RELATIONSHIP OF BODY TEMPERATURE AND WELFARE OF DAIRY COWS

SVEJDOVA KATERINA, SIMKOVA ANNA, SOCH MILOSLAV, ZABRANSKY LUBOS, SIMAK- LIBALOVA KRISTYNA, SVARCOVA ANNA, FREJLACH TOMAS, CERMAK BOHUSLAV

Department of Animal Husbandry Sciences
University of South Bohemia in Ceske Budejovice
Studentska 13, 370 05 Ceske Budejovice
CZECH REPUBLIC

Ramandu@seznam.cz

Abstract: This study was carried out on a commercial dairy farm located in the Central Bohemia region of the Czech Republic. Dairy cows of Holstein cattle were monitored during 2 times of year (winter-summer). There were recorded temperature characteristics for selected cows. They were divided into 3 groups according to the period of lactation. The characteristics were obtained by using a thermographic camera and rectal thermometer. Data about ambient temperature were acquired using manually air temperature sensor. It was investigated the influence of the ambient temperature in behavior and welfare of dairy cows in the stable during 2 seasons. It was not detected ambient temperature effect on behavior in animals due to optimum conditions in the barn.

Key Words: temperature, dairy cows, thermographic camera, welfare

INTRODUCTION

Cattle generally belong to animals with very good thermoregulation capabilities. It is able to be much better adapted to low temperature environment than at high temperatures (Doležal 2010, Šoch 2005). For the thermal comfort of cattle is considered temperature -5 to 20°C. It always depends on the actual performance of the animal, on his condition, individuality, and not least on the values of other elements of microclimate (relative humidity of the air, cooling value, air velocity, etc.) (Zejdová et al. 2014). A body temperature belongs to the best indicators of physiological response to stress. It is under non-stressed conditions almost constant. On the basis of its changes can be quickly deduce the thermal load on the body and on the involvement of adaptive mechanisms (Nový et al. 1996). Individual parts of the body vary in temperature, which is caused by their different metabolic levels, blood flow in the area, or distance from the body surface. It is the most stable inside the body in the abdomen, chest and skull – called "core body temperature". The temperature of the body skin (skin, subcutaneous tissue, superficial muscles) is more dependent on the ambient temperature.

The method of thermography has found many applications not only in the industry, but also in human and veterinary medicine, particularly for diagnostic purposes (Knížková 2007). It was used to investigate the organism of livestock, specifically changes in the vascular circulation as a result of an increase or decrease in temperature of the tissue, as a measuring method for the assessment of these areas (Harper 2000). Spruyt (1995) recommends thermography measurement as a good method for the study of thermoregulation. The main advantage of this method is that it does not require direct physical contact with the monitored surface, and thus allows a direct reading of the temperature distribution (Speakman, Ward 1998).

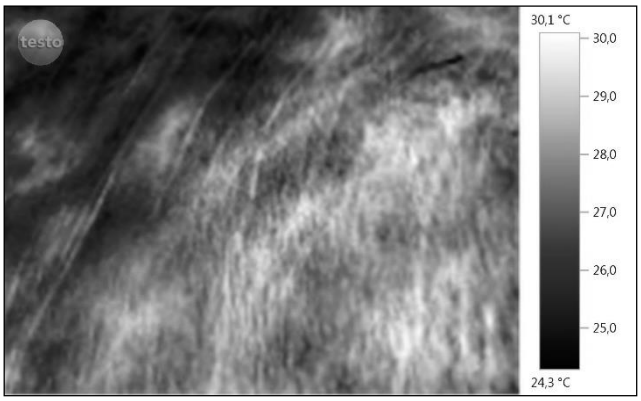
Observing the distribution of surface temperature by infrared thermography as an alternative method for the examination of environmental and physiological processes associated with the thermal comfort dealt e.g. Zotti (2011). Infrared camera can detect changes in peripheral blood flow and resulting changes in heat loss, so this method can be a useful tool for measuring stress to the animals (Stewart 2005).

