Turk J Vet Anim Sci
28 (2004) 531-536

Research Article

A Comparative Study on the Milk Yield and Milk Composition of Two Different Goat Genotypes under the Climate of the Eastern Mediterranean

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Received: 25.12.2002

Abstract: Milk yields and milk compositions of 2 different goat breeds with high milk yields, the Damascus (Shami) goat and the German Fawn x Hair goat crossbred (B_1), were monitored during lactation in order to evaluate their performance under Eastern Mediterranean conditions as an alternative to the Hair goat which has a low milk yield and shorter lactation period. The milk yield was recorded by the ICAR A4 method at 28-day intervals throughout the 240 days of lactation. After weaning on the 60th day of lactation, milk samples were collected at 28-day intervals and were analysed for different milk components. The results showed that there was no significant difference between the milk yields and gross compositions of these 2 goat breeds ($P > 0.05$). The average milk yield, and total solids, protein, fat, lactose and ash contents were 347.6 ± 19.05 and 316.8 ± 35.61 l, 12.2 ± 0.16 and 12.4 ± 0.28 (%), 3.5 ± 0.07 and 3.4 ± 0.11 (%), 4.3 ± 0.12 and 4.1 ± 0.23 (%), 3.6 ± 0.08 and 4.2 ± 0.11 (%), and 0.77 ± 0.02 and 0.72 ± 0.03 (%), for the Damascus and the crossbred, respectively. It was concluded that the breeding of both the Damascus and the crossbred should be encouraged in the Mediterranean region of Turkey in order to increase goat milk production since both breeds had higher milk yields than that of the Hair goat as reported in the literature.

Key Words: Shami goat, German Fawn x Hair goat (B_1) crossbred, milk composition

Doğu Akdeniz Bölgesi İklim Koşullarında Farklı İki Keçi Genotipinin Süt Verimi ve Süt Bileşenlerinin Karşılaştırılması Üzerine Bir Araştırma

Özet: Bu çalışmada, düşük süt verimi ve kısa laktasyon süresine sahip olan Kıl keçiye alternatif olarak Damaskus (Şam) keçileri ile Alman Alaca x Kıl keçi (G_1) melezlerinin, Akdeniz şartlarındaki, laktasyon süt verimleri ve süt kompozisyonları karşılaştırılmıştır. Süt kontrolleri, 240 günlük laktasyon boyunca ICAR A4 metoduna göre 28 gün ara ile yapılmıştır. Laktasyonun 60. günündeki sütten kesimden sonra 28 gün ara ile süt örnekleri toplanmış ve süt bileşenlerinin tespiti için analiz edilmiştir. Sonuçlar iki ırkın süt verimi ve süt bileşenleri arasında istatistiksel olarak önemli farklılıklar olmadığını göstermiştir. Çalışmada, ortalama süt verimi, kuru madde, protein, yağ, laktoz ve kül içerikleri Şam keçileri ve melezler için sırası ile, 347,6 ± 19,05 ve 316,8 ± 35,61 lt, 12,2 ± 0,16 ve 12,4 ± 0,28 (%), 3,5 ± 0,07 ve 3,4 ± 0,11 (%), 4,3 ± 0,12 ve 4,1 ± 0,23 (%), 3,6 ± 0,08 ve 4,2 ± 0,11 (%), 0,77 ± 0,02 ve 0,72 ± 0,03 (%), olarak saptanmıştır. Sonuç olarak Türkiye'nin Akdeniz bölgesinde keçi sütü üretimini artırmak için hem Şam keçileri hem de melezler tavsiye edilebilir. Çünkü, çalışmada her iki ırkın süt verimleri de Kıl keçi için yapılmış olan literatür bildirişlerinden daha yüksek bulunmuştur.

Anahtar Sözcükler: Şam keçisi, Alman Alaca x Kıl keçi (G_1) melezleri, süt bileşenleri

Introduction

With its 7,022,000 goats, Turkey ranks first in Europe. In contrast to the size of the goat population, only 219,795 t of goat's milk is produced annually, which represents 2.3% of the total milk production of the country (1). The reason for the low goat's milk production is that the majority of the goat population (93.4%) is composed of indigenous Hair goats with low milk yields (70-150 kg/lactation) (2,3) and short lactation periods (154 days) (4).

Of the goat population, the most significant proportion (approximately 30%) is concentrated in the Mediterranean region (5). Some attempts have been made to improve the production of goat's milk by

crossing the indigenous breed with exotic breeds in this region (2,6). Promising results were reported on German Fawn x Hair goat crossbreds in terms of milk yield (6), but the gross composition of the goat's milk during the lactation was not given.

