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MAINTENANCE AND COMPETITIVE BEHAVIOUR STUDY IN DAIRY CALVES

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ABSTRACT

The purpose of this study was to investigate the effect of age, gender and sire on behaviour of calves. The study involved 40 dairy calves kept in pens with straw bedding. Three observations of maintenance behaviour were done: at 14, 19 and 24 weeks of age. The activities were registered during 24 h by direct observations at intervals of 10 minutes. The social dominance rank was determined by recording herdmate encounters during 1 h feeding on access to limited amounts of feed during three consecutive days in 22nd week. Maintenance behaviours were increasing with the age ($P<0.001$). Total standing time was steadily decreased from the age of 14 weeks to the age of 24 weeks ($P<0.001$). Total time of eating at the age of 19 weeks was significantly higher opposite to other ages ($P<0.001$). Calves spent lying on the left side and ruminating while lying on the left side longer time. The longer period of total lying, lying on the left side, and lying on the right side was found at the age of 19 weeks. Periods number was increasing within ages in ruminating while on the left and right sides, ruminating while lying, and total ruminating. Eating periods were decreasing from the age of 14 to 24 weeks. The genotype of Sire 3 was significantly manifested in times of total standing, total eating, and number of eating periods. Sire 1 progeny was realized in higher time of total lying and number of lying periods. No significant differences were found between male and female gender in maintenance behaviour. The most successful in competition were calves from Sire 1. They had the most win and total duels ($P<0.05$). No significant differences were found among sires in social index; however, the highest value was recorded for Sire 3. We found higher number of win duels and lower number of total duels in female calves.

Key words: calf, maintenance behaviour, social behaviour, age, gender, sire

INTRODUCTION

An important criterion in the assessment of dairy calve welfare is their maintenance behaviour. Dairy calves have been housed individually, but concerns about animal welfare have led to increased interest in group housing for calves. Group housing can promote growth through an increased feed intake caused by a social facilitation, especially at weaning (Hänninen *et al*., 2005). On the other hand, group housing may disturb calves resting behaviour; especially if the space is restricted (Le-Neindre, 1993; Debrecéni *et al*., 2009). Housing and management conditions can affect rest in young ruminants (Boe *et al*., 2006, Kottferová *et al*., 2008). Lying time, frequency and duration of lying bouts has been used as a measure of cattle comfort (Munksgaard and Simonsen, 1996; Herlin, 1993; Haley *et al*., 2000).

Behaviours involving one of two opposing limbs may be performed on either the right or left side of the body, demonstrating a difference in preference or ability between the two sides. Such behavioural lateralities may be related to asymmetry in body morphology (Phillips *et al*., 2003). Albright and Arave (1997) observed that rumination is more common when cattle are recumbent on the left side rather than the right side and conclude that left side laterality facilitates rumination. Broucek *et al*. (2001) found significant effect of sire on the number of standing bouts, significant effect of gender in the time of lying and standing. The effect of age was significantly differed in the times lying, and lying while ruminating, in

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the time of standing, ruminating and feeding.

Veissier *et al.* (1994) determined the effects of rearing on the subsequent social behaviour of calves. After mixing at 14 weeks, more agonistic and non-agonistic encounters were observed in calves previously kept individually than in group housing. After mixing at 19 weeks, there were only slight differences between calves. The calves that had always been in groups achieved hierarchical ranks higher than calves kept individually. Reinhardt *et al*. (1978) studied mounting and pushing behaviour between female and male calves. Male calves were significantly more active than female calves.

MATERIALS AND METHODS

We assessed 40 Holstein calves (23 males and 17 females) descended from 3 bulls (Sire 1, n=12; Sire 2, n=16; Sire 3, n=12). The calves were kept in pens of loose housing. The calves were moved from the calf barn into the experimental barn at the age of 10 weeks. The group compositions were the same throughout the study. Twenty calves were kept in a pen 9 x 4.5 m (2 m^2 per animal).

We conducted three observations of maintenance behaviour at 14, 19 and 24 weeks of age. At intervals of 10 minutes the general activity of each of the animals was recorded using following categories: lying (laterality and semi laterality on the left and right side), standing, eating concentrates, eating of forage fodder, drinking, ruminating, walking, mooing, grooming myself and others, defecating, urinating, licking the walls, sniffing the walls or others animals.

The social dominance rank was determined by recording herd mate encounters during 1 h feeding on access to limited amounts of feed during three consecutive days in 22nd week. Linear feed trough (2 x 0.5 m) was limited, so that only 14 animals within each pen could feed at once. The main types of encounters recorded were threat, butt and physical combat, displace, and turn away. The dominance value was calculated by dividing the number of animals who are a calf dominated (i.e. this calf displaced the other one at least twice as frequent as the other way around) by the number of animals a calf dominated plus the number of animals dominating the calf (Sambraus, 1975). A mean dominance value of each animal was calculated using the average of three observations. The social index was calculated by dividing the number of win duels by the number of total duels.

