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Feeding characteristics and rumination time of dairy cows around estrus

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ABSTRACT

Against the background of decreasing reproduction efficiency, estrus detection is gaining increased importance. The objective of this study was to evaluate changes of feeding characteristics and rumination time in dairy cows in the days around estrus. Feeding characteristics were recorded by weighing troughs, and rumination time by acoustic sensors. Analysis included data from 25 primiparous and 37 multiparous cows, which were successfully inseminated (day of insemination = d 0). Feeding time and rumination time were decreased on d -1 and 0, feed intake, and feeding rate on d 0. Primiparous and multiparous cows differed in their reference values, but their feeding and rumination times on the day of insemination were reduced to similar extents. Rumination time was reduced in a time frame of 30 h around estrus whereby the main drop was found during the time period between 0600 h on d -1 and 1200 h on d 0. The change of almost all evaluated feeding characteristics and rumination time around estrus indicated their potential for useful addition in early detection of estrus.

Key words: feeding, rumination, estrus, sensor

INTRODUCTION

Efficient reproduction management has an immediate effect on milk production (Diskin and Sreenan, 2000). Despite all progress in reproduction management, the detection of cows suitable for insemination is still regarded as an essential problem in dairy farming (Roelofs et al., 2010). Consequently, reliable automatic monitoring of estrus in dairy cows is needed. The traditional and mostly used method of detecting cows in estrus is direct observation by the farm staff (Palmer et al., 2010). The efficiency of estrus detection based on observation varies from below 50% up to 90% (Roelofs et al., 2010). In the past, several devices for automation of estrus detection have been developed to face decreased observation time per cow in growing dairy

herds (Firk et al., 2002). The combination of 2 or more physiological parameters led to improvement in detection rates (Brehme et al., 2008) and is expected to reduce error rates (Firk et al., 2002). As stated by Firk et al. (2002), it is essential for practical implementation of parameters that these are easily and continuously recordable.

The behavior of dairy cows during the stage of estrus is characterized by specific features. Standing to be mounted by fellows (Hurnik et al., 1975) is often considered as most meaningful factor for estrus detection (De Silva et al., 1981; Van Eerdenburg et al., 1996; Palmer et al., 2010). Further behavioral features characterizing estrus are, for example, restlessness, sniffing the vulva of another cow, flehmen, licking or resting with the chin on the back of another cow (Van Eerdenburg et al., 1996; Sveberg et al., 2011). The altered behavior patterns of cows during estrus indicate an increased physiological activity as an expression of searching for a compatible mating partner (Kerbrat and Disenhaus, 2004).

In addition to the above named alterations in behavior patterns, estrus is accompanied by alterations in feeding and rumination. The effects of estrus on feeding behavior vary in different studies: Lukas et al. (2008) described an increased DMI during estrus, Maltz et al. (1997) and Reith et al. (2014) found a decrease in DMI, and De Silva et al. (1981) found no effect on DMI. In addition, a decrease in rumination time during estrus was described by Reith and Hoy (2012). Feeding and rumination have been investigated separately in former studies, whereas the current study evaluated feeding behavior and rumination time during estrus simultaneously, and thereby helps to deepen the knowledge about temporal concordance of the 2 behavior patterns. The objective of the current study was to evaluate feeding characteristics and rumination time of dairy cows in the days and hours around estrus.

MATERIALS AND METHODS

Animals, Housing, and Feeding

The study was conducted at the federal state research farm LVZ Futterkamp (chamber of agriculture,

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Schleswig-Holstein, Germany). The farm milked around 190 German Holstein cows with an average herd yield of 10,700 kg of milk/305 d (3.9% milk fat and 3.2% milk protein) during the trial period. Data on feeding and rumination were gained from 4 separately conducted trials which were scheduled between August 2010 and August 2011. Only data from cows confirmed to be pregnant after insemination ($n = 62$) were included in the analysis. According to their lactation number, the animals were classified as primiparous (first lactation; $n = 25$) or multiparous (\geq second lactation; $n = 37$) cows. On average, cows had been milked for 2.2 lactations. Furthermore, animals were grouped into lactation stage 1 (≤ 100 DIM; $n = 15$), 2 (101 to 200 DIM; $n = 33$), and 3 (≥ 201 DIM; $n = 14$).