The introduction of Damascus (Shami) goats in place of Hair goats to the Mediterranean region of Turkey also appeared to be another promising solution in order to increase goat's milk production. These goats have a higher milk yield than that of Hair goats (7). These goats are an indigenous breed in Syria and have been imported into other Middle East countries, Cyprus and North Africa (7,8). Although Turkey has a long border with Syria, surprisingly there are only a small number of Damascus goats in Hatay province in Turkey, which is the province neighbouring Syria (9). So far, studies carried out with Damascus goats have focussed on the increase in milk yield and on improving the gross composition of the milk (7,10-13). Again, changes in the gross composition of milk from Damascus goats during lactation are scarce.

It is well known that the composition of goat's milk changes throughout lactation (14-16). Any changes in milk composition will be reflected in the nutritional, technological and economic values of goat's milk as well as of other dairy products. Therefore, the extent of these changes should be determined in order to ensure standard production of dairy products.

The present study served 2 purposes. First, the performance of German Fawn x Hair goat crossbred and Damascus goats under Mediterranean conditions was evaluated. The results are also discussed in the light of the information on Hair goats available in the literature. Second, changes in the gross composition of these goats' milk during lactation were determined.

Materials and Methods

This study was carried out with Damascus goats and German Fawn x Hair goat crossbred (3/4 German Fawn + 1/4 Hair goat) goats kept at the Research and Training Farm of the Agriculture Faculty of Mustafa Kemal University in Antakya province in Turkey. Antakya is located between 36° North latitude and 36° East longitude in the Eastern Mediterranean region and neighbours Syria where climatic conditions are hot and dry in summer, and warm and rainy in winter.

Animals were housed in semi-open sheds under semi-intensive conditions. Damascus (10 heads) and crossbred goats (8 heads) were randomly chosen from the flock of 200. All the experimental goats were 4 years old. All animals in both groups were fed 600 g/day of concentrate (16% crude protein and 2500 kcal metabolisable energy per kg dry matter) individually in milking sites and grazed on 150 ha of pasture during lactation.

Milk yield was recorded by the ICAR (International Committee for Animal Recording) A4 method at 28-day intervals during the 240 days of lactation (17). Kids were weaned at the age of 60 days. All goats were milked after weaning by an automatic milking system that can measure the milk yield automatically. Milk yields of the dams were measured using the alternate day system until weaning. In this system, goats were milked at 6 AM on the recording day. Then, kids were fed with dams' milk with the assistance of the stock person and suckled their dams until 6 AM the following day. Kids were isolated from their dams until the 6 PM milk recording. Sampling was started after weaning. Every 28 days, 200 ml milk samples were collected from the morning milk and immediately taken to the laboratory in an icebox. The samples were analysed for total solids by the gravimetric method, for fat by the Gerber method, for ash by the gravimetric method, and for titratable acidity as lactic acid using N/10 NaOH as described in Turkish Standard and for No TS1018 (18). Total protein was determined by the phenol titration method as described by James (19). By subtracting the sum of protein, fat and ash from the total solids content, the lactose content was calculated.

All data obtained were evaluated statistically using one-way ANOVA on the SPSS program (20).

Results

Data of milk yields and milk compositions for Damascus (Shami) goats and German Fawn x Hair goat crossbreds (B_1) are shown in Table.

Throughout lactation, considerable changes occurred both in milk yields and in the main components of the milk samples (Figures 1, 2 and 3).

Table. Milk yield and composition of goat's milk from Damascus and German Fawn x Hair goat breeds.

Parameter	Damascus				German Fawn x Hairgoat				
	R	X	s.e.	n	R	X	s.e.	n	Sig.
Lactation yield (l)	277.5-458.0	347.6	19.05	10	178.8–512.2	316.8	35.61	8	n.s.
Total solids (%)	11.3-12.9	12.2	0.16	10	11.4-13.6	12.4	0.28	8	n.s.
Total protein (%)	3.2-3.9	3.5	0.07	10	2.9-3.8	3.4	0.11	8	n.s
Fat (%)	3.6-4.9	4.3	0.12	10	3.1-5.0	4.1	0.23	8	n.s.
Lactose (%)	2.3-4.9	3.6	0.08	10	2.3-5.1	4.2	0.11	8	n.s.
Ash (%)	0.68-0.89	0.77	0.02	10	0.58-0.81	0.72	0.03	8	n.s.
Titratable acidity	0.14-0.21	0.17	0.007	10	0.15-0.21	0.17	0.007	8	n.s

