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MEASURING THE BODY SURFACE TEMPERATURE OF ANIMALS USING A THERMOGRAPHIC CAMERA

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Abstract: in this experiment it was used contactless measurement method using a thermographic camera. Surface temperatures were recorded from three different parts of the animal,(the surface of the core body, the eyes and the udde)r. The aim of this study was to determine how much the temperature values that are obtained using the thermographic camera are accurate.. Its accuracy depends on many factors such as particularly good settings of the thermographic camera, a microclimate of environment, an emissivity of measured object, the character and colour of the coat or the degree of muscles. It was also monitor the correlation of the measured surface temperatures with a rectal temperature, which is an indicative of the internal body temperature.

Keywords: body surface temperature, thermographic camera, dairy cows, emissivity, rectal temperature

INTRODUCTION

There are many methods to measure the surface temperature. This may be the method as the contact (e.g. thermocouples) as well as the non-contact

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(pyrometry, thermal imaging) (Mlčák et al., 2007). Contactless surface temperature measurement using an infrared thermography is a modern, non-invasive and safe technique of thermal profile visualisation (Vadlejch et al., 2010). The thermographic method has found many opportunities not only in industry, but also in human and veterinary medicine, primarily for diagnostic purposes (Harper, 2000; Markel et al.2005). The environmental factors have major influence on feeding and energy metabolism of animals (Pârvu et al., 2011).According to (Montanholi et al., 2008) this technology is also useful for assessing the physiological responses of dairy cows for milking and feeding. Critical temperatures for dairy cows, causing for example heat stress, may vary depending on several factors. That by (Brouček et al., 2009) may be degree of acclimatization, production, pregnancy status, air movement around the animals and relative humidity. Every object of the surface temperature above absolute zero (0 K = -273.15 °C) emits electromagnetic radiation corresponding to the surface temperature. This heat radiation located in the infrared part of the light spectrum is subject to the intensity and spectrum distribution of which depends on the temperature of the mass and the radiation properties of its surface layer (Kunc et al., 2007). Short- and long-wave radiation fluxes are one of the most important meteorological factors affecting livestock on the range, especially in tropical regions (Da Silva et al., 2010). Using a thermographic camera (a thermographic scanning equipment) able to detect this type of radiation can be even accurately monitored also sudden temperature changes. The data obtained by scanning is computer-processed, and displayed as heat maps that provide for a detailed analysis of the temperature heat (Knížková et al., 2007). Because the radiation is a function of object surface temperature, the camera allows calculate and display this temperature. However, the radiation measured by thermographic camera does not only depend on the temperature of the object, but is also a function of its emissivity (Kunc et al., 2007). In living organisms, changes in the vascular circulation results in an increase or decrease of tissue temperature, which is then used to assess the area (Harper, 2000). To evaluation of the health status of animals can help regular measurement of the body surface temperature of animals and so immediately respond to the first signs of illness. It is important to find the right part of the body whose temperature will point to the first potential signs of the disease. One objective of this experiment was to find how the body temperature is correlated with the surface temperature of animals. The best indicator of the physiological response to stress is body temperature because it is under nonstressed conditions almost constant. On the basis of the changes of the rectal temperature can quickly deduce on the thermal load of the body and the involvement of an adaptive mechanisms (Nový et al., 1996).

MATERIALS AND METHODS

The experiment was conducted during three month (February to May) at almost weekly intervals. Dairy cows and heifers from the agricultural farm in Petrovice were measured. These animals were stabled in the stables with free boxing barns. 36 dairy cows and heifers were measured during each monitoring. These 36 animals were divided by 12 pieces in three groups. Cows and heifers from the second day to two months after calving were in the first group. The second group was consisted of cows from fourth to fifth month after birth. The third group included cows from seventh to eight month after calving. Measurements were carried out in the stable where measured dairy cows and heifers were fixed in the boxing. Three different groups of cows and heifers were evaluated in two sheds with different microclimate conditions. The first two groups were found in the stable with the artificial lighting and ventilation through open doors and fans. The third group of animals was in the other stable with natural ventilation through windows and doors and natural light. The surface temperatures were scanned using a thermographic camera TESTO 875 from three different parts of the body. This was a body core surface temperature , udder surface temperature and eye temperature. At the same time the rectal temperature was also measured. It was given in the correlation with the particular measured surface temperatures. Thermal images of three body parts of animals (the body core, the eye and the udder) were obtained using the thermographic camera to record to memory. These thermograms were evaluated in the appropriate computer program and dates were processed into tables. The average body parts surface temperatures of animals from each measurement were given in the correlation with the average rectal temperatures. These were obtained with the using of the rectal thermometer. The resulting values were processed into graphs and tables using a computer program Microsoft Excel.

