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THE EFFECT OF SPRING SHEARING ON MILK YIELD AND MILK COMPOSITION IN TSIGAI EWES

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Abstract: Milk yield and milk composition responses to shearing were assessed in Tsigai ewes kept indoors. Sheep was offered 700g/head daily concentrate and chopped hay administered *ad libitum* and was milked twice daily - at 08:00 and at 18:00 h. Average for the two weeks post-shearing, daily milk yield dropped by 7.2 % due to the 8.2 and 2.2 %, respectively, reduction in the morning and in the afternoon milk yields. Fat and protein concentrations in the morning and in the afternoon milk on day 1, day 7 and day 14 after shearing surpassed vastly pre-shearing values whilst milk lactose concentration showed a trend towards post-shearing reduction. On the three sampling post-shearing days daily output of different milk constituents exceeded the corresponding mean pre-shearing values by 16.2, 11.6 and 9.1 % in milk fat, 1.6, 3.5 and 6.2 % in milk protein, and 4.1, 7.2 and 2.2 % in total solids. The increase in daily output of milk constituents occurred despite the decline in daily milk yield. Lactose daily output, on the contrary, dropped by 6.9, 7.7 and 9.3 % relative to the mean pre- shearing value. Post-shearing adaptive adjustments including changes in nutrient partitioning appear to underlie the alterations in milk yield and milk composition. It may be concluded that post-shearing changes in milk composition makes for the improvement of milk processing characteristics.

Key words: sheep, shearing, milk yield, milk composition

Introduction

Shearing is the common farm routine working disturbances in the thermal homeostasis which brings into action various adaptive responses related to its re-adjustments. Post-shearing metabolic and endocrine adaptations would be expected to influence plasma concentration of metabolites and alter nutrient partitioning that may affect milk yield and milk composition *(McBride and Christopherson, 1984; Symonds, et al., 1990)*. These changes in milk performance may affect energy supply to the offspring and/or processing characteristics of the milk that may, ultimately, influence the financial performance in dairy farms. In the literature reviewed scarce information was found about shearing effect on milk yield and milk composition in sheep.

The aim of the present study was to elucidate the shearing effect on milk yield and milk composition in Tsigai ewes.

Materials and Methods

Six Tsigai sheep in their 4th month of lactation were involved in the study. Daily ration consisted of 700 g/head concentrate, given in two meals, and chopped hay administered *ad libitum*. Water and salt were freely available. Ewes were shorn at mid-April and were hand milked twice a day at approximately 08:00 h and 18:00 h. Sheep was shorn soon after the morning milking. Milk yield from each ewe was recorded and daily yield was obtained by summing the morning and afternoon yield. Samples for milk composition analysis were taken from the milk of each sheep obtained in the morning and in the afternoon milking on the day before shearing, and on day 1, day 7 and day 14 thereafter. The samples were analyzed for fat, protein, and lactose content using a Milko Scan 133 B, calibrated for sheep milk. Mean daily output of milk constituents in the morning and in the afternoon milk at sampling days was also calculated. Feed and water intake and air temperature in the barn were also recorded twice a day.

The results are presented as mean and standard error of the mean. Significant differences in daily milk yield, concentration and daily output of milk constituents in the milk obtained before and after shearing of ewes were assessed by a Student's *t* test using the mean value for each trait (Snedecor and Cochran, 1989).

Results and Discussion

Mean daily MY in unshorn sheep averaged 604.2 ± 3.5 g/day. The greatest fall in daily yield occurred on day 2 after shearing when it dropped to 85.2 % ($P < 0.01$) of the mean pre-shearing value (Figure 1). Daily MY increased gradually thereafter nearing the pre-shearing level on the sixth day after fleece removal. Afternoon MY showed a sharp, short-term, decline followed by fast recovering. Average for the two weeks post-shearing, daily MY dropped by 7.2 % due to the 8.2 and 2.2 %, respectively, reduction in the morning and in the afternoon milk yields (Figure 1).

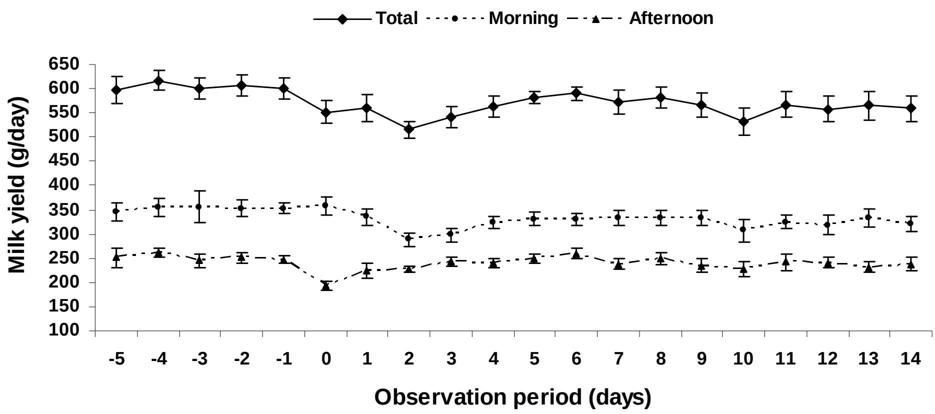

Figure 1. Mean daily milk yield (total), and yield obtained with the morning and afternoon milking. Each point represents the mean for 6 ewes. Vertical bars represent SEM. Day 0 = shearing day

