



Productive and reproductive parameters in high and low growing Syrian Awassi lambs

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ABSTRACT. The objective of this study was characterize some productive and reproductive parameters in Syrian Awassi ewe lambs during different age stages. Thirty Syrian Awassi ewe lambs aged around 3 months were divided equally into 2 groups, high and low growing to identify productive and reproductive parameters during different stages. Blood samples were collected to determine progesterone and leptin concentrations. Daily milk samples were collected to determine the average daily production. At puberty, average body weight of higher growing was higher (48.4 kg) than de crescimento low growing (42.8 kg). Average age at puberty was 359.5 and 394.9 days for high and low groups, respectively with no differences. Mating, lambing and fecundity rates were similar among groups. Progesterone concentration was very low and increased rapidly at puberty with a sharp increase during pregnancy, followed by a noticeable decrease post lambing. There were individual variations in leptin concentration with no clear trend in groups. Average leptin concentration at puberty was 2.42 and 2.50 ng mL⁻¹ for higher and low groups, respectively with no difference. Average daily milk production was higher for the higher group (1.495 g day⁻¹) compared to 1.077 g day⁻¹ for low groups. Thus, the lambs growing alter productive and reproductive parameters.

Keywords: leptin; milk production; progesterone; puberty.

Parâmetros produtivos e reprodutivos de cordeiros Awassi da Síria de taxa rápida e lenta de crescimento

RESUMO. O objetivo deste estudo foi caracterizar alguns parâmetros produtivos e reprodutivos em cordeiros sírios Awassi com diferentes estagio de crescimento. Trinta cordeiros Awassi com cerca de 3 meses de idade foram divididos igualmente em dois grupos: cordeiros de crescimento rápido e lento, para identificar os parâmetros produtivo e reprodutivo, durante diferentes estágios. Foram coletadas amostras de sangue para determinar a concentração de progesterona e leptina. Também, foram coletadas amostras diárias de leite para determinar a média de produção diária. Na puberdade, a média geral dos pesos dos cordeiros de crescimento rápido foi maior (48,4 kg) comparado aos de crescimento lento (42,8 kg). A idade média da puberdade foi de 359,5 e 394,9 dias para o grupo rápido e lento, sem diferenças. As taxas de acasalamento, parto e fecundidade foram semelhantes entre os grupos. A concentração de progesterona foi baixa e aumentou rapidamente na puberdade, com um aumento acentuado durante a gravidez, seguido por um notável decréscimo no pós-parto. Houve variações individuais na concentração de leptina sem uma clara tendência nos grupos. A média de concentração de leptina na puberdade foi de 2,42 e 2,50 ng mL⁻¹ para o grupo de higher and low, respectivamente. A produção diária de leite foi maior para o grupo de crescimento rápido (1.495 g dia⁻¹) comparada com 1.077g dia⁻¹ para os animais de crescimento fraco. Assim, a taxa de crescimento alterou os parâmetros produtivos e reprodutivos.

Palavras-chave: Leptina; produção de leite; progesterona; puberdade.

Introduction

Puberty is an important reproductive trait and extreme delay in reaching puberty will have a negative effect on breeding efficiency (Esmailzadeh, 2014). The onset of puberty is linked to the attainment of critical body mass (Rosales Nieto et al., 2013), and when body weight was below that threshold, first ovulation in Mouflon and Manchega

ewe lambs did not occur until the beginning of the next breeding season (Moreno, Brunet, Debulines, Villar, & Sebastian, 2000). Carcangiu, Mura, Vacca, and Bini (2005) reported that body weight is the most important factor for the onset of puberty in the Sarda female lambs. Hormonally, puberty is associated with increasing pulsatile secretion of the hypothalamic gonadotropin releasing hormone

(GnRH), which stimulates the release of gonadotropins and in turn gonadal activity (Delemarre, Felius, & Delemarre-Van Waal, 2008).

Blood progesterone concentrations have been extensively used in the studies of animal reproduction to determine the onset of puberty in female sheep such as Suffolk in Brazil (Ferra et al., 2010) Rambouillet and Suffolk in the USA. Progesterone concentrations have been also used during the oestrous cycle (Jarquin, Roldan, Zarco, Berruecos, & Valencia, 2014), during pregnancy (Alwan, Amin, & Ibrahim, 2010), in early diagnosis of pregnancy (Adama, Chiezy, Ajanusi, & Lawal, 2013), and other reproductive parameters (Grazul-Bilska et al., 2014) in female sheep.

