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IMPROVEMENT OF GOAT MILK YIELD AND QUALITY IN SEMI-ARID REGION BY THE USE OF EXOTIC BREED

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SUMMARY

This study was carried out at Bourg El-Arab Experimental farm belonging to Ministry of Agriculture on 174 Barki (B), 209 Damascus (D), 168 F_1 (D X B), 10 F_2 (¾D X ¼B) and 83 (¾B X ¼D) does over ten seasons (1984-1995) to investigate the possibility of improving milk quantity and quality of Desert Barki goats.

Milk yield reached its peak at the 4th week of lactation. The D does had the highest milk yield and the B does had the lowest milk yield. F1 and F2 of the crossbred genotypes gave more milk than the indigenous goats (B) during suckling period (the first 8 weeks) and during milking period (weeks 9-25). Lactation length of B had been improved from 16 weeks to 19.96 weeks for (DXB), 20.08 weeks for (¾D X ¼B) and 18.08 weeks for (¾B X ¼D). Heritability and repeatability of milk yield during suckling period or during milking period and that of total milk yield in B goats was higher than that in D goats while heritability and repeatability of lactation length of D was higher than those of B goats.

Fat, protein, total solids percentages and energy content reached minimum level at the 4th and 5th weeks of lactation then increased till the end of lactation, but lactose and pH remained almost constant through the lactation period. B does had the highest fat and total solids percentages and D does had the lowest percentages, while among crossbreeds (¾B X ¼D) had the highest fat, total solids and energy content (MJ/ kg), followed by (DXB) and then by (¾D X ¼B). Yet the (DXB) had the highest protein percent.

Results indicate that use of D bucks realized an improvement of milk production and milk composition of B goats.

Keywords: Damascus, Barki, milk yield, milk quality, heritability, repeatability

INTRODUCTION

There are an estimated 3,570,000 heads of goats in Egypt, 10% of them are mainly Barki which raised in the western desert (Ministry of Agriculture, 1997). Barki breed as most of the subtropical breeds of goats have low kid performance, milk yield and high fertility and moderate prolificacy (Eissa, 1996).

The present study was established to study how milk yield and milk composition of Barki breed could be improved through crossing with a more developed breed (Damascus) which can stand the prevailing conditions in the desert.

MATERIALS AND METHODS

The present study was carried out at Bourg-El-Arab Experimental Farm, Ministry of Agriculture. The Farm situated in the coastal zone of the western desert. Data were collected on 174 Barki (B), 209 Damascus (D), 168 F1 (D X B), 10 F2 (¾D X ¼B) and 83 (¾B X ¼D) does over ten years (1984-1995).

Animals were kept in confinement all the year round and were fed Berseem (Trifolium alexandrinum) and straw plus supplement of concentrate mixture during the period from October -May. While from June-September were fed on Berseem hay supplemented with the same concentrate mixture according to their maintenance and milk production requirement. Water was offered twice daily. The does were mixed with fertile bucks for the first time when they were reached 1.5 years old. Mating season started in September and lasted for 45 days. During breeding season, Barki does were divited into two groups, the first was mated with Barki bucks to produce replacement and the second group was mated with Damascus bucks to produce the ½DX½B crossbreds. This cross was backcrossed with Barki to produce ¾BX¼D and was upgraded with Damascus to produce ¾DX¼B.

Dams and their progeny were weighed within 24 hours after parturition. Kids were kept with their dams until weaning at about eight weeks of age.

Milk yield was measured individually for each doe once biweekly till weaning at eight weeks of lactation using kid suckling technique (the milk consumed by kids and surplus milk was taken as average daily milk yield). After weaning, does were hand milked twice a day to estimate their milk yield till the end of lactation when daily milk yield reached 100 grams/ day.

Milk samples were chemically analyzed every week till the 16th week of lactation for fat, protein, lactose, total solids, pH and specific gravity by A.O.A.C. (1980). Energy values were calculated from the chemical composition (Eissa, 1996).

Data were analyzed using least-squares analysis with unequal subclass numbers using GLM procedure (SAS, 1995).

Statistical model describing any observation of milk production, lactation length or milk composition traits included:

$$Y_{ij} = \mu + B_i + e_{ij}$$

Where:

Y_{ij} = an observation on individual j.

μ = the overall mean

B_i = the fixed effect of the ith breed of dam,

E_{ij} = the random error assumed to be normally distributed with mean = 0 and variance = σ^2.

Eight Barki bucks and ten Damascus bucks were used to estimate heritability and repeatability. The heritability estimates were estimated after the significant effect of breed had been removed repeatability estimates were obtained by doe variance component.

