Macedonian Journal of Animal Science, Vol. **2**, No. 3, pp. 263–267 (2012)
112
In print ISSN 1857 – 6907
Received: June 12, 2009
On line ISSN 1857 – 7709
Accepted: November 10, 2009
UDC:636.3.083.43 : 637.12.05
Original scientific paper

MILK YIELD RESPONSES TO SHEARING IN BULGARIAN FINE WOOL BREED OF SHEEP

Yordan Aleksiev

Institute of Mountain Stockbreeding and Agriculture,
281 V. Levski Str, 5600 Troyan, Bulgaria
yordan_aleksiev@yahoo.com

Milk yield (MY) response to winter shearing was studied in 12 Bulgarian fine wool sheep kept in an open shed. Ewes were divided into two groups, of six sheep each, according to their daily milk production: a high level group (HL) and a low level group (LL), and were shorn in February. Ewes were fed a ration of chopped hay administered ad libitum and concentrate and were hand milked twice daily at approximately 8:00 h and 16:00 h. Shearing at minimum ambient temperatures below the freezing point brought about a sharp decrease ($P < 0.001$) in daily MY in the HL ewes and a negligible drop ($P > 0.05$) in LL sheep compared to the pre-shearing levels. Average for the week after shearing mean daily MY in HL and LL sheep dropped by 28.7 % and 5.6 %, respectively, compared to unshorn ewes. The observed reduction in daily MY mainly was at the expense of morning yield, whereas the afternoon one remained almost unchanged throughout the study. The results suggest that shearing affects the level of production altering the capacity for homeorhetic regulation of nutrient partitioning.

Key words: sheep; winter shearing; milk yield

ПРОДУКЦИЈАТА НА МЛЕКО ВО РЕЛАЦИЈА СО СТРИЖЕЊЕТО КАЈ БУГАРСКАТА ТЕНКОРУНЕСТА РАСА НА ОВЦИ

Беше проучувана продукцијата на млеко како одговор на зимското стрижење кај 12 бугарски тенкорунести овци чувани во отворена штала. Овците беа поделени во две групи, во секоја по шест овци, според нивната дневна продукција на млеко: група со високо ниво (VN) и група со ниско ниво (NN). Стрижени беа во месец февруари. Овците беа хранети со оброк од сецкано сено ad libitum и концентрат и беа рачно молзени два пати дневно, приближно во 8:00 и 16:00 часот. Стрижењето при ниски амбиентални температури под точката на мрзнење предизвика остро намалување ($P < 0,001$) на дневната продукција на млеко кај VN овците и незначителен пад ($P > 0,05$) кај NN овците, споредено со вредностите пред стрижењето. Во просек за една недела по стрижењето дневната продукција на млеко кај VN и NN овците опадна за 28,7% односно 5,6% во споредба со нестрижените овци. Редукцијата во дневната продукција на млеко главно беше за сметка на утринската продукција, додека попладневната остана речиси непроменета за време на студијата. Резултатите сугерираат дека стрижењето влијае на нивото на продукцијата на млеко, менувајќи го капацитетот за хомеоретичната регулација на додадената сецканата храна.

Клучни зборови: овца; зимско стрижење; продукција на млеко

INTRODUCTION

Thermal stress induced by shearing activates a sequence of compensatory responses aimed at balancing heat production and heat dissipation. In a cold environment the increase of metabolizable energy for maintenance reduces the energy available for productive functions that may ultimately affect the milk yield in dairy ewes. In addition, environmental temperatures below the limit of thermoneutrality may directly or indirectly influence the level of milk production, affecting synthetic processes in the gland (Thompson et al., 1981), mammary blood flow (McBride and Christopherson, 1984a), and glucose uptake by the udder (Thompson G., 1985). In the short-term laboratory studies it would not be expected to take into consideration the different adaptations which occur over a longer period and may influence the productive capacity. The literature reviewed indicated a scarcity of information about milk yield responses to shearing under practical conditions.

This study was undertaken to determine the effect of winter shearing on milk yield in Bulgarian fine wool sheep with different level of production.

