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The effect of milking frequency on the milk production of *Chios* ewes and *Damascus* goats

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Summary

Omission of one daily milking caused a significant reduction (21.6 p. 100) in the milk production of *Chios* ewes during the first phase (56 to 146 days post-partum) of a two-phase trial. The reduction was more marked in low yielding ewes. During the second phase of the trial (from day 147 post-partum till the end of lactation) half of the ewes milked twice daily were switched to one daily milking. The total reduction in the milk yield (phases I + II) of ewes milked once daily throughout the trial was about 28 p. 100, and that of ewes switched from two to one daily milking was only 13.3 p. 100, compared to those milked twice daily throughout the total experimental period. Lactation length was very little ($p > 0.05$) affected by milking frequency. Only low yielding ewes milked once daily had a significantly shorter lactation.

The milk production of *Damascus* goats during mid or late lactation was not seriously ($p > 0.05$) affected by the omission of one daily milking; goats milked once produced about 7.0 p. 100 less milk compared to goats milked twice daily. Milking frequency had no significant effect on milk fat percentage.

Introduction

Chios sheep and *Damascus* goats in Cyprus, like most small ruminants in the Mediterranean area, are exploited as dual purpose animals. Milk and meat contribute equally to the farmer's gross income. Milking is, however, very laborious and time consuming and requires a constant availability of labour during the lactation period.

Some of the ways to combating the ever increasing labour cost have been reduction in daily milkings, suppression of one or more milkings per week, application of machine milking and different intervals between morning and afternoon milkings. Omission of one daily milking caused, in most cases, a significant reduction in the total milk production of sheep (MORAG, 1968 ; BATTAGLINI *et al.*, 1979) and dairy breeds of sheep (CASU, BENYOUCEF & FLAMANT, 1978 ; CASU, BOYAZOGLU & RUDA, 1978) and goats (MOCQUOT & AURAN, 1974 ; MOCQUOT & GUILLIMIN, 1976 ; MOCQUOT, 1978). On the other hand, it was reported that *Sardinian* ewes were only slightly influenced by reduction in daily milkings (CASU & LABUSSIERE, 1972 ; ENNE *et al.*, 1972).

Furthermore, the omission of one or more milkings per week resulted in a substantial loss in the milk production of *Sardinian* (CASU & LABUSSIERE, 1972) and *Prealpes du Sud* ewes (LABUSSIERE, COMBAUD & PETREQUIN, 1974). The purpose of the present work was to study the effects of frequency of daily milkings on milk production and composition in *Chios* sheep and *Damascus* goats.

Material and methods

Sheep

Ninety six multiparous *Chios* ewes (2nd, 3rd and 4th lactation) that lambed within a month's period (September 23 to October 24, 1978) were used from day 56 *post-partum* till the end of lactation. All ewes were weaned at 49 ± 3 days *post-partum* and their individual milk yields were recorded within 7 days from weaning. The ewes were distributed into high and low level of production based on individual milk yields (Table 1). The allocation of treatments (one or two milkings daily) to individual ewes was at random within level of production, such that three groups were formed. The experiment was divided into two phases. Phase I lasted 90 days during which two groups of ewes were milked twice daily and the other group once daily. During the second phase of the experiment, which followed phase I and lasted on average 89 days (range 59 to 104), one of the groups milked twice daily in phase I, was milked only once daily. All lactations were terminated when individual milk yields dropped below 0.2 kg.

TABLE 1

Distribution and initial daily milk production of ewes in the experimental groups during phase I and phase II of the trial.

Distribution et production initiale de lait des brebis pendant la 1re et la 2e phase de l'expérience.

Group	Level of production	Milking frequency		No. of observ.	Initial daily milk yield (kg)	SE
		Phase I	Phase II			
I	High	Twice	Twice	16	1.91	0.28
	Low	Twice	Twice	16	1.24	0.25
II	High	Twice	Once	17	1.90	0.27
	Low	Twice	Once	15	1.22	0.31
III	High	Once	Once	16	1.90	0.21
	Low	Once	Once	16	1.28	0.29

The distribution of ewes according to level of milk production had a twofold objective. The first one was to study whether milking frequency had a differential effect on high or low yielding ewes. Furthermore, it provided the basis for a more rational feeding according to requirements for maintenance and production.