RESULTS AND DISCUSSION

Milk Yield

It could be noticed that, generally milk yield of does for all groups studied reached the peak at the fourth week of lactation, then declined till the end of the lactation period. The declining rate in most of the groups was slow after the peak until the eighth week from parturition, but was more rapid afterwards (Fig. 1). Similar trend was found by Kala and Prakesh (1990), Peris *et al.* (1997) and Marzouk *et al.* (2000).

The yield peak was higher in the Damascus followed by that in the (¾D X ¼B) crossbred does (½DX½B) does, then by that in (¾B X ¼D) does, and finally by that in the Barki (B) does whose yield peak was the lowest.

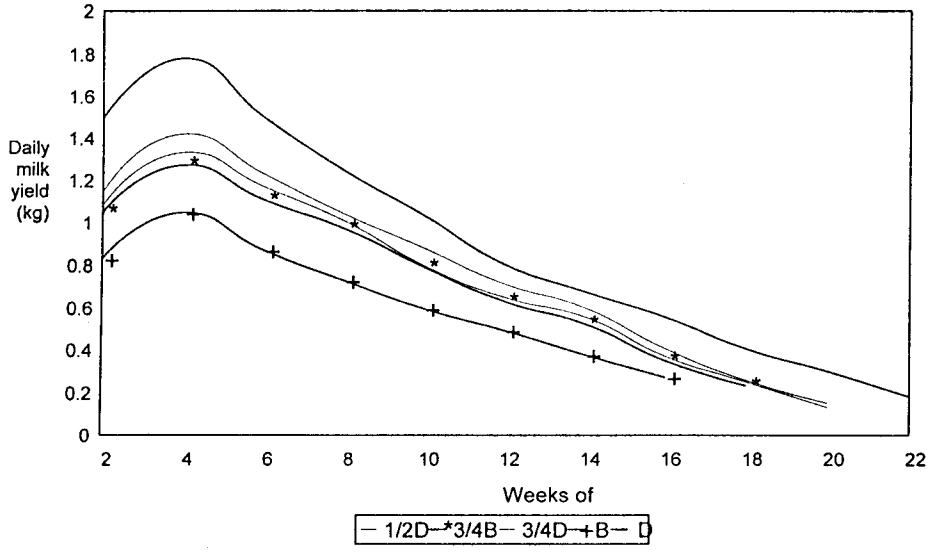

Fig. 1. Daily milk yield recorded during lactation period for different genotypes studied.

Results show that the Damascus does had the highest milk yield and the Barki does had the lowest milk yield while the crossbred does were intermediate between them in all traits studied. Among crossbreds, upgrading to Damascus (¾D X ¼B) had the highest milk yield, followed by those of the first cross (½DX½B) and then by those of (¾B X ¼D) in all stages studied (Table 1).

Table 1. Least-square means ± standard errors of milk production (kg) and lactation length (weeks) for different genotypes

Breed of dam	No	Stage of lactation		Total milk yield (kg)	Lactation length (weeks)
		0 - 8 weeks (kg)	9th week till end of lactation (kg)		
		**	**	**	**
Barki (B)	194	50.33 ± 2.78^{d}	26.02 ± 1.70^{c}	76.51 ± 4.21^{d}	16.37 ± 0.50^{d}
Damascus (D)	209	88.90 ± 9.42^{a}	56.57 ± 5.46^{a}	145.64 ± 13.56^{a}	22.78 ± 1.61^{a}
½ D. ½ B	168	65.97 ± 2.80^{bc}	43.82 ± 1.70^{b}	109.32 ± 4.22^{bc}	19.96 ± 0.50^{b}
¾ D. ¼ B	10	69.66 ± 4.78^{c}	43.89 ± 2.81^{b}	113.65 ± 6.97^{c}	20.08 ± 0.83^{b}
¾ B. ¼ D	83	65.21 ± 3.40^{b}	40.67 ± 2.04^{b}	106.75 ± 5.06^{b}	18.08 ± 0.60^{c}

Means in columns followed by the same letter are not significantly different from each other.

From the present results, it could be observed that crossbreeding Barki does with Damascus males increased milk yield above those of the indigenous breed (B) by 31% for F1 (½DX½B), 38% for F2 (¾D X ¼B) and about 30% for the backcrosses with Barki (¾B X ¼D) during the first 8 weeks of suckling period. During the subsequent milking period (marketable milk production) weeks 9 to the end of lactation, the crossbred genotypes, F1, F2 and backcrosses with Barki gave 1.7, 1.7 and 1.6 times more milk, respectively, than the indigenous goats (B).