Fat concentration was greater in the milk obtained in the afternoon whilst protein and lactose concentrations were similar in the morning and in the afternoon milk throughout the observation period (Table 1). Of all milk components milk fat exhibited the greatest post-shearing elevation. Before shearing, milk fat concentration averaged 5.74 % in the morning milk, and 6.77 % in the afternoon milk. On day 1, day 7 and day 14 after shearing it increased up to 7.05, 6.81 and 6.91 % ($P < 0.05$) in the morning and up to 8.60 ($P < 0.05$), 7.81 and 7.64 % in the afternoon milk. On the three sampling post-shearing days concentrations of protein and total solids in the morning and in the afternoon milk also surpassed the mean values in unshorn ewes. Daily output of milk constituents followed closely the changes in their concentrations (Table 1). On the three sampling post-shearing days daily output of different constituents exceeded the corresponding pre-shearing values by 16.2, 11.6 and 9.1 % in milk fat, by 1.6, 3.5 and 6.2 % in milk protein, and by 4.1, 7.2 and 2.2 % in total solids, respectively. The increase in daily output of milk constituents occurred despite the decline in daily milk yield. Lactose daily output, on the contrary, dropped by 6.9, 7.7 and 9.3 % compared to the pre-shearing value.

Table 1. Mean daily milk yield, milk composition, and daily output of different constituents in the morning and in the afternoon milk and total for the sampling days before and after shearing (mean ± SEM)

Parameters	Before shearing	After shearing		
		1^{st} day	7^{th} day	14^{th} day
Morning milk				
Milk yield (g/day)	353 ± 12	335 ± 17	333 ± 17	321 ± 16
Fat (%)	5.74 ± 0,38	7.05 ± 0.41	6.81 ± 0.31	6,91 ± 0.25 *
Protein (%)	5.37 ± 0,17	5.92 ± 0.27	5.84 ± 0.26	6.08 ± 0.28
Lactose (%)	5.38 ± 0.05	5.34 ± 0.09	5,20 ± 0.04	5.20 ± 0.06
Total solids (%)	17.08 ± 0.48	18.90 ± 0.59	18.48 ± 0.50	18.78 ± 0.45
Fat output (g/day)	20.26 ± 1.75	23.62 ± 1.87	22.68 ± 1.58	22.18 ± 1.43
Protein output (g/day)	18.96 ± 0.99	19.83 ± 0.51	19.45 ± 1.15	19.52 ± 1.07
Lactose output (g/day)	19.00 ± 0.59	17.89 ± 0.78	17.32 ± 0.79	16.69 ± 0.77
Total solids output (g/day)	60.29 ± 3.01	63.32 ± 3.89	61.54 ± 3.13	60.28 ± 3.05
Afternoon milk				
Milk yield (g/day)	247 ± 7	225 ± 15	238 ± 9	238 ± 14
Fat (%)	6.77 ± 0.35	8.60 ± 0.35 *	7.81 ± 0.40	7.64 ± 0.41
Protein (%)	5.31 ± 0.16	5.67 ± 0.28	5,78 ± 0.25	6.11 ± 0.28
Lactose (%)	5.23 ± 0.05	5.32 ± 0.06	5.10 ± 0.05	5.15 ± 0.06
Total solids (%)	17.89 ± 0.48	20.16 ± 0.52	19.4 ± 0.61	19.51 ± 0.62
Fat output (g/day)	16.72 ± 0.99	19.35 ± 1.65	18,59 ± 1.45	18.18 ± 1.37
Protein output (g/day)	13.12 ± 0.43	12.76 ± 0.92	13,76 ± 0.96	14.54 ± 0.92
Lactose output (g/day)	12.92 ± 0.35	11.97 ±0.79	12,14 ± 0.60	12.26 ± 0.59
Total solids output (g/day)	44.15 ± 1.71	45.38 ± 3.24	50.46 ± 2.86	46.49 ± 2.72
Total for the sampling day				
Milk yield (g/day)	600 ± 22	560 ± 27	572 ± 24	559 ± 27
Fat output (g/day)	36.98 ± 2.59	42.97 ± 3.09	41,27 ± 2.89	40,36 ± 2.61
Protein output (g/day)	32.08 ± 1.34	32.60 ± 2.29	33,21 ± 2.04	34.06 ± 2.01
Lactose output (g/day)	31.92 ± 0.67	29.86 ± 1.37	29.46 ± 1.08	28.95 ± 1.23
Total solids output (g/day)	104.44 ± 4.26	108.70 ± 6.40	112.00 ± 5.72	106,77 ± 5.43

