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PRODUCTION OF DAIRY COWS AT DIFFERENT ENVIRONMENTAL CLIMATIC PARAMETERS

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ABSTRACT:

Cattle have a constant body temperature, which held up to a certain limit. Due to changing ambient climatic parameters (temperature, humidity, THI index), can lead to certain consequences which have a deleterious effect on the health of the animals, and even can cause death of the animal. The assumption of this research was that the environmental climatic parameters have an impact on cows in milk production.

The study involved 50 Holstein cows, which were divided in the same building and in the two groups: the first (n = 25) = 30 kg milk and 2 (n = 25) = 30 and more kg of milk. The results showed that the surface temperature of the body was measured on the left side of the body cows (area rumen) increased no matter what was the level of milk production. However, the surface temperature of the udder measured from the back of the cows showed a different trend. The temperature of the udder of the cow in the first (with a milk production of less than 30 kg) was constant (average of 34.95 ° C), in contrast to the other groups of cows (with a milk production of 30 kg or more), where the surface temperature is increased as the udder increased and THI index in the barn.

The increase in metabolic activity in animals (such as dairy cows) and leads to an increase in surface heat in certain parts of the body, and what is even more pronounced when the animals are in inadequate surroundings or barn that is not adapted to cows with high milk production.

Key words: dairy cows, environmental, climatic parameters, THI index

INTRODUCTION

Cattle belong to homeothermic animals, or those their body temperature up to certain limits can be maintained constant. The relatively constant temperature is required for operating the vital and manufacturing processes. It is necessary to maintain a balance between heat production and heat emission to the environment (Richter et al., 2006). The body temperature of cows is influenced by different factors: varies with the stage of lactation, milk production (Bohman, 2006), and shows the highest increase after feeding (Yousef, 1985). In addition, also the climatic conditions affect the amount of body temperature. Cattle, like most homeothermic animals, produce excess heat, which must be released into the environment. The skin, which makes the link between the environment and the heat, maintains the balance between heat production of the body and its immediate surroundings. In this way it can meet the physiological needs of the body. Therefore, the infrared thermography suitable diagnostic tool for the detection of all types of diseases, which are in any way

related to changes in blood flow (Voice, 2008). Khalifa (2003) states that in cases when the ambient temperature falls below the lower critical temperature, cattle trying to maintain their body temperature to increase metabolic activity and trembling. However, with the increase in ambient temperature above the critical temperature the body tries to balance the load imposed and increased perspiration and a reduction in metabolic heat production. The higher the ambient temperature, then it takes more energy for thermoregulation. This mechanism is important because animals in this way prevents the increase of their own body temperature. For Holstein cows to the area where the ambient temperature is between 23-26°C (Igone et al., 1992; Hahn, 1999). With increasing temperature the body tries to reduce heat production. This makes the reduction of food intake, but consequently leads to the decrease in production (West, 2003). If these mechanisms are not sufficient, body temperature begins to rise and then can lead to hyperthermia (Robertshaw, 1981). Temperatures of between 42 and 43°C can lead to heat stroke, which in most cases fatal ends (Jessen, 2000). For dairy cows the temperature range of thermal neutrality is different, depending on the author. So Bianca (1971) and Yousef (1985) in the field of thermal neutrality state ambient temperature from 0 to 16°C, Heidenreich et al. (2004) of 4 to 16°C, while Małków-Nerge et al. (2005) report from -7 to 17°C.

The aim of this study was to measure the value of the most important climatic parameters in the barn, milk producing cows that reside in this area, the body temperature of cows on certain parts of the body, and to determine how these climatic parameters in the barn affect cows with different heights of milk production.

MATERIALS AND METHODS

The study was conducted on a Holstein dairy farm in Eastern Croatia. Cows, in accordance to the daily milk production, were divided into two groups: Group 1 (n = 25) with a daily production <30 kg of milk (13 to 29.99 kg) and Group 2 (n = 25) with a daily production of >= 30 kg of milk (30 to 53.50 kg). The farm is a modern concept of building: free grazing, semi-open type. Milking was performed by robots Lely Astronaut A4 automatic milking. The period of study was from 10.06.2013 to 31.03.2014. The daily measures of milk yield was available for analysis. Temperature (T) and humidity (H) in the barn were measured with digital device "Data Logger PCE-HT71". Temperature-humidity index (THI) was calculated according to Kibler (1964). The data on external climate parameters are taken from the Meteorological and Hydrological Service of the Republic of Croatian. The measurements of the surface temperature of the cow's body was measured by the thermo camera Flir i7 brand and from a distance of 2 m. Cows were measured from the left side (area rumen) and on the area of the udder from the rear cows. To process the thermal images software Flir QR was used. For statistical analysis of the data GLM procedure of SAS statistical program was used.

RESULTS AND DISCUSSION

Air temperature in the barn during the study (Table 1) ranged in interval from 2.9 to 28.3°C, with an average value of 20.71 °C. Optimal temperatures according to some sources (Bianca, 1971; Heidenreich et al. 2004) suggest that the average temperature in our research was above the recommended. The temperature of the udder from the cow's rear side measured by the thermal camera had an average value of 35.32 °C, while the temperature of the cow's body measured from the left side (area of the rumen) was slightly lower and amounted to 33.05 °C. The average daily milk production was 30.42 kg.