MATERIAL AND METHODS

Milk yield response to winter shearing was studied in 12 Bulgarian fine wool sheep at a similar stage of lactation. The ewes were kept in a shed where 1.6 m^2 floor space per sheep was insured. Ewes were divided into two groups, of six sheep each, according to their daily milk production: a high level group (HL) and a low level group (LL). Mean daily milk yield in the former averaged 402 ml, whereas in the latter it averaged 182 ml. Ewes (mean live weight 52.4 ± 1.2 kg) were shorn in February when they approximated the fourth month of lactation. Ewes were fed a ration of chopped hay (9.24 % crude protein, 29.11 % crude fiber) administered ad libitum and concentrate (12.76 % crude protein and 7.43 % crude fiber) 600 g per ewe daily. Sheep were hand milked twice daily at approximately 8:00 h and 16:00 h and the milk yield of each ewe was recorded volumetrically. Ewes were watered three times daily. Measurements were made for 4 days before shearing and for 11 days thereafter. Air temperatures under the shed were recorded at 7, 14 and 21 h. All measurements were conducted at sheep's height.

RESULTS AND DISCUSSION

Shearing at minimum ambient temperatures below the freezing point brought about a sharp decrease ($P < 0.001$) in daily milk yield (MY) in the HL ewes and a negligible drop ($P > 0.05$) in LL sheep compared to the pre-shearing levels (Fig. 2). Average for the post-shearing period mean daily MY in HL and LL sheep dropped by 27.6 % and 5.6 %, respectively, compared to unshorn ewes. In HL ewes the mean reduction in the morning and the afternoon MY after shearing were 31.1 and 22.2 %, respectively, compared to the corresponding values in unshorn sheep (Fig. 3). In LL ewes the observed reduction over the post-shearing period was much less being 4.1 and 7.3 %, respectively, in the morning and in the afternoon MY compared to the pre-shearing levels (Fig. 4). In these ewes the evening yield decreased by 11.3 % on the first day after shearing while the morning yield remained unchanged and dropped by 9.7 % thereafter.

The results were presented as mean and standard error of the mean. The differences were tested by the Student's *t*-test. Data were analyzed using software package statistics (Exel, 2003).

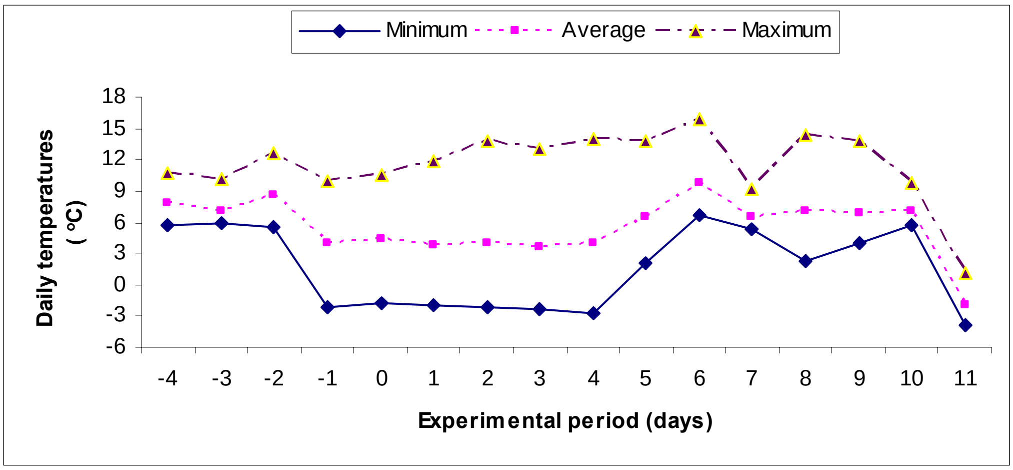

Fig. 1. Minimum, maximum and average daily temperatures in the shed

The values of minimum, maximum and average daily temperatures over the experimental period are presented in Fig 1. During the first four days after shearing the minimal temperature dropped below the freezing point. Throughout the study minimum, average and maximum temperatures were below the lower critical temperature, specified by different authors within the range from 13 to 18 °C for shorn sheep at a high plane of nutrition (NRC, 1981).