MATERIAL AND METHODS

This experiment was carried out in stables with free boxing barns in the agricultural cooperative Petrovice in the Central Region in the Czech Republic. The measurement conducted within the barn in which cows were fixed in boxing. There were evaluated three different groups of cows and heifers in two stables with different microclimate conditions. A total of 36 selected dairy cows and heifers were divided by 12 pieces into three groups. In the first group were cows and heifers from the second day to two months after calving. The second group consisted of cows from 4 to 5 months after birth. The third group included cows in seventh to eighth month after calving. The surface temperatures of the body core areas were scanned using thermographic camera TESTO 875. These temperatures were given in correlation with ambient temperature, which was sensed by a thermal TESTO 425 axnemometer with permanently attached thermal probe. Operating temperature of this unit is in a range from -20 to +50°C and the probe measuring range is from -20 to +70°C. The probe is measured with an accuracy of ± 0.5°C and 0.1°C Further, for each of these selected cows and heifers there was measured a rectal temperature using a digital rectal thermometer. There were compared temperatures during the winter and summer of 2014.

Thermal images of core body of animals were taken using thermographic camera TESTO 875 with the record in the memory (Figure 1). Recording images was then evaluated and tabulated. The resulting values were summarized in tables and graphs using Microsoft Excel.

Figure 1 Thermal image of the body surface (Švejdová 2014)



RESULTS AND DISCUSSION

There are the results of the correlation of core body temperature of each group of dairy cows and heifers with the ambient temperature (see Figure 2-4). The average rectal temperature of the measurements animals ranged between 37–38°C. Literature mentioned that range of rectal temperature in cattle is 37.5 to 39.5°C. Bukvaj (1986) states based on the actual measurement of rectal temperature fluctuations in dairy cows from 36.9 to 39.1°C. According to Knížková, Kunc (2003) temperatures above 39.5°C are considered to be a response to high temperature environments. The average rectal temperature was the highest in summer, when there were measured also the high air temperatures. According to Zejdová (2014) 20°C is considered to be a borderline temperature when there is threaten a heat stress.

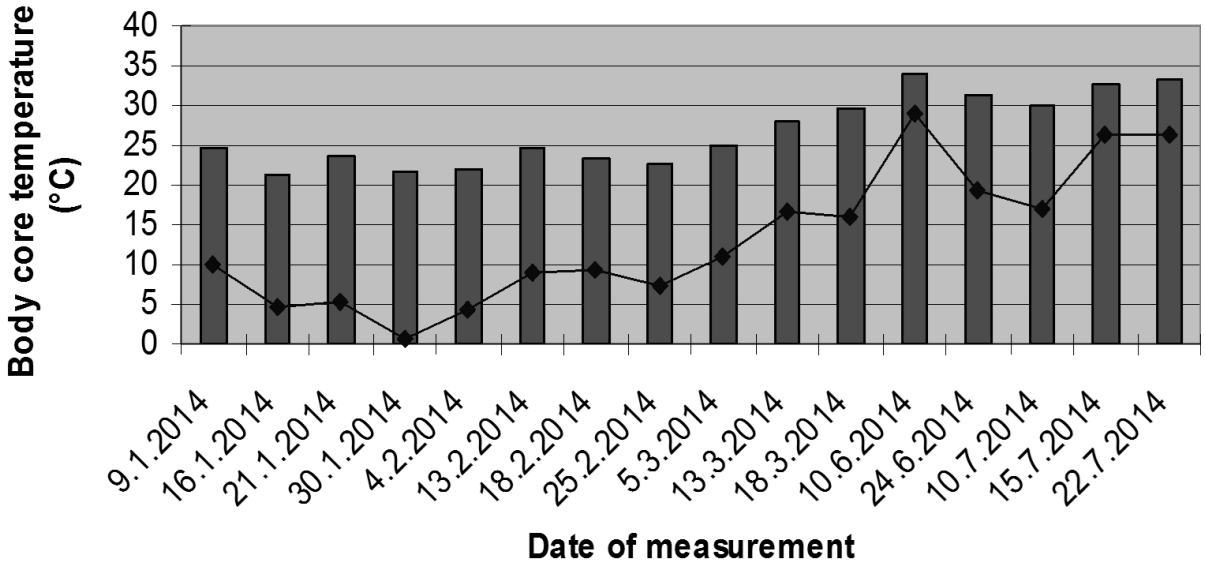
Regarding the effect of high temperatures on the welfare of dairy cows, according to Dolejš (2005) in the interval 16–21°C there is no significant changes in yield, animal behaviour and the quality of their products. In the same way Vokřálová, Novák (2005) show, that the thermoneutral zone for dairy cows is given in the range of -5 to + 24°C, and for high yield dairy cows with moved to the upper limit of 21°C. Increased heat load causes the behavioral and physiological responses including the increase of body temperature and reduction of respiration activity, food intake and milk production. Significant differences in measured values rectal temperatures, especially in summer, were located at the 3rd group of dairy cows and heifers. In this group were cows and heifers at the highest level of lactation compared to the previous group, so there were most striking fluctuations in rectal temperature values.

