

Determination of certain reproductive and productive parameters in female Mountain (Jabali) and crossbred goats during different age stages

M. Zarkawi^{1†}, M. B. Al-Daker²

¹ *Division of Animal Production, Department of Agriculture, Atomic Energy Commission, P. O. Box 6091, Damascus, Syria;* ² *Animal Wealth Research Administration, General Commission for Scientific Agricultural Research, P. O. Box 113, Doma, Damascus, Syria*

SUMMARY

The objective of the present study was to determine certain productive and reproductive parameters of female goats (Syrian Mountain: Jabali and crossbred: Damascus x Mountain) during different age stages. Thirty female goats from each breed kept at Ura Station for Improving the Mountain Goats, located about 15 km south of Sweida city (115 km south of Damascus), were used at an age of about three months with an average weight of around 13 kg. Jugular blood samples were collected to determine plasma progesterone concentrations using radioimmunoassay. Statistical analyses were carried out using StatView-IV programme. Individual variations among the females in both weight and age at puberty were observed, averaging 24.2 and 22.8 kg, 316.1 and 297.8 days for female Syrian Mountain and crossbred goats, respectively with no significant ($P>0.05$) differences between them in either parameter. Mating and kidding rates in both breeds were 100 and 93.3%, respectively, whereas fecundity rate was 143 and 161% for Syrian Mountain and crossbred female goats, respectively, with no significant ($P>0.05$) differences between them. Average weight of kids born to the female Syrian Mountain and crossbred goats was 3.1 and 3.4 kg, respectively, with no significant ($P>0.05$) differences between them. While, in both breeds, weight of single births was significantly ($P<0.05$) higher than that of twin ones (3.5 and 2.8, and 3.8 and 3.2 kg for Syrian Mountain and crossbred goats, respectively). Progesterone concentration in blood plasma was very low at the start of the study until the puberty stage (below 1 nmol L^{-1}), indicating an ovarian quiescence. However, the concentration rapidly increased at puberty stage averaging 11.1 and 11.6 nmol L^{-1} for female Syrian Mountain and crossbred goats, respectively. At the sponge insertion and withdrawal, average progesterone concentration was 1.09 and 0.23, 0.2 and 0.2 nmol L^{-1} for Mountain and crossbred females,

[†] Corresponding author e-mail: ascientific@aec.org.sy

respectively, indicating the efficiency of the sponges in oestrus synchronizing. During the oestrous cycle, progesterone concentration rose from the basal level (below 0.25 nmol L^{-1}) to about 4 nmol L^{-1} within 3 days, followed by a 16-day period where elevated progesterone concentration were observed (above 20 nmol L^{-1}), then a sharp decrease at the end of the oestrous cycle (around 0.5 nmol L^{-1}). Average progesterone concentration in the samples collected on day 21 post mating was 32.6 and $31.73 \text{ nmol L}^{-1}$ for female Syrian Mountain and crossbred goats, respectively, consequently, the accuracy of positive diagnosis of early pregnancy was 93.3%. Results could conclude the good performance of both breeds as compared to other international goat breeds in terms of the onset of puberty, kidding and fecundity rates. In addition, results clearly confirmed that the studied parameters of both breeds (including milk production and components, data not shown) were similar.

Keywords: crossbred goats, Mountain (Jabali) goats, progesterone, puberty, reproductive parameters

INTRODUCTION

Goats are important small ruminants and the major livestock of many countries such as India, Pakistan and Bangladesh (Khanum et al., 2000). They are considered highly suitable animals for raising in harsh conditions (Alamer, 2006), and play a vital role in the socio-economic structure of rural poor (Pal et al., 2011).

In west Asia including Syria, goats are raised in dry regions with prolonged drought, extreme climate fluctuation and water scarcity (Iñiguez, 2004). The number of goat population in Syria was estimated around 1.5 million, in which about 95% of them are Syrian Mountain and the remaining are Damascus goats (AASA, 2010).

