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EFFECT OF MAXIMAL MICRO-CLIMATIC VALUES IN STABLE ON MILK PRODUCTION OF HOLSTEIN COWS ON 2nd LACTATION

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Abstract

Aim of this study was to investigate influence of maximal micro-climatic values in stable on milk production of Holstein cows on 2nd lactation. Fifteen Holstein cows on 2nd lactation were kept together in identical conditions in loose housing stable with bedding and fed ad libitum a complete ration. Cows were milked twice a day at 4.00 and 16.00 h. In the period from 1st May to 26th August 2009 (118 days) were monitored parameters of stable microclimate and daily milk yield. As stable microclimatic values were monitored air temperature (ºC), relative humidity (%) and counted temperature–humidity index (THI).
The average milk yield was 32.6 kg per day. Maximal daily temperature resp. THI reached 35.3 ºC resp. 82.7 with mean 26.4 ºC resp. 72.3. The milk production was mostly influenced by maximal resp. average daily THI (r= -0.55 resp. r= -0.57).
Keywords: cows, milk production, stable, temperature, relative humidity, THI, heat stress

Introduction

From a global perspective, Czech Republic (CZ) lies in the temperate zone with a regular distribution of precipitation throughout the year. Prevailing circulation conditions in Central Europe and the orographic conditions of our territory determine the typical distribution of climate in CZ, where a warmer and drier climate is typical for lowland areas and a colder and wetter climate for highland and mountain areas (*Tolasz et al,* 2007).

Problems with global warming are worldwide discussed. It is evidently apparent that husbandry conditions belong to the influence of global warming. Relatively specific problem is negative impact of high temperature on cattle in conditions of stable microclimate. Also *Hahn* (1999) presents that global warming has the potential to exacerbate impact of summer weather on vulnerable animals.

The most sensitive cattle categories to high ambient temperature are lactating dairy cows. Lactating dairy cows create a large quantity of metabolic heat and accumulate additional heat from radiant energy. Heat production and accumulation, coupled with compromised cooling capability because of environmental conditions, causes heat load in the cow to increase to the point that body temperature rises, intake declines and ultimately the cows productivity declines (*West*, 2003).

The objective of the present study was to examine influence of maximal micro-climatic values in stable on milk production of Holstein cows on 2nd lactation.

Materials and methods

It were evaluated the effect of stable daily maximal micro-climate values on milk production at fifteen Holstein cows on 2nd lactation placed on university farm in Zabcice (CZ) lies in lowland area (49°0'4"North, 16°36'East, 179 m of altitude). All fifteen cows were kept together in identical conditions in loose housing stable with bedding and fed ad libitum a complete ration. Cows were milked twice daily at 4.00 and 16.00 h.

In the period from 1st May to 26th August 2009 (118 days) were monitored parameters of stable microclimate and daily milk yield. As stable microclimatic factors were monitored air temperature (ºC), relative humidity (%) and temperature–humidity index (THI). Temperature and humidity was obtained by three data loggers (HOBO) in 15 min. intervals placed in withers area in the stable. Than was counted average daily temperature and humidity as mean from measured values at 7, 14, 21 hours and detected maximal daily values from whole day. THI was calculated by adapted equation of *Hahn* (1999) cited *Eigenberg et al.* (2005):

$$THI = 0.8\, t_{db} + (t_{db} - 14.4) * RH /100 + 46.4,$$

where t_{db} = daily average dry bulb temperature and RH = relative humidity in decimal form. We used program Statistica 9.0 for all statistic analyses.

Results and discussion

Statistic characteristics of average daily values as mean, range and variability are presented in *Table 1*. Average daily milk yield per cow was 32.6 kg. Maximal daily temperature varied from 16.0 to 35.3 ºC during the observed period. Average daily temperature was from 12.4 to 27.8 ºC. It has been recorded 76 summer days resp. 12 tropic days when the average daily temperature exceed 20 resp. 25 ºC. Maximal daily relative humidity was from 25.4 to 91.6% and maximal daily temperature–humidity index (THI) was from 60.1 to 82.7. In *Table 2* there are presented correlation coefficients between average daily milk yield, maximal and average micro-climatic values. The milk yield was more influenced by average daily THI (r= -0.57) than maximal daily THI (r=-0.55). As far as relationships betwen maximal and average values were concerned the higher relation was between maximal daily THI and average daily THI (r=0.94).