According to Doležal (2010) high yield lactation dairy cows at the top of lactation are especially sensitive to the heat stress, due to its narrowly focused production function, high efficiency of feed utilization, and thus high production of metabolic heat. In a herd of dairy cows are more susceptible on heat stress cows with high milk yield than cows with low milk yield and dry cows. This group of cows and heifers was in stable where the ventilation only through open doors and windows was. In contrast to the barn, where there was a 1st and 2nd group of cows and heifers and where ventilation was used by fans and open doors. In an environment with high temperatures cattle feed consumption fluctuates and

this decline is given in connection with the decline of milk production (Doležal 2010). In the case of this experiment, it was found that the effects of high temperatures during the summer months, which moved up to around 26.4°C, there was no significant decrease in the average yield of animals.

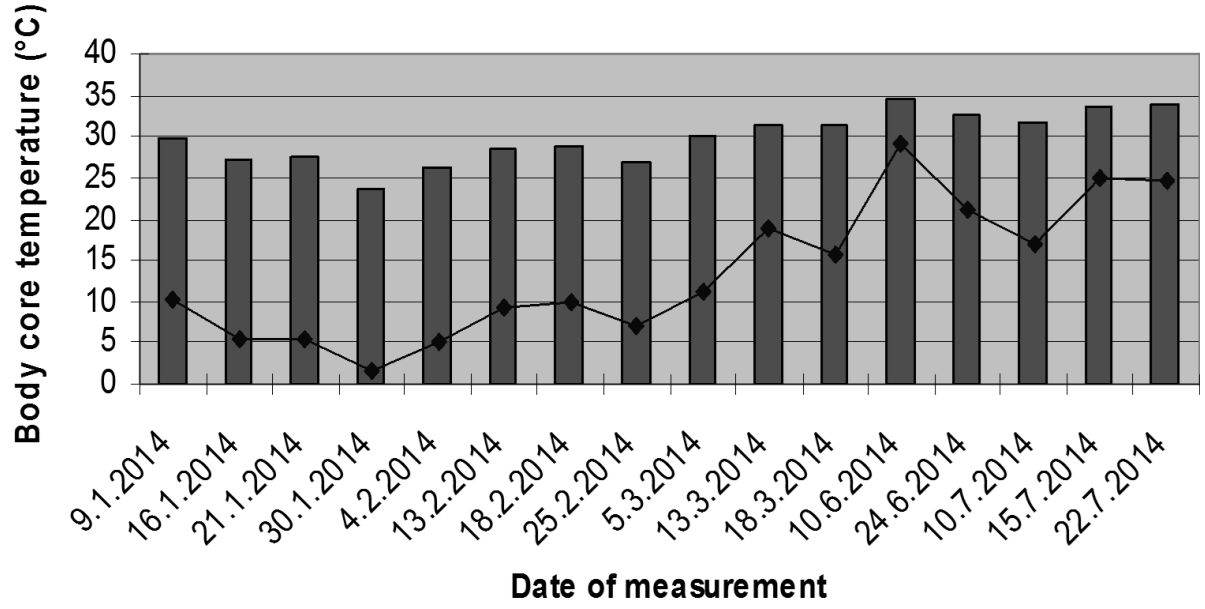
There is a comparison of average winter and summer measured body surface temperatures (see Figure 5). The surface temperature during the measurement does not be altered significantly. The most striking difference between winter and summer was for the first group of cows and heifers. Surface sensing of body frame are most often affected by external factors such as light, air temperature and air flow. Also, characteristics such as structure, color and coat pollution play a very important role. Finally, it also depends on the correct setting of the thermographic camera, the distance the subject and emissivity. The highest values of surface temperatures occurred mainly during the summer. Sensing temperatures in this period, however, were very influenced by microclimate conditions in the barn (ventilation equipment, sprinkling).