The information available regarding Syrian Mountain goats is both limited and confusing. The few documents available are derived from general assessments, and most of the information provided is obtained from discussions with people who have worked in goat production stations (Kassem, 2005). The Syrian Mountain goats inhabit the extremely unfriendly and harsh environment. They are black goats, with dropping ears and a curved head; both sexes have horns (Wurzinger et al., 2008), with the majority of goats having no tassels (AlKouri, 1996). As for the Damascus goat, it is seasonal where certain reproductive parameters in the female Damascus goat have been studied (Zarkawi, 2007; Zarkawi and Soukouti, 2010). Moreover, the Damascus goat was introduced into some countries to improve the local breeds (Khalil et al., 2010). The definition of the breed (Jindal, 1984) is of usually reddish brown colour, with long straight hair which is smoother and

shorter on the neck and head, a convex profile, the head is beardless, long with two tassels, and some animals have small curled-back horns while others are hornless.

A crossbreeding programme between Damascus and Syrian Mountain goats was initiated in Ura Station near Sweida city, and the characteristics of the crossbred goats were described by Bakri (2010) as the colour usually black, wide ears, long neck with few individuals have tassels, slight convex profile, some animals have small horns while others are hornless.

There is a threshold of live weight necessary for the attainment of puberty in the first breeding season, and when live weight was below that threshold, first ovulation did not occur until the beginning of the next breeding season (Moreno et al., 2000) when the initiation of frequent LH pulse secretion was inhibited (Rhind, 1992). Nakada et al. (2002) suggested that the development of capacity to secrete LH in response to GnRH before puberty is one of the factors for deciding the time at puberty in heifers. Moreover, a group of peptides called "kisspeptins" was recently reported to stimulate GnRH release. Kisspeptins are required for puberty and maintenance of normal reproductive function (de Tassingny and Colledge, 2010).

Blood progesterone concentrations have been extensively used in the studies of animal reproduction (Krakowsky et al., 2011) including determination of the onset of puberty in female goats such as Damascus goats in Syria (Zarkawi and Al-Masri, 2002), Nubian in Sudan (Yagoub and Elsheikh, 2003), Shiba in Japan (Sakurai et al., 2004), Red Sokoto in Nigeria (Malau-Aduli et al., 2005), Saanen-Criollo crossbreed in Mexico (Torres-Moreno et al., 2009), Saanen, Anglonubian and their crossbred in Brazil (Ferraz et al., 2009) and others. Progesterone concentrations have been also used during the oestrous cycle (Zarkawi and Soukouti, 2001) and pregnancy (Charallah et al., 2010), in early diagnosis of pregnancy (Boscós et al., 2003), to confirm the clinical and morphological findings shown by laparoscopy (Zarkawi and Soukouti, 2010), and other reproductive parameters (Khanum et al., 2007) in female goats.

In Syria, as mentioned above, several studies have been carried out on female Damascus goats only, with no work concerning the reproductive parameters being done on either Syrian Mountain or crossbred female goats. Therefore, the main objectives of the present study were to determine (1) age and weight at puberty, (2) the response of the females in both breeds after puberty to the intravaginal sponge treatment, and (3) progesterone concentrations in blood plasma during different age stages.

MATERIAL AND METHODS

Study site and experimental animals

This study was performed in Ura Station for Improving the Mountain Goats, belonging to the Scientific Agricultural Research Centre in Sweida, General Commission for Scientific Agricultural Research. The station is located about 15 km south of Sweida city (115 km south of Damascus), 985 m above sea level and with an average annual rainfall of approximately 300 mm.

Sixty female goats (30 Syrian Mountain and 30 Syrian Mountain x Damascus crossbred), weaned at an age of about two months, with similar age (about three months), and weight (around 13 kg) were used for a period of about two years covering several stages (prepubertal, puberty to mating and pregnancy to kidding).

Oestrus detection and mating

At an age of about 1.5 years, females in both breeds were treated for oestrus synchronisation with intravaginal sponges containing 40 mg of flugestone acetate (FGA, Chronogest®, Intervet International B.V., The Netherlands) for 18 days. Four fertile bucks (two Syrian Mountain for female Syrian Mountain goats and two crossbred for female crossbred goats) were introduced twice daily (10:00-13:00h and 17:00-18:00h) starting about 24 hours after sponge withdrawal for oestrus detection and natural mating. Bucks were kept with the females until all females were mated and females in oestrus were observed and recorded.

