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Short communication: Rumination and feeding behaviors differ between healthy and sick dairy cows during the transition period

K. Schirmann,*† D. M. Weary,* W. Heuwieser,†[1] N. Chapinal,* R. L. A. Cerri,‡ and M. A. G. von Keyserlingk*[2]
*Animal Welfare Program, Faculty of Land and Food Systems, University of British Columbia, 2357 Main Mall, Vancouver, BC, V6T 1Z4, Canada
†Clinic for Animal Reproduction, Faculty of Veterinary Medicine, Freie Universität Berlin, Königsweg 65, 14163 Berlin, Germany
‡Faculty of Land and Food Systems, University of British Columbia, 2357 Main Mall, Vancouver, BC, V6T 1Z4, Canada

ABSTRACT

The objectives of this study were: (1) to describe the rumination and feeding behavior of freestall-housed Holstein dairy cows in the weeks around parturition, and (2) to determine the relationship between postpartum disease and precalving rumination and feeding behavior. Eighty cows were enrolled at approximately 2 wk (18 ± 7 d, mean ± standard deviation) before calving. Using automatic monitoring systems, rumination and feeding behavior were recorded continuously from 10 d before until 3 wk after calving. Postpartum health checks were performed each day, and metritis assessment was conducted 2 times/wk. Blood β-hydroxybutyrate was measured 3 times/week, and cows with ≥1.2 mmol/L during the first 14 d postpartum were diagnosed as having subclinical ketosis. The final data set included 64 cows in 5 groups: healthy (n = 20), metritis (n = 18), subclinical ketosis (SCK; n = 9), metritis+SCK (n = 9), and >1 health problem and not included before (MULT, n = 8). We compared rumination and feeding data between healthy cows and the 4 categories of ill animals in each of 4 periods relative to calving: precalving (d −7 to −2), period 1 (d 3 to 8 postpartum), period 2 (d 9 to 14 postpartum), and period 3 (d 15 to 20 postpartum). Cows with SCK spent less time ruminating during the precalving period. Compared with healthy cows, those with SCK and metritis+SCK had lower dry matter intake during the precalving period and continued to eat less until d 14 and d 20 postpartum, respectively. Cows with metritis and MULT cows had lower dry matter intake during the first 2 wk postpartum. Precalving feeding time was lower for SCK, metritis+SCK, and MULT cows compared with healthy cows. The difference in feeding time between healthy and metritis+SCK cows had disappeared by period 2 and between all health categories except MULT by period 3. MULT cows visited the feed bins less often and were less often replaced at the feed bin throughout all 4 periods of the study. Automatic monitoring of intake and rumination showed promise for the detection of health problems after calving. We observed differences in precalving rumination and feeding behavior. Further research is necessary to better understand the onset of behavioral changes and the relationship between rumination and disease.
Key words: rumination collar, subclinical ketosis, metritis, automatic monitoring, disease

Short Communication

There is growing interest in how to use behavior to identify disease early and, ideally, automatically (see reviews: Weary et al., 2009; von Keyserlingk and Weary, 2010). In this context, feeding and rumination behavior are of particular interest. Feeding behavior describes the parameters involved in active feeding, such as the time spent feeding, the amount of feed intake, and the rate at which feed is ingested. Rumination behavior (needed for particle breakdown and rumen pH balance) describes the time spent ruminating previously ingested feed and consists of regurgitation, re-insalivation, remastication, and reswallowing of feed boluses. Feeding behavior is sensitive to management situations and health, especially during the transition period (von Keyserlingk and Weary, 2010). For example, Huzzey et al. (2007) and Goldhawk et al. (2009) found that changes in DMI and time spent feeding in the days before calving identified cows that were later diagnosed with metritis or subclinical ketosis (**SCK**) postpartum, respectively. Rumination activity has been linked to the detection of anxiety (Bristow and Holmes, 2007), distress (Schirmann et al., 2011), disease (Fogsgaard et al., 2012), and metabolic disorders (Hansen et al., 2003; DeVries et al., 2009). Recent work has also shown some promise in the use of rumination as an indicator for dis-

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[1]Current address: Department of Population Medicine and Diagnostic Science, College of Veterinary Medicine, Cornell University, Ithaca, NY.
[2]Corresponding author: nina@mail.ubc.ca

ease during the transition period (Soriani et al., 2012; Calamari et al., 2014; Kaufman et al., 2016). However, none of these studies monitored feeding behavior. To date, no information is available on how health-related differences in time spent ruminating during the transition period are related to feeding behavior.