Table 1. **Statistic characteristics of milk production and micro-climatic values**

Value	Units	Mean	Range	Vx [%]
Avg. milk yield	Kg/d	32,6	27,5-37,7	8,6
Max. daily temperature	ºC	26,4	16,0-35,3	17,0
Max. daily RH	%	42,9	25,4-91,6	32,6
Max. daily THI	-	72,3	60,1-82,7	6,9
Avg. daily temperature	ºC	20,8	12,4-27,8	17,1
Avg. daily RH	%	64,5	38,5-93,6	19,1
Avg. daily THI	-	67,1	54,7-77,2	7,7

In *Figure 1* are presented the relationship between daily milk production and maximal daily temperature. It has beed found decreasing tendency in milk production along with increasing of temperature.

General decline of milk yield was evidently caused by temperature comfort level. *Bouraoui* (2002) as well as *Armstrong* (1994) presented that when is exceeded the critical THI 72 comfort level is disturbed. As well *Berman et al* (1985) indicated that the upper critical air temperature for a dairy cows is 25 to 26 ºC.

The effect of only the relative humidity on milk production was very low which is in conformable with many authors e.g. *Šoch et al* (2003). Explanation can be that high humidity periods are when is the lower temperature during the year (spring and autum) how stated *Walterová et al* (2009).

***Table 2*. Correlation coefficients between average daily milk yield, maximal and average micro-climatic values**

	Max. daily Temp.	Max. daily RH	Max. daily THI	Avg. daily Temp.	Avg. daily RH	Avg. daily THI
Max. daily Temp.						
Max. Daily RH	-0,50					
Max. Daily THI	0,97	-0,29				
Avg. Daily Temp.	0,92	-0,29	0,94			
Avg. Daily RH	-0,25	0,82	-0,05	-0,11		
Avg. Daily THI	0,89	-0,19	0,94	0,99	0,02	
Avg.Milk Yield /day	**-0,51**	**0,03**	**-0,55**	**-0,57**	**-0,06**	**-0,57**

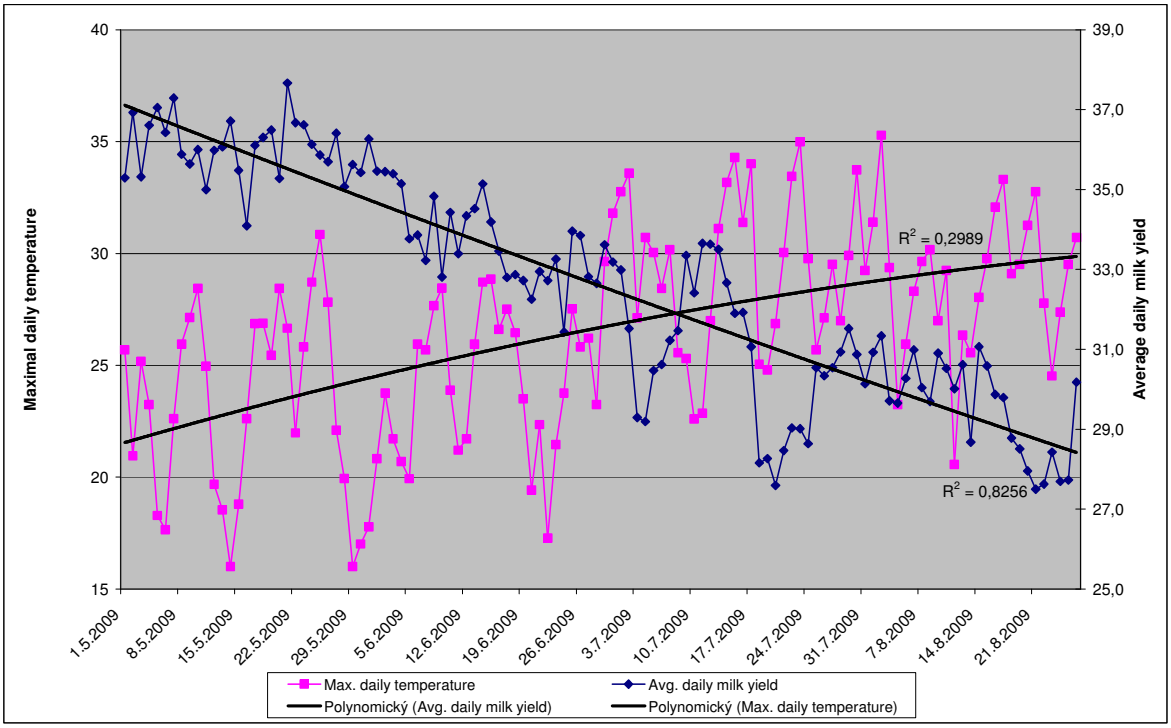

***Fig. 1*. The relationship between daily milk production and maximal daily temperature**

Conclusion

The milk production was mostly influenced by maximal resp. average daily THI (r= -0.55 resp. r= -0.57). It has found decreasing tendency of milk production when the temperature increase above 22 ºC.

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