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EFFECTS OF TIME OF SHEARING ON GROWTH RATE AND SOME PHYSIOLOGICAL RESPONSES IN FINE WOOL OF TWO TOOTH SHEEP**

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** Original scientific paper

Abstract: Rectal temperature, pulse and respiratory rate dynamics and body weight changes were studied in two tooth fine wool sheep kept in barn and shorn at different time of the year. The sheep from the experimental group were shorn in February and the control ones – in May. A considerable decrease ($P<0,01$) in the daily gain was observed during the first weeks after winter shearing compared to pre shearing period and to unshorn controls but later on the growth rate was higher in the shorn sheep. The remarkable fall ($P<0,01$) in rectal temperature following the winter shearing persisted for two more months and recovered to pre shearing level in May. Similar decrease in rectal temperature after fleece removal was found in sheep shorn in May. Pulse rate increased after winter shearing ($P<0,001$) and recovered to pre shearing level by the third month after shearing. Shearing was found to reduce respiratory rate ($P<0,01$) in winter and spring shorn sheep but a significant increase ($P<0,01$) was registered in both group in May. The results suggest that energy expenditure shortly after shearing predominated over the energy intake independently of the level of feed intake, which resulted in reduced growth rate and activation of the compensatory mechanisms for saving the body heat.

Key words: time of shearing, growth rate, rectal temperature pulse rate, respiratory rate.

Introduction

Conventional management system employed in Bulgaria and other European countries is based on sheep confinement during the winter months.

Shearing of sheep at this time of the year offers some management advantages as a reduction of the lying area, reduction of the trough frontage *(MAFF,* 1982), improvement of the reproductive performance and uniformly distribution of seasonal labour requirement (*Aleksiev*, 1994; *Husain et al.*, 1997; *Russel et al*., 1985; *Vipond et al*., 1987). The expected increase in the cost of feeding may be balanced by the value of advantages achieved by winter shearing. In fine wool sheep lambing time usually coincide with the seasonal reduction in fiber growth and prenatal winter shearing is an effective mechanism for shifting the fiber tinning nearer to the tip of the staple, which contributes to avoid wool breakage during the combing process (*Aleksiev*, 1994; *Smith and Bray*, 1997; *Visser*, 1985). But the processes of energy exchange between an animal and its surroundings are greatly affected by the fleece, which is known to play a noticeable role in the maintenance of the thermal balance. The uncontrolled loss of body heat in newly shorn sheep enhances the metabolic rate, which results in increase feed intake in order to meet the increase energy demands for heat production. Under environmental temperatures, much lower than the critical, the rate of heat loss may be critical for the maintenance of the thermal status and the productive potential of the sheep. Along with the increase in feed intake, associated with metabolic adaptation, other compensatory physiological responses limiting heat losses like peripheral adaptation and reduced evaporative heat loss can also be observed. Most of the adaptive responses have usually been studied in climatic chambers or under short-term periods and results often could not be directly applied into the practice (*McArthur*, 1987).

The aim of this study was to explore the effect of cold stress, induced by shearing, on growth rate and some physiological responses in fine wool two tooth sheep shorn at different age and time of the year.

Material and methods

The experiment was performed on 20 two tooth female sheep, kept under conventional management practice- grazing during the summer months and housed in winter. The sheep were randomly assigned into two groups (experimental and control) according to the live weight and kept in solid barn. The daily ration included concentrate-commercial mix containing 12,7% protein, (600 g per head daily) and hay offered ad libitum. The food was given two times daily: in the morning between 08:00 and 08:30 h and in the early afternoon between 16:00 and 16:30 h. The sheep from the

experimental group were shorn on February the 25th at 14 months of age and sheep from the other group, serving as a control, were shorn on May 29th, at 17 months of age, which is the conventional age and time of shearing for the fine wool breed of sheep. During the course of the experiment air temperature was recorded daily. Rectal temperature, heart rate and respiratory frequencies were recorded once daily at 12:00 h. Rectal temperature was recorded by clinical electronic thermometer (Microlife MT 16C2) inserted at a depth of 6 cm, and respiratory and pulse rate – by stethoscope. Live weight was recorded before shearing, at the shearing day and at certain intervals afterwards. Analyses were carried out according to *Snedecor and Cochran* (1970)

Results and discussion.