Figure 2 The relationship of body temperature and ambient temperature - Group 1



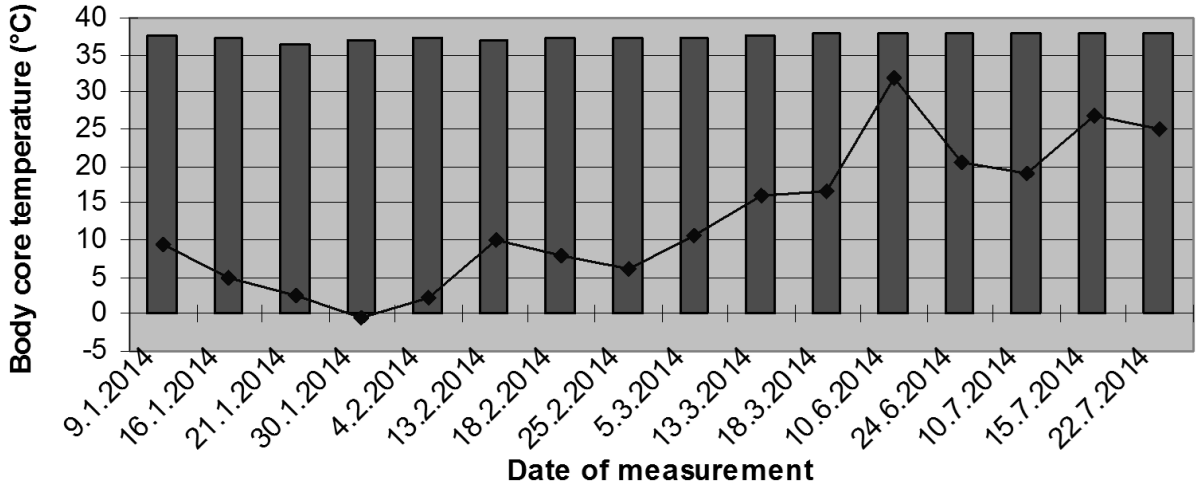
Legend: red – Body core temperature; blue- ambient temperature

Figure 3 The relationship of body temperature and ambient temperature - Group 2



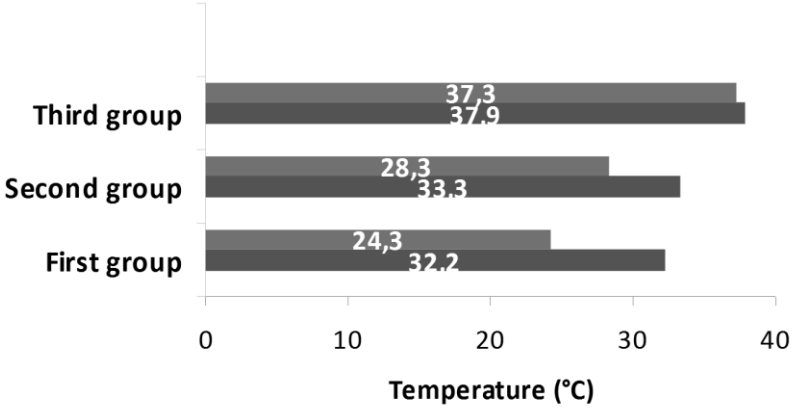
Legend: red – Body core temperature; blue- ambient temperature