RESULTS AND DISCUSSIONS

The results of correlation of the rectal temperature and average body parts temperatures of animals (body core, the eyes and an udder) are shown in

Figures 4, 5, 6. It was found that the temperatures of the measured body parts of animals were noticeably affected by the ambient temperature. The most significant fluctuations were in the third group of dairy cows and heifers. This group of cows occurred in the different stable than the first and second groups which were together in other stable. The third group was housed in another shed with the significantly different microclimate conditions. The figures show that the average rectal temperatures were in all three measured groups of dairy cows and heifers between 37 – 38°C. Literature gives the range of the rectal temperature in cattle from 37.5 to 39.5°C (Nový et al., 1996). And Bukvaj (1986) shows fluctuations in rectal temperature in dairy cows even from 36.9 to 39.1°C. The emissivity and the setting of the thermographic camera played the main role during the measurement. The different factors, such as a length and density of coat, a colour or degree of muscularity, on which significantly depends the emissivity (the ability to emit infrared radiation), acted especially in two measured parts of the body – the body core and the udder. Greatest impact on the measured surface temperature results had microclimatic parameters of environment (the temperature of environment, air circulation, light etc.). The measured temperatures in the eye were the closest to the rectal temperature values. Schaefer et al. (2004) used infrared thermography for identifying calves with bovine viral diarrhoea virus. They discovered that increases in eye temperature were more consistent than other anatomical areas. There were also significant changes in eye temperature several days to one week before other clinical signs of infection.

