretion of pituitary and ovarian hormones during follicular and early luteal phase of the estrous cycle are well characterized in intact ewes and in the auto transplanted model (Fortune et al., 2001).

Farafa sheep is a native fat-tailed breed that dominates in El-Farafra Oasis of the Egyptian western desert. A flock has been transported to Mallawi Animal Production Research Station belonging to APRI , Ministry of Agriculture and located in El Menia governorate of Egypt (Latitude 28°07 N, longitude 30°`33`E). They kept under intensive management system. Relatively, little information is available on reproductive performance of this breed.

The objective of the present study was to investigate the effect of the season of the year on some reproductive traits of Egyptian Farafra ewes.

MATERIALS AND METHODS

Animals and management

Thirty healthy non-lactating, non-pregnant Farafra ewes, 2 to 4 years old and 35 to 40 kg body weight, were used in this study. The animals raised in semi-open pens at Mallawi Station.

The ewes were fed concentrate feed mixture, crop residuals or green fodder, and wheat straw which provided 14% crude protein (CP) and 70% total digestible nutrients (TDN). Water, salt and mineral blocks were available all the time.

The reproductive traits were studied and evaluated during the four successive seasons of the year, winter, spring, summer and autumn.

Estrus detection

Ewes were detected for estrus using teaser rams twice daily (8:00 am and 4:00 pm) throughout different seasons of the year. Ewes receptive to rams and stood for mounting were considered in estrus. Percentages of ewes showing estrus, number of estrous cycle /ewe/season, estrous cycle length and heat duration were measured throughout the year.

Average of estrous cycle length (days) from the onset of the 1st estrous to the 2nd estrous were estimated throughout the year.

Estrous cycles length were classified according to their length to short estrous cycle length (<17 days), normal estrous cycle length (17-19 days) and long estrous cycle length (>19 days).

Heat duration of estrus (hours), period from the start of estrus behavior to the end of heat.

Heat duration was classified to short heat duration (<30hrs), normal heat duration (30-36 hrs) and long heat duration (>36 hrs).

Laparoscopy

Thirty ewes per season were selected randomly to estimate the ovarian activity. The Laparoscopy walf /8933/7mm made in USA with German lens system was used. The ewes were fasted for 24 hours before laparoscopic examination. Percentage of ewes ovulated, ovulation rate, number of large graffian follicles, (>3 mm diameters) and small follicles (<3 mm in diameters), were estimated.

Blood samples and hormonal assay

Plasma progesterone concentration from peripheral blood was determined. Blood samples were collected at 0 day of estrous cycle, then day after day until day 18 of the estrous cycle. Samples were collected from jugular vein into 10-ml heparinized vacationer tubes (Prand, France). Samples were centrifuged at 3000 rpm for 15 min for plasma aspiration. Plasma was then stored at –20˚C until assay of progesterone level.

Direct RIA technique was used to determine plasma Progesterone concentration in the peripheral blood. Plasma progesterone was determined using coated tube kit (USA, Catalog No. 3900, Meizger 1992). The standard curve ranged between 0 and 25ng/ml. Sensitivity of the curve was <0.03 ng/ml. Intra and inter –coefficient of variation for plasma progesterone was 4.2 7.6%, respectively.

Statistical Analysis

Data were analyzed using fixed model (SAS, 2000) to test the significance of studied fixed effect of seasons. Time of measurement was

classified into four classes 0, 2 - 6, 8 - 14 and 16 – 18, and the interactions between season and time was measured. Significant differences between seasons were tested according to Duncan New Multiple Range test (Duncan, 1955):

$$Y_{ijk} = \mu + S_i + T_j + (S*T)_{ij} + e_{ijk}$$

Y_{ijk}	Is the record of hormone measured in i^{th} season and j^{th} time of measurement,
μ	Is the overall mean,
S_i	Is the fixed effect of i^{th} season where i = 1 (winter), 2 (spring), 3 (summer) and 4 (autumn),
T_j	Is the fixed effect of j^{th} time of measurement where j = 0 (2), 1 (8-14), and 3 (16-20),
$(S*T)_{ij}$	Is the effect of interaction between season and time of measurement,
e_{ijk}	Is the effect of random error assumed to be NID ($0, \sigma_e^2$)