Average daily temperature fluctuations, classified by three day intervals, are showed in figure 1. During the course of the experiment the ambient temperatures were lower than the critical for the shorn sheep.

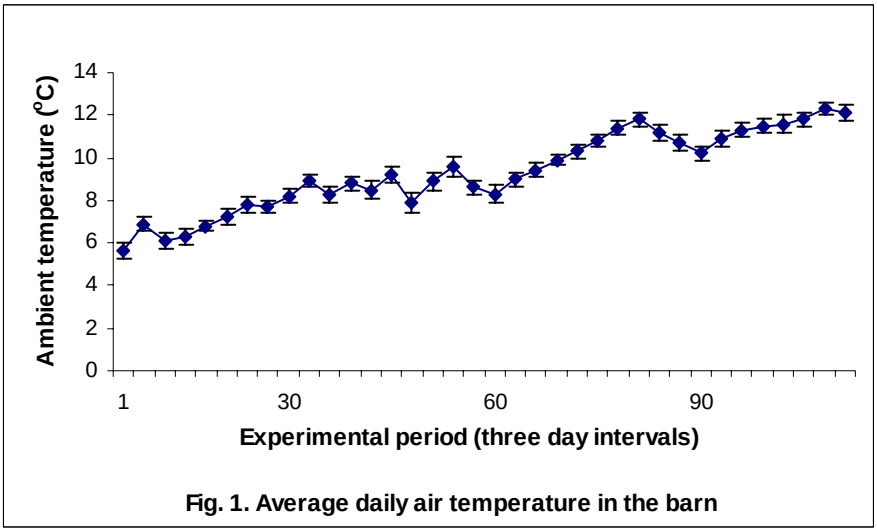

Fig. 1. Average daily air temperature in the barn

Sheep from the both groups had similar daily gain during the last 30 days preceding the shearing while for the next few weeks it was five fold lower in the winter shorn sheep ($P<0,01$). During the second and third month after

shearing the average daily gain in shorn sheep was higher (P>0,05) compared to unshorn ones. Shearing of the control sheep in May was also accompanied by measurable decline (P>0,05) in the average daily gain compared to the previous period (Table 1)Rectal temperature, pulseand respiration rate dynamics, at three day intervals, are presented in figures 2, 3 and 4. Similar values of rectal temperature, heart rate, and respiratory frequencies were observed at pre shearing period in both groups of sheep. Shearing resulted in noticeable decrease (P<0,01) in rectal temperature, which persisted up to the third month after shearing. In May similar values of rectal temperature were monitored in sheep of both groups, but after spring shearing of the control animals a significant decline (P<0,01) in rectal temperature was recorded.

Table 1. Average daily gain (g/day) in sheep shorn at different time of the year.

Treatment	Pre shearing	Periods after shearing, days				Average for the period
		15	45	100	114	
Unhorn[1]	124±15	110±16**	100±14	36±13	13±13[3]	60±14
Shorn[2]	132±12	25±11	116±12	58±12	50±11	68±12

[1] Sheep were shorn on May 29th, [2]Sheep were shorn on February25th
[3] Average daily gain for a two week period after spring shearing.
** Significant difference (P<0,01) between the groups.