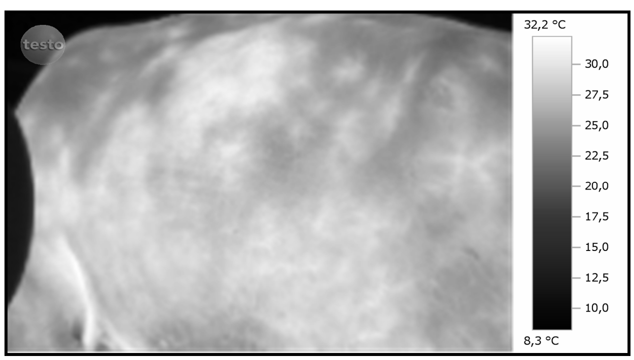

Figure 1. Thermal profile of the body core of dairy cow

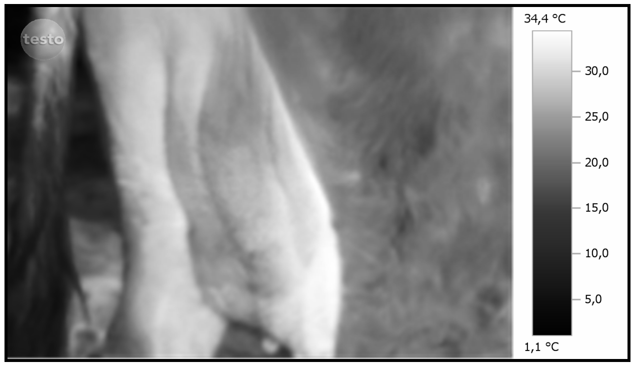

Figure 2. Thermal profile of the udder of dairy cow

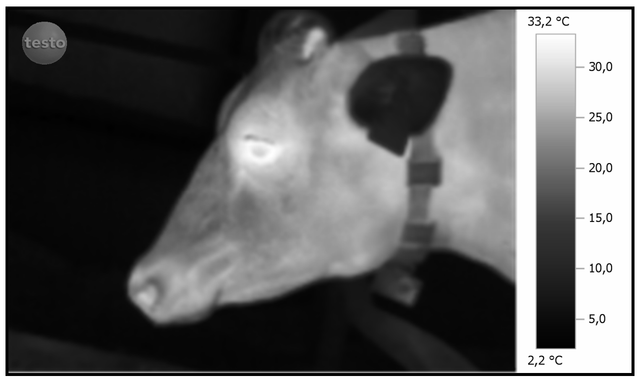

Figure 3. Thermal profile of the eye of dairy cow

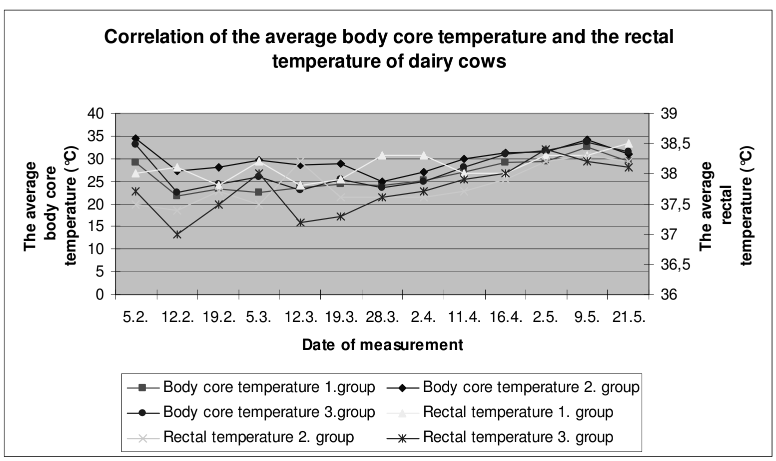

Figure 4. Correlation of the average body core temperature and the rectal temperature of dairy cows

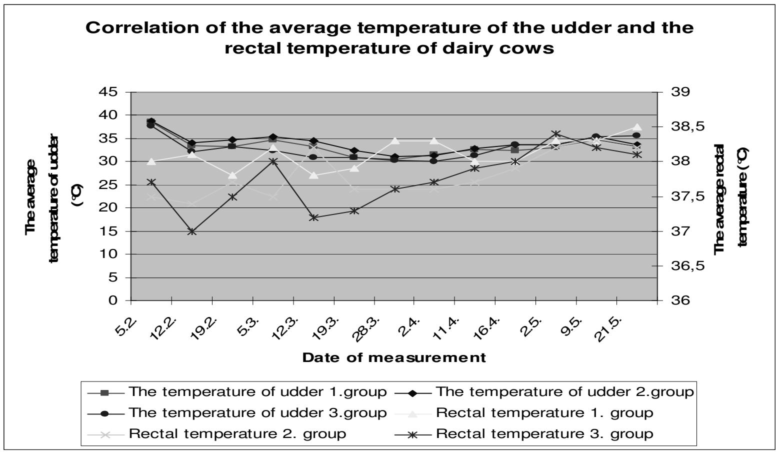

Figure 5. Correlation of the average temperature of the udder and the rectal temperature of dairy cows

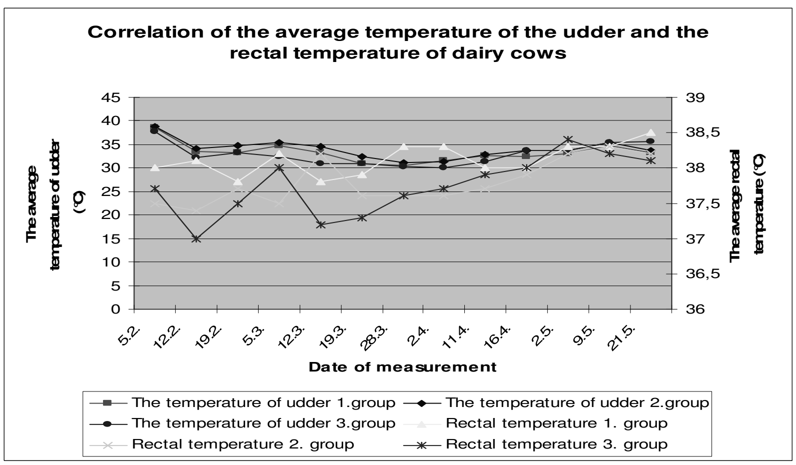

Figure 6. Correlation of the average temperature of the eye and the rectal temperature

CONCLUSIONS

36 dairy cows and heifers from the agricultural farm in Petrovice were measured. It was measured body surface temperatures of three different parts of the body (body core surface temperature, udder surface temperature and eye temperature). These temperatures were scanned using a thermographic camera TESTO 875. It was measured also the rectal temperature with the rectal thermometer. The average rectal temperatures were in all three measured groups of dairy cows and heifers between 37 – 38°C. The measured

temperatures in the eye were the closest to the rectal temperature values. It was found that the temperatures of the measured bod parts of animals were noticeably affected by the ambient temperature. A main role played the emissivity and the setting of the thermographic camera. Different factors such as the nature coat or degree of muscular acted for each animal. These significantly affected the results. Dairy cows and heifers showed no negative effects of thermal comfort though the high measured value of the optimal cooling values of the environment.

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