The data were analyzed using a General Linear Model ANOVA by the statistical package STATISTIX, Version 9.0. The normality of data distribution was evaluated by the Wilk-Shapiro/Rankin Plot procedure. All data conformed to a normal distribution. Significant differences between groups were tested by Comparisons of Mean Ranks. Values are expressed as means ± SE.

RESULTS AND DISCUSSION

The results of duration of maintenance behaviour showed that almost all activities were increasing with the age (Table 1). The differences were significant ($P<0.001$) excepting total standing. The time was steadily decreased from the age of 14 weeks to the age of 24 weeks (663.21±9.85 min., 610.96±9.68 min., 555.96±10.00).

Almost all activities were increasing with the age. Similar results were obtained in our former study (Broucek *et al*., 2001). Times spent lying, ruminating and feeding were increasing with the age, similar to the number of bouts lying while ruminating, lying on the left side with rumination, ruminating and lying bouts on the right side. Calves, like the young of all species, require more rest than adults (Albright and Arave, 1997). Calves spend most of their time lying when very young (90 % of their time at 1-5 weeks), but this rest time decreases with age, especially after weaning (75 %) (Hänninen *et al*., 2005). These support also our findings on total standing time which was steadily decreased from the age of 14 weeks to the age of 24 weeks.

Total time of eating at the age of 19 weeks was significantly higher oppositely to other ages (289.18±7.40 min., 395.93±7.20 min., 316.93±6.91; $P<0.001$). At the age of 19 weeks the calves performed more eating behaviour. This time elevation with subsequent decreasing is hard to explain. The behaviour of dairy calves can be affected by housing system and management (Sato and Kuroda, 1993; Brouček *et al*., 2008). The patterns of activity during a day depend on housing conditions, diet and daily lighting rhythm. Changes in the time budget may reflect adaptation to specific conditions. However, experimental animals were kept in the same environment during the experiment.

Calves spent lying on the left side and ruminating while lying on the left side longer times. The most periods of total lying (41.13±0.69), lying on the left side (20.86±0.48), and lying on the right side (20.31±0.66) were found at the age of 19 weeks (Table 2). Periods number were increasing within ages in ruminating while lying on the left and right sides, ruminating while lying, and total ruminating. Eating periods were decreasing from the age of 14 to 24 weeks (16.82±0.33, 15.22±0.29, 15.14±0.31).

Calves spent longer time lying on the left side and ruminating while lying on the left side. The development of a functional rumen may influence calve laterality during recumbence (Lane and Phillips, 2004). Left side laterality decreased with age (Arave and Walters, 1980). Laterality in behaviour and asymmetry in morphological characteristics are accentuated by stress. Stress is also

Table 1: Duration of maintenance behaviour at different ages

Time	N	Age in weeks			P	Significance
		14	19	24		
		$\bar{x}$ ± SE	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
total lying	40	747.03±8.50	825.53±8.62	883.03±7.97	0.0000***	3:1,2*** 1:2**
- left side	40	405.15±9.17	436.65±9.00	457.65±9.10	0.0000***	1:3*** 1:2*
- left side, rumin	40	174.82±6.65	251.07±6.75	274.82±6.65	0.0000***	1:2,3*** 2:3*
- right side	40	351.79±9.08	389.29±8.90	425.29±9.22	0.0000***	1:3*** 2:1,3*
- right side, rumin	40	131.29±6.98	164.79±6.98	176.04±7.20	0.0000***	1:3*** 1:2**
- with rumination	40	306.11±10.04	415.86±10.00	450.86±10.30	0.0000***	1:2,3*** 2:3*
total rumination	40	321.67±10.85	449.17±11.00	476.67v10.70	0.0000***	1:2,3***
total standing	40	663.21±9.85	610.96±9.68	555.96±10.00	0.0000***	1:2,3*** 2:3***
total eating	40	289.18±7.40	395.93±7.20	316.93±6.91	0.0000***	2:1,3*** 1:2*

*P<0.05; **P<0.01; ***P<0.001; SE = standard error of mean;
rumin = rumination

Table 2: Number of periods of maintenance behaviour at different ages

Periods	N	Age in weeks			P	Significance
		14	19	24		
		$\bar{x}$ ± SE	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
total lying	40	35.13±0.75	41.13±0.69	39.78±0.81	0.0000***	1:2,3***
- left side	40	18.36±0.47	20.86±0.48	19.71±0.42	0.0014**	1:2***
- left side, rumin	40	6.37±0.24	8.57±0.21	8.97±0.22	0.0000***	1:2,3***
- right side	40	16.76±0.66	20.31±0.66	20.06±0.60	0.0002***	1:2*** 1:3**
- right side, rumin	40	5.43±0.24	7.00±0.24	7.33±0.24	0.0000***	1:2,3***
- rumination	40	11.80±0.35	15.58±0.35	16.28±0.32	0.0000***	1:2,3***
total rumination	40	13.64±0.44	18.32±0.44	18.92±0.40	0.0000***	1:2,3***
total standing	40	45.34±0.97	32.41v0.98	33.96±0.97	0.0000***	1:2,3***
total eating	40	16.82±0.33	15.22±0.29	15.14±0.31	0.0007***	1:2,3**

*P<0.05; **P<0.01; ***P<0.001; SE = standard error of mean;
rumin = rumination

suspected to increase the consistency of behavioural laterality in cattle, thereby allowing decision making to be focused on essential aspects of survival (Phillips *et al*., 2003). Environmental factors may play a major role in developing laterality during ontogeny.