Animal housing, feeding and hygiene

Animals were kept indoors at night and outside for most of the day. Indoors, they were offered diets based on barley and wheat straw supplemented by vitamins. Water and mineral licks were available *ad libitum*. Outdoors, they had free access to natural grazing. In addition, all animals received preventive vaccinations according to the programme adopted in the station.

Blood sampling and progesterone analysis

EDTA-k₃ vacutainer tubes (VACUETTE®, Austria) were used to collect approximately 8 mL of jugular venous blood from each female goat once fortnight throughout the study period until kidding. Moreover, additional 20 samples were collected from each animal during the period starting from 17 August to 30 September, three times a week (at an age of about 1.5 years), to accurately characterise the different stages of the oestrous cycle during the breeding season in both breeds.

Plasma was prepared using a refrigerated centrifuge at 3500 rpm for 15 minutes and was stored frozen at -20°C until determination of progesterone using validated progesterone RIA kits (Coat-A-Count, Siemens, USA). Progesterone levels exceeding 3.18 nmol L^{-1} for the first time, followed by the appearance of regular oestrous cycles were indicative of the onset of puberty (Zarkawi, 2010).

Parameters and statistical analysis

The following reproductive and productive parameters were measured and calculated in both breeds:

- Monthly weight of females (kg) throughout the study.
- Onset of puberty (weight and age).
- Progesterone concentration during different stages, and early diagnosis of pregnancy on day 21 post mating (nmol L^{-1}).
- Oestrus synchronisation using intravaginal sponges.
- Weight at mating and after kidding.
- Mating (oestrus) rate: (number of females showing oestrus/total number of females) x 100.
- Duration of pregnancy (days).
- Kidding rate: (number of females kidding/ total number of mated females) x 100.
- Number and type of kidding (single, twin).
- Fecundity rate: (number of kids born/ number of females kidding) x 100.
- Weight of kids at birth (kg).

Statistical analyses were carried out using StatView-IV programme (StatView, 1996) on an IBM system. A separation test on treatment means was conducted using Fisher's PLSD.

RESULTS AND DISCUSSION

Weight and age at the onset of puberty

Average birth weight of the female goats used in the study was 3.4 ± 0.5 (2.7-4.6) and 3.5 ± 0.4 (3.0-4.6) kg, and at weaning at about two months of age was 12.3 ± 1.1 (11-14) and 12.1 ± 0.8 (11-14) kg for female Syrian Mountain and crossbred goats, respectively, with no significant ($P > 0.05$) difference between them in either parameter.

The evolution of body weight of the females in the two breeds of goats from an age of three months to the onset of puberty is shown in Figure 1, indicating that the growth of animals in the both breeds was normal and greatly comparable. However, there were huge individual variations in both

weight and age at puberty, with no significant ($P>0.05$) difference between the two breeds in either parameter (Table 1). Similar individual variations in both weight and age at puberty were reported in female Damascus goats in Syria (Zarkawi and Al-Masri, 2002).

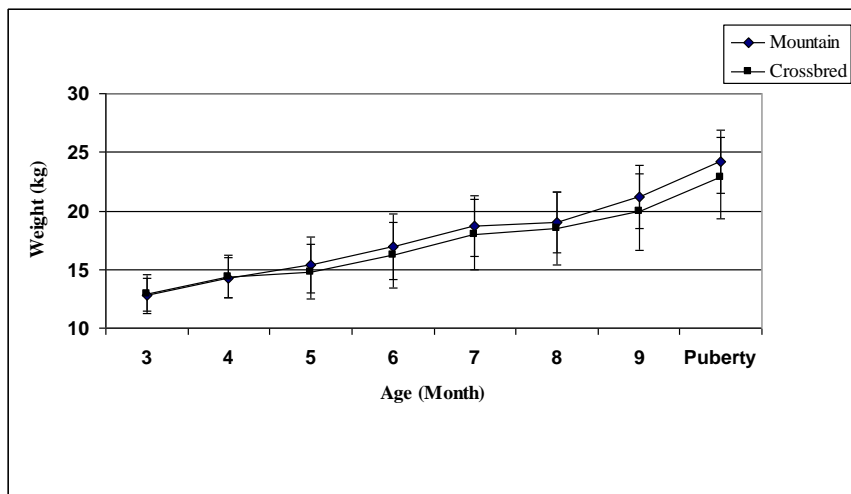


Figure 1. Average (\pm SE) live weight of female Syrian Mountain and crossbred goats from an age of 3 months to puberty.

