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RESEARCH ARTICLE

Factors Influencing the Milk Production of Awassi Sheep in A Flock With the Selected Lines at the Agricultural Scientific Research Centre in Salamieh/Syria

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Summary

This study was conducted at the Agricultural Scientific Research Centre in Syria within the Arab Center for the studies of the Arid Zones and Dry Lands (ACSAD). Milk yield records from 6411 Awassi ewes were collected between 1991-2005. These records were used to evaluate the factors influencing the milk production and to define the differences between the selected meat and milk lines. Results showed that lactation milk yield (LMY) was significantly (P<0.01) affected by ewe line (EL), year of production (YP), parity (P) and birth type (BT). Lactation period (LP) averaged 157.69±0.63 days and was significantly affected (P<0.01) by the same factors with the exception of birth type (BT). Lactation milk yield for the whole flock averaged 243.3±3.96 kg with significant differences (P<0.05) between milk and meat lines (272.5±4.93 vs. 224.0±4.88 kg respectively). Ewe body weight at lambing was also found to have a positive effect (P<0.01) on LMY. Lactation milk yield increased at a rate of 1.35 kg for each 1kg the ewe was above average body weight at lambing. These results provided evidence that the response to selection program for milk traits in Awassi sheep is significant. Selection for LMY can be improved with a simplified record system.

Keywords: *Awassi sheep, Milk yield, Lactation period, Selection line, Syria*

Suriye'de Bilimsel Tarım Araştırma Merkezi'nde Seleksiyonla Elde Edilmiş Hatların Oluşturduğu Bir İvesi Sürüsünde Süt Verimini Etkileyen Faktörler

Özet

Bu çalışma, Arab Center for the Studies of the Arid Zones and Dry Lands'ın çerçeve programı dahilinde Suriye'nin Salamieh şehrinde bulunan Bilimsel Tarım Araştırma Merkezi'nde yapılmıştır. Araştırmada, 1991 ve 2005 yılları arasında 6411 İvesi koyununa ait süt verim kayıtları toplanmıştır. Bu veriler süt verimini etkileyen faktörler ile seleksiyonla elde edilmiş et ve süt yönlü hatların süt verim özelliklerinin karşılaştırılmasında kullanılmıştır. Araştırma sonuçlarına göre, seleksiyonla elde edilmiş hatlar, yıl, doğum sayısı ve doğum tipi süt verimini önemli düzeyde etkilemiştir (P<0.01). Laktasyon süresi ortalama 157.69±0.63 gün bulunmuş ve doğum tipi hariç incelenen diğer faktörlerin bu özelliğe etkisi önemli bulunmuştur (P<0.01). Bütün sürünün ortalama süt verimi 243.3±3.96 kg olup süt ve et yönlü hatların süt verimleri de sırasıyla 272.5±4.93 ve 224.0±4.88 kg olarak belirlenmiştir (P<0.05). Canlı ağırlığın toplam süt verimi üzerine etkisi önemli bulunmuştur (P<0.01). Ortalama canlı ağırlığın üzerindeki her bir kg'lık canlı ağırlık artışı süt verimini 1.35kg/laktasyon arttırmıştır. Elde edilen sonuçlara göre İvesi koyunlarının süt verimi için yapılan seleksiyona önemli düzeyde olumlu cevap verdikleri görülmüştür. Yani, laktasyon süt verimi basitleştirilmiş kayıt sistemlerinin kullanımıyla yapılacak seleksiyonla iyileştirilebilir.

Anahtar sözcükler: *İvesi, Süt verimi, Laktasyon süresi, Seleksiyon, Suriye*

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INTRODUCTION

Sheep production is a major system in large areas where is not suitable for crop production. It is also a production activity in developed and developing countries in areas ranging from wet, temperate uplands to arid zones. Milk is a valuable yield obtained from sheep. Although use of sheep milk is generally a tradition especially in Mediterranean countries, it is getting more important in dairy sector because of its high dry matter content. Awassi is one of the dual-purpose, fat-tailed sheep breeds which can be accepted as a sheep-milk resource in south-west Asia (Iraq, Jordan, Palestine, Lebanon and Turkey). In Syria Awassi is the only breed which is the largest Awassi population in the area with 19.651 million sheep [1]. It also exists in Europe, Australia, New Zealand, and China. The breed is well adapted to harsh conditions and capable of producing and reproducing under these circumstances. Traditionally, the Awassi sheep are raised to be herded from one place to another seeking pasture in Syria.