RESULTS

The reproductive traits of Farafra ewes as affected by seasons of the year are presented in Table (1). The highest cyclic activities were observed in autumn and summer (87.1 and 84.0%), while the lowest activity was recorded in spring (64.3%). During spring 28.6 and 25.0% of the ewes showed one and two estrous cycle, respectively. Meanwhile, in summer and autumn most ewes exhibited 3 to 4 estrous cycles. In winter, 36.7 and 20.0% of the ewes exhibited 2 and 3 estrous cycles, respectively (Table 1).

The percentage of ewes exhibited the highest estrous cyclic activity was observed in September (88.2%), October (91.7%), July (86%) and August (87.4%), while it markedly reduced in the months of February (45.8%), March (33.3%) and April (29.2%), (Figure 1). Season had no significant effect on length of the estrous cycle. Percentages of ewes exhibited normal estrous cycle length (17-19 day) during winter, spring, summer and autumn were 73.3, 47.0, 64.0 and 44.5%, respectively, while the highest percentage of the ewes that exhibited short estrous cycle length was in autumn (37.0%). During spring, summer and winter, the percentage of ewes with long estrous cycle length were 25.0, 20.0 and 20.0 %, respectively (Table 1 and Figure 2). Season had significant effect on long estrus duration. In autumn, heat duration differs significantly ($P<0.05$) as compared to winter and summer. However, most ewes showed normal heat duration during autumn (63.0%) and summer (56.0%)), while ewes exhibited short heat duration (53.6% and 50%) were during spring and winter (Table 1 and Figure 3).

Laparoscopic examination of the ovaries showed that, the highest ($P<0.05$) ovulation rate was recorded in autumn (1.75). While, the lowest was in winter (0.82), (Table 2). The number of large follicles was the highest ($P<0.01$) in winter (Table 2). Number of small follicles did not differ significantly ($P>0.05$) among different seasons. The percentages of ovulated ewes were significantly ($P<0.05$) higher during summer and autumn than winter and spring. On the other hand, in spring and winter the percentages of ewes showed estrus were higher than the percentages of ovulated ewes (Figure 4).

Seasons had significant effect on plasma progesterone concentration. It was at the highest level during autumn (1.8 mg/ml) compared to other seasons (Figure 5). Plasma progesterone concentration was always low at the onset of estrous cycle and increased gradually to a maximum level in day 8 and remained till day 14 (luteal phase), then declined in day 16 in winter, spring and summer and at day 18 in autumn (Table 3 and Fig.6).

Discussion

Based on the current results of estrous cycle and progesterone hormone concentration, it could confirmed that Farafra ewes are almost cyclic during all the studied seasons. The highest percentage of ewes showed estrus recorded during autumn followed by summer and winter, while the sexual activity reduced markedly in spring. The changes in estrous activity of local Farafra ewes might due to the changes in day length of different seasons (El-Nakhla, 1985). The same finding observed in other fat tailed subtropical sheep breeds (Aboul-Ela and Chemineau, 1989; Aboul-Naga *et al.*, 1991; Teleb *et al.*, 2008). The highest

number of ewes exhibited estrus was recorded during October, while the lowest number was observed in April (Figure 1). These results are in agreement with the finding of Rodrigues *et al.*(2007) and Teleb *et al*.(2008)

Estrous cycle length varied among individual ewes. Farafra ewes showed short, normal and long estrous cycle length, where season of the year had no significant effect on the length of estrous cycle (Kandil *et al.,* 1993 and Teleb *et al.,* 2008). The mean duration of estrus is species- dependent and varies from one female to another within the same species (Hafez, 1993).

The ovulation rate reached the highest value during autumn, spring and summer, while the lowest value was recorded in winter season. Kaulfuss *et al.* (2006) reported low variation in ovulation rate throughout the year in ewes. Teleb *et al*. (2008) recorded the highest level of ovulation rate in Saidi ewes during summer, autumn and winter, while the lowest was recorded in spring. In the same context, ovulation rate may differ according to sheep breed (Avdi *et al*., 1993).