Table 1. Average (\pm SE) weight at birth, weaning and at the start of the study; and weight and age at puberty of female Syrian Mountain and crossbred goats used in the study.

| Parameter | Breed | |
|---------------------------------------|---------------------------------|---------------------------|
| | Syrian Mountain ($n = 30$) | Crossbred ($n = 30$) |
| Birth weight (kg) | 3.4 ± 0.5 | 3.5 ± 0.4 |
| Range | (2.7-4.6) | (3-4.6) |
| Weaning weight (kg) | 12.3 ± 1.1 | 12.1 ± 0.8 |
| Range | (11-14) | (11-14) |
| Weight at the start of the study (kg) | 12.8 ± 1.4 | 12.9 ± 1.7 |
| Range | (11-16) | (11-18.5) |
| Weight at puberty (kg) | 24.2 ± 2.7 | 22.8 ± 3.5 |
| Range | (19-28) | (17-29.5) |
| Age at puberty (days) | 316.1 ± 38.6 | 297.8 ± 32.0 |
| Range | (257-367) | (234-348) |

Differences in both weight and age of female goats at puberty have been reported according to the breed. West African Dwarf goats in Nigeria attained puberty at an average weight of 8.68 kg (Idiong and Udom, 2011), whereas, in local goats in Mexico, the weight ranged between 27 and 32 kg (Delgadillo et

al., 2007). Age at puberty in female goats was: 137 days in Dwarf in Pakistan (Khanum et al., 2000), 150 days in Sahel in Nigeria (Bukara et al., 2006), 366 and 374 days in Hebsi and Zomri, respectively in Saudi Arabia (AlHozab and Basiouni, 1999).

Age and body weight at puberty were compared between pure and crossbred goats raised in the same environment. Nubian x Saanen female crossbred goats in Sudan attained puberty earlier than the pure ones (148.1 and 256.3 days, respectively), and their mean body weight at puberty was significantly lower than that of the pure ones (13.6 and 16.9 kg, respectively) (Yagoub and Elsheikh, 2003). In contrast, Ferraz et al. (2009) in Brazil reported that Saanen breed attained puberty earlier than Anglonubian and the crossbred goats (135 vs 342 and 264 days, respectively), but had lower weight 19.7 vs 31.0 and 29.8 kg, respectively). Other researchers (Waldron et al., 1999), however, reported no difference at the onset of puberty between Spanish and its cross with Boer in Spain (225 vs 231 days, respectively).

Oestrus synchronisation, mating rate, weight at mating and post kidding

All females in both breeds showed oestrus behaviour within 48 hours post sponge withdrawal indicating the effectiveness of the sponges in oestrus synchronisation. Intravaginal sponges have been widely used in many countries for oestrus synchronisation of small ruminants (Carcangiu et al., 2011). This treatment is usually accompanied with equine chorionic gonadotropin injection to improve ovulation rate (Kelidari et al., 2010).

Table 2. Average (\pm SE) mating rate, kidding rate, mating and kidding weight in female Syrian Mountain and crossbred goats used in the study.

| Parameter | Breed | |
|---------------------|-----------------------------|-----------------------|
| | Syrian Mountain (n = 30) | Crossbred (n = 30) |
| Mating rate (%) | 100 | 100 |
| Kidding rate (%) | 93.3 | 93.3 |
| Mating weight (kg) | 40.5 \pm 4.5 | 39.4 \pm 5.5 |
| Range | (32-50) | (29-53) |
| Kidding weight (kg) | 42.3 \pm 6.7 | 41.8 \pm 6.0 |
| Range | (30-55) | (31-55) |

All female goats were naturally mated, therefore, mating rate was 100%, while 28 females in each breed kidded thus kidding rate was 93.3%. This rate is higher than 80% reported by Al-Merestani et al. (2003) in female Damascus goats in Syria, and similar to 94.3% reported in Hair goats in Turkey (Toplu and Altinel, 2008).