The productivity of Awassi sheep has been estimated in Iraq by many researchers as low [2-4]. However, the breed contributes remarkably to the national economy of the Arab countries and provides the main income resource for rural families in the marginal and dry lands. The improved Awassi strain in is known to have the highest milk production after the East Friesian sheep [5]. Awassi also possesses very desirable characteristics as far as endurance to nutritional fluctuations, resistance to diseases and parasites, tolerance to extreme temperatures beside its high milk producing and growth abilities [6,7].

Environmental influences on milk production in sheep have been studied in detail, for breed effect [8], year and season [9], age at first parturition [10], production level [11], variety [12].

A study was run on two lines of Awassi sheep from Turkey and Syria and their crosses, and it was found that the differences among the lines were significant in terms of milk yield and Turkish line yielded the highest amount [12]. Also reported that pure Awassi breed can produce more milk than Charollais X Awassi and Romanow X Awassi crosses [13]. Furthermore, lactation, season, feeding, psychological state and health of the animal may affect either milk or milk content [14-15]. Several attempts have also been made to improve the productivity of the Awassi breed, for example, in Iraq [3], Palestine [16], Iran [16], Cyprus [17], and Turkey [18-20]. All these studies indicate the importance of Awassi sheep.

In recognition of the importance of this breed in the Arab Countries, the Arab Centre for the Studies of Arid Zones and Dry Lands [20], in collaboration with the Syrian Ministry of Agriculture and Agrarian Reform established a project to improve the breed through genetic selection at the Agricultural Scientific Research Centre (ASRC) in Salamieh, Syria, in 1973. The ideology of this project was to develop three flocks (strains or lines) for milk, meat, and wool through selection for each trait separately, and then to combine the three lines into one multi-purpose strain. The ultimate target of the project is to disseminate the improved genes throughout the Arab countries participating in the project, thereby improving their local flocks. The wool improvement project was temporarily suspended as the economic value of wool is low compared to meat and milk values. Accordingly, the flock was divided into two flocks (meat and milk) based on their capacity of production. Selection was practiced for each trait within each flock separately, except selection for twinning rate within the meat flock was practiced regardless of the high milk production capacity that some dams might possess (in addition to high twinning rate). After achievement of certain genetic progress, the two lines (milk and meat) were mixed together during 1991-1994 in an attempt to produce a genetically improved line of high milk and meat production. In 1995 the two lines were re-isolated from the joined flock as it was believed that selection for one trait may negatively affect the other. Moreover, this step was associated with the concept of keeping options open for breeders to improve their flocks for either trait, especially those breeders raising sheep for only meat production.

Present study aimed to investigate the effects of factors on lactation milk yield (LMY) and lactation length (LP) with the analyses of a large data set. Study also aimed to show the differences between the selected meat and milk lines in terms of milk traits. Used large data set gave an extra importance to the study in order to define the characteristics of the breed.

MATERIAL and METHODS

This study was conducted at the Agricultural Scientific Research Centre (ASRC) General Agricultural Scientific Research Commission, in Salamieh, 240 km north east of Damascus, Syria, within the framework of cooperation with the Arab Centre for the Studies of Arid Zones and Dry Lands [20].

Five hundred mature Awassi ewes were involved in this study. The animals were segregated into three specialized flocks (milk, meat and wool) according to their production capacity. The flocks were kept in semi-shaded barns. From March to May, the ewes grazed mainly on natural pastures and some green forage legumes and cereals. From June to November, they grazed on post-harvest crop residues and also had access

to graze Atriplex spp shrubs. In addition, supplements (250-500 g/head) of feed composition of concentrates were supplied according to the physiological status of the ewes. During the winter months they were fed 0.5-1.0 kg/head concentrates of mixed grains, cotton seed cakes and bran in addition to 0.5-1.0 kg of hay and straw.

The milk yield was measured fortnightly from second week after parturition with twelve hour intervals. On milk recording days, lambs were isolated from their dams at 7:30 pm, and the dam's udders were manually evacuated of surplus milk. On the next day at 7:30 am, ewes were milked, and the milk produced was weighed and recorded. This amount was multiplied by two to approximate the anticipated daily milk yield. This procedure was routinely repeated until lambs were weaned at 60 days of age.

In post-weaning period, the ewes were routinely milked at 7:30 pm to evacuate their udders. On the following day, they were milked at 7:30 am, and again at 7:30 pm. The volumes of milk recorded at the morning and evening milk yields were combined to calculate the 24 h milk yield. This fortnightly practice was continued until the ewes dried off at the end of the lactation season.