* $P < 0.05$

The initial post-shearing drop in daily MY may be attributed to the cumulative effect of cold stress and emotional disturbance. Fluctuations in daily MY, especially in the afternoon one, provided evidence for the short-term effect of the psychic stress on milk performance. Over the two weeks post-shearing mean daily temperatures in the barn ranged from 7.8 to 12.7 °C, being below the level of thermo-neutrality *(Yousef, 1985),* that would be expected to drive numerous adaptive adjustments. On the shearing day roughage intake dropped by 7.9 % but the reduction was short-term and on the second day after shearing consumption achieved the pre-shearing level *(Aleksiev, 2010c).* This decrease in energy intake was unlikely to affect substantially plasma substrate concentrations and/or the rate of milk synthesis since the blood metabolite concentrations may be maintained by mobilization of body reserves during a short-term food deprivation. It was found *(McBride and Christopherson, 1984)* cold stress to affect the mammary blood flow that could influence the rate of supply of precursors and the rate of milk synthesis. Conversely, *Lacasse and Prosser (2007)* reported that the rate of blood flow to the udder is primarily associated with metabolic activity of the mammary gland tissues. Therefore, neither the disturbance in mammary blood flow, nor the alterations in the energy balance, due to the post-shearing changes in feed intake and/or the rate of heat dissipation, seem to account for the variations in daily MY and milk composition. The results of our trial suggest that the most possible underlying mechanism appeared to be the registered 19.8 % post-shearing reduction of water consumption *(Aleksiev, 2010c).* The resultant decrease in total body water content and attendant elevation of blood osmolality may limit water movement from blood to milk causing a decrease in the volume of daily MY. Thus, in short-term, the changes in daily MY may be linked primarily to the psychic stress whereas, in long-term, they may be attributed to the adaptive responses and particularly to the voluntary dehydration of sheep promoting homeothermy maintenance.

Different mechanisms, among which diurnal changes in hormonal profile, alteration of plasma nutrient concentrations and/or their partitioning to/or their uptake by the different body tissues may have contributed to the greater reduction in the morning MY. The greater degree of cold stress experienced by the sheep during the cool night hours and/or the inhibition of milk ejection may also cause a depression in milk secretion rate and reduction in the morning yield. Diurnal pattern of water consumption was associated with the feeding pattern *(Aleksiev, 2010c),* which both exhibited a reduction during the nighttime. This may additionally influence plasma osmolality and water content of milk. Similar post-shearing changes in the morning and in the afternoon MY were found in Danube fine wool breed of sheep shorn in February *(Aleksiev, 2009)* and in Pleven blackhead ewes shorn in March *(Aleksiev, 2010a),* pointing towards the involvement of homeostatic adjustments in regulation of milk synthesis.

It would, however, be misleading to consider the post-shearing changes in daily milk yield separately from the changes in milk composition. Lactational performance correlates with the total production of the individual milk constituents which, in this trial, exhibited a substantial post-shearing increase (Table 1). Nutrition is considered as the major factor related to milk performance since it determines the diurnal dynamic of blood metabolites. Average for the two weeks post-shearing, roughage intake (on dry matter basis) increased by 2.3 % compared to the mean pre-shearing level *(Aleksiev, 2010c)*, that was not likely to affect measurably milk composition. Possible post-shearing changes in the rate of digesta passage and digestibility, particularly in roughages, what was found in newly shorn sheep by *Christopherson (1985)*, would not be expected to affect considerably the concentration and/or proportion of volatile fatty acids in the rumen and blood concentration of precursors. Clearly, other mechanisms appear to take part in regulations of the plasma concentration of metabolites, nutrient partitioning to/or their uptake by the mammary gland, and the rate of biochemical reactions related to the synthesis of milk constituents. Changes in milk composition may be attributed to the post-shearing adaptive adjustments associated with alterations in the homeorhetic capacity of the ewe. This contention corresponds with similar post-shearing changes in milk composition observed in Pleven blackhead ewes, shorn in March *(Aleksiev, 2010c)* and in Tsigai sheep, shorn at the beginning of April *(Aleksiev, 2010b)*. Our results, in general, were in agreement with the findings of *Knight et al. (1993)* in lactating Dorset ewes, kept on natural pastures and shorn at different months of the year. *Rassu et al. (2007)* also found a considerable post-shearing increase in milk fat and milk casein concentrations in Sarda ewes shorn in June at. Similarly, *Peana et al. (2007)* noticed that even in unshorn sheep the drop in ambient temperatures from the thermoneutral values of 9 – 12 °C down to – 3 °C during the winter period influenced negatively milk yield causing the 25 % decrease from the value obtained in optimal temperature conditions.

