Shearing effect on milk yield and milk composition in Bulgarian dairy sheep

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SUMMARY

Shearing effect on milk yield and milk composition was studied in Awassi type of Bulgarian dairy sheep synthetic population. Ten ewes, at their fourth month of lactation, were grazed on a natural pasture and were shorn in June. Milk yield from each ewe was recorded in the morning and in the afternoon milking. Milk samples for chemical analysis were taken on the day prior to, and on 2nd, 5th and 10th day after shearing. Shearing influenced the rate of decline of daily milk yield. Changes in protein and total solids concentrations, even in the same direction, were lower than in fat content. Daily output of milk fat exceeded the pre shearing value on the 2nd day after shearing. Protein and total solids yields in all samples were lower compared with the corresponding pre-shearing values reflecting the decline in daily milk yield. Hormonal and metabolic modifications related to adaptive adjustments seem to underlie the changes in milk yield and milk composition.

Keywords: sheep, shearing, milk yield, milk composition

INTRODUCTION

In many Eastern European countries sheep of different breeds are triple purpose animals. The first part of lactation is used to rear lambs and in the remaining part sheep are used for milk production. Traditional sheep production systems in Bulgaria usually involved late spring shearing just when the climatic conditions are quite variable. An unshorn sheep is well protected from deviations in the thermal environment and is able to maintain homeothermy without substantial metabolic efforts. However, a shorn ewe, particularly the newly shorn one, is vulnerable to environmental extremes and various adaptive responses need to be driven to readjust the deviations of the thermal equilibrium. These hormonal and metabolic responses to shearing may negatively influence sheep welfare and production efficiency (Young et

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al., 1987). In lactating sheep post-shearing adaptive adjustments may affect daily milk yield (MY) and milk composition (Benchini and Pulina, 1997). Removing of the external insulation exerts its effect on production by both changes in metabolic activity and alteration of the capacity for nutrient partitioning.

The objectives of the present study were to assess the effect of shearing on daily MY and milk composition in Awassi type of the Bulgarian dairy sheep synthetic population.

MATERIAL AND METHODS

Ten ewes at similar age (third parity) and at their fourth month of lactation were randomly selected from a flock and were shorn at mid-June. Sheep grazed on a natural pasture consisting of a mixture of grasses, legumes and herbs where perennial ryegrass (*Lolium perenne*) and Bermuda grass (*Cynodon dactylon*) tended to dominate. The study was carried out on a sheep farm in northern Bulgaria. Commercial feed (14.2 % crude protein and 6.3 % crude fiber) was administered (700 g/head) in two meals. Salt was freely available in the yard where the sheep was confined during the night. Sheep used tap water during the night, and had a free access to the natural water recourses during the day. After the morning hand milking ewes were moved to the pasture and grazed throughout the day with the exception of a short period when they were moved for the afternoon milking. The sheep spent the hottest noon hours under the trees scattered under the trees that ensured protection against direct solar radiation Milk yield from each sheep was recorded in the morning (7 am) and in the afternoon (5 pm) milking for a week before and for ten days after shearing. Daily (24-h) milk yield were obtained by summing the morning and the evening yields.

Milk samples for composition were taken from the milk obtained in the morning and in the afternoon milking on the day before, and on 2^{nd}, 5^{th} and 10^{th} day after fleece removal. The samples were analyzed for fat and protein content using a Milko Scan (model 133, manufactured by A/S N, Foss Electric and Berwyn Instruments) calibrated for sheep milk. Mean daily output of milk constituents was also calculated on the base of individual MY on the corresponding sampling days. Air temperature during the observation period was also recorded using minimum and maximum thermometers.

The results are presented as mean and standard error of the mean. Shearing effect on daily yield was assessed in sheep with different level of production. Regressions of daily MY on days in lactation were determined separately in high and low yielding sheep Differences in daily milk yield, concentration and daily output of milk constituents were assessed by a

Student's *t* test using the mean value for each trait (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Environmental conditions corresponding to the productivity may vary greatly with time. During the pre-shearing period minimum and maximum temperatures were, on average, 16.2 ± 0.9 °C and 29.1 ± 1.5 °C, whereas after the fleece removal these values were 19.6 ± 1.7 °C and 31.4 ± 2.9 °C, respectively. During the entire experimental period the recorded values exceeded the lower critical temperature (18 °C) for a shorn sheep (Yousef, 1985).

Daily milk yield at the beginning of the study varied from 1050 g to 1390 g (1156 ± 42) reflecting individual differences in the capacity for nutrient partitioning. On shearing day the afternoon MY dropped significantly (P < 0.05) but the reduction was short term and the yield approached the pre-shearing level by the next afternoon milking (Fig. 1). These brief oscillations reflected the dominant influence of the psychic stress on milk secretion rate during the immediate post-shearing period.