The ewes were housed in two open-yard pens (high or low yielding ewes) and were fed a concentrate feed composed of crashed barley (65 p. 100), sorghum (20 p. 100), soyabean meal (12.5 p. 100) and a vitamin-mineral mixture (2.5 p. 100). In addition, all ewes were offered barley hay or barley straw depending on whether they grazed or not. It was calculated that the ewes were offered 50 g crude protein (CP) and 1.9 Mcal metabolisable energy (ME) to meet maintenance requirements and 90 g CP and 1.8 Mcal ME for each kg of milk produced.

All ewes were hand milked. Those milked twice were milked at 7.00 am and 3.00 pm and those milked once, only in the morning. Milk yield was recorded at 14-day intervals and feeding level was adjusted accordingly.

The individual live weight of all ewes was recorded at the beginning and at monthly intervals thereafter to control and evaluate the feeding level.

The data were analysed using standard statistical methods (STEEL & TORRIE, 1960) and treatment means were tested using Duncan's multiple range test.

Goats

Two trials were carried out using multiparous *Damascus* goats (2nd to 6th lactation). The first trial utilized data on 58 goats at the declining stage of lactation (approximately 186 days *post-partum*) and lasted 56 days. The mean lactation length of these goats was 260 days. The goats were paired according to individual milk production (Table 5) and were randomly assigned to one of two experimental treatments (one or two milkings daily). The interval between morning and afternoon milking was 8 hours. The goats were housed together in an open-yard shed regardless of treatment. They were fed on concentrates and barley hay according to the level of initial milk production throughout the trial. The composition of the concentrate mixture provided 160 g of CP and 2.75 Mcal ME per kg feed. All goats were hand milked and their yield was individually recorded daily during the first 35 days and twice weekly thereafter until the end of the trial. Milk fat percentage was determined only once at the middle of the experimental period.

Forty six goats were used in the second trial, which lasted 42 days. The goats were approximately 102 days *post-partum*. The mean lactation length of these goats was 242 days. They were paired according to individual milk production and live weight (Table 5) and were randomly allocated to either once or twice daily milking. The same procedure for housing, feeding and milking was followed as in the first trial. Milk production was individually recorded at 5-day intervals throughout the trial and fat percentage was determined at every second recording.

Analyses were carried out using standard statistical methods (STEEL & TORRIE, 1960).

Results and discussion

Sheep

Mean squares and tests of significance for 90-day milk production of ewes during phase I are given in Tables 2 and 3. Omission of one of the daily milkings significantly reduced milk production by 21.6 p. 100 during the first phase of the trial. Similar findings have been reported by CASU, BOYAZOGLU & RUDA (1979) and BATTAGLINI *et al.* (1979), in *Sardinian* and *Wurttemberg* sheep, respectively. A loss of about 20 p. 100 was also observed by MORAG (1968) between udder halves of a mutton breed of sheep milked once or twice daily. Unlike these findings, ENNE *et al.* (1972) and CASU & LABUSSIERE (1972) reported similar yields in *Sardinian* sheep milked once or twice daily. The difference of 21.3 p. 100 in milk production between high and low yielding ewes was mostly due to low yielding ewes milked once daily. The milk production of ewes milked twice daily, whether of low or high level of initial production, was not significantly different. In addition, high yielding ewes were very little affected by the frequency of milking.

TABLE 2

Mean squares and tests of significance for ewe milk production.

Moyennes des carrés et tests de signification statistique pour la production laitière des brebis.

Source	Phase I		Phase II		Phase I + II	
	df	MS	df	MS	df	MS
Level of production (L) ...	1	6 226.2**	1	3 699.0*	1	24 618.2**
Milking frequency (M)	1	7 763.5**	2	3 922.5*	2	11 027.5*
L × M	1	522.8	2	2 233.3	2	2 758.1
Error	92	516.2	90	893.8	90	2 569.0

* Significant at $p < 0.05$.
** Significant at $p < 0.01$.