R, range; X, mean value; s.e., standard error; n, number of animal or samples; n.s., non-significant

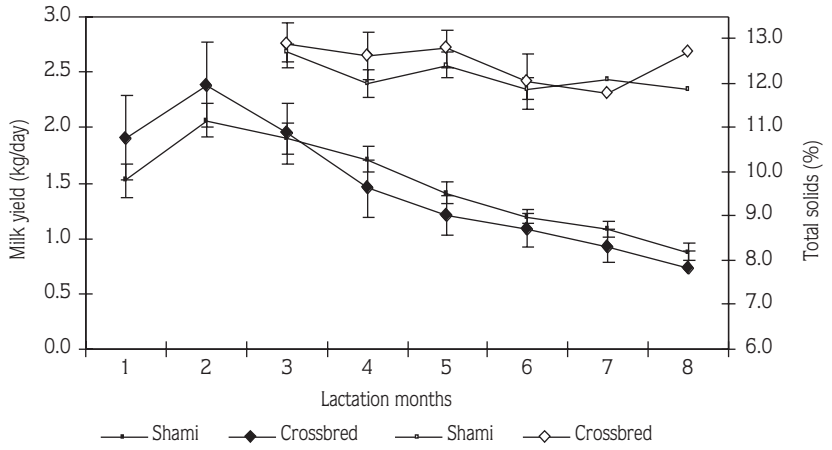

Figure 1. Changes in milk yield and total solids contents of milk samples obtained from Damascus goats (■,❑) and German Fawn x Hair goat crossbreds (●,❍) during lactation. Filled and void symbols indicate milk yield and total solids, respectively. Vertical lines show error bars.

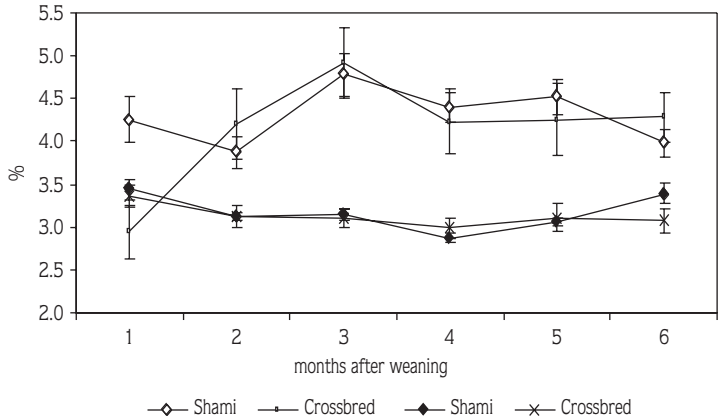

Figure 2. Changes in protein and fat contents of milk samples obtained from Damascus goats (■,❑) and German Fawn x Hair goat crossbreds (●,❍) during lactation after weaning at 60 days. Filled and void symbols indicate protein and fat contents, respectively. Vertical lines show error bars.

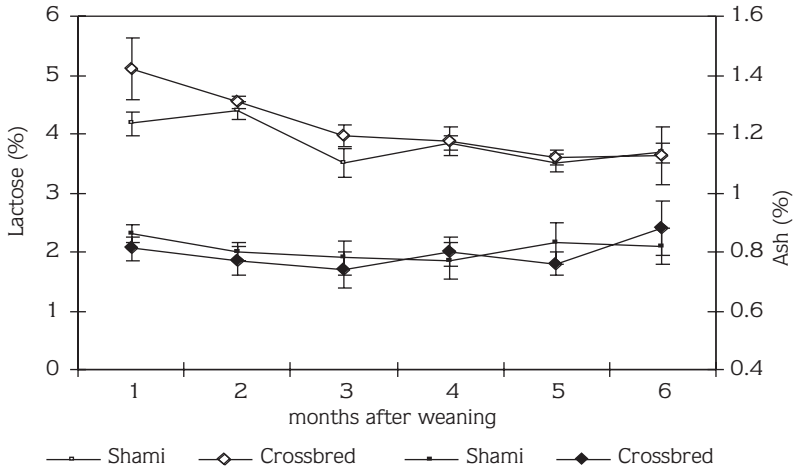

Figure 3. Changes in ash and lactose contents of milk samples obtained from Damascus goats (■,❑) and German Fawn x Hair goat crossbreds (●,❍) during lactation after weaning at 60 days. Filled and void symbols indicate ash and lactose contents, respectively. Vertical lines show error bars.