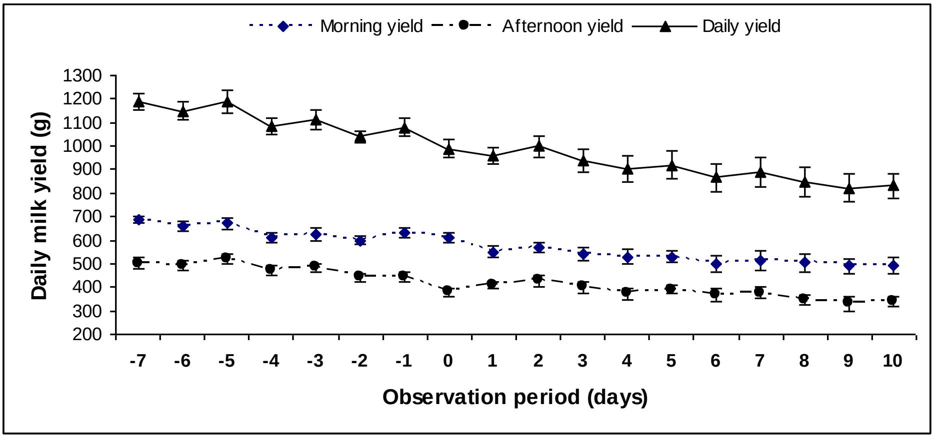

Fig 1 Milk yield dynamic during the observation period. Each point represents the mean value from 10 ewes. Vertical bars represent SEM. Day 0 – shearing day.

Mean daily MY exhibited a reduction with the advancing of lactation. The rate of decline of daily yield during pre- and post-shearing period constituted 23.3 g/day and 17.6 g/day (P < 0.01), respectively. This positive effect of shearing on performance may be due to adaptive metabolic modifications and changes in nutrient partitioning

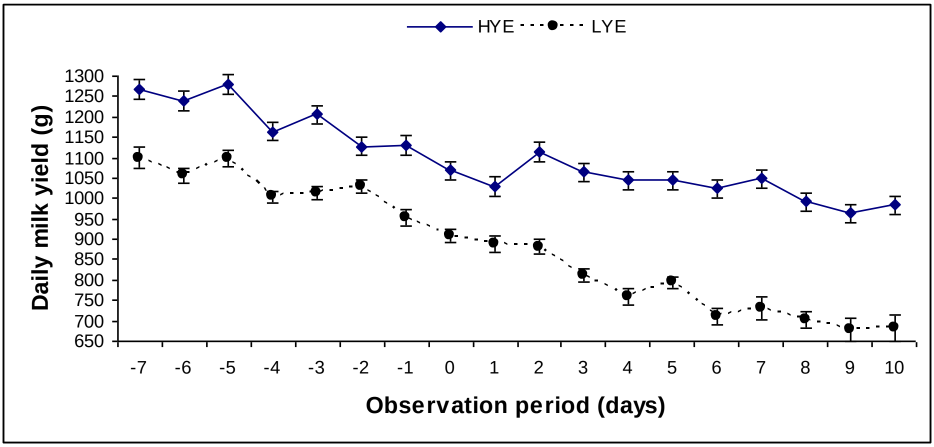

Fig 2 Changes in daily milk yield in high (HYE) and low (LYE) yielding ewes. Each point represents the mean from 5 ewes. Vertical bars represent SEM. Day 0 - shearing day.

A noteworthy point was the effect of shearing on daily MY in sheep with different level of production (Fig. 2). During the pre- and post-shearing period the rate of decline of daily MY in high yielding ewes constituted 25.4 and 11 g/day, whilst in low yielding animals these values were 21.7 and 24 g/day, respectively. The data suggested that shearing increase the capacity for nutrient partitioning in high yielding ewes slowing off the rate of decline of daily MY. The results support the notion that differences in homeorhetic capacity represents the most important mechanism underlying individual differences in productivity.

The main milk composition response to shearing was the increase of fat concentration. Milk fat content in the morning and in the afternoon milk increased steadily and the differences between pre- and post-shearing values were significant or approached significance (Table 1). Changes in the protein and total solids concentrations, in spite of being in the same direction, were smaller than the elevation in fat content. Milk constituents are synthesized by different intracellular routes within the mammary epithelial cells and, unlike daily MY, milk composition is highly resistant to meteorological influences (Finocchario et al 2005; Peana et al, 2007) and nutritional manipulations (Purdie et al. 2007). A possible post shearing change in grass intake would not be expected to be large enough to affect considerably blood metabolite concentrations and/or synthesis of different milk constituents. Our studies in Tsigai ewes kept indoor (Aleksiev, 2011) showed that shearing in April brought about an essential elevation in the concentration of all milk constituents without increasing feed intake. This suggests that the development of hormonal and metabolic modifications rather than changes in feed intake underlie the post shearing shifts in milk composition. Our results were in accordance with the findings of Rassu et al (2007) in lactating Sarda sheep shorn at the beginning of June, as well as with the results of Knight et al (1993) who reported a positive effect of shearing on milk constituent concentrations in Dorset sheep. Moreover, the increase of fat, protein and total solids content has been observed regardless of the time of shearing and/or stage of lactation.