Lambs were weighed at birth and fortnightly at the pre-weaning stage of lactation. Thereafter they were weighed monthly (after 12 h of fasting) until they attained 480 days of age. Growth rates during the various stages of their lives were measured and lambing and twinning rates were also recorded.

The data for this study (for the period 1991-2005) were extracted from the original data set that started from 1976. A cumulative milk yield of each ewe was calculated by using the formula: $LMY = C\sum m_i$

Where LMY is the cumulative milk yield or lactation milk yield; C is the constant to convert the single test day milk yield (i.e. 14 days), and mi is the i^{th} test day of milk yield. Data were analyzed statistically by using Least Squares of Harvey according to the following linear mixed model [21] and pair-wise comparison Scheffe's test was used to define the significant subgroups;

$$X_{ijklmn} = \mu + S_i + Y_j + L_k + P_l + Z_m + YL_{jk} + YZ_{jm} + LP_{kl} + LS_{km} + PZ_{lm} + b_l(A-\bar{A}) + E_{ijklrnn}$$

Where:

X_{ijklmn} is the lactation milk yield, lactation period, or a test of daily milk yield of the n^{th} observation of the trait belonging to the fixed effect factors of m^{th} litter size (single or twins), born in l^{th} ewe parity of kth production ewe lines (milk or meat) within j^{th} lambing years (1991-2005), and ith random sired.

μ is the overall mean effects of the traits.

Fixed effects; sire, year, line, parity, litter size as symbolized (S_i, Y_j, L_k, P_l, Z_m)

YL_{jk} + YZ_{jm} is the interaction of the ewe production line with litter size and lambing years.

LP_{kl} + LS_{km} is the interaction of ewe parity with litter size and ewe parity with ewe production lines.

PZ_{km} is the interaction of ewe parity with litter size.

b_1 is the regression coefficient of each trait on ewe lambing weight, and

E_{ijkinm} is the random error term.

RESULTS

The overall means of LMY and LP (248.3±3.46 kg and 157.7±0.63 days) are presented in *Table 1*. This table

Table 1. *The Least Squares Means of the lactation milk yield (LMY) and lactation period (LP) in Awassi sheep**
Tablo 1. *İvesi koyunlarında laktasyon süt verimi ve laktasyon süresine ait düzeltilmiş ortalama değerler*

Source of Variation	The Least Square Mean ± SE		
	No	LMY (kg)	LP (day)
Overall Means	6411	248.26±3.96	157.69±0.63
Lambing Years			
1991	333	219.40±16.59	142.50±3.57
1992	303	240.77±16.67	157.01±3.59
1993	265	240.93±12.54	146.64±2.67
1994	362	274.45±10.50	164.40±2.22
1995	420	263.27±9.32	162.86±1.95
1996	411	244.87±8.51	158.25±1.76
1997	445	236.42±7.93	158.26±1.63
1998	503	269.68±8.22	158.76±1.70
1999	524	220.48±7.32	151.99±1.49
2000	470	240.23±7.80	149.93±1.60
2001	487	255.75±8.48	157.50±1.75
2002	488	260.88±9.62	155.24±2.02
2003	493	244.64±10.98	159.60±2.32
2004	428	229.97±13.41	172.11±2.87
2005	479	282.13±14.53	170.24±3.12
Ewe Line			
Milk line (1)	3622	272.48±4.93	157.34±0.90
Meat line (2)	2789	224.03±4.88	158.03±0.89
Parity			
1st	1819	231.87±7.57	151.33±1.54
2nd	1386	261.41±6.24	160.11±1.23
3rd	1062	273.38±5.49	162.18±1.04
4th	802	259.06±5.52	162.61±1.05
5th	575	251.58±6.32	161.03±1.25
6th	398	242.21±7.66	156.63±1.57
7th +	369	218.29±9.38	149.91±1.96
Birth Type			
Singles	5082	242.10±4.06	159.40±0.66
Twins +	1329	254.42±4.82	155.97±0.87
	Reg. coefficients on:		
Ewe-lambing wt		1.35±0.20	-0.18±0.04

** Significance level of the factors were defined in Table 2*

shows that average LMY in the milk line (272.5±4.93 kg) is greater (P<0.01) than that of the meat line (224.0±4.88 kg). Although the differences between the two lines are statistically significant, it seems, from the biological and economical view points, they are unimportant. This result could be due to mixing the two lines together during 1991-1994, which in turn distorted the result and reduced the differences. However, the differences between the two lines in respect to milk yield increase progressively over time from 1996 till 2005 as illustrated in *Fig 1*. Furthermore, selection for twinning rate, regardless of any high milk production potential that some ewes possess, might be associated with the stimulation effect of twins being higher in reducing these differences.