Figure 4 The relationship of body temperature and ambient temperature - Group 3



Legend: red – Body core temperature; blue- ambient temperature

Figure 5 The comparison of body core temperatures



Legend: blue – winter; green - summer

CONCLUSION

The monitoring results show that the welfare of cows in optimal conditions in the stable is not affected by summer or winter temperatures. It was examined how the high temperature affects the organism, what is their impact on heat stress and how overall comfort of dairy cows and heifers is influenced. The average rectal temperature of the animals was between 37–38, 5°C. The aim was to identify and assess how the high temperature affects the organism and whether it can be used as thermal radiation mechanism referring to the health status and welfare of animals. The surface temperature is in the sensing a thermal camera most affected by external environmental conditions (flow and air temperature, light, humidity).

A big impact on the resulting surface temperatures also have characteristics such as surface emissivity especially, structure of hair, colour, and pollution. Suitable stable environment, corresponding to all the essential requirements of the housed animals is one of the decisive factors in the success of farming. In this experiment must be taken into account that it have been taken only during the summer and winter temperatures. Therefore it would be appropriate to repeat the experiment to verify the accuracy of the data.

ACKNOWLEDGEMENT
The research was financially supported by the project NAZV QJ1210144 and GAJU 020/2013/Z.

REFERENCES

Bukvaj J. 1986. *Vztah organismu skotu k prostředí ve velkochovech*. Praha: VŠZ Praha.

Dolejš J. 2005. Účinnost ochlazování dojnic při tepelném stresu. *Náš chov*, 9(64): 32–34.

Doležal O., Bílek M., Dolejš J. 2004. *Zásady welfare a nové standardy EU v chovu skotu.* Praha-Uhříněves: VÚZV Praha-Uhříněves.

Harper D. L. 2000. The value of infrared thermography in a diagnosis and prognosis of intres in animals. *Inframation 2000*, 115–122.

Knížková I., Kunc P. 2003. Dojnice a tepelný stres. *Farmář*, 7: 41**–**43.

Knížková I., Kunc P., Gürdil G. A. K., Pinar Y., Selvi K. C. 2007. Applications of infrared thermography in animal production. *Journal of Fakulty of Agriculture*, 22(3): 329–336.

Nový Z., Knížková I., Jílek F., Kunc, P. 1996. Vliv nízkých teplot na termoregulaci a energetický metabolismus u dojnic. *Živočišná výroba,* 41(6): 251–255.

Speakmen J. R., Wars S. 1998. Infrared thermography: Principle and applications. *Zoolog*, 101: 224–232.

Spruyt P., Ghafir Y., Art T., Lekeux P. 1995. La thermographie infrarouge dans l'etude de la thermoregulation. *Revue de la liteerature*, *Annales de Médecine Vétérinaire,* 139: 413–418.

Stewart M., Webster J. R., Schaefer A. L., Cook N. J., Scott, S. L. 2005. Infrared thermography as a non-invasive tool to study animal welfare. *Animal welfare*, 14 (4): 19–25.

Šoch M. 2005. *Vliv prostředí na vybrané ukazatele pohody skotu*. České Budějovice: ZF JČU v Českých Budějovicích.

Vokřálová J., Novák P. 2005. Klimatické extrémy a laktace. *Náš chov,* 9: 40–42.

Zejdová P., Chládek G., Falta D. 2014. *Vliv stájového prostředí na chování a mléčnou užitkovost dojnic*. Brno: Mendlova univerzita v Brně.

Zotti C., De Toledo L. M., Oltramari C., De Miranda M. S., Ambrosio L. A. 2011. Infrared thermography as an alternative measurement of thermal comfort in dairy heifers. In: *Animal hygiene and sustainable livestock production. Proceedings of the XVth International Congress of the International Society for Animal Hygiene*. July 3–7, 2011, Tribun EU, Vienna, Austria, 747–749.