There were no significant ($P > 0.05$) differences among the females in both breeds in terms of mating and kidding weights (40.5 and 42.3 kg, and 39.4 and 41.8 kg, for female Syrian Mountain and crossbred goats, respectively (Table 2). However, these weights are lower than those reported in female Damascus goats in Syria averaging 48.5 and 55.9 kg, respectively (Zarkawi, 2007).

Duration of pregnancy, birth type, kidding rate, fecundity rate and weight of kids born

Duration of pregnancy ranged between 150 and 156 days in the females in both breeds, with no significant ($P > 0.05$) difference between them. Zarkawi (2007) and Aritonang (2009) reported a duration of pregnancy around 149 days in both female Damascus goats in Syria and in female Kosta goats in Pakistan. Likewise, type of birth (single or twin) had no effect on duration of pregnancy (Table 3).

Table 3. Average (\pm SE) duration of pregnancy, duration of pregnancy for single and twin births, fecundity rate in female Syrian Mountain and crossbred goats used in the study; and overall birth weight, and single and twin birth weight.

| Parameter | Breed | |
|---|---------------------------------|----------------------------|
| | Syrian Mountain ($n = 28$) | Crossbred ($n = 28$) |
| Duration of pregnancy (days) | 152.8 \pm 2.2 | 153.6 \pm 2.1 |
| Range | (150-156) | (150-156) |
| Single birth duration of pregnancy (days) | 153.0 \pm 2.1 | 154.0 \pm 1.9 |
| Range | (150-156) | (150-156) |
| Twin birth duration of pregnancy (days) | 152.7 \pm 2.3 | 153.3 \pm 2.3 |
| Range | (150-156) | (150-156) |
| Fecundity rate (%) | 143 | 161 |
| Overall birth weight (kg) | 3.1 \pm 0.6 | 3.3 \pm 0.7 |
| Range | (1.8-4.2) | (2.0-5.4) |
| Single birth weight (kg) | 3.5 \pm 0.5 ^a | 3.8 \pm 0.9 ^a |
| Range | (2.6-4.2) | (2.5-5.4) |
| Twin birth weight (kg) | 2.8 \pm 0.5 ^b | 3.2 \pm 0.6 ^b |
| Range | (1.8-3.6) | (2.0-4.2) |

^{a, b} Means between columns followed by different letters are significantly different ($P < 0.05$).

There were 16 single and 12 twin kiddings in Syrian Mountain vs 11 single and 17 twin kiddings in crossbred goats, thus, fecundity rates were 143 and 161%, respectively, with no significant ($P > 0.05$) difference between the two breeds (Table 3). Fecundity rates in female Damascus goats in Oman ranged between 140 and 170% (El Hag et al., 1995), and in Syria was 180% (Al-Merestani et al., 2003), while fecundity rate ranged between 125 and 188% in female Kosta goats in Pakistan (Aritonang, 2009).

There was no significant ($P>0.05$) difference in the overall average weight of births produced by female Syrian Mountain and crossbred goats, whereas weight of single birth was significantly ($P<0.05$) higher than twin birth in both breeds (Table 3). These findings agree with those reported by Zarkawi et al. (1999) in Damascus goats in Syria.

Progesterone concentration in blood plasma during different reproductive stages

During the prepubertal period, plasma progesterone concentrations were very low (below 1 nmol L^{-1}) and remained so, indicating no oestrus activity. A similar finding was reported by Khanum et al. (2000) in Dwarf goats in Pakistan. However, at the onset of puberty, the concentration rose sharply reaching an average of 11.1 ± 6.8 (3.54-22.98) and 11.6 ± 7.5 (3.35-25.67) nmol L^{-1} for female Syrian Mountain and crossbred goats, respectively.