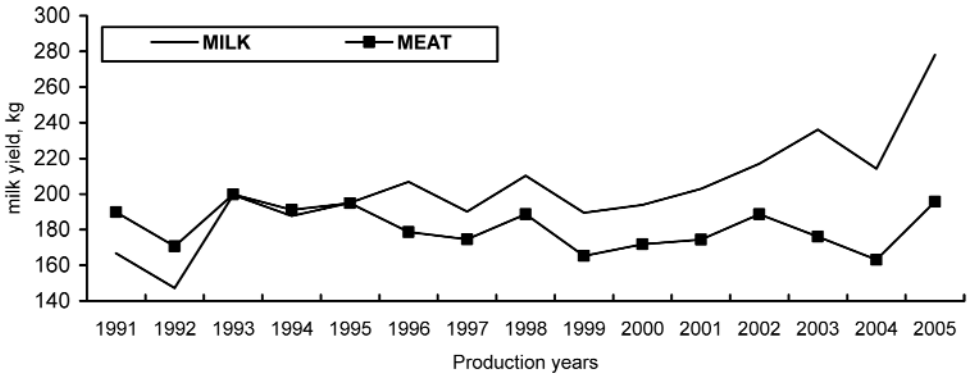

Fig 1. Lactation milk yield of the milk and meat flocks in relation to year of production

Şekil 1. Sütçü ve etçi sürülerde üretim yılına göre laktasyon süt verimleri

Table 2. *Analysis of variance for some factors affecting lactation milk yield (LMY) and lactation period (LP) in Awassi sheep*
Tablo 2. *İvesi koyunlarında laktasyon süt verimi ve laktasyon periyodunu etkileyen bazı faktörlerin variyans analizi*

Source of Variation	d. f.	Mean Squares	
		LMY	LP
Sire	511	24759.32 **	772.91 **
Lambing Years (LY)	14	74664.73 **	8536.77 **
Ewe lines (EL)	1	722210.03 **	144.06 ns
Parity (P)	6	145993.96 **	11129.68 **
Birth Type (BT)	1	94788.65 **	7316.78 **
Interaction			
ELxYr	14	55348.17 **	2131.22 **
LSxYr	14	24192.45 **	422.91 ns
P*El	6	55554.08 **	446.53 ns
LS*El	1	1295.14 ns	160.15 ns
LS*P	6	6682.58 ns	318.49 ns
Reg On:			
Ewe-lambing wt	1	459249.93 **	7839.70 **
Residual	5835	10311.56	491.51

*****:*** *P<0.01,* ***ns:*** *P>0.05*

In the current study, total milk yield was affected (P<0.01) by ewe line (EL), Lambing Year (LY), Parity (P), Birth Type (BT). Lactation period was similarly affected by the same factors with the exception of EL *(Table 2)*.

Ewe body weight at lambing was also found to have a positive effect (P<0.01) on LMY *(Table 1)*. Total milk

Table 3. *Phenotypic correlations (rp) between the 1st five milk records (DM) and total milk yield (LMY), and lactation period (LP) in Awassi sheep*
Tablo 3. *İvesi koyunlarında laktasyon süresi, laktasyon süt verimi ile ilk beş kontrol günü süt miktarı arasındaki fenotipik korelasyon katsayıları*

Traits	DM_1	DM_2	DM_3	DM_4	DM_5	LMY
DM_2	0.65 *					
DM_3	0.58 *	0.71 **				
DM_4	0.53 *	0.63 *	0.72 *			
DM_5	0.48	0.55 *	0.62 *	0.74 **		
LMY	0.61	0.68 **	0.71 **	0.70 **	0.67	
LP	0.02	-0.06	-0.09	-0.03	0.08	-0.09