No statistical differences in ewe liveweight gain were found during this phase of the trial (Table 3). The range was 1.9 kg per ewe for the total 90-day period. Most ewes maintained their initial liveweight, although those of low production milked once or twice daily gained slightly more live weight.

The performance of ewes during the second phase of the trial is shown in Table 4. As stated earlier, liveweight control was used to check the adequacy of the rations offered in satisfying maintenance and production requirements. Live weight gain was similar for all treatments. No statistical differences were found among any of the treatments.

TABLE 3

Milk production and liveweight changes of ewes during phase I of the trial.
Production laitière et changement de poids des brebis pendant la première phase de l'expérience.

Main effect	Subclass	No. of observ.	90 day milk yield (kg)	Initial weight (kg)	Weight gain (kg)
Level of production	High (H)	49	83.1 a	57.3	1.4
	Low (L)	47	65.4 b	55.5	2.2
Milking frequency	Once (O)	32	62.9 a	55.3	2.7
	Twice (T)	64	80.2 b	57.0	1.2
Level × frequency	H — O	16	74.9 a	55.4	1.5
	H — T	33	87.0 a	58.2	0.9
	L — O	16	50.8 b	55.2	2.8
	L — T	31	72.9 a	55.7	2.5

Means within columns and main effects followed by different letters are significantly different (see Table 2 for level of significance).

The milk production of high yielding ewes continued to be higher compared to that of low yielding ewes. Switching from two to one daily milking caused a significant reduction in milk yield. The total reduction in milk yield (phases I + II) of ewes milked once daily throughout the trial was approximately 28.0 p. 100 and in those milked once only during the second phase of the trial it was only 13.3 p. 100 compared to ewes milked twice daily throughout the trial. The reduction in the milk yield of ewes switched to one daily milking during phase II was mostly attributable to the low yielding ewes, whereas low yielding ewes, milked twice daily produced a similar quantity of milk with those of the high yielding groups irrespective of frequency of milking.

Lactation length remained almost unaffected with the exception of low yielding ewes milked once daily throughout the trial. One daily milking in this case probably acted in a manner similar to drying off those animals.

Goats

The milk production of *Damascus* goats was not seriously ($p > 0.05$) affected by the omission of one daily milking during the declining stage of lactation (Table 5). The lactation peak of *Damascus* goats was located between 5 to 6 weeks *post-partum* (LOUCA, MAVROGENIS & LAWLOR, 1975) and a steady decline was observed thereafter until the end of lactation. In trial I, goats milked once daily produced 6.3 p. 100 less milk, with similar fat content, than goats milked twice daily ; this difference, however, was not statistically significant. The reduction in the milk yield of goats

TABLE 4

Average milk production and lactation length of ewes during phase II of the trial.

Production laitière et durée de lactation des brebis pendant la seconde phase de l'expérience.

Main effect	Subclass	No. of observ.	Milk yield in phase II (kg)	Days in milk (phase II)	Total yield Phase I + Phase II (kg)	Weight gain (kg)
Level of production	High (H)	49	52.6 a	95.8	135.7 a	3.6
	Low (L)	47	36.7 b	81.8	102.1 b	3.0
Milking frequency	Once-once (O)	32	36.4 b	81.2	99.3 b	3.4
	Twice-once (TO)	32	39.3 b	84.0	119.7 ab	3.0
	Twice-twice (T)	32	58.0 a	101.6	138.0 a	3.5
Level × frequency	H — O	16	52.5 a	103.3 a	127.4 a	4.5
	H — TO	17	43.7 ab	80.6 ab	131.5 a	2.7
	H — T	16	60.7 a	104.3 a	146.9 a	3.6
	L — O	16	20.3 c	59.0 b	71.1 c	2.3
	L — TO	15	34.3 bc	87.8 a	106.1 bc	3.4
	L — T	16	55.3 a	98.9 a	129.1 ab	3.3

Means within columns and main effects followed by different letters are significantly different.