The percentage of milk production up to weaning time amounted to 66%, 61%, 60%, 61% and 61% from total milk yield of Barki, Damascus, (½DX½B), (¾B X ¼D) and (¾D X ¼B) does, respectively.

Concerning differences observed among the purebreds studied, the present results confirm those of Haider *et al.* (1994) and Eissa (1996) who reported that the different breeds differed in their milk yield and that the more imporved breeds, such as European breeds and also the Damascus goats had higher milk yield, as compared with the other less improved breeds such as the native types of the tropics and those of Barki of the present study.

Breed of dam had highly significant effect on milk yield and lactation length (Table 1). The milk yield recorded at different stages of lactation presented that the Damascus goats (D) had significantly higher milk production than the Barki (B) and corssbred goats. There were significant differences between milk yield of (¾D X ¼B) and both of (½DX½B) and (¾B X ¼D) does in milk yield during the suckling period but the differences were not significant between (½DX½B) and (¾D X ¼B) in milk yield during milking period and in total milk yield. The differences between the purebred goats and all crossbreds in all traits were highly significant ($P < 0.01$).

Table (1) shows that the (B) goats had a shorter lactation period (16.37 weeks) than the (D) does (22.78 weeks). Nevertheless, lactation length of Barki had been improved due to crossbreeding with D breed from 16 weeks to 19.96 weeks for (½DX½B), 20.08 weeks for (¾D X ¼B) and 18.08 weeks for (¾B X ¼D). The differences in lactation length that were due to breed of dam were highly significant. Moreover, differences in lactation length between purebred and corssbred were highly significant. Lactation length for corssbred does were significantly longer ($P<0.01$) than for native goats. This result is in agreement with Eissa (1996), Donkin & Boyazoglu (2000) and Özturk (2000).

The present results concerning the significance of breed of dam on milk yield, with the crosses being superior to indigenous breeds are in close agreement with Eissa (1996), Singh and Mukherjee (1998) and Marzouk *et al.* (2000).

Chemical Composition:

Figure 2 shows that milk fat percentage reached the minimum level during the fourth week for Barki and (¾B X ¼D) crossbred does and at the fifth week of lactation period for Damascus, (½DX½B) and (¾D X ¼B) crossbred does, then increased till the end of lactation. Milk of Barki does had the highest fat percent followed, in descending order, by those of (¾B X ¼D), (½DX½B), (¾DX ¼B) and Damascus does. This may be due to their amount of milk where the Barki had the lowest milk yield and the Damascus had the highest milk yield. Wuschko and Seifert (1991) found that the higher the level of

milk production the lower is the production of total solids especially fat. Fat percentage in milk of Barki does decreased from 5.11% in the first week to 4.24% in the 8th week and then increased to 5.67% at the end of milking period. Fat percent in milk of Damascus decreased from 3.86% to 2.99%at the first and last weeks of the suckling period, respectively, then increased to 4.72% at the end of milking period while that in milk of first cross does, (¾D X ¼B) and (¾B X ¼D) does decreased from the beginning until the end of the suckling period from 4.01 to 3.4%, 3.92 to 2.97% and 4.14% to 3.56%, respectively. During milking period fat percentage increased to 5.28%, 5.10% and 5.46% in milk of (½D X ½B), (¾D X ¼B) and (¾B X ¼D), respectively.

Protein percentage in all genotypes studied had the same trend. It decreased from the first week of lactation until the fifth to the sixth week then increased till the end of lactation period with an exception in the case of (¾B X ¼D) which had a decreasing tendency in its protein content till the 7th week and then increased till the end of lactation. Protein percentage in milk of D, B, (½DX½B), (¾D X ¼B) and (¾B X ¼D) does decreased during the suckling period from 3.17% to 2.18%, from 3.52% to 2.79%, from 3.74% to 3.17%, from 2.76% to 2.23% and from 3.18 to 2.44%, respectively. During the milking period protein percentages increased to 3.92% in milk of Damascus does to 3.83% in milk of Barki, to 3.96% in milk of (½DX½B), to 3.83% in milk of (¾D X ¼B) and to 3.98% in milk of (¾B X ¼D) does, respectively.

Total solid percentage exerted negative trend with milk yield, being the minimum during the fourth week of lactation in Barki and (¾B X ¼D) crossbred does while at fifth week in Damascus, (½DX½B) and (¾D X ¼B) does, then increased till the end of lactation. It seemed that when milk yield reached the peak, the total solids percentage had the lowest value. Total solids percentage in milk of Damascus, Barki, (½DX½B), (¾D X ¼B) and (¾B X ¼D) does decreased during the suckling period from 12.76%, 14.53%, 13.20%, 12.00% and 13.21% respectively, in the first week to 11.80%, 12.5%, 11.88%, 11.75% and 11.98% respectively, in 8th week, then increased to 14.45, 14.65, 14.20%, 14.1% and 14.32%, respectively during the milking period. pH and Lactose percentages had the same trend in the all genotypes studied, variation from week to week was lower.