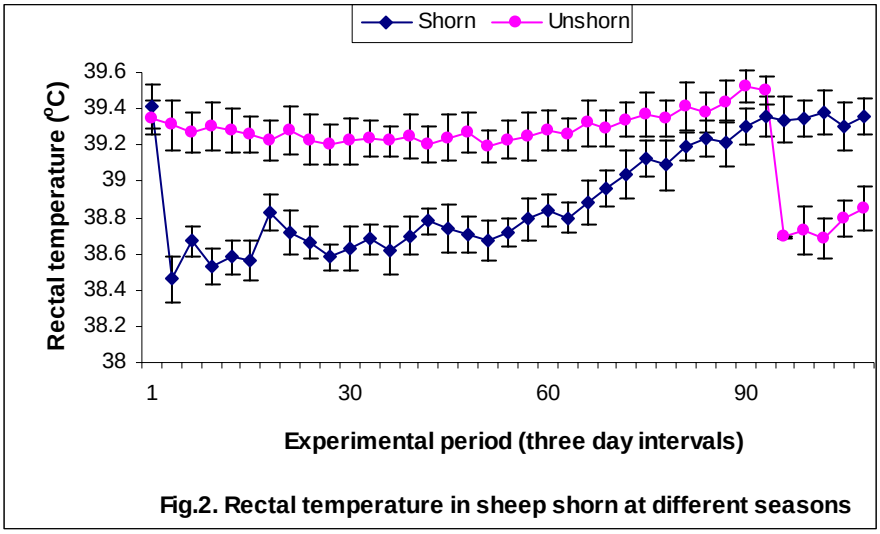

Fig.2. Rectal temperature in sheep shorn at different seasons

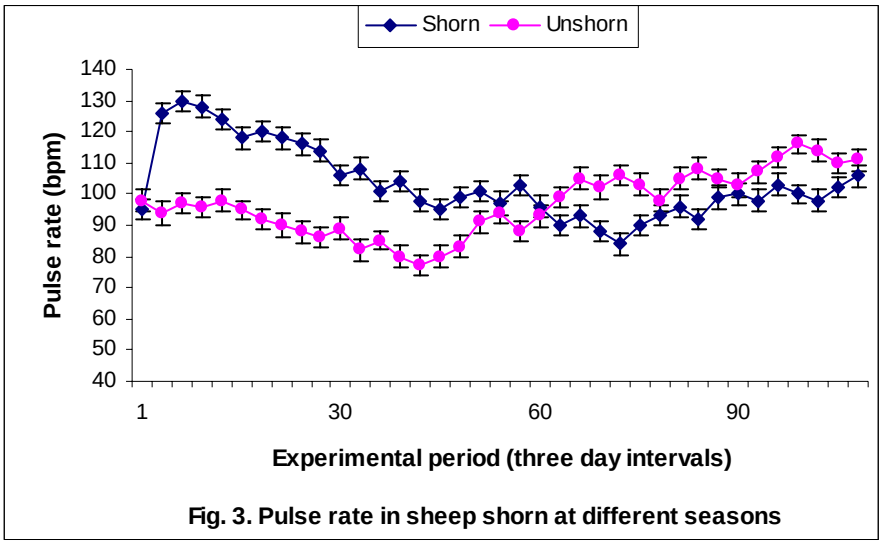

Fig. 3. Pulse rate in sheep shorn at different seasons

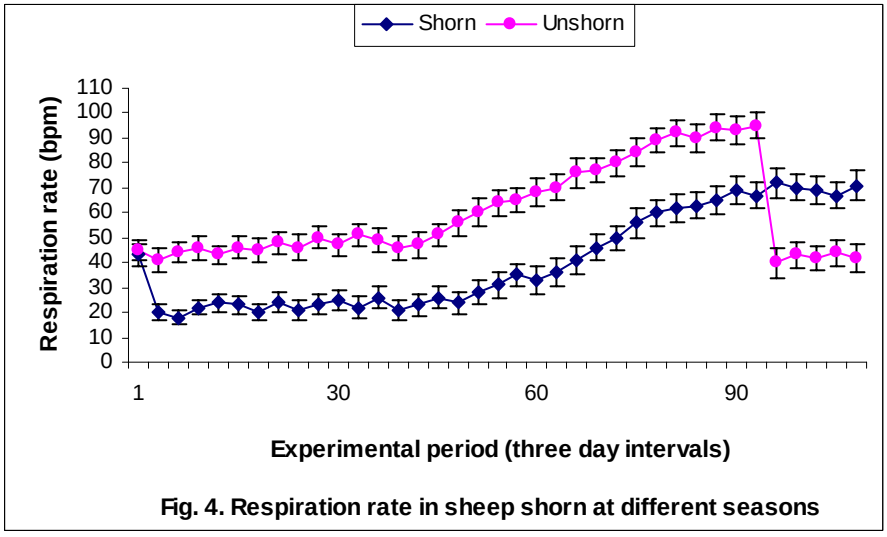

Fig. 4. Respiration rate in sheep shorn at different seasons

A considerable increase (P<0,001) in heart rate compared to pre shearing time and to control sheep was observed during the first few weeks after shearing followed by gradual decline up to the third month. At the same time heart rate in unshorn sheep remained almost unchanged and increased, in

parallel with that in shorn sheep, during the month before spring shearing (P<0,05).