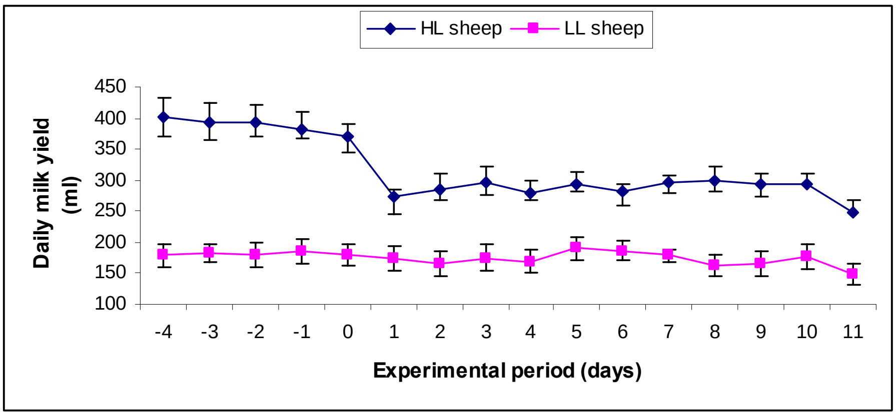

Fig. 2. Mean daily milk yield in HL ewes and LL ewes
Each point represents mean value for 6 ewes. Vertical bars denote SEM. Day 0 = shearing day

Shearing at minimum ambient temperatures lower than 0 °C brought about a sharp decrease ($P < 0.001$) in daily milk yield (MY) in the HL ewes and a negligible drop ($P > 0.05$) in LL sheep compared to the pre-shearing levels (Fig. 2). Average for the post-shearing period mean daily MY in HL and LL sheep dropped by 27.6 % and 5.6 %, respectively, compared to unshorn ewes. In HL ewes the mean reduction in the morning and in the afternoon MY after shearing were 31.1 % ($P < 0.01$) and 22.2 % ($P < 0.05$), respectively, compared to the corresponding pre-shearing values (Fig. 3). In LL ewes the observed reduction over the post-shearing period was much less being 4.1 and 7.4 %, respectively, in the morning and the afternoon milk yield compared to the pre-shearing levels (Fig. 4). In these ewes the evening yield decreased by 11.3 % on the first day after shearing while the morning yield remained unchanged and dropped by 9.7 % on the second post-shearing day.

The observed between group differences in daily MY reflected the differences in the efficiency with which food energy was used for maintenance as well as the extent of mobilization of fat reserves in supporting milk production. The preferential utilization of nutrients by the mammary gland is genetically determined and is associated with the homeorhetic capacity of the animal. In HL ewes, having greater capacity for homeorhetic regulation, redistribution of nutrients was in favor of the tissues essential for milk secretion which resulted in a higher level of production.

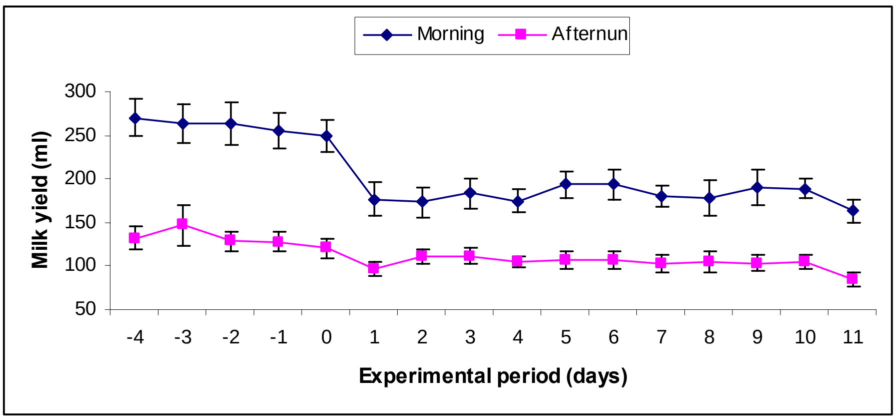

Fig. 3. Mean daily morning and afternoon milk yield in HL ewes
Each point represents mean value for 6 ewes. Vertical bars denote SEM. Day 0 = shearing day