Table 1. Basic statistics of the investigated parameters (n=50)

Variable	Unit	Mean	Std Dev	Min	Max
Air temperature in barn	°C	20.71	7.60	2.90	28.30
Humidity in barn	%	63.16	12.16	46.80	89.90
THI in barn	-	66.21	11.19	38.40	78.10
Air temperature outside barns	°C	19.75	7.92	-2.50	29.20
Humidity outside barns	%	54.22	15.72	38.00	96.00
THI outside barns	-	63.99	10.95	28.17	7622
Surface temperature of the body left by cows	°C	33.05	2.70	26.60	37.00
Surface temperature of the udder - viewed from behind	°C	35.32	1.34	30.60	37.20
Average daily milk production	kg	30.42	9.45	13.00	53.50

Table 2 shows the Lsmeans values determined for the first and second group, and the significance of the differences between compared groups. The average daily milk production in the first group was 23.22 kg, while in the second group was 37.63 kg. Among these groups, a highly significant difference (P <0.001) for the average daily milk production was found. Highly significant differences (P <0.001) were also found for the other tested parameters (surface temperature of the body with the left hand and the surface temperature of the udder from the rear of the cow).

Table 2. Lsmeans and the differences between the experimental groups

Variable	Unit	1. group (< 30 kg of milk)		2. group (=> 30 kg of milk)		Difference
		Mean	Std Dev	Mean	Std Dev	
Average daily milk production	kg	23.22	5.31	37.63	6.76	***
Surface temperature of the body left by cows	°C	32.52	2.99	33.58	2.31	***
Surface temperature of the udder - viewed from behind	°C	34.95	1.63	35.70	0.84	***

*** P<0,001

Figure 1 presents a first group of cows with daily milk production lower than 30 kg. The measured surface temperature of the body on the left side of the cows increased as increased THI index in the barn. However, these cows did not change the surface temperature of the udder. Figure 2 refers to a

group of cows with daily milk production equal and higher than 30 kg. In these cows, increase of THI index was followed by the increase of the surface temperature of the body to the left, as the temperature of the udder. This phenomenon of rising temperatures comment by certainly with increasing milk production comes to higher metabolic processes that occur due consequently to an increase in temperature. Speakman and Król (2010) state that the heat is actually a by-product of metabolic processes. It has different values, depending on what the animal is doing. Thus, the warm-blooded animal production of low heat when the animals are in the basal state or elevated in animals that have a high production. This fact explains the situation that was found in this research.

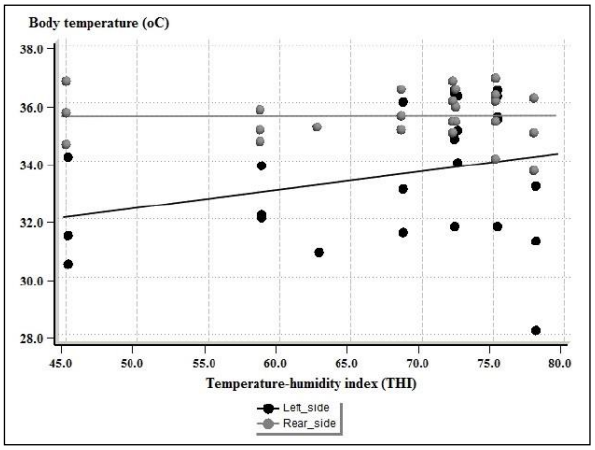

Figure 1. The temperature of the body of cows (°C) with daily production <30 kg of milk at different values of THI in the barn

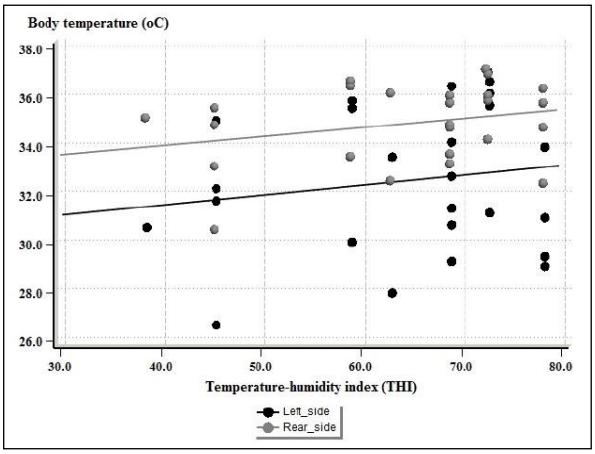

Figure 2. Temperature bodies cows (°C) with daily production => 30 kg of milk at different values of THI in the barn

CONCLUSION

Based on the research it could be concluded that the environmental climatic parameters affecting the animals and their environment in which they reside. This is especially true in highly productive animals, such as dairy cows, which most of their productive life staying indoors or in adequate conditions. Climate change is more and more pronounced, therefore, with purpose of a successful production, and ensuring the animal welfare, object adaptation is needed. Additionally, it will be needed to introduce additional measures to overcome the period with increased temperature, humidity or THI index.

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