Table 1. Milk yield, milk composition (%) and daily output (g) of different milk constituents in the morning and in the afternoon milk and total for the sampling days. Data represents the mean and standard error of the mean from 10 ewes

Traits	Before shearing	Days after shearing		
		2	5	10
Morning milk yield (g)	633	570	528	493
Fat (%)	6.07 ± 0.22	6.70 ± 0.18 ns	6.95 ± 0,15 **	7.26 ± 0.21 **
Protein (%)	5.35 ± 0.12	5.27 ± 0.12 ns	5.49 ± 0.08 ns	5.53 ± 0.13 ns
Total solids (%)	16.79 ± 0.26	17.24 ± 0.23 ns	17.75 ± 0.22 ns	18.04 ± 0.33 *
Fat output (g)	38.42 ± 2.1	38.19 ± 2.0 ns	36.70 ± 3.4 ns	35.79 ± 4.1 ns
Protein output (g)	33.87 ± 1,7	30.04 ± 2.1 ns	28.99 ± 2.3 ns	27.26 ± 2.9 ns
Total solids output (g)	106.28 ± 5.7	98.27 ± 4.6 ns	93.72 ± 5.1 ns	88.94 ± 6.0 ns
Afternoon milk yield (g)	446	428	391	340
Fat (%)	6.51 ± 0.12	6.94 ± 0.19 ns	7.46 ± 0.16 ***	8.07 ± 0.28 ***
Protein (%)	5.23 ± 0.16	5.26 ± 0.11 ns	5.56 ± 0.14 *	5.65 ± 0.09 **
Total solids (%)	17.15 ± 0.21	17.41 ± 0.14 ns	18,32 ± 0.27 *	19.03 ± 0.39 **
Fat output (g)	29.03 ± 1.7	29.70 ± 2.2 ns	29.17 ± 2.6 ns	27.44 ± 2.4 ns
Protein output (g)	23.33 ± 1.6	22.51 ± 1.2 ns	21.74 ± 2.1 ns	19.21 ± 1.5 ns
Total solids output (g)	76.49 ± 4.1	74.52 ± 3.2 ns	71.63 ± 3.6 ns	64.70 ± 4.5 ns
Daily milk yield	1079	998	919	833
Fat output (g)	67.45 ± 3.0	67.89. ± 4.29 ns	65.87 ± 4.7 ns	63.23 ± 5.3 ns
Protein output (g)	57.20 ± 3,5	52.55 ± 3.88 ns	50.73 ± 4.1 ns	46.47 ± 4.3 ns
Total solids output (g)	182.77 ± 7.1	172.79 ± 6.8 ns	165.35 ± 7.3 ns	153.64 ± 7.5 ns

Means of different periods (days), in the same row, on 2nd 5th and 10th day after shearing differ from the pre-shearing values as follows: N.S. not significant ($P > 0.05$); $*P < 0.05$ $**P < 0.01$ $***P < 0.001$. Differences between post-shearing periods were not tested.

Daily output of milk constituents is a good index related to milk processing characteristics. Daily output of milk fat exceeded slightly the corresponding pre-shearing value on the first sampling day, whilst yield of milk protein exhibited a reduction (Table 1). Post shearing increase of fat, protein and total solids concentrations was insufficient to compensate the decline of daily MY (Fig. 1) that resulted in a decrease of their daily output. The data did not agree with changes in milk content found in Tsigai ewes shorn in April, when daily output of fat, protein and total solids exceeded the pre-shearing values of the traits up to the 14th day after fleece removal (Aleksiev, 2011). Long term, post-shearing increase in milk fat content was reported (McBride and Christopherson, 1984) in Suffolk ewes, exposed to 0 °C, compared to control sheep kept at thermoneutrality (21 °C), despite the greater heat loss and net energy deficit in the cold exposed sheep. Therefore, different effects of shearing on MY and milk composition found in different studies and breeds of sheep could be primarily related to the extent to which different adaptive mechanisms has been driven.

In a newly shorn sheep, even in the zone of thermoneutrality, peripheral receptors are suddenly exposed to the diurnal fluctuations of the meteorological variables which may cause a number of homeostatic displacements. Sympathetic stimulation via changes in the hormonal profile increases mobilization of body stores and plasma concentration of precursors for milk synthesis. This, however, may not be the single factor that contributed to the stated shift in milk composition. A number of hormonal pathways and local factors are related to milk synthesis control mechanisms. Endocrine post shearing adjustments may alter both the partition of nutrients to the mammary gland (Symonds et al, 1990) and the mammary milk precursors transport capacity, as well as the activity of the enzyme complexes involved in milk synthesis (Shenmann and Peaker, 2009). It is difficult to assess the relative contribution of different factors which, acting individually or in an additive manner, may be responsible for the overall adaptive response that seems to underlie the changes in MY and milk composition.

Conclusions

Shearing altered the rate of decline of daily MY and increased milk fat, milk protein and total solids concentrations which may have beneficial effect on the milk processing characteristics. Post-shearing decrease in daily MY resulted in a decline of daily output of total solids. The data suggest the need of further investigations in order to elucidate the shearing effect on milk yield and milk composition in different sheep breeds in different environment.

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