AIR TEMPERATURE IMPACTS ON THE BEHAVIOUR OF HOLSTEIN CALVES IN INDIVIDUAL OUTDOOR CALF HUTCHES ACCORDING TO AGE OF OBSERVED CALVES

VACULIKOVA MARTINA, CHLADEK GUSTAV
Department of Animal Breeding
Mendel University in Brno
Zemedelska 1, 613 00 Brno
CZECH REPUBLIC

xvaculi1@node.mendelu.cz

Abstract: The aim of this study was evaluating the influence of air temperature on behaviour of Holstein calves in individual outdoor calf hutches according to age of calves. Experimental part of this study has been done on the university's dairy facility - farm Žabčice. Among the analysed behavioural manifestations were especially: time spent standing or lying down, either inside or outside the hutch. Within obtained results it can be said that the temperature is important factor while evaluating its impact on Holstein calves kept in individual outdoor calf hutches behaviour, however more important factor was the age of calves.

Key Words: age, calves, individual outdoor calf hutches, temperature

INTRODUCTION

Air temperature is an important factor of stable microclimate and it affects the microclimate the most. Along with other physical characteristics, such as airflow and relative humidity it also has the greatest impact on the thermal condition of animal and its thermal comfort (Doležal et al. 2004). The range of thermal comfort – the thermoneutral zone, does not only depend on the species of livestock, but also on the breed, gender, performance, weight, nutrition, but mainly on age. Cattle, in comparison with other species, shows relatively broad thermoneutral zone (10°C or more). But in calves the range of optimal temperature is very narrow (Malá et al. 2010). Despite the fact that even newborn calves can resist cold and deal with it very well, the risk of hypothermia threatens about 5% of their (Jedlička 2006). Calves have also greater difficulty coping with sudden temperature changes within first few days after birth (Borderas et al. 2009). Immediately after birth the newborn calf gets in temperature discomfort because of the change of environment – from the inner environment of mother's uterus with optimal temperature to much cooler outside environment (Doležal et al. 2008). The lower critical temperature to newborn calves in draft-free conditions is 9°C (Malá et al. 2010, Ježková 2014, Doležal 2012). For older calves the lower critical temperature is 0°C (Ježková 2014). Successful adaptation of dairy calf to cold depends on adequate nutrition (Nonnecke et al. 2009). If the animal is not able to remove sufficient heat via sweating to ensure the maintenance of thermal balance, the body temperature is increasing and heat stress occurs, to which all the environmental factors contribute, but the most important one is the increase of air temperature (Colturato 2012). While calves are born with a very well developed thermoregulation, calves born in summer or during tropical days are worse off than those born in winter months (Doležal 2012), because the temperature and intensity of sunlight in the summer often exceeds the critical (Doležal 2008) and air temperatures above 25°C means a significant burden for the calf's organism (Malá et al. 2014). We can assume that this is due to the fact that older categories of cattle have already created a more efficient system to eliminate the heat stress (Rožnovský, Litschmann 2005).

MATERIAL AND METHODS

For the purpose of this study the behavioural observation of calves was conducted. There were two phases of observation – at low temperatures (from 31st January to 7th March 2014) and at high temperatures (from 20th June to 25th July 2014). The behaviour at low and high temperatures was

important. The observation took place at university's dairy facility in Žabčice. Only Holstein heifers from 4 days of age were observed. All animals were housed in individual outdoor calf hutches of same type and common sizes. Hutches were placed side by side in two rows with inlet openings situated to the east or west. Both stages of observation took place since morning feeding to afternoon feeding (6.30 to 16.30). Data were recorded at 15 minute intervals to ethogram. Calves were divided into two groups by their age – young age and advanced age. The average age of young calves in the period from 31st January to 7th March 2014 was 24 days. The average age of advanced calves in the same period was 46 days. The average age of young calves in the period from 20th June to 25th July 2014 was 22 days. The average age of calves in the same period was 41 days. The number of calves in the group were taken into account within days. Throughout the study calves were fed ad libitum starter and water. They were also fed milk replacer two times a day. In this ethological monitoring, time spent lying down or standing, either outside or inside the hutch, were observed. The results of observation are displayed in Table 1. The results of observation were processed by conventional mathematical – statistical methods.

RESULTS AND DISCUSSION

Table 1 Basic parameters of ethological observation at lower daily temperature – the impact of age on the monitored vital signs in calves

Basic parameters of ethological observation		First stage – observation at lower daily temperature						Σ
Date of observation		31.1.	7.2.	14.2.	21.2.	28.2.	7.3.	6 weeks
Number of records		925	950	1064	1064	1064	1092	6159
								x̄
Average age (days)		22	29	33	40	47	54	38
Average weight (kg)		49.7						49.7
Average temperature (°C)		0.6	1.7	3.4	4.8	3.1	5.1	3.1
Maximum temperature (°C)		1.7	4.2	9.6	11.7	8.4	9.6	7.5
Minimum temperature (°C)		-0.9	-3.2	-3.7	-2.1	-1.3	1.2	-1.7
	Monitored major activities and their frequency in the group							Σ
Young age	Total standing	207	173	223	221	202	225	1251
	Total lying	200	245	309	311	330	321	1716
	Outside the hutch	45	74	138	169	168	170	764
	Inside the hutch	362	344	394	363	364	376	2203
	Monitored major activities and their frequency in the group							Σ
Higher age	Total standing	279	248	200	199	193	228	1347
	Total lying	239	284	332	333	339	318	1845
	Outside the hutch	106	177	152	167	169	190	961
	Inside the hutch	412	355	380	365	363	356	2231