Milk energy was high in the first week of lactation for all genotypes, then it declined till the fourth week for Barki and (¾B X ¼D), but till the fifth week for Damascus, (½DX½B) and (¾D X ¼B) does, then increased till the end of lactation. It is interesting to notice that the caloric value of milk followed nearly the same trend observed for total solids as both decreased to reach their least values during the 3rd to the 7th weeks of lactation and increasing gradually thereafter.

Table (2) shows that Barki (B) does had the highest fat and total solids percentages, whereas Damascus (D) does had the lowest percentages. The crossbred does were intermediate. The results concerning the crossbred does show that the backcross to Barki had the highest fat, total solids percentages and energy (Mj/Kg) followed by those of the first cross (½DX½B) and then by those of backcross to Damascus. The milk of Barki was of higher protein percent than that of Damascus does while the first crossbred (DXB) had the highest protein percent than all purebred and crossbred. Differences in milk lactose and pH due to different genotypes were insignificant.

Breed of dam had a significant effect on fat and energy values in milk ($P < 0.05$) during lactation period. There were significant differences between Barki and Damascus, and also between Damascus and (¾B X ¼D) does, but no significant differences between Barki, or Damascus and each of (½DX½B) and (¾D X ¼B) and also between Barki and (¾B X ¼D) does were found. The differences between all genotypes in total solids, protein, lactose and pH were insignificant. In general the breed of dam had a significant effect on fat and energy ($P < 0.05$) of milk while had no significant influence on other traits.

Table 2. Least-square means ± standard errors for fat, protein, total solids, lactose, pH and energy content in milk of different genotypes studied

Item	No.	Fat %	Protein %	Total solid %	Lactose %	pH	Energy Mj/kg
Barki (B)	10	4.57±.23^{b}	3.09±.27^{a}	13.05±.27^{b}	4.08 ± .02^{a}	6.62±.01^{a}	3.06±.09^{a}
Damascus (D)	10	3.43±.29^{a}	2.89±.34^{b}	12.31±.34^{a}	4.07 ± .02^{a}	6.61±.02^{a}	2.68±.10^{b}
½ D . ½ B	10	3.96±.22^{ab}	3.36±.25^{a}	12.85±.25^{ab}	4.09 ± .02^{a}	6.61±.01^{a}	2.91±.10^{ab}
¾ D . ¼ B	5	3.79±.24^{ab}	2.58±.28^{b}	12.78±.28^{ab}	4.07 ± .02^{a}	6.62±.01^{a}	2.87±.09^{ab}
¾ B . ¼ D	10	4.24±.35^{b}	3.18±.41^{ab}	12.88±.41^{b}	4.06 ± .03^{a}	6.62±.02^{a}	2.98±.15^{ab}

a, b, in the same column means with same letter are not significantly different

These results are in agreement with those of Wuschko & Seifert (1991), Eissa (1996) and Marzouk *et al.* (2000). They concluded that there was a negative correlation between milk yield and fat

percentage. The results obtained for milk components in the present work are similar to those reported for Alpine breed by Voutsinas *et al.* (1990) and Marzouk *et al.*, (2000).