Cows were kept in 2 pens of a freestall barn on concrete solid floor, which was cleaned by folding slides. Each of the 2 pens held space for 36 cows by providing 36 cubicles, 18 weighing troughs, and 2 water troughs. Overcrowding of pens did not occur during trials. The core of both groups remained stable, and only a small number of cows were taken into or out of the groups according to stage of lactation. At the beginning of each of the 4 separate trials, the groups were reassembled and feed composition was adapted.

Water and TMR were provided ad libitum. Compounds of TMR were corn silage, grass silage, concentrate, straw, and additives. The composition of TMR was calculated to meet requirements of cows with a daily milk yield between 32 and 34 kg. Fresh TMR was supplied 2 times per day at 0600 and 1600 h. No additional concentrate was fed. Cows were milked in a milking parlor between 0500 and 0700 h in the morning and between 1500 and 1700 h in the afternoon. Cow individual milk yield was measured with electronic milk meters (MM25, DeLaval, Glinde, Germany) at each milking.

Weighing Troughs

The 2 research pens of the freestall barn, in which cows were housed during the trial, were equipped with in total 36 feed weighing troughs and 4 water weighing troughs (both Insentec, Marknesse, the Netherlands), that is, one feeding place per 2 cows. The troughs were locked when no cow was feeding, opened after identifying the entering cow via transponder, and closed after the cow had left. The system recorded visit duration and feed intake for each bunk visit of each cow and stored the summed data in units of 24 h. Feeding time was assumed to be equal to visit duration (i.e., comprises times when cows were present at weighing troughs without measurable feeding activity). Feeding

rate was calculated as quotient from daily sums of feed intake and feeding time. The daily feeding time and number of feed bunk visits per day were used to calculate an average duration per feed bunk visit per day.

Rumination Sensors

The sensors used for monitoring of rumination were HR-Tags (SCR Engineers Ltd., Netanya, Israel). They consisted of a microphone for sound detection, a microprocessor for data processing, and a transponder for data transfer. Sensors were positioned on a collar behind the left jaw of the cow to identify characteristic sounds of regurgitation and rumination. Rumination time per 2-h periods was calculated internally by algorithms of the system based on raw data. For the analysis in the current study, rumination time per 2 h and per 24 h was considered. Data transfer was conducted by infrared technology. In the current study, readers were placed above water troughs to ensure regular readout.

Artificial Insemination

Cows in estrus were identified by visual observation of herd staff or by physical activity (Alpro, DeLaval, Glinde, Germany). Cows were considered as being in estrus when standing while mounted by other cows. Both systems were used complementary at the same time. Cows in first lactation were inseminated after a waiting period of 75 DIM, multiparous cows from 45th DIM on forward. Artificial inseminations were conducted twice a day, after milking times, by a freelancing veterinarian. Cows were separated into a treatment box directly after milking and regrouped to the herd after insemination. Approximately 40 d after insemination, cows were diagnosed for pregnancy via ultrasound. Only cows inseminated successfully were taken into consideration for analysis. The day of insemination was declared as d 0. On average, cows had been 155 DIM on d 0. Among the 62 cows included in the present study, 46% were inseminated once and 54% 2 times or more for conception.

Statistical Analysis

Daily mean values from d -7 to -3 before insemination and from d $+3$ to $+7$ after insemination were averaged, resulting in one individual day of reference per cow for all feeding and rumination variables. The individual reference values were then compared with each of the 5 d around the day of insemination (d -2 , -1 , 0 , $+1$, $+2$). Feeding characteristics were calculated in 24 h-periods, and those of rumination time in 24-h periods

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