The results show that in the period from 31st January to 7th March 2014 - Basic parameters of ethological observation at lower daily temperature – the impact of age on the monitored vital signs in calves are displayed in Table 1; animals were lying more than standing and they were more inside the hutch than outside, and with rising temperature and increased age calves in the group of young age tend to lie even more, which corresponds to the claim (Hauptman et al. 1972), which states that the

younger calves spend more time lying down than standing. Assuming calves had well littered bed, dry and clean bedding, we can assume that more calves were lying due to the assertion (Malá et al. 2014), which states that dry bedding is very important for thermoregulation, since it reduces heat loss from the body by conduction, thus helps calves overcome low temperature environment. Preference of these calves to stay in hutch was in decline, but it still held a higher proportion than staying outside. Calves in the group of higher age preferred more lying than standing with increasing temperature and age, while with rising temperature and age the preference of staying in the hutch was in decline, but still held a higher proportion than staying outside. The differences in observed vital signs between the group of young and higher age were not particularly striking during this period.

Table 2 Basic parameters of ethological observation at higher daily temperature – the impact of age on the monitored vital signs in calves

Basic parameters of ethological observation		Second stage – observation at higher daily temperature						Σ
	Date of observation	20.6.	27.6.	4.7.	11.7.	18.7.	25.7.	6 weeks
	Number of records	468	640	760	760	760	760	4148
								x̄
	Average age (days)	21	23	26	33	40	47	32
	Average weight (kg)				49.2			49.2
	Average temperature (°C)	15.6	18.7	21.1	18	22.6	20.1	19.4
	Maximum temperature (°C)	21.5	27.5	29.2	25	32.6	29.5	27.6
	Minimum temperature (°C)	8.9	8.7	9.6	13.6	15.8	12.8	11.6
	Monitored major activities and their frequency in the group							Σ
Young age	Total standing	97	62	132	96	86	96	569
	Total lying	176	178	210	246	256	246	1312
	Outside the hutch	98	61	116	80	79	81	515
	Inside the hutch	175	179	226	262	263	261	1366
	Monitored major activities and their frequency in the group							Σ
Higher age	Total standing	74	129	104	119	129	159	714
	Total lying	121	271	314	299	289	259	1553
	Outside the hutch	58	125	96	97	121	154	651
	Inside the hutch	137	275	322	321	297	164	1516

Behavioural observation during the time period from 20th June to 25th July 2014 – basic parameters of ethological observation at higher daily temperature – the impact of age on the monitored vital signs in calves, are displayed in Table 2 – shows, that calves were lying down more than standing and they were more inside the hutch than outside, while with increasing temperature and age, calves in the group of younger age tend to lay down more, apart from 2nd and 3rd week of monitoring, when compared to the 1st week we observed a big drop of this preference. The preference of staying in the hutch was increasing, except for the 2nd week of observation, where there was big drop of this preference compared to first week. Calves in the group of higher age preferred lying down more than standing, while with increasing temperature and age the trend to lie down was in decrease from the 3rd week, but still held a higher proportion than the trend to stand. A trend to stay inside the hutch was in decrease with increasing temperature and age, but still held a higher proportion than being outside the hutch. High temperature definitely has the effect of raising the surface temperature of the body of calves (Rožnovský, Litschmann 2005) and in individual outdoors calf hutches there is significant relationship between the inside temperature and sunshine intensity, i.e. the higher the intensity of solar radiation, the higher the temperature inside the hutch (Vegricht et al. 2013). These allegations are in accordance with the detected results. When comparing the preferences to lie down and stay inside the hutch in calves of young and higher age, during this observation period (from 20th June to 25th July

2014) there were noticeable differences in observed vital signs. In the group of young age calves compared to higher age calves it is evident that older calves tend to stay inside the hutch more. Furthermore, the preference to lying down was higher with higher age calves than with younger calves, despite the fact that (Bonk et al. 2013) indicates that there is some relationship between time spent lying down and age, or: the elderly calves are, the more they increase their activity and they prefer lying less (Hrouz 2012). It can therefore be concluded that there was some age influence. When comparing the results for the entire observation at lower and higher daily temperature (impact of age), there are noticeable differences in overall preference to lying between younger calves at lower and higher daily temperature. Young calves spent 27.9% observation time lying down at lower daily temperature and 31.6% observation time at higher daily temperature. We can conclude that there was some influence of the temperature. Furthermore, calves of higher age at lower daily temperature spent 30% of observation time lying down and at higher daily temperature 37.4% time. We can assume that the difference of 7.4% was due to the temperature. Out of the results regarding the stay inside the hutch we can conclude that younger calves at lower daily temperature were lying down 35.8% of observation time and at higher daily temperature it was 32.9% of observation time. It can be said that the temperature had only marginal impact in this case. Calves of higher age at lower daily temperature lay 36.2% of observed time and at higher daily temperature they lay 36.5% of observed time.

CONCLUSION

When observing the impact of age to the vital signs of calves at lower and higher temperature, calves were generally lying down more than staying and they were more inside the hutch than outside. The differences in observed vital signs between the group of young and higher age at lower temperature were not significant. There are, however, apparent differences at higher daily temperature, especially of higher age were more inside the hutch than younger calves. Also the preference to lie down was greater in older calves.

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