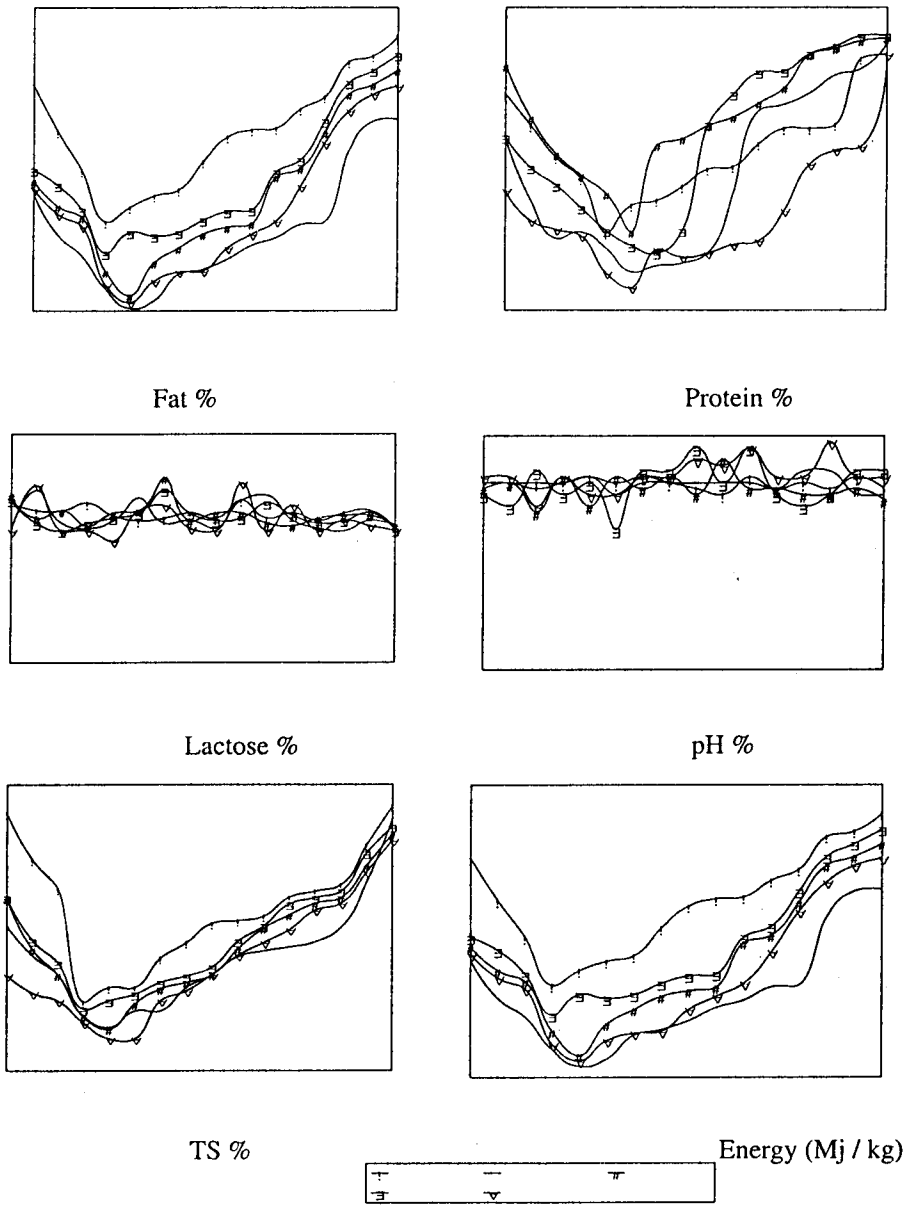

Fig. 2. Milk composition of different genotypes of does

Heritability and Repeatability

Table 3 illustrated that Barki breed had higher heritability and repeatabiliy estimates than Damascus breed for all traits studied except for lactation length. The heritability of milk yield at (2-8 weeks) was higher in Barki (0.22) than that in Damascus goats (0.18), yet the repeatability of milk yield was higher in Barki than in Damascus goats by about 43%. At milking period which represented the surplus milk, heritability estimates of milk yield were 0.33 and 0.25, while repeatability estimates were 0.38 and 0.30, for Barki and Damascus, respectively. The heritability of total milk yield is higher in Barki than in Damascus goats by about 3%. The repeatability of total milk yield averaged 0.46 and 0.32 in Barki and Damascus goats, respectively.

Table 3. Heritabilities and repeatabilities ± standard errors for milk yield at different stages of lactation, total milk yield and lactation length for Barki and Damascucs goats

Trait	Breed	h2 ± S.E	r ± S.E
Milk yield at (2 - 8 week)	Barki	0.22 ± 0.011	0.30 ± 0.013
	Damascus	0.18 ± 0.006	0.21 ± 0.009
Milk yield at milking period	Barki	0.33 ± 0.014	0.38 ± 0.016
	Damascus	0.25 ± 0.009	0.30 ± 0.012
Total milk yield	Barki	0.32 ± 0.013	0.46 ± 0.019
	Damascus	0.29 ± 0.011	0.32 ± 0.013
Lactation length	Barki	0.20 ± 0.009	0.22 ± 0.011
	Damascus	0.25 ± 0.011	0.28 ± 0.012

From the same table, it could be noticed that the heritability of lactation length was higher in Damascus than in Barki goats by about 5%. The same trend was also found in the repeatability estimate of lactation length, which was higher in Damascus than in Barki by about 6%.

These results are in agreement with the estimates of Eissa (1996), Goncalves and Wechsler (2000), Queiroz *et al.* (2000) and Ribeiro *et al.* (2000).

It could be concluded that the introduction of Damascus genes into Barki goats had a positive effect in improving yield and chemical composition of milk.

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