It would be expected shearing to cause a short-term decrease in feed intake as it was stated in other studies (Degen and Young, 1980; Aleksiev, 2009), but this did not account for the sharp drop in MY which occurred immediately after fleece removal. The reduction of blood flow to the skin and consequently to the mammary gland, as a skin structure, could not be the only factor that may influence the rate of milk secretion. The post-shearing biochemical and physiological adjustments aimed at maintenance of the thermal homeostasis may account for, at least partly, the sharp fall in daily MY especially in HL ewes. Numerous physiological changes occur during the post-shearing adaptation, which are associated with alterations in plasma hormone concentrations involved in milk production. Cold exposure has been found to reduce prolactin and growth hormone concentrations in cattle (Wettemann and Tucker,1976; Peters et al., 1981) and lactating sheep (Thompson et al., 1981), which in turn may influence milk secretion. Daily MY may also be influenced by the voluntary dehydration in sheep that occurs in cold environment (Degen and Young, 1980). Considerable reduction in water intake immediately after shearing was recorded in our studies on lactating ewes of different breeds (Aleksiev, 2008; Aleksiev, 2009). This results in an increase in plasma osmolality and reduction in the volume of water that may be transferred into milk (Thompson, 1985)

The results suggest that under acute cold stress homeostatic controls for survival apparently overwhelm homeorhetic mechanisms acting in support of a given dominant physiological function. Therefore, different response to shearing in HL and LL ewes indicated changes in the homeorhetic capacity of sheep. The negligible MY decline in LL ewes may be due to the fact that they had enough energy stores to meet the increased energy requirements for supporting the thermal homeostasis. Furthermore, there may exist genetically, determined minimum for milk production supporting the secretion of certain minimum amount of milk. Thus, even in extreme conditions the survival of the progeny would be insured.

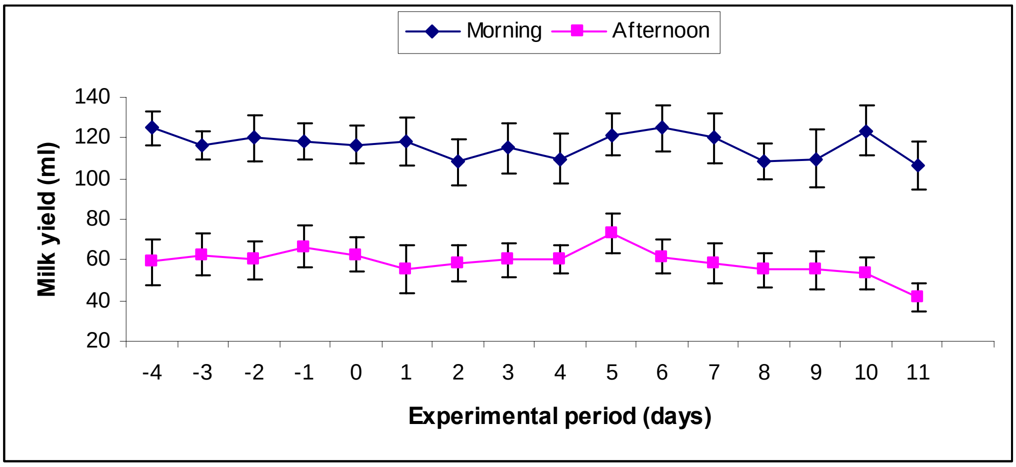

Fig. 4. Mean daily morning and afternoon milk yield in LL ewes
Each point represents mean value for 6 ewes. Vertical bars denote SEM. Day 0 = shearing day

The morning MY in HL ewes after shearing fell more substantially than the afternoon one, whereas in LL sheep the drop was greater in the afternoon MY**.** Different intervals between milking (16 vs. 8 h) suggested that milk obtained in the morning was secreted for a longer time than the afternoon one. Therefore, it would be expected milk secretion to be stronger affected by the adverse environment during the colder night hours. On the other hand, in LL ewes afternoon MY was influenced more substantially than the morning one. Moreover the afternoon MY dropped immediately after shearing while there was a delay in the reduction of the morning MY up to the second day post-shearing. This indicated that in LL ewes before and after shearing homeorhetic control, governing metabolic priorities of different tissues, have been aimed at supporting body functions other than milk synthesis. Mollett and Malven (1981) found out in lactating cows a diurnal rhythm in plasma prolactin concentration which was the highest between 10:30 and 18:00 h, and started to decrease thereafter. Similarly, Memillen et al (1991) pointed out in sheep a progressive increase in plasma prolactin during the day and a sharp reduction at the nightfall. This, in conjunction with the general decline of prolactine secretion in cold environment, may further contribute to the depression in milk secretion during the night hours and to the reduction in morning MY. Morning MY showed a trend to increase with rising of ambient temperature. This most likely reflected the changes in partitioning of metabolizable energy for heat production and milk synthesis.