The percentage of ovulated ewes was higher than the percentages of ewes exhibiting estrus in summer and autumn seasons, (Figure 4). These results confirm the fact that some ewes were ovulated without estrus signs before normall cycling (silent ovulation). The silent ovulation occurs in the absence of progesterone priming, which is required for behavioral expression of estrus (Hall et al. 1986). On the other hand, the percentage of ewes showing estrus was higher than those ovulated during spring and winter seasons, might due to that estrus observation included early ovulated ewes before laparoscopic examination (Teleb *et al*., 2008).

In Farafra ewes, total number of large follicles was significantly ($P<0.05$) higher during winter, this results contrasted with Teleb et al. (2008) who recorded that the highest number of large follicles was observed during summer in Saidi ewes. The greatest number of small follicles recorded in winter season (Table 2). Ali *et al*. (2006) reported similar trend that total number of follicles >2 mm in diameter was significantly higher in winter.

Plasma progesterone concentration was significantly higher ($P<0.01$) during autumn compared to winter, spring and summer. This result is in agreement with those of Ali *et al.* (2006) and Teleb *et al* (2008). Season, breed and nutrition of sheep could influence the maximum concentration of secreted steroids and ovulation rate (Gordon, 1997). The circulating progesterone concentration during the days of estrous cycle, throughout the different seasons, showed a cyclic pattern (Dicki and Holzmann, 1992 and Johhnsun *et al.,* 1992). The rise in progesterone level from day 8 to day 14 attributed to the growth and development of the corpus luteum (CL) (Cunningham *et al.,* 1975 and Hafez, 1993), while the decline due to the regression of CL (Pant *et al.,* 1977).

The highest plasma progesterone concentration was recorded during autumn in luteal phase (Table 3). Plasma progesterone concentration in the luteal phase was generally higher in detected cyclic ewes rather than non-detected estrous (Gabr, 1986 and Forcada *et al.,* 1992) and related to ovulation rate (Quirk and Gosling, 1975 and Wheeler and Land, 1977).

In conclusion, subtropical Farafra ewes were almost cyclic throughout the year. Reproductive performance of Farafra ewes still need more studies to reveal the strength and potential of this breed.

Table (1). Effect of season of the year on estrous cycle of Farafra ewes

Items	Seasons			
	Winter (n=30)	Spring (n=28)	Summer (n=25)	Autumn (n=27)
Ewes showed estrous cycle (%)	80	64.34	84.0	87.1
Ewes showed one estrous cycle (%)	16.7	28.6	4	3.7
Ewes showed two estrous cycles (%)	36.7	25	8	13.1
Ewes showed three estrous cycles (%)	20	7.14	40	29.6
Ewes showed four estrous cycles (%)	6.6	3.6	32	40.7
Short estrous cycle Length (<17 day)	16.0±0.30	15.0±1.2	15.4±1.0	15.1±0.29
(%)	6.7	28	16	37
Normal estrous cycle length (17-19 day)	16.8±0.30	16.8±0.40	16.7±0.31	16.7±0.29
%	73.3	47	64	44.5
Long estrous cycle length(>19day)	26.0±1.4	28.7±2.1	26.5±1.3	26.2±2.1
%	20	25	20	18.5
Normal heat duration (30-36 hr)	32.5±0.86	31.5±1.0	31.9±0.88	32.5±0.86
%	43.3%	46.4%	56%	63%
Short heat duration (<30 hr)	14.5±0.77	14.9±0.88	13.6±0.65	15.0±0.88
%	50%	53.6%	36%	29.6%
Long heat duration (>36 hr)	48 ± 1.9^{b}	--	51.3 ± 1.6^{ab}	64.7 ± 3.8^{a}
%	6.7		8%	7.4%

n= numbers of animals.

Table (2). Least squares means (±S.E) of ovulation rate, number of large and small follicles of Farafra ewes as affected by season of the year.