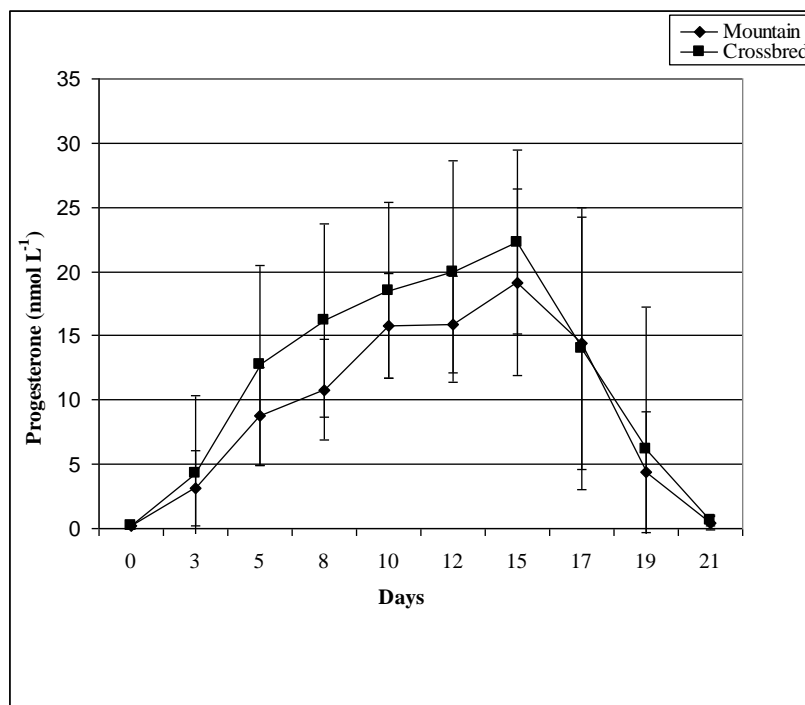


Figure 2. Average (\pm SE) concentration of plasma progesterone in female Syrian Mountain and crossbred goats from sponge removal (day 0) for a period of 21 days

Average progesterone concentration at sponge insertion and withdrawal was 1.09 and 0.23, 0.2 and 0.2 nmol L^{-1} for female Syrian Mountain and crossbred goats, respectively, confirming once again the effectiveness of the intravaginal sponges in oestrus synchronisation. As for the period from sponge

withdrawal (day 0) to day 21 post withdrawal covering an oestrous cycle (Zarkawi and Al-Masri, 2002), Figure 2 clearly illustrates for the first time the changes in progesterone concentrations in the plasma of female Syrian Mountain and crossbred goats during the different phases of the oestrous cycle. Basal level of progesterone rose from below 0.25 nmol L^{-1} to about 4.0 nmol L^{-1} within three days (early luteal phase), followed by a 16-day period where progesterone was elevated (luteal phase) reaching a maximum of 19.14 and 22.3 nmol L^{-1} for female Syrian Mountain and crossbred goats, respectively, then, declined to a very low concentration (about 0.5 nmol L^{-1} at the last 2-3 days of the oestrous cycle (follicular phase).

Our results are similar to those reported by Gaafar et al. (2005) who studied the progesterone profile during the oestrous cycle of female Damascus goats raised in Egypt, and reported progesterone concentrations of 0.32 - 0.64 , and 8.27 - $17.17 \text{ nmol L}^{-1}$ during follicular and luteal phases, respectively. In Iranian Abadeh female goats, Emady et al. (2006) reported concentrations of progesterone on days 0-4, varied between 0.32 and 2.54 nmol L^{-1} , during luteal phase 8.59 - $12.40 \text{ nmol L}^{-1}$, and the follicular and luteal phases of the oestrous cycle lasted about 4-5 and 14 days, respectively. Cueto et al. (2006) reported that progesterone concentration in Neuquen-Criollo female goats in Argentina decreased between days 17 (above 1.59 nmol L^{-1}) and day 19 (below 1.59 nmol L^{-1}) of the oestrous cycle.

At mating, progesterone concentration was very low averaging 1.32 ± 1.04 and $1.0 \pm 0.73 \text{ nmol L}^{-1}$ for female Syrian Mountain and crossbred goats, respectively. Similar results were reported in female Damascus goats in Cyprus (Mavrogenis, 1988) and female Malabari goats in India (Selvaraju et al., 2007).

