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The effect of lying motivation on cow behaviour

Marianna Norring*, Anna Valros

Research Centre for Animal Welfare, Faculty of Veterinary Medicine, University of Helsinki, FI-00014 Helsinki, Finland

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ABSTRACT

Cows in dairy barns spend time standing while waiting for milking, accessing feed and entering the resting area. It has been suggested that high yielding cows may represent a trade off situation regarding eating and lying particularly in systems where there is a long waiting period before milking. We tested the effect on lying motivation of preventing cows of different production levels from lying down.

The study included 14 primiparous cows and 14 multiparous cows in tiestalls at their 8th week of lactation. Cows were milked at approximately 06:00 and 18:00 h and milk yield was recorded. The behaviour of the cows was observed over 2 days when the cows were prevented from lying, either from 10:00 to 14:00 or from 14:00 to 18:00 h and during 2 preceding baseline days. Lying, eating, ruminating and lying with neck muscles relaxed (used as a behavioural indicator for sleep) were observed for 4 h before and 4 h after milking. The percentage time allocated to different behaviours per period was analysed using mixed models. In addition, stereotypic leaning behaviour was observed during the deprivation period.

We established that the cows lay more after deprivation compared with during the baseline period for that time of day (21% *vs*. 34% before milking and 49% *vs*. 55% after milking). The cows spent less time eating after forced standing (23% *vs*. 21%). Cows used more time lying inactively without ruminating and lying with neck relaxed post treatment (11% *vs*. 19%). In addition, milk yield and lying time were correlated during the period after forced standing, indicating greater motivation in high yielding cows to rest. In total, 19 of 28 cows housed in tie stalls exhibited leaning behaviour. The duration of leaning was associated with the duration of standing.

In conclusion, a 4-h standing period appeared sufficient to increase the motivation for lying and sleeping. Milk yield correlated with shorter lying duration when the cows were motivated to rest. The motivational background of the leaning behaviour in cows requires further investigation.

1. Introduction

Many studies have shown the importance of lying behaviour in cows (Munksgaard and Simonsen, 1996; Fisher et al., 2002; Cooper et al., 2008) and under time constraints dairy cows prioritize their lying time even over eating time (Munksgaard et al., 2005). Total daily lying time is higher in low yielding cows than in high yielding cows (Norring et al., 2012). A link between milk yield or anticipation of milking and lying was supported by the observation that time spent lying decreased towards the subsequent milking (Overton et al., 2002) and that cows milked frequently rested more at dawn than cows milked less frequently (Österman and Redbo, 2000). In addition, cows increased their mooing and stood more by the gate when one of the daily milkings was skipped (Pomiès et al., 2007) and a skipped milking event increased milk leakage and udder firmness, and resulted in decreased total lying duration and shorter lying bouts (O'Driscoll et al., 2011). Changes in lying and standing durations were suggested to be indicative of udder discomfort during mastitis (Medrano-Galarza et al., 2012). Cows subjected to abrupt cessation of milking exhibited behaviours indicative of anticipated milking more than cows that were gradually weaned from milking (Zobel et al., 2013). Moreover, dry-off resulted in shorter duration of lying, indicating udder discomfort and higher motivation to be milked to be linked with reduced lying times (Zobel et al., 2013).

The motivational background of increased standing duration of high yielding cows is still unknown. According to Norring et al. (2012) cows were lying down 22% of their time before evening milking and 50% of their time after milking. However, it is not clear why the lying duration prior to milking was lower than after milking. It might be caused by anticipation of milking, or by relaxation after milking. It is also possible that the resting motivation changes during the course of the afternoon due to some other reason. A way to study the underlying motivation, and the link to milk yield, more

* Corresponding author.
E-mail address: Marianna.Norring@Helsinki.fi (M. Norring).

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specifically, while controlling for *e.g.* diurnal variation, is to manipulate the lying motivation by depriving cows of the opportunity to lie down during a specific period.

Lying deprivation induces both physiological and behavioural stress responses in dairy cows (Ruckebusch, 1974; Munksgaard and Simonsen, 1996; Fisher et al., 2002). Even short bouts of 2–4 h standing has an effect (Metz, 1985; Cooper et al., 2007, 2008; Krebs et al., 2011). Pressing or leaning the muzzle on stall constructions is described as leaning behaviour and this behaviour is suggested to be increased during lying deprivation and during tethering (Krohn, 1994; Munksgaard and Simonsen 1996). However, there are not enough studies about leaning behaviour to be able to fully understand how the environment and characteristics of individuals contribute to this behaviour.

In order to shed further light on the reasons for the decreased lying observed prior to milking, we investigated the consequences of 4 h of forced standing on behaviour before and after evening milking. We also investigated whether milk yield was connected to the responses to deprivation of lying. In addition, the effect of lying deprivation on leaning behaviour was explored.