Items	Seasons of the year			
	Winter	Spring	Summer	Autumn
Ovulation rate	0.82 ± 0.19^{b}	1.15 ± 0.18^{b}	1.25 ± 0.18^{a}	1.75 ± 0.18^{a}
Number of large follicles	2.76 ± 0.45^{a}	1.35 ± 0.41^{b}	1.5 ± 0.41^{b}	1.75 ± 0.41^{a}
Number of small follicles	2.59 ± 0.55^{a}	2.45 ± 0.51^{a}	1.95 ± 0.51^{a}	1.85 ± 0.51^{a}

[a-b-] Values with different superscripts within a row are significantly different (P<0.05).

Table (3). Blood plasma progesterone concentration (ng/ml) in Egyptian Farafra ewes as affected by season of the year.

Time of estrous	Season of the year			
	Winter	Spring	Summer	Autumn
0 day of onset estrous cycle	0.3 ± 0.3	0.2 ± 0.2	0.3 ± 0.2	0.1 ± 0.3
2 - 6 days of estrous cycle	1.2 ± 0.2	1.3 ± 0.5	1.4 ± 0.3	1.6 ± 0.6
8 – 14 days of estrous cycle	2.3 ± 0.4	2.1 ± 0.4	2.4 ± 0.5	3.8 ± 0.7
16 – 18 days of estrous cycle	0.6 ± 0.3	0.2 ± 0.4	0.5 ± 0.1	1.4 ± 1.4

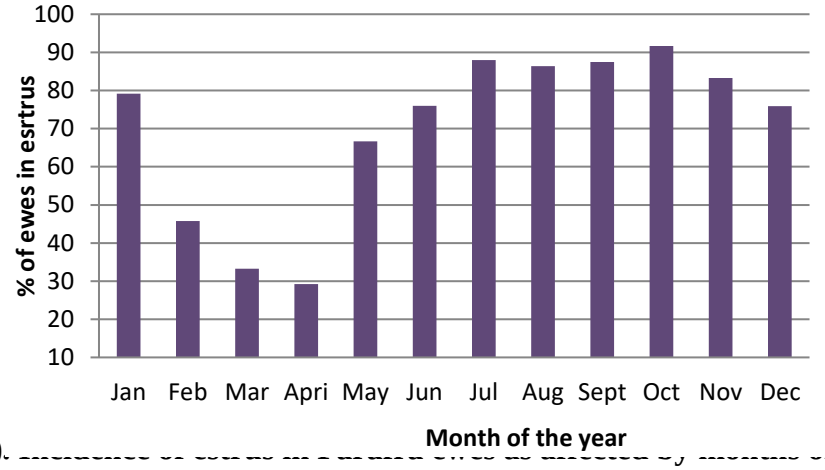

Figure (1). [illegible] **.**

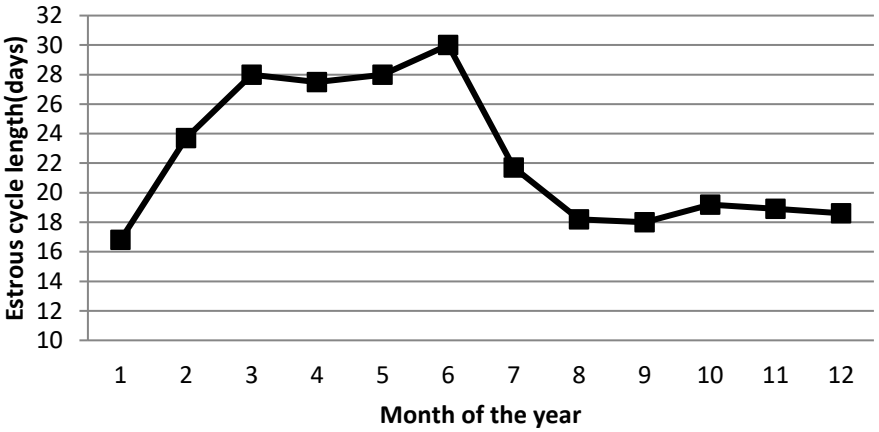

Figure (2). Estrous cycle length of Farafra ewes as affected by months of the year.