Leptin was first described by Zhang et al. (1994) as a protein consisting of 146 amino acids, weighing 16 kDa, and resembling cytokines in its structure. Leptin is an adipocyte-derived hormone that suppresses feed intake and is involved in regulating body temperature (McFadin, Morrison, Buff, Whitley, & Keisler, 2002). There is a debate on the role of leptin in pubertal maturation of animals. Leptin has been reported to be required for the normal onset of puberty (Chehab, Mounzih, Lu, & Lim, 1997), and has direct effects through steroidogenesis on the ovary (Ryan et al., 2002), but, in the contrary, Cheung, Hohmann, Clifton, and Steiner (2001) suggested that leptin is not a metabolic trigger for the onset of puberty in the male and female rats; instead, leptin is one of several factors, their presence may be necessary but alone is not sufficient to initiate sexual maturation in the rodents.

Syrian Awassi sheep (fat-tailed triple purpose) are seasonal breeders, mate between June and September (Zarkawi, 1997), and normally lamb once annually. In Syria, several productive and reproductive parameters in female Awassi sheep were studied, such as hormonal changes during different reproductive stages (Zarkawi, 2010), effects of some veterinary drugs (Zarkawi, 2010), and others. The current study aimed at characterizing some productive and reproductive parameters in Syrian Awassi ewe lambs during different age stages.

Materials and methods

This study was performed in the Scientific Agricultural Research Centre, General Commission for Scientific Agricultural Research. The centre is located about 5 km west of Salamiah city (240 km north east of Damascus), with an average annual rainfall of approximately 250 mm. Average monthly maximum and minimum temperature, as well as the

relative humidity throughout the year is illustrated in Table 1.

Table 1. Average maximum and minimum temperature, as well as the relative humidity throughout the year recorded in the study site.

Months	Maximum Temperature, °C	Minimum Temperature, °C	Relative Humidity (%)
January	15.8	6.4	67
February	15.9	6.5	62
March	21.4	8.2	48
April	24.2	9.3	48
May	29.0	12.5	43
June	32.3	16.2	44
July	34.7	18.2	46
August	37.4	19.7	42
September	33.1	16.9	51
October	27.7	14.8	42
November	18.3	8.0	64
December	15.2	7.3	73

Thirty Syrian Awassi ewe lambs, aged around 3 months were used. Lambs were equally divided according to their birth and weaning weights in 2 groups, fast growing (FG) and weak growing (WG) lambs. Lambs were weaned at about two months age. Birth dates of lambs were almost similar (19 November to 04 December), and the characterizations of the ewe lambs used in the study are summarised in Table 2.

Table 2. Type and weight of birth, weight at weaning and at the start of the study of Syrian Awassi ewe lambs in the 2 groups.

Group	Type of Birth	Birth Weight (kg)	Weaning Weight (kg)	Initial Weight (kg)
Fast Growing	6 Singles and 9 twins	4.9± 0.7 ^a	22.7± 3.2 ^a	23.8± 2.9 ^a
Weak Growing	8 Singles and 7 twins	4.3± 0.8 ^b	17.1± 1.4 ^b	17.4± 1.9 ^b

Means within a column followed by different letters (^a ^b) are significantly different ($p < 0.05$).

Two Awassi ewe were introduced twice daily (10:00-13:00h and 17:00-18:00h) at the second breeding season (about 2 years of age) starting on 15 June for oestrus detection and natural mating, until all females were mated and females in oestrus were observed and recorded (all females were mated between 17 June and 24 July).

All animals were kept indoors in semi-open barns at night and outside for most of the day. Indoors, they were offered diets based on barley, maize and wheat straw and wheat bran, supplemented by vitamins. Water and mineral licks were available *ad libitum*. Outdoors, they had free access to natural grazing consisting mainly of *Atriplex halimus* and *Salsola vermiculata* in addition to barley (semi-intensive husbandry system). In addition, all animals received preventive vaccinations according to the programme adopted in the Scientific Agricultural Research centre. In addition, all animals

were weighed twice a month throughout the study.

EDTA- k_3 vacutainer tubes (Vacuette®, Austria) were used to collect approximately 8 mL of jugular venous blood from each female once fortnight as follows:

- Progesterone: for 2 years starting from weaning, pre-puberty, puberty, throughout pregnancy and post lambing.
- Leptin: for 6 months starting at an age of 6 months.