Early and accurate pregnancy diagnosis, especially in seasonal animals such as the goat is very important in order to prevent delay in rebreeding, causing unnecessary decrease in income because of loss both milk and kids (Al-Merestani et al., 2003), consequently economic loss to the farming community (Selvaraju et al., 2007). The use of progesterone concentrations as an indicator for early diagnosis of pregnancy is becoming increasingly common (Abdulkareem et al., 2011). In the present study, average progesterone concentration in the samples collected on day 21 post mating was 32.6 ± 9.09 (9.03 - 45.34) and 31.73 ± 11.42 (10.09 - 53.57) nmol L^{-1} for female Syrian Mountain and crossbred goats, respectively. Among the mated animals that were diagnosed as pregnant, 28 out of 30 in each breed kidded, therefore, the accuracy of positive diagnosis of early pregnancy was 93.3%, and pregnancy diagnosis was confirmed by kidding (Boscos et al., 2003). Rates of accurate positive pregnancies on days 21-22 post mating using progesterone RIA were 90.5% in female Damascus goats in Syria (Zarkawi et al., 2003) and 86.7% in female Malabari goats in India (Selvaraju et al., 2007), whereas, using

progesterone enzyme immunoassay on day 21 post AI, the rate was 73.5% in Swiss and local Greek female goats (Boscós et al., 2003).

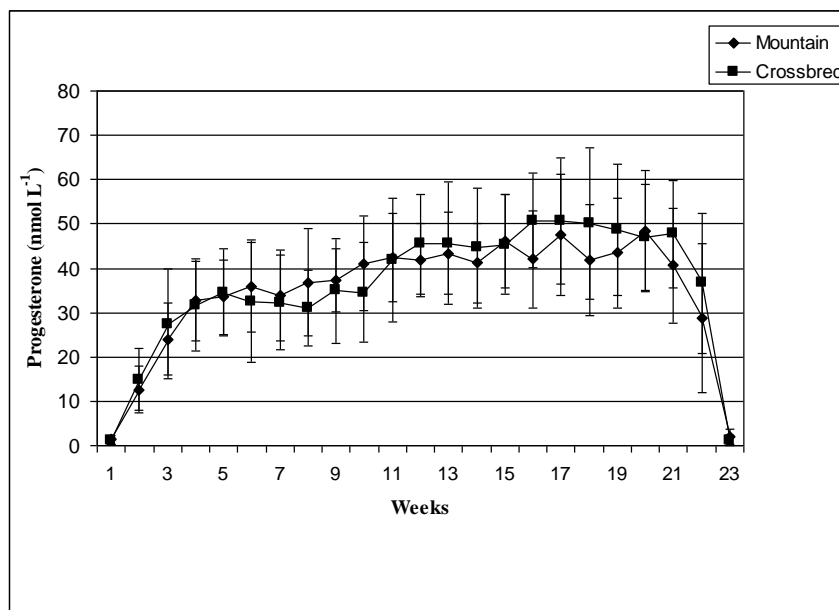


Figure 3. Average (\pm SE) concentration of plasma progesterone in Syrian Mountain and crossbred female goats at mating (week 1), during pregnancy (weeks 2-22) and post kidding (week 23)

Due to the activity of the corpus luteum during pregnancy, progesterone concentrations rose from basal levels and remained elevated throughout pregnancy, but declined sharply after kidding (Figure 3). Similar results were reported by Zarkawi (2007) in female Damascus goats in Syria.

CONCLUSIONS

For the first time in Syria, the reproductive and productive parameters of the female Syrian Mountain and crossbred goats have been characterised. These parameters may indicate the good performance of both breeds as compared to other international goat breeds in terms of the onset of puberty, kidding and fecundity rates. In addition, results clearly confirmed that the studied productive and reproductive performance of both breeds (including milk production and components, data not shown) was similar.

ACKNOWLEDGMENTS

The authors would like to thank the Director General and the Head of the Department of Agriculture of the Atomic Energy Commission of Syria, General Commission for Scientific Agricultural Research and Animal Wealth Research Administration for their support.

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