****:*** *P<0.05,* *****:*** *P<0.01*

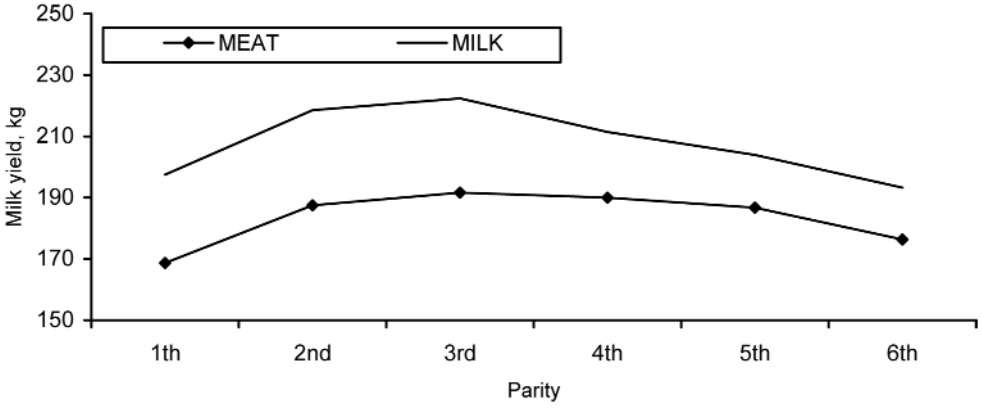

Fig 2. Total milk production of the milk and meat flocks in relation to ewe parity

Şekil 2. Sütçü ve etçi sürülerde doğum sayısına göre laktasyon süt verimi

yield increased at a rate of 1.35 kg for each 1 kg the ewe was above average ewe body weight at lambing.

The phenotypic correlations between each of the 1st five milk records ranged between 0.48-0.74 *(Table 3).*

DISCUSSION

Regardless of the factors involved in the selection process over the project period, the increment of total milk yield from 128.4 kg in the control flock at the initiation of the project to 275.5 kg in the milk flock (nearly 2.1 times) in 2005 reflects the high response to the genetic improvement process [20]. If the data were corrected for management (represented by high variation of lambing dates-over three months), traditional production system, parity, lamb sex and type of birth, the value of total milk yield would be much greater, and then production capacity of milk yield would be justified. This result seems to be consistent with those of who reported 167-287 kg milk yield/head within a lactation period of 84-183 days/year in Awassi sheep [22-24].

Table 2 showed that total milk yield increased over time from 219 kg in 1991 until its maximum at 282.13 kg in 2005. The same trend of increase over time was observed for the lactation period (from 142.5 to 179.2 days for the same corresponding years). These results seem to be in agreement with those obtained by [25].

Milk yield in this study increased progressively with advancing parity until the third parity (273.4 kg) and then declined gradually until the seventh (213.3 kg). This is interpreted as the effect of maturity with advancing age or parity [26]. The same trend was observed with LP [27].

Total milk yield also increased with high twinning rates. This can be attributed to the higher stimulation effect in ewes giving birth to twins rather than singles. This result is similar to those obtained by [3,16,28].

The superiority of milk yield from the milk line in relation to the year of study and parity *(Fig 1 & 2)* reflects the high attention paid to selection of milk yield within milk line [28]. Total milk yield was reported by Pollolt and Gootwine [16] to be 506±161 kg within 214±49 days in an improved Awassi flock in Palestine under an intensive production system. Total milk yield of the present study (272.26±3.2 kg) was obtained in 157.7±0.63 days under a traditional production system, with high variation in lambing dates (nearly three months). If these associated effects were excluded or corrected, then LMY in this study would increase to a value close to that reported by Pollott and Gootwine [16].

The phenotypic correlation between each of the 1st five milk records ranged between 0.48-0.74 *(Table 3).* These values are in agreement with values of 0.41-0.97 reported by Ligda et al.[30], Serrano et al.[31] and Sanna et al.[32]. These values are also similar to the values reported by Ligda et al.[30] and Macciotta et al.[33] in Sarda and Chios sheep (0.255-0.792 and 0.32-0.97, respectively).

However, Pollott and Gootwine [16] reported a much higher (0.57±0.013) phenotypic correlation between LMY and LP in Awassi sheep than found in the present study (-0.09). This indicates that the effects of environmental factors on the observations are significantly inconsistent.

It is concluded that the Awassi breed is responsive to selection in terms of milk yield. Total milk yield can be predicted from the initial records; consequently selection for this trait can be practiced during the early stage of lactation and better animals can be selected with the help of new techniques as mentioned by Karabulut and Tekin [33]. In addition, the current milk recording system can be simplified. It is recommended that the Awassi breed in Syria is further researched in order to explore its actual potential and support the experimental pilot flock.

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