The greater fat content in the milk obtained in the afternoon before and after shearing of ewes resulted from the higher fat concentration of the milk remaining in the alveoli after milking compared to cisternal milk Afternoon milking was performed only 10 hours after the morning one and it was found *(Labussiere, 1988)* that the shorter the interval between milking the greater milk fat content. *Benchini and Pulina (1997)* noticed that milk composition may be affected more substantially by the milking interval in breeds not selected for dairy production as was the case with Tsigai sheep used in the current study.

Yield of milk fat, milk protein and total solids largely depends on MY. In this respect of particular interest was the post-shearing increase in daily output of different milk constituents. It may be suggested that changes in the plasma concentration of milk precursors and alteration of homeorhetic capacity both coacted in generation of the changes in milk composition. Our results were in agreement with the contention of *Symonds et al. (1990)* who noticed that post-shearing endocrine alterations may increase the partition of nutrients towards milk production improving energy content of the milk. Another noteworthy point in our trial was the reduction in lactose concentration and lactose daily output that may be ascribed to the post-shearing changes in the whole body glucose metabolism and/or to the alteration in the blood substrate availability. Lactose output is related to the rate of glucose uptake which, however, may not be proportional to its plasma concentration, and subsequent output in the form of lactose. A possible depression in glucose uptake by the udder in shorn ewes may influence lactose secretion since the blood glucose is the main precursor of milk lactose. Lactose daily output showed a greater decline in the morning milk exhibiting greater post-shearing reduction (Fig. 1). In the afternoon milk daily output of lactose did not differ substantially from the pre-shearing value. Lactose is the major osmotic compound of the milk and an increase of its concentration, proportionally to the post-shearing elevation of other constituents, could lead to an increased osmotic movement of water from blood to the milk. In a nursing ewe, such a raise of daily MY may increase the lamb's total body water content and thermal conductivity of the peripheral tissues. Therefore, the post-shearing decline in daily MY accompanied by an increase in daily output of milk fat and milk protein may be assumed as an adaptive, anticipatory response improving energy supply to the offspring and its thermoregulatory capacity. The stated changes in milk yield and milk composition may be considered to indicate central pathways in the post-shearing adaptive adjustments including milk synthesis control mechanisms.

Conclusion

Daily milk yield over the two weeks post-shearing exhibited an average drop of 7.2 % due to the 8.2 and 2.2 %, respectively, reduction in the morning and in the afternoon yields. Milk fat and milk protein concentrations increased compared to the corresponding mean pre-shearing values.

Mean daily output of milk fat, milk protein and total solids after shearing increased despite the reduction in daily milk yield, whereas lactose daily output dropped relative to its pre-shearing value

The data suggest that post-shearing changes in milk composition make for the improvement of milk processing characteristics.

Uticaj prolećne strože na prinos i sastav mleka ovaca rase cigaja

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Rezime

Ocenjivana je reakcija prinosa i sastava mleka na strižu kod cigaja ovaca koje se drže u zatvorenom prostoru. Ovce su dobijale 700g/po grlu dnevno koncentrata i iseckanog sena, *ad libitum* i mužene su dva puta dnevno - 08:00 i

18:00 h. U proseku, za period od dve nedelja nakon strižе, dnevni prinos mleka je smanjen za 7.2% zbog 8.2 i 2.2%, respektivno, smanjenja prinosa mleka u jutarnjoj i večernjoj muži. Koncentracije mlečne masti i proteina u jutarnjoj i večernjoj muži 1., 7. i 14. dana nakon strižе su bile znatno više od vrednosti pre strižе, dok je vrednost koncentracije laktoze pokazao trend smanjenja nakon strižе. U tri uzorka uzeta nakon strižе, dnevni prinosi različitih konstituenata mleka su nadmašili odgovarajuće srednje vrednosti pre strižе za 16.2, 11.6 i 9.1 % kod mlečne masti, 1.6, 3.5 i 6.2 % kod proteina u mleku, i 4.1, 7.2 i 2.2 % kod ukupne čvrste materije. Povećanje dnevne proizvodnje konstituenata mleka se desilo uprkos smanjenju prinosa mleka. Dnevna proizvodnja laktoze, suprotno gore navedenim vrednostima, je pala za 6.9, 7.7 i 9.3 % u odnosu na srednje vrednosti pre strižе. Adaptivne modifikacije nakon strižе uključujući promene u balansiranju hrane su u osnovi promena u prinosu i sastavu mleka. Može se zaključiti da promene u prinosu i sastavu mleka nakon strižе utiču na poboljšanje osobina mleka koje su važne za njegovu preradu.

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