Plasma was prepared using a refrigerated centrifuge at 3000 rpm for 15 minutes and samples were stored frozen at -20°C until determination of progesterone (Izotop, Budapest, Hungary) and leptin (Demeditec Diagnostics, Kiel-Weissee, Germany) concentrations using validated progesterone RIA kits. Progesterone levels exceeding 3.18 nmol L^{-1} for the first time, were indicative of the onset of puberty (Ferra et al., 2010).

Females in both groups were manually and completely milked twice daily (morning: 06:00h and evening: 18:00h) for a period of 90 days, starting 60 days after lambing (weaning). Milk samples were collected and weighed individually, and total daily milk yield/female was calculated.

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

- Onset of puberty (weight and age).
- Progesterone and leptin concentrations during different age stages.
- Twice a month weights throughout the work period, plus at mating and post lambing, and mass weight (kg lambs born/lambing).
- Mating (oestrus) rate: (number of females showing oestrus/total number of females) $\times 100$.
- Duration of pregnancy (days).
- Lambing rate: (number of females lambing/ total number of mated females) $\times 100$.
- Number and type of lambing (single, twin).
- Fecundity rate: (number of lambs born/ number of females lambing) $\times 100$.
- Average daily milk production/female.

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

Figure 1 illustrates the changes in body weights of the females used in the current study from 3 to 15 months of age indicating that the growth rate of the females in the FG was better than in the WG group.

At puberty, there were huge variations among

individuals in both weight and age. Average body weight at puberty was $48.4 \pm 3.5 \text{ kg}$ and $42.8 \pm 3.4 \text{ kg}$, ranging 42-54 kg and 37-52 kg for FG and WG groups, respectively, with a difference ($p < 0.05$) among them. The overall average weight was $45.8 \pm 4.3 \text{ kg}$, which is higher than 23.6 kg in Sudanese Desert ewe lambs and 30 kg in Sarda ewe lambs in Italy (Carcangiu et al., 2005), 34.1 kg in crossed ewe lambs in Brazil (Ferra et al., 2010), 36.5 kg in Awassi ewe lambs in Jordan (Kridli, Yousef Abdullah, Mohamed, & Al-Momani, 2006), 36.7 kg in Finnish Landrace \times Rahmani ewe lambs in Egypt (El-Gohary, Abdel-Khalek, Ashmawy, Teleb, & Sallam, 2011) and 39.4 kg in Merino ewe lambs in Australia (Rosales Nieto et al., 2013).

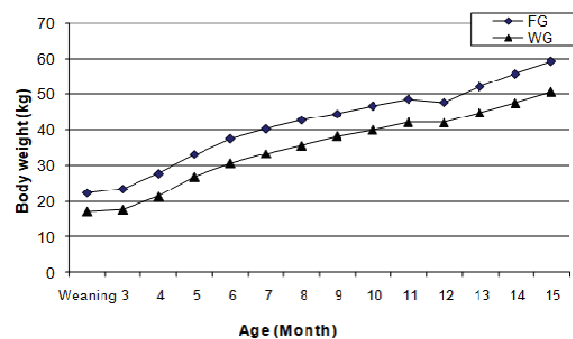


Figure 1. Average body weight of fast growing (FG) and weak growing (WG) Syrian Awassi ewe lambs from weaning to an age of 15 months.

Average age at the onset of puberty was 359.5 ± 90.2 days, ranging 271-573 days for the FG group and 394.9 ± 90.4 days ranging 328-577 for the WG group, with no difference between them. The overall average of age for both groups was 377.2 ± 90.4 days, which is higher than 145.6 days in Sudanese Desert ewe lambs, 276.5 days in crossed ewe lambs in Brazil (Ferra et al., 2010), 280 days Awassi ewe lambs in Jordan (Kridli et al., 2006), 257 days in Rahmani ewe lambs (Khalifa et al., 2013), 300 days in Finnish Landrace \times Rahmani ewe lambs in Egypt (El-Gohary et al., 2011) and 330 days in Merino d'Arles ewe lambs in France (Abella, Cogne, Thimonier, Seck, & Blanc, 2005).

All female lambs were naturally mated, therefore, mating rate was 100%, while 14 (an abortion case occurred after 3 months of pregnancy for unknown reason) and 15 females lambed in FG and WG, respectively, consequently, lambing rate was 93.3 and 100%, respectively. The overall lambing rate was 96.6%, which is higher than 77.7 and 90.3% reported by Lassoued and Rekik (2001) in Queue Fine del'Ouest and Queue Fine del'Ouest \times D'Man breeds, respectively in Tunisia, 83.3% in Rahmani

breed in Egypt (Khalifa et al., 2013) and 91% in Kermani ewes in Iran (Mohammadabadi & Sattayimokhtari, 2013).