Comparing behaviour of calves according to sires we have found that the genotype of Sire 3 was significantly manifested in times of total standing (641.67±12.18), total eating (366.67±10.18), and number eating periods (16.53±0.36) (Table 3). Sire 1 progeny was realized on the longest time of total lying and the highest number of lying periods (836.67±12.71 min., 40.83±0.87).

Genotype of sires was manifested in times of lying, standing, eating, and number of eating periods. It is

very difficult to explain this phenomenon. There is a lack of sources; nobody has probably dealt with this problem except for us. We concluded from our previous work that the effect of the sires' genotype was manifested only in the number of standing bouts (Broucek *et al*., 2001).

The most successful in competition were calves from Sire 1 (Table 4). They had the most win (8.25±1.56, 6.13±1.43, 7.26±1.57) and total duels (16.64±1.04, 15.34±0.95, 12.90±1.05, P<0.05). No significant differences were found among sires in social index; however, the highest value was recorded in Sire 3 (Table 4). We found higher number of win duels in female calves and contrarily a lower number of total duels.

Table 3: Duration of maintenance behaviours according to sires

Index	Sire			P	Significance
	1	2	3		
	$\bar{x}$ ± SE	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
times					
total lying	836.67±12.71	828.75±11.01	729.50±12.71	0.0329*	1:3*
- left side	433.33±9.92	449.58±8.59	412.22±9.92	0.0199*	2:3*
total standing	600.56±12.18	591.04±10.55	641.67±12.18	0.0064**	2:3**
total eating	329.72±10.18	310.42±8.81	366.67±10.18	0.0003***	2:3*** 1:3*
periods					
total lying	40.83±0.87	37.29±0.75	38.61±0.90	0.0105*	1:2*
total eating	14.94±0.36	15.73±0.31	16.53±0.36	0.0106*	1:3*

*P<0.05; **P<0.01; ***P<0.001; SE = standard error of mean;
Sire 1, N = 12; Sire 2, N = 16; Sire 3, N = 12

Table 4: Social behaviour according to sire lineage

Number of duels	Sire			P	Significance
	1	2	3		
	$\bar{x}$ ± SE	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
win	8.25±1.56	6.13±1.43	7.26±1.57	0.6081	
total	16.64±1.04	15.34±0.95	12.90±1.05	0.0497*	1:3*
Social index					
1st day	0.49±0.09	0.39±0.09	0.54±0.10	0.5504	
2nd day	0.49±0.09	0.37±0.08	0.55±0.09	0.3271	
3rd day	0.44±0.11	0.45±0.09	0.61±0.11	0.4720	
Average	0.47±0.09	041±0.08	0.55±0.09	0.5347	

*P<0.05; **P<0.01; ***P<0.001; SE = standard error of mean;
Sire 1, N = 12; Sire 2, N = 16; Sire 3, N = 12

Table 5: Social behaviour according to gender

Number of duels	Gender		P	Significance
	Male	Female		
	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
win	7,08±1,18	7.34±1.33	0.8875	
total	15.36±0.79	14.56±0.88	0.5119	
Social index				
1st day	0.47±0.07	048±0.08	0.9250	
2nd day	0.44±0.07	0.50±0.07	0.5240	
3rd day	0.51±0.08	0.48±0.09	0.8155	
Average	0.47±0.07	0.49±0.08	0.8209	

*P<0.05; **P<0.01; ***P<0.001; SE = standard error of mean;
male, N = 23; female, N = 17

Calves descended from Sire 1 were the most successful in competition, however, no significant differences were found among sires in social index. The most social encounters are recorded on the days the calves were grouped (Veissier *et al*., 1994). It may be concluded from our results that the decrease of social contacts by long common stay in stabile group has an effect on the competitive behaviour. It would be probably reversed by mixing non-familiar calves. Early experience affects an animal‘s initial dominance, which may be determined at a young age (Mülleder *et al*., 2003). Just how young dominance is established may be open to question (Albright and Arave, 1997).

No significant differences were found between male and female gender in maintenance behaviour. This finding is supported also by the results of Fournier and Festa-Bianchet (1995) who state that the age is not such a significant factor. Dairy males may have longer lying times than females (Albright and Arave, 1997). Gender had no effect on laterality in the lambs and behaviours studied (Lane and Phillips, 2004). Under modern husbandry, calves from weaning until 5-6 months are usually kept in groups of similar age and with both genders. The behaviour of herds with a natural sex ratio distribution has been studied insufficiently (Hall, 2002).

The results of the present study suggest that all maintenance activities except total standing time were increased with the age. Period’s number was increased within ages in ruminating while lying and total ruminating animals. Effect of sire lineage was manifested in times of total lying, standing, eating, and number of eating and lying periods. No differences in gender observation have been found.

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