TABLE 5

Milk production, fat percentage and liveweight of Damascus *goats milked once or twice daily (trials 1 and 2).*

Production laitière, pourcentage de matière grasse et poids vif des chèvres Damascus *traites une ou deux fois par jour.*

Trial and duration (days post-partum)	Milking frequency	No. of observ.	Initial milk yield (kg)	Total milk yield (kg)	SE	Fat (%)	SE	Live weight (kg)
1	Once daily	29	1.32	56.14	4.05	4.39	0.16	—
186-242	Twice daily	29	1.33	59.91	4.29	4.11	0.15	—
2	Once daily	23	2.00	77.54	5.37	3.17	0.16	60.5
102-144	Twice daily	23	1.95	83.76	5.82	3.24	0.11	60.4

milked once a day was about 7.4 p. 100 in trial 2 (difference non significant). MOCQUOT & GUILLIMIN (1976) reported a 20 p. 100 loss in the milk yield of goats milked once daily after the second month of lactation. MOCQUOT & AURAN (1974) found that one or two daily milkings had no effect on the fat content of goat milk. Furthermore, there were no health problems or incidence of mastitis with either treatment in the present study.

The mean daily milk production of goats in trial 2 remained almost constant throughout the 42-day experimental period, irrespective of the frequency of milking. In trial 1, there was a steady drop in milk yield, which was again almost similar for both treatments. The simple correlation coefficients between initial daily milk yield and total milk yield were 0.96 and 0.95 for trial 1, and 0.89 and 0.94 for trial 2, for goats milked once and twice daily, respectively. It is, therefore, evident that the rate of decline in the milk production of goats milked once or twice daily for a short period, is almost similar regardless of the level of production within a given lactation curve.

A single daily milking generally caused a reduction in the milk production of different sheep breeds. However, variable milk production responses to a single daily milking, both among and within sheep breeds (e.g. *Sardinian*) have been reported. The contradictory results may *to some extent* be attributed to differences in the morphological characteristics of the udder and the volume of cisterns. CLAESSON *et al.* (1959) showed that in dairy cattle there is considerable within-breed genetic variation in the response to one daily milking. Similar findings were reported by MOCQUOT (1978) in goats. The results of this study suggest that in *Chios* sheep the effect of one daily milking on the total ewe milk production depends on the level of ewe productivity, since high yielding ewes are much less affected

compared to low yielding ewes. The milk production of *Damascus* goats was not significantly reduced by the omission of one daily milking during mid or late lactation, when milked for a relatively short period of time.

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Résumé

Effet de la fréquence de traite sur la production laitière chez la brebis de Chios *et la chèvre de* Damascus

Chez la brebis de *Chios,* durant la première période (56 à 146 jours *post-partum*) d'une expérience, l'omission d'une traite par jour avait comme résultat une réduction significative (21,6 p. 100) de la production de lait. Cette réduction était plus importante pour les brebis faibles productrices (tableau 3). Durant le deuxième stade de l'expérience (du 150e jour *post-partum* à la fin de la lactation) la moitié des brebis traites deux fois par jour ont été mises à une seule traite par jour. La réduction totale de la production de lait des brebis traites une seule fois par jour pendant toute la durée de l'expérience (stades I + II) est d'environ 28 p. 100. Chez les brebis mises à une traite, la réduction est seulement de 13,3 p. 100, comparée à la production des brebis traites deux fois par jour pendant la durée totale de l'expérience (tableau 4). La fréquence des traites n'a que peu d'effet sur la durée de la lactation. Seules les brebis traites une fois par jour, durant toute l'expérience, ont une période de lactation plus courte.

La production de lait des chèvres *Damascus* n'est pas sérieusement affectée par l'omission d'une traite par jour. Leur production n'est que de 7 p. 100 plus basse que celle des chèvres traites deux fois par jour (tableau 5). La fréquence des traites n'a presque aucun effet sur le taux butyreux.

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