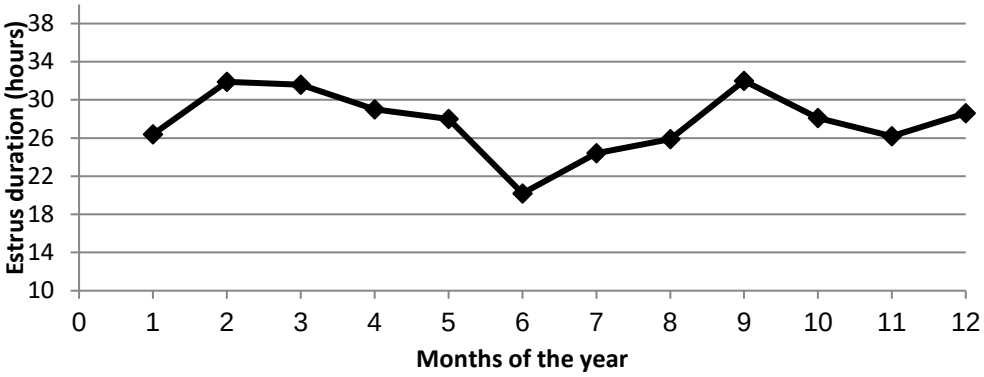

Figure (3). Estrus period (hours) of Farafra sheep as affected by months of the year.

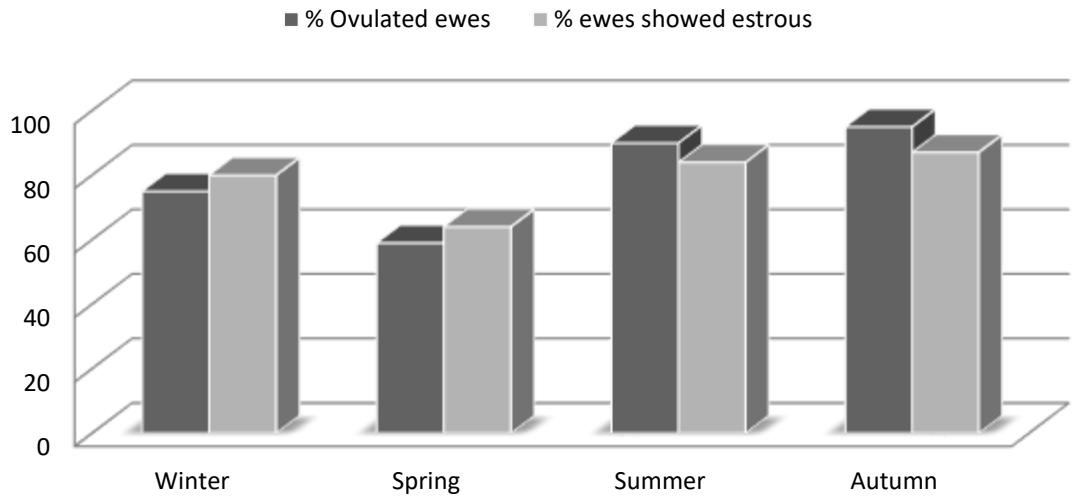

Figure (4). Seasonal variation and percentages of ewes showed estrus and ovulation rate of Farafra ewes.