Overall average mating and post lambing weights was 58.3 ± 6.2 and 65.9 ± 8.3 kg, respectively. There were differences among the females in both groups in terms of mating and post lambing weights (61.5 ± 5.3 and 70.6 ± 6.4 kg, and 54.1 ± 4.3 and 61.5 ± 7.4 kg, for FG and WG groups, respectively). These weights are higher than those reported by Lassoued and Rekik (2001) in Queue Fine del'Ouest and Queue Fine del'Ouest x D'Man breeds averaging 45.7 and 40.5, respectively.

Duration of pregnancy averaged 151 ± 3.4 (143-157) and 150.6 ± 2.6 (143-154) days for FG and WG groups, respectively, with no difference between them, and the overall average was 150.8 ± 3.0 days. The overall average is close to 151.0 days in Syrian Awassi sheep reported by Zarkawi (2010), and 150.5 days in Afshari ewes in Iran (Aliyari, Moeini, Shahir, & Sirjani, 2012). Moreover, type of lambing (singles or twins) had no significant ($p > 0.05$) effect on the duration of pregnancy, averaging 150.8 ± 3.7 and 151.8 ± 1.5 days, and 151.1 ± 3.4 and 148.8 ± 3.0 days, respectively. This finding is in agreement with Zarkawi (2011) in Syrian Awassi sheep.

There were 6 single and 8 twin for FG vs. 9 single and 6 twin lambings in WG group, thus, fecundity rates were 157.1 and 140%, respectively, with no difference between the two groups (Table 2). As for birth mass, the overall average was 5.62 ± 1.5 kg, and averages were 6.0 ± 1.6 and 5.3 ± 1.2 kg for FG and WG groups, respectively, with no difference between them. Aliyari et al. (2012) reported a birth mass of 6.5 kg in Afshari ewes in Iran. The results of the above parameters are summarized in Table 3.

Table 3. Average (\pm SE) mating and lambing rates, mating and post lambing weights, duration of pregnancy, duration of pregnancy for single and twin births, fecundity rate and birth mass of FG and WG ewe lambs used in the study.

Parameter	Group	
	Fast Growing	Weak Growing
Mating rate (%)	100 ^a	100 ^a
Lambing rate (%)	93.3 ^a	100 ^a
Mating weight (kg)	62.1 ± 5.5^a	54.1 ± 4.3^b
Post lambing weight (kg)	69.9 ± 5.5^a	61.4 ± 7.5^b
Duration of pregnancy (days)	151.0 ± 3.4^a	150.6 ± 2.6^a
Single birth duration of pregnancy (days)	150.8 ± 3.7^a	151.0 ± 3.4^a
Twin birth duration of pregnancy (days)	151.1 ± 3.4^a	148.8 ± 3.0^a
Fecundity rate (%)	157.1 ^a	140 ^a
Birth mass (kg)	6.0 ± 1.6^a	5.3 ± 1.2^a

Means between rows followed by different letters (^a, ^b) are significantly different ($p < 0.05$).

During the prepubertal period, progesterone concentrations were very low (below 1 nmol L^{-1}) and remained so, indicating no oestrus activity. A similar finding was reported by El-Gohary et al. (2011) in Finnish Landrace x Rahmani ewe lambs in Egypt. However, at the onset of puberty, the concentration rose sharply reaching an average of 10.7 ± 5.4 and $8.20 \pm 5.4 \text{ nmol L}^{-1}$ for FG and WG groups, respectively, with no difference between them. In Rahmani ewe lambs in Egypt, Khalifa et al. (2013) reported similar results, with progesterone concentration at the onset of puberty averaging 8.94 nmol L^{-1} .

At mating, progesterone concentration was very low (below 1 nmol L^{-1}), and 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 lambing (Figure 2). Similar results were reported by Zarkawi (2011) in female Syrian Awassi sheep.