There was a significant fall in respiratory frequencies (P<0,01) during the next two months after winter shearing. In May significant increase was registered in both groups (P<0,001) up to the shearing time. Shearing of the sheep of control group was also accompanied by two fold decrease (P<0,001) in respiratory frequencies.

The metabolic adaptation after shearing is accompanied by an increase in feed intake, which is well established by different authors (*Aleksiev and Iliev*, 2003; *Dabiri, et al*., 1995; *Russel et al*., 1985; *Symonds et al*., 1988; *Vipond et al*., 1987). The extent of this increase depends on different factors amongst which the degree and duration of the cold stress, type of the diet and the quality of roughages included, age, and reproductive status of the sheep (*Weston*, 1989). Despite the appreciable increase in feed consumption, noticed after winter shearing (average 14,3% for the whole post shearing period compared to unshorn sheep), it has obviously been insufficient to meet the increased energy demands for maintenance of the homeothermy shortly after removal of the fleece when the heat production according to *McC. Graham* (1959) was almost doubled compared to the pre shearing level. It must be marked that the reducing in feed intake was observed for a few days after winter and spring shearing possibly as a result of the combined effect of emotional and cold stress. Some other authors (*Dabiri et al.,* 1996; *Parker et al*., 1991) also pointed out that responses in feed intake may not be evident until some weeks after shearing. The stimulatory effect of shearing on growth rate may presumably occur when the stimulating effect on the appetite is greater than that required to meet the increased demand for heat production. The significant fall (P<0,01) in the average daily gain in newly shorn sheep supports the suggestion that tissue energy stores have been utilized for heat production and body temperature maintenance. During the next month after shearing a five fold increase in average daily gain was found which might be due to increased feed consumption and reduction of heat loss in view of the elevation of ambient temperatures and adaptation of sheep to the environment. The rate of body weight gain decreased substantially with age in both groups of sheep but was still noticeably higher in winter shorn sheep. Shearing was also found to depress daily gain in sheep shorn in May, which showed that the borders of the thermoneutral zone in these sheep has been narrowed after removal of the external insulation and that the lower critical temperature has been increased. Spring shearing also resulted in short-term depression of feed

intake and this in conjunction with the elevation of energy expenditure for heat production led to a lowering of the growth rate.

Body temperature, pulse and respiration rates are widely used physiological indicators for studying adaptation to the environment. The considerable fall in rectal temperature recorded after winter shearing ($P<0,01$), which continued to persist within two months, indicated a possible shift of thermoregulatory set point as a result of shearing. It returned to the pre shearing level in May as a result of elevation of the ambient temperature and restored external insulation. Shearing at the end of May was also accompanied by remarkable decrease ($P<0,01$) in rectal temperature, showing that the ambient temperatures at this time of the year are still out of the zone of temperature indifference. The decrease of the core temperature may be considered as an adaptive response in order to lower the temperature gradient between the core and the periphery, which is associated to a reduction of heat dissipation through convection and conduction. The data obtained in the present study are similar to those obtained in newly shorn sheep by *Gudev and Aleksiev* (1994); *Donnelly et.al*.(1974); *Slee and Sykes* (1967).

Other reviewed papers (*Slee*, 1978; *Sykes and Slee*, 1968; *Terrill*, 1968) concerning the effect of cold environment on physiological responses, noticed an increased level of heart rate and reduction in respiratory frequencies. In this observation a tangible increase in pulse rate in winter shorn sheep was recorded shortly after shearing indicating enhanced level of metabolism required to meet the heat loss. Later on a gradual fall was stated which reflected the improvement of the peripheral adaptation and lowering the temperature gradient between the sheep surface and environment. During the observed period heart rate in unshorn sheep remained almost unchanged. In May in both group an increase in hart rate was recorded which might be related to the seasonal rhythmicity in biological functions.

