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## THE EFFECT OF TEMPERATURES ON THE BEHAVIOUR OF CZECH FLECKVIEH COWS

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### ABSTRACT

A group of 98 Czech Fleckvieh cows (one section) was observed over the period of one year with the aim to determine the variation in their milk performance and behaviour at cowshed different cowshed temperatures. Behaviour were recorded once a week (on the same day) at 10:00. Periods of 8 weeks with the highest temperature (hot period – H) and of 8 weeks with the lowest temperature (cold period – L) were then compared. The cows were housed in one section (1/4 of the total capacity) of the free-cubicle shed and where the cubicles were distributed into three rows. Row A (32 cubicles) was close to the feeding plateau, row B (33 cubicles) was in the centre and row C (38 cubicles) was peripheral, close to the side wall. The cowshed temperature was monitored on a daily basis and the mean temperature was 23.2 °C in the hot period and -1.7°C in the cold period, relative humidity 60.2 % (H) and 74.6 % (L) and THI 69.4 (H) and 33.4 (L). The behaviour of the cows was recorded 1568 times, showing them mostly lying down (1037) or standing (531). The cows tended to prefer lying down on their left sides (594 observations) as opposed to their right sides (443).

**Key words:** Czech Fleckvieh, temperature, behaviour, cows, lying, standing

### INTRODUCTION

Although the process of domestication brought about a number of important, even essential, changes in farm animal performance, the environmental requirements of animals remained relatively invariable throughout their phylogenesis. The impact of environmental factors on domesticated animals is extremely complex and difficult to define. The more the original environmental conditions change, the greater the responsibility of the breeder to provide adequately for animals' needs (Chládek, 2004).

Cowshed microclimate is, together with nutrition, type of housing and animal handling, one of the main factors affecting the animal. It affects cows' well-being and performance and subsequently herd performance and profitability. Cowshed microclimate is defined in terms of air temperature, relative humidity, air velocity and the presence of various components – gasses, dust, microorganisms, etc. (Matějka, 1995).

According to Bílek (2002) cowshed temperature is the most important factor. The negative impact of high temperature is heightened by air humidity Koukal (2001). With increasing relative humidity, heat tolerance and stress resistance of cows decrease (Doležal et al., 2003). The Temperature-Humidity Index (THI) is used to describe the combined effects of temperature and relative humidity (West, 2003).

The time spent lying down is an indicator of the housing quality and a comfortable laying-down area is therefore one of the most important housing design criteria for dairy cows (Ito et al., 2009). The amount of time spent comfortably laying down is fundamental for cows' welfare (Thorne, 2008). It can be extended by various means, e.g. through the provision of additional bedding (Colam-Ainsworth, 1989; Drissler, 2005). The quality of cubicle surface, the number of cubicles and the area available for each cow are important characteristics affecting laying behaviour (Fregonesi et al., 2007). In order to maintain a good level of welfare of cows it is essential to analyse and understand their behavioural responses to cowshed microclimate changes, including the impact of low and high temperatures on the general behaviour and performance of cows.

## MATERIAL AND METHODS

The primary objective of the experiment was to assess the effects of low and high cowshed temperatures on the behaviour of Czech Fleckvieh cows. Observations were recorded on a private farm GenAgro Ricany a.s. (Czech Republic; geographic coordinates 49°12'30.370''N, 16°23'43.092''E). The observed section (1/4 of the cowshed) included 103 comfortable cubicles arranged into three rows (see Figure 1.) Row A (32 cubicles) was the closest to the feeding plateau, row B (33 cubicles) was in the middle of the section and row C (38 cubicles) was situated peripherally, close to the side wall. Some other experiments described by Erbez et al. (2012) and Javorova et al. (2014) were carried out in this cowshed.

The average number of cows housed in the observed section was 98 and in various days in milk (30d and more) and lactation number (1<sup>st</sup> to 8<sup>th</sup>). The average milk yield was about 28.1 kg per cow per day. There were no dry cows. The data on milk yield consistency and days of milk were recorded on the test days using the milking parlour software FASTOS 2000.