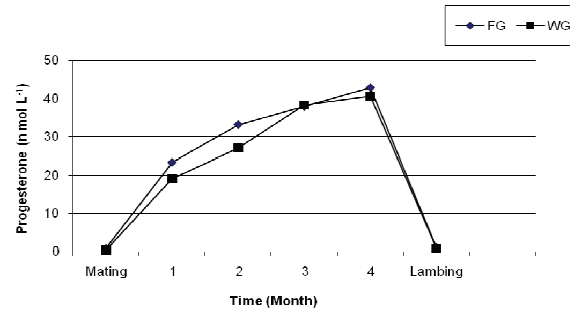


Figure 2. Average progesterone concentration in the plasma of fast growing (FG) and weak growing (WG) Syrian Awassi ewe lambs from mating throughout pregnancy until lambing.

Leptin concentrations did not change pre, during or post puberty in both groups (Figure 3). However, individual variations were reported in leptin concentration ranging from 1.02 to 4.47 ng mL^{-1} . Average leptin concentration was $2.50 \pm 0.84 \text{ ng mL}^{-1}$, and 2.43 ± 0.83 and $2.57 \pm 0.85 \text{ ng mL}^{-1}$ for FG and WG groups, respectively with no difference among the groups, and the overall average concentration was $2.50 \pm 0.84 \text{ ng mL}^{-1}$.

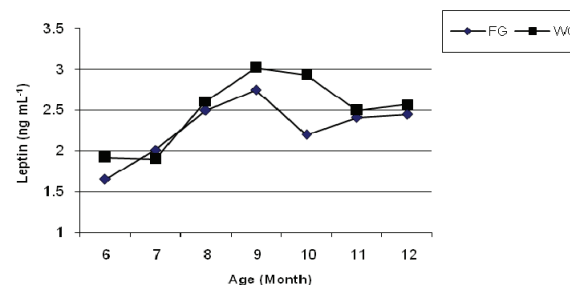


Figure 3. Average leptin concentration in the plasma of fast growing (FG) and weak growing (WG) Syrian Awassi ewe lambs from 6 to 12 months of age.

At puberty, average leptin concentration was similar among the groups, being 2.42 ± 0.59 and 2.50 ± 0.8 ng mL⁻¹ for FG and WG groups, respectively. Our results agree with those reported by Recabarren, Lobos, Torres, Oyarzo, and Sir-Petermann (2004) in Suffolk ewe lambs in Chile at 4.6, 6 and 7 months of age (1.6 - 2.3 ng mL⁻¹) who suggested that leptin concentrations could not correlate with the onset of puberty in that breed, and with Blanc et al. (2007) who reported that plasma leptin is not the only metabolic signal that initiates puberty in Merino ewe lambs in France. However, and in the same sheep breed (Syrian Awassi), leptin concentration was significantly ($p < 0.05$) higher in ram lambs (Zarkawi & Al-Daker, 2016) than ewe lambs at similar ages.

Huge individual variations in daily milk production were observed among the experimental animals in the two groups. Average daily milk production/female was 1.495 ± 480 and 1.075 ± 340 g for FG and WG groups, respectively, with a difference between them. Maximum and minimum daily milk production was 2.050 and 740, and 1.775 and 590 g, respectively. Similar individual variations in daily milk production were reported in Wad (146-217 g) and Yankasa (210-327 g) ewes in Nigeria (Adewumi & Olorunnisomo, 2009) and in Pleven Blackhead (527-803 g) in Bulgaria (Aleksiev, 2011).

Comparing the overall average daily milk obtained in the present study being 1280 g with those of other sheep breeds, it could be seen that the value was within the normal values reported in other breeds. The overall average was higher than 340 g in Najdi ewes in Saudia Arabia (Ayadi, Matar, Aljumaah, Alshaikh, & Abouheif, 2014), around 437 g in improved Valachian, Tsigai and Lacaune purebred and crossbred ewes in Slovak Republic (Margetín, Oravcová, Makovický, Apolen, & Debrecéni, 2013), 770 g in Zom ewes in Turkey (Koncagül, Karataş, Akça, Vural, & Bingöl, 2012), 182, 267, and 324 g in Wad and Yankasa and cross, respectively in Nigeria (Adewumi & Olorunnisomo, 2009) and 580 and 560 g in Awassi and Karradi ewes, respectively in Iraq (Al-Samarrae, 2009).

Conclusion

Under the work conditions, results indicated the good performance of the animals as compared to other sheep breeds in terms of the onset of puberty, lambing and fecundity rates and milk production. However, when comparing the performance of the FG and WG groups, it is concluded that the age at puberty, lambing and fecundity rates were similar

among them, but milk production, which is an important parameter, was higher in FG group.

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