Respiratory frequencies in the sheep of the control group was found to be unchanged until May when about a two fold raise was observed compared to the previous periods. The increased ventilation of the upper respiratory tract is considered to be a fundamental route for heat dissipation in sheep (*Robertshaw*, 2006*; DaSilva et al*, 2002) and indicated that the housed unshorn sheep, in still air condition, experienced some degree of heat stress. This possibly had a negative effect on the level of feed consumption and growth performance in these sheep at that time of the year. After shearing in May respiratory rate fall significantly, showing that the environmental temperature was still lower than the critical temperature. The fall of rectal

temperature and respiratory frequencies and the retained levels of pulse rate after spring shearing witness that the adaptation in the control sheep has been realized mostly through the reducing of heat loss by the changes in blood distribution and the rate of evaporative heat loss. A significant decrease ($P<0,01$) in respiratory rate was observed after winter shearing in order to minimize heat loss, which contributes to maintaining the internal thermal condition. Similar signs of adaptation to the environment, independently of the time of shearing showed that the heat budget in both groups was, after fleece removal, largely depend on ambient temperatures. In May the respiration rate in winter shorn sheep increased above the pre shearing level. This, combined with elevated body temperature, marked that in the given ambient temperatures and restored external insulation the sheep were close to a thermoneutrality. A similar pattern of change in the physiological responses has been found in other studies associated with the effect of shearing in cold environment on sheep adaptation (*Gudev and Aleksiev*, 1994; *Slee, J.*, 1987; *Sykes and Slee*, 1968).

Conclusions

Shearing of sheep kept in barn in winter resulted in considerable decrease in growth rate compared to the pre shearing period and to the control unshorn sheep ($P<0,01$) during the first weeks after shearing. During the next two months average daily gain in winter shorn sheep was higher than in unshorn controls.

Rectal temperature decreased significantly and remained lower than that recorded in the pre shearing period and that stated in unshorn sheep ($P<0,01$) throughout the two months after winter shearing. A significant fall in rectal temperature was observed in the sheep shorn in spring ($P<0,01$) but at a smaller extent than those shorn in winter.

Pulse rate increased during the first weeks after winter shearing ($P<0,001$) while after spring shearing it remained almost unchanged. In both groups of sheep an enhancement was registered in May.

A reduction of respiratory frequencies was observed after winter ($P<0,01$) and spring ($P<0,001$) shearing. A significant increase ($P<0,001$) in respiratory frequencies was stated in May in both groups of sheep compared to the previous months of the year.

UTICAJ VREMENA STRIŽE NA BRZINU PORASTA I NEKE FIZIOLOŠKE REAKCIJE JEDNOGODIŠNJIH FINORUNIH OVACA

Y. Aleksiev

Rezime

Rektalna temperatura, puls i respiratorna dinamika i promene u telesnoj masi su ispitivane na jednogodišnjim finorunim ovcama gajenim u štalama i šišane u različitim terminima tokom godine. Ovce eksperimentalne grupe su šišane u Februaru, a kontrolne u maju. Značajno smanjenje ($P<0,01$) dnevnog prirasta je zabeleženo tokom prvih nedelja nakon zimskog šišanja u poređenju sa periodom pred šišanje i nešišanim kontrolnim ovcama, ali, kasnije, stopa/brzina porasta je bila veća kod šišanih ovaca. Primetan pad ($P<0,01$) rektlne temperature nakon zimskog šušanja se zadržao tokom dva meseca i povratila se na nivo pre šišanja u maju. Sličan pad rektalne temperature nakon uklanjanja vune je utvrđen i kod ovaca šišanih u maju. Broj otkucaja srca u minuti/ puls se povećao nakon zimskog šišanja ($P<0,001$) i vratio se na nivo pre šišanja u roku od tri meseca nakon šišanja. Utvrđeno je da šišanje smanjuje respiratornu brzinu ($P<0,01$) kod ovaca šišanih zimi i u proleće, ali signifikantno povećanje ($P<0,01$) je registrovano kod obe grupe u maju. Rezultati ukazuju da trošak energije ubrzo nakon šišanja dominira nad unosom energije nezavisno od nivoa unosa hrane, što je rezultiralo u smanjenoj brzini porasta i aktiviranju kompenzatornih mehanizama da bi se sačuvala telesna toplota.

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