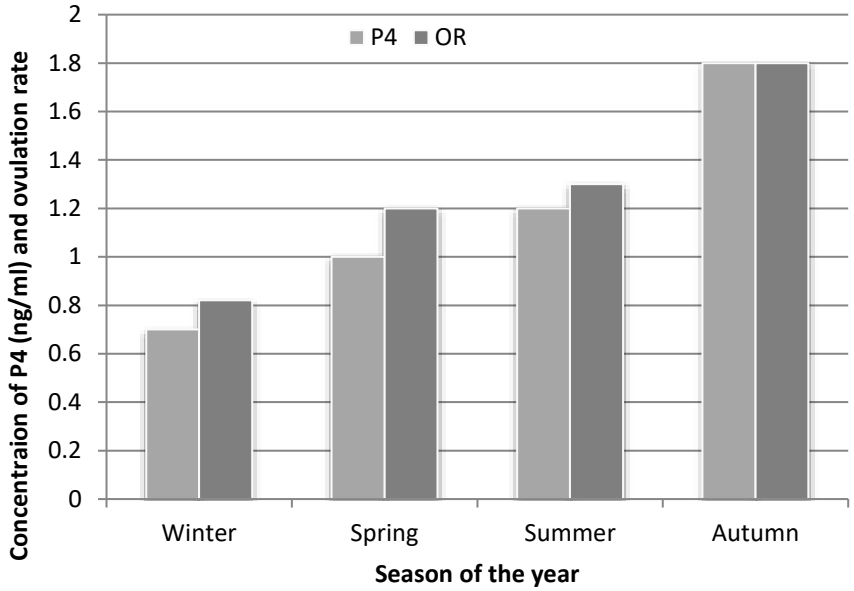

Figure (5). Blood plasma progesterone concentration (ng/ml) and ovulation rate in Farafra ewes as affected by season of the year.

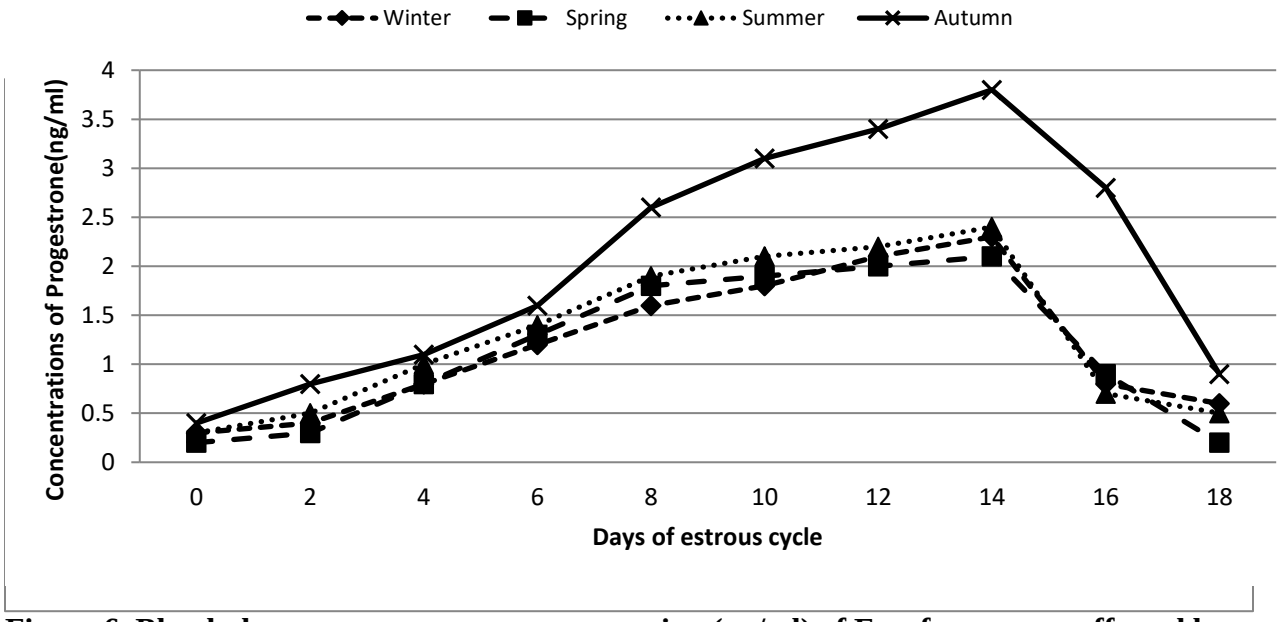

Figure 6. Blood plasma progesterone concentration (ng/ml) of Farafra ewes as affected by seasons of the year

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