Data were collected over a period of one year (from the 1<sup>st</sup> June to 31<sup>st</sup> May). Behaviour were monitored once a week, always on the same day, at 10.00. Then data from the 8 hottest (H) and 8 coldest (L) weeks were compared. The behaviour was described as the number of cows standing or lying down, the number of cows lying down on their left or right side. The microclimate characteristics (air temperature and relative humidity) were recorded by HOBO data loggers which were distributed throughout the cowshed. Their detailed placement and function were described in Erbez et al. (2012). THI values were calculated using the following equation (Hahn, 1999):

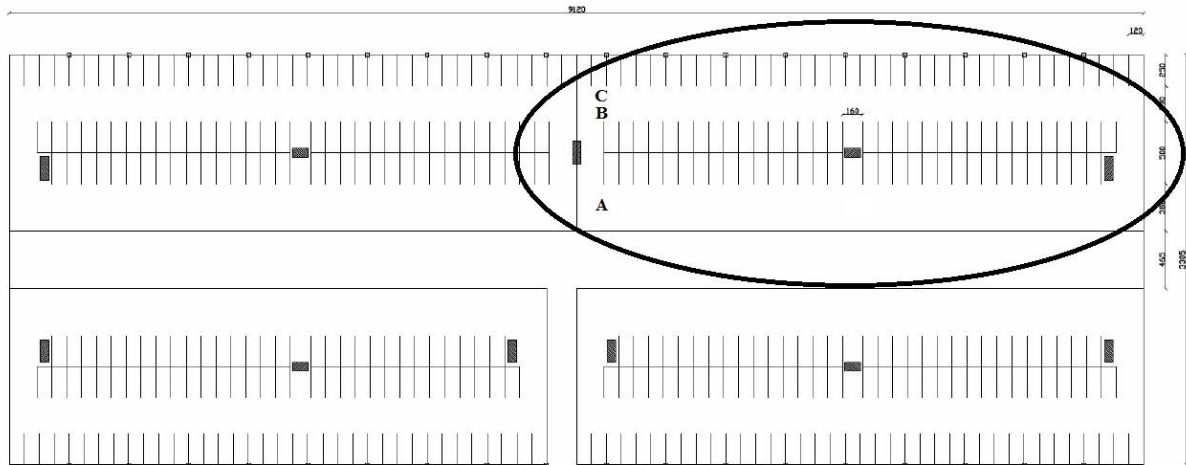
$$THI = 0.8 tdb + (tdb - 14.4) * RH/100 + 46.4$$

Where:

tdb = cowshed temperature

RH = relative humidity

The calculated values were statistically evaluated by GLM procedure (to test for mean) and chi-square test (Statistica 10.0).



**Figure 1:** The scheme of the observed section

## RESULTS AND DISCUSSION

### The differences in the frequency of lying down and standing

The cowshed microclimatic characteristics (temperature, relative humidity and THI) are presented in **Table I**. Mean values of the characteristics were +23.2 °C, 60.2 % and 69.4 in H period (high temperature) and -1.7 °C, 74.6 % and 33.4 in L period (low temperature). The differences between H and L periods were statistically highly significant.

According to Erbez et al. (2012) heat stress develops at temperatures of +21 °C and higher. The upper temperature limit recorded in this study was +2.2 °C (+23.2 °C) higher than this threshold temperature value indicated in literature.

The milk yield, lactation number and days in milk of in H and L periods and the differences in the frequency of lying down and standing behaviour of the cows are presented in **Table II**.

The number of observations recorded in hot and cold periods (H and L) were equal – 784 observations in each group. The recorded cow behaviour shows that cows were lying down (1037 observations) or standing (531 observations). The cows preferred lying down (1037 observations which makes up 66% of the total number) to standing and the milk yield of the cows lying down was non-significantly higher (by 0.6 kg milk) compared to the standing cows (531 observations). The lactation number was greater in the cows lying down but no statistical differences were found in days in milk and milk yield between the laying and standing cows.

The effect of temperature on laterality (preference of one side of the body over another) of cows' lying down behaviour, milk yield, lactation number and days in milk are described in **Table III**.

The total number of observations was 1 037. The cows preferring laying on their left sides produced significantly more milk (by 0.9 kg) and were of higher lactation number than the cows showing preference for laying on their right sides. There was no difference among the stages of lactation.

Cows showed preference for lying down on their left sides in both hot and cold periods. The combination of laterality and cowshed temperature showed that cows showing preference for lying on their left sides produced more milk in both periods.

Table I Climatic characteristics measured inside the cowshed

Period and climatic characteristics			Period		
			High	Low	Sig.
Temperature (°C)	avg.	10.8	23.2	-1.7	**
	min.	-9.4	21.0	-9.4	
	max.	26.8	26.8	1.9	
Relative humidity (%)	avg.	67.1	60.2	74.6	**
	min.	46.9	46.9	48.4	
	max.	96.1	67.4	96.1	
THI	avg.	51.4	69.4	33.4	**
	min.	26.3	66.0	26.3	
	max.	74.9	74.9	39.6	

Within the column (Sig.), values marked with \* and \*\* differ ( $P < 0.05$ ) and ( $P < 0.01$ ), respectively or the difference is not significant (NS)

Within the row, values marked with different letters a, b, c, differ significantly