Unlike the results obtained in the current study, McBride and Christopherson (1984b) found out that during prolonged cold exposure of ewes (0 °C for 8 wk) mammary blood flow tended to decrease but this reduction did not appreciably affect milk secretion. At the same time heat production increased by up to 55 %, compared to that in sheep kept at thermoneutrality. Symonds et al (1990) noticed an increase of milk production in shorn ewes, compared to unshorn counterparts at equal level of energy intake, as a result of either the improved ability to mobilize body reserves or altering of the nutrients partitioning to different body tissues, or both. Knight et al (1993) stated no effect of shearing in Dorset ewes on daily milk yield, but it would be suggested that shearing has been performed at much higher, than in our study, ambient temperatures. The inconsistency of the findings, as well as the results obtained in our studies on milk yield response to shearing in Tsigai and Pleven blackhead ewes (Aleksiev, 2008; Aleksiev, 2009), suggest the existence of a certain temperature threshold in different breeds and genotypes at which coacting of the homeorhetic and homeostatic mechanisms is disturbed in the interest of survival.

CONCLUSION

Winter shearing brought about a shift in the relative significance of the homeostatic and homeorhetic regulations supporting different body functions. Coacting between these two mechanisms was apparently disturbed by the cold stress which resulted in a decline of the homeorhetic capacity, but to a different extent in HL and LL sheep. At ambient temperatures well below the zone of thermal indifference homeostatic mechanisms over-ride homeorhetic regulations which led to a drop in milk yield especially in HL ewes. Post-shearing endocrine changes may further contribute to the alterations in the milk secretion rate throughout the day and night hours.

REFERENCES

[1] Aleksiev, Y. (2008): Effect of shearing on feed intake and milk yield Tsigai ewes. *Bulg. J. Agric. Sci.*, **14**: 87–92.

[2] Aleksiev, Y. (2009): Feed intake and milk yield responses to shearing in Pleven Blackhead sheep with different levels of production. *Bulg. J. Agric. Sci*., **15**: (in print).

[3] Degen, A., Young, B. (1980). Effect of cold exposure on live weight and body fluid compartments in sheep. *Can. J. Anim. Sci.*, **60**: 33–41.

[4] Knight T., Benchini, R., Haack, N., Death, A. (1993): Effects of shearing on milk yields and milk composition in machine-milked Dorset ewes. *New Zeal. J. Agric. Res*., **36**: 123–132.

[5] Mcbride, G., Christopherson, R. (1984a): Effects of cold exposure on blood flow to the mammary gland and tissues of the hind limb of the lactating ewe. *Canad. J. Anim. Sci*., **64**: 391–402.

[6] Mcbride, G., Christopherson, R. (1984b): Effects of cold exposure on milk production and energy balance in the lactating ewe. *Canad. J. Anim. Sci*., **64**: 391–402.

[7] Mollett, T., Malven, P. 1982. Chronological profiles of prolactin and growth hormone in lactating cows. *J. Dairy Sci.*, **65**: 211–216.

[8] NRC (1981): *Effect of environment on nutrient requirements of domestic animals*, National Academy Press, Washington , DC, pp 5–12.

[9] Peters, R., Chapin, L., Emery, R., Tucker, H. (1981): Milk yield, feed intake, prolactin, growth hormone and glucocrticoids response of cows to supplemented light. *J. Dairy Sci.*, **64**: 1671–1678.

[10] Symonds, M., Briant, M., Lomax, M. (1990): Metabolic adaptation during lactation in winter shorn sheep. *J. Agric. Sci.*, **114**: 201–205.

[11] Thompson, G., Hartman, P., Goode, J., Lindsey, K. (1981). Some effects of acute fasting and climatic stress upon milk secretion in Friesland sheep. *Comp. Biochem. Physiol*., **70A**: 13–16.

[12] Thomson, G. (1985). Lactation and the thermal environment. In: Yousef M. K. (Ed), *Stress Physiology in Livestock*. V. 1. CRC Press, Boca Raton, Fl, pp 205–226.

[13] Wettemann, P., Tucker, H. (1976): The influence of low and elevated ambient temperature on serume prolactin and growth hormone in heifers – Areview. *Int. J. Biomet.*, **20**: 36–41.