Discussion

The means of the data from the chemical analysis of milk samples and milk yield measurements for each breed are illustrated in Table, along with the statistical evaluation. In terms of milk yield, data obtained from Damascus goats were in agreement with the findings of various researchers (7,9,21), who reported milk yields of 348 kg, 351-466 kg and 317.1 kg. For German Fawn x Hair goat crossbreds, on the other hand, a lower milk yield (283.1 ± 30.0 l/lactation) than our findings was reported by Güney et al. (6). It could be claimed that such improvement is the result of selection of crossbreds during the last 10 years. The milk yields of both breeds were considerably higher than that of the Hair goat (70-150 kg/lactation) (2,3).

In terms of average gross composition, the results obtained from Damascus goats were in line with the findings of Hadjipanayiotou (12), but higher than those of Shetaewi et al. (8). Hadjipanayiotou and Koumas (13) reported a higher protein content, which could be the result of an increased protein content of the feeding concentrate. There were no data available with which to compare our findings on German Fawn x Hair goat crossbreds, but our data were within the range reported for goat's milk in the literature (15,22,23).

As shown in Table 1, no significant differences were found between the breeds regarding the average milk yields and the average gross compositions ($P > 0.05$). However, those figures were considerably lower than the findings of Konar (24) for the Hair goat (15.2% total solids, 3.9% protein, 4.1% lactose and 6.2% fat). The relation between milk yields and contents could explain the similarity between the experimental goat breeds and the differences from the Hair goat. Studies showed that there is a negative correlation between milk yield and milk components, mainly total solids, protein and fat, and that the magnitude of this relation varies depending on the breed and the number of lactations (14,25,26).

As shown in Figure 1, both breeds showed similar lactation curves with a steady decrease in average daily milk yield after peak lactation. This is a natural pattern for goats, and was also observed for Damascus goats by Louca et al. (10). It was reported that secretory cell proliferation and differentiation during pregnancy and postpartum (27) and a decrease in the number of mammary secretory cells (28) were responsible for this pattern. In contrast to our findings, Shetaewi et al. (8) observed a continuous decrease in milk yield from 3 to 12 weeks. The authors, however, carried out the experiment under arid conditions. As is clear from Figure 1, a decline in milk yields was accompanied by a decrease in total solids content up to month 7 of lactation. From that point, the decline in total solids content was followed by a steady increase towards the end of lactation, indicating that the milk contents became progressively more concentrated. Such a pattern is very common for goats and is in agreement with the findings of Boros (29).

Variations in 2 main components of goat's milk, fat and protein, are illustrated in Figure 2. Protein contents fell slightly until month 7 of lactation, and then increased over the remaining period, which could be the result of changing casein content as reported by Brown et al. (30). In contrast to protein, an increase in fat content was observed at the beginning of lactation, which tended to show a slight decrease. Similar fluctuations were also observed for Saanen goats and an indigenous Greek breed (14). The initial differences in the fat content of the milks could be attributed to breed characteristics, suggesting that changes in the gross composition of the colostrums should also be determined.

Lastly, the changes in 2 soluble components of goat's milk, lactose and ash, are presented in Figure 3. These are the major components regulating the osmotic pressure of milk. The lactose content decreased gradually during lactation while a slight increase in ash content was observed. Similarly, Antunac et al. (31) reported a decrease in lactose content and an increase in the ash content of milks for Alpine and Saanen goats. A decrease in the rate of lactose synthesis with advancing lactation is the most likely explanation for this behaviour (28).

From the overall results, it became clear that there were no major differences between the milk yields and milk compositions of Damascus goats and those of German Fawn x Hair goat crossbred goats, and both breeds had a higher milk yield than that of Hair goats as reported in the literature. Although the average gross composition of the experimental goats was lower than that of the Hair goat, the higher milk yield and longer lactation period make them superior to the Hair goat. When the topography of Hatay, which is shaped by mountains and plains, is considered both German Fawn x Hair goat crossbred and Damascus goats are good candidates since the former is recommended for mountains and the latter is recommended for plains. For these reasons, the breeding of both Damascus goats and the German Fawn x Hair goat crossbred should be encouraged in the Mediterranean region in place of the Hair goat in order to increase goat's milk production.

In addition, changes in the composition of the milk of these 2 genotypes during lactation should be taken into consideration when milk is processed into dairy products such as cheese.

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