Cows spend on average 13 hours per day (h/d) laying down (Houpt, 1998). Tucker et al. (2004) specified the range between 9.4 – 14.7 h/d. In adverse conditions cows tend to spend more time standing than laying down, are more susceptible to health problems and produce less milk (Thorne, 2008). According to O’Driscolla et al. (2009) cows spend more time laying down in winter than in summer in any kind of housing arrangement. Vecera et al. (2012) also found greater numbers of cows laying down in colder periods compared to cows standing. A non-significant tendency regarding the preference of left side corresponds with the results of Hrouz et al. (2007), who found that 53 – 70 % of the observed cows preferred to rest on their left sides. Tucker et al. (2009) also observed left-side laterality in loose-housed dry cows; however the authors admitted that cows in pens or on pasture may exhibit no laterality when laying down. Although the cows show no overall preference of side as a group, there might be strong individual preferences (Gibbons et al., 2012).

**Table II, Milk production, lactation number and days in milk of cows during H and L periods; differences in lying and standing**

Period and row	n / avg.	Period			Lying x standing			Period x lying and standing					
Number and parameter		High	Low	Sig.	Laying	Standing	Sig.	High x Lie	High x Stand	Low x Lie	Low x Stand	Sig.	Sig. of inter.
Number	1568	784	784		1037	531		518	266	519	265		
Milk production (kg/cow/day)	28.9	30.4 <sup>A</sup>	27.4 <sup>B</sup>	**	29.1	28.5	NS	30.6	30.0	27.6	27.0	NS	NS
Lactation number (l/cow)	3.12	3.21 <sup>A</sup>	3.02 <sup>B</sup>	**	3.18 <sup>a</sup>	2.99 <sup>b</sup>	*	3.25	3.15	3.12	2.84	NS	NS
Days in milk (days/cow)	129.2	131.5	126.9	NS	130.4	126.9	NS	133.1	128.4	127.7	125.3	NS	NS

Within the column, values marked with \* and \*\* differ ( $P < 0.05$ ) and ( $P < 0.01$ ), respectively or the difference is not significant (NS)

Within the row, values marked with different letters a, b, c, differ significantly

**Table III, Milk production, lactation number and days in milk of cows during H and L periods; lying laterality**

Period and row	n / avg.	Period			Side			Period x lying laterality					
Number and parameter		High	Low	Sig.	Left	Right	Sig.	High x Left	High x Right	Low x Left	Low x Right	Sig.	Sig. of inter.
Number	1037	518	519		594	443		293	225	301	218		
Milk production (kg/cow/day)	29.1	30.6 <sup>A</sup>	27.5 <sup>B</sup>	**	29.5 <sup>a</sup>	28.6 <sup>b</sup>	*	31.1	30.0	27.8	27.0	NS	NS
Lactation number (l/cow)	3.18	3.26 <sup>A</sup>	3.10 <sup>B</sup>	**	3.19 <sup>a</sup>	3.17 <sup>b</sup>	*	3.16	3.37	3.22	2.97	*	*
Days in milk (day/cow)	130.4	133.5	126.8	NS	131.5	128.9	NS	130.6	136.4	132.4	121.3	NS	NS

Within the column, values marked with \* and \*\* differ ( $P < 0.05$ ) and ( $P < 0.01$ ), respectively or the difference is not significant (NS)

*Within the row, values marked with different letters a, b, c, differ significantly*

Zejdova et al. (2011) reported that older cows (4<sup>th</sup> lactation number and older) lay on the left side more often than younger cows (2<sup>nd</sup> and 3<sup>rd</sup> lactation). A greater milk yield in cows preferring the left side (Vecera et al., 2012) might be due to the anatomical differences in the left and right lung. A greater respiration capacity of the right lung allows better lung ventilation in cows lying on their left side. Presumably, there are more factors affecting laterality but the specific anatomy of adult ruminants is likely to be the main cause. This presumption was supported by Phillips (2002) who claimed that calves show no laterality because their rumen has not been developed and they are not forced to rest in the sternal position.

The findings of this study do not conclusively prove the anticipated negative impact of high temperatures on milk yield with Czech Fleckvieh cows. Findings do however suggest that high temperatures negatively affected milk yield in Holstein dairy cows, due to their greater sensitivity to heat stress (e.g. in Zejdova et al., 2011).

## CONCLUSIONS

The findings reported in this study suggest important variations in behaviour of cows associated with high and low cowshed temperatures. Cows with a tendency to laying down were older (greater consistency) than the cows with a preference for standing and tended to produce more milk (a non-significant difference). Cows showing preference for laying down on their left sides produced more milk and were older than the cows laying down on their right sides.

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