2. Material and methods

2.1. Animals and housing

The time budget of 28 cows was observed over 4 days. We used Finnish Ayrshire cows in the 8th week of lactation with a mean of 58.3 days (SD 5.1) from parturition on the first day of observation. Fourteen of the cows were primiparous and the remainder had calved 2.5 (SD 1.1) times. The cows weighed a mean of 616 kg (SD 66). The gaits of the cows were visually scored according to Sprecher et al. (1997), and only cows with a normal gait score (1 or 2) and cows that were not being treated for any disease were included in the experiment. The University of Helsinki ethical committee approved the experiment.

Water was offered *ad libitum* from a water bowl. Cows were milked at 06:00 and 18:00 h in their tie-stalls. Before and during the experiment, all cows were housed in the same insulated barn in tie-stalls (170 × 121 cm) with rubber mats (2 cm thick, Delaval, Sweden) bedded with sawdust. The cows were tethered to a neck bar.

The cows were fed grass silage *ad libitum* . Silage was added approximately at 05:00, 12:00, 14:00, 15:00 and 16:00 h according to the working schedule of the caretakers. The leftover silage was removed daily. In addition, all cows were fed a mixture of 2 commercial concentrates (Suomen rehu, Espoo, Finland). Cows were fed concentrate according to milk yield following Finnish feeding recommendations, the daily amount ranging from 12.5 to 20.5 kg per cow (Tuori et al., 2000). The daily total amount of concentrate intake of each cow was divided among 6 equal meals and offered to the animals at approximately at 05:00, 08:00, 11:00, 14:00, 17:00, and 20:00 h.

2.2. Procedures and observations

When a cow reached her 8th week of lactation she was placed in one of the experimental stalls. The cows were allowed to adapt to their new location in the barn for 2 days. Subsequently the behaviour of the animals was recorded at 14:00 to 22:00 h during 4 days. If a cow was inseminated filming was postponed for one day and the day of insemination was excluded. Data on baseline behaviour was collected on days 1 and 2. On days 3 and 4 cows were prevented from lying for a 4-h period each day. Lying was prevented using a girth that went around the cow's trunk and was attached to the ceiling above her tie stall. Lying behaviour was prevented from 10:00 until 14:00 and from 14:00 until the evening milking at approximately 18:00 h. Half of the cows (14) were prevented from lying from 10:00 and the other half beginning from 14:00 h on day 3 and vice versa on day 4. The effect of lying deprivation on the behaviour of the cows was observed both before and after milking, in order to establish the effect of increased lying motivation on behaviour during this specific time period.

Table 1
Postures and behaviours observed and the definitions of observations. Lying inactive without ruminating and lying with the neck relaxed were observed to estimate resting and sleeping time.

Posture	
Lying	Rump on the floor
Standing	Standing on four feet
Behaviour	
Eating	Taking silage into the mouth and jaw moving, or muzzle in contact with silage and moving
Ruminating	Jaw moving, not taking silage into the mouth
Inactive without ruminating	Jaw not moving, head not moving, head up
Lying with the neck relaxed	Jaw not moving, neck relaxed and head in contact with the feeding Table in front of the cow, or reversed along her body
Other activities	All other behaviours of the head not mentioned above, for example head moving actively, drinking, eating concentrate, licking, social behaviour, pressing the muzzle towards equipment

The milk yield was measured according to milk recording standards at each milking; the accuracy achieved was ±200 g (Tru-test Limited, Pakuranga, New Zealand).

Three regular, adjacent tie-stalls, in the middle of the row of tie-stalls, were equipped as experimental stalls. A total of 8 video cameras (Sanyo VCB-3372P, Watford, UK) were used to observe the cows' behaviour. Time-lapse (Panasonic AG-6730, Secaucus, NJ) recording with 24 h time mode was used, and the pictures from all cameras were fed to a single tape using a multiplexer (Robot, Tyco, Princeton, NJ).

2.3. Behaviours

Recordings were made of the lying or standing posture, head and jaw movements indicative of eating, rumination and sleeping behaviours (Table 1). The behaviours and postures were recorded through continuous observation (Observer Noldus, Wageningen, the Netherlands) and were analysed with an accuracy of 1 min while observing the videos. The bout of a single behaviour was considered to end when another behaviour began.

Leaning behaviour was observed from 14:00 until 18:00 on 2 baseline days and on one day while the cows were prevented from lying from 14:00 to 18:00. The video analyses of leaning behaviour were made during separate viewings using continuous observation. We were not able to record if the leaning included the weight shift towards the head, thus all pressing or leaning or contact of the muzzle or nostril on stall constructions, including the feeding bowl or front curb, were recorded as leaning behaviour.

2.4. Statistical methods

Based on visual inspection of histograms the data was considered to be normally distributed. Percentage time used in different behaviours during the 4-h period before and after evening milking was analysed using the mixed procedure of SPSS. The behavioural responses in time periods 14:00–18:00 and 18:00–22:00 h were analysed separately. Treatment (no forced standing, forced standing 10:00–14:00 or forced standing 14:00–18:00 h), order of treatment (forced standing at 10:00–14:00 followed by forced