The objectives of this study were to use rumination and feeding data captured using validated technologies (1) to describe time spent ruminating and feeding behavior (consisting of DMI, time spent feeding, feeding rate, and visits to the feed bin) of freestall-housed dairy cows in the weeks before and after parturition, and (2) to determine the relationship between postpartum disease and rumination behavior before and after calving.

This study was conducted at the University of British Columbia's Dairy Education and Research Centre (Agassiz, BC, Canada). Animals were managed and cared for according to the guidelines set by the Canadian Council on Animal Care (2009). A total of 80 multiparous Holstein cows (parity 3.3 ± 1.6, mean ± SD) were enrolled. Primiparous cows were excluded, because research has shown differences in behavior compared with multiparous animals (Hasegawa et al., 1997; González et al., 2003). Cows were enrolled at 18 ± 7 d (mean ± SD) before calving. Behavior and health status were recorded for 5 wk (2 wk before calving to 3 wk after calving). Cows were kept in a freestall barn: 1 pen housed 12 prepartum cows, and 2 pens (each containing 12 cows) housed the postpartum animals. Cows were assigned in an alternating fashion to the postpartum pens. All pens were equipped with 12 lying stalls fitted with a mattress (Pasture Mat; Promat Inc., Woodstock, ON, Canada) and covered with approximately 5 cm of sand bedding; 6 Insentec feed bins (Insentec BV, Marknesse, the Netherlands) and 1 Insentec water bin. The cow-to-stall ratio was 1:1 throughout the study. Group composition was dynamic, with cows entering and leaving the pre- and postpartum pens, depending on expected and actual calving dates and duration spent in the pen. Prepartum cows were checked multiple times daily for signs of imminent calving. Cows showing signs such as vaginal discharge, milk letdown, or relaxation of the pelvic ligaments were moved to 1 of the 2 individual maternity pens. The maternity pens were deep-bedded with sand and covered with fresh straw; cows stayed here until their first milking. Milking took place twice each day at approximately 0700 h and 1700 h.

Pre- and postpartum diets were formulated according to NRC (2001) recommendations. Prepartum cows were fed at approximately 0800 h, and postpartum cows were fed twice daily at approximately 0700 and 1600 h. Fresh TMR samples were collected and frozen weekly. Samples were thawed and dried at 60°C for 48 h to determine DM content. Samples were then ground, pooled monthly, and sent to Cumberland Valley Analytical Services Inc. (Maugansville, MD) for analysis (AOAC International, 2005) to determine average CP, ADF, NDF, and NE_L content. Prepartum TMR consisted of 43.9% corn silage, 34.7% alfalfa hay, and 21.4% prelactation concentrate and mineral mix on a DM basis (DM: 44.5 ± 3.4%; CP: 15.4 ± 0.9% of DM; ADF: 32.4 ± 1.7% of DM; NDF: 44.1 ± 2.5% of DM; NE_L: 1.4 Mcal/kg). Postpartum TMR consisted of 39.7% mineral and concentrate mix, 32.9% grass silage, 19.2% corn silage, and 8.2% alfalfa hay on a DM basis (DM: 51.4 ± 3.2%; CP: 18.1 ± 0.9% of DM; ADF: 21.1 ± 1.6% of DM; NDF: 33.4 ± 0.9% of DM; NE_L: 1.6 Mcal/kg). Thawed TMR samples were used to determine particle size distribution with the Penn State Particle Separator (Kononoff et al., 2003), consisting of 3 sieves and the bottom pan. The pore sizes of the 3 sieves were 19 mm (upper), 8 mm (middle), and 1.18 mm (lower). The prepartum TMR was composed of 28.3% of particles >19 mm, 37.1% of particles >8 mm, 24.4% of particles >1.18 mm, and 10.2% of particles <1.18 mm. The postpartum TMR was composed of 20.8% particles >19 mm, 36.1% of particles >8 mm, 30.3% of particles >1.18 mm, and 12.8% of particles <1.18 mm.

The Insentec system, validated by Chapinal et al. (2007), was used to monitor time spent feeding, duration of feeding, and amount of feed consumed during each visit to a bin. We used a previously validated replacement criterion (Huzzey et al., 2014) to automatically assess social behavior in the form of replacements at the feed bunk using data collected from the Insentec system. A replacement was defined as 1 cow (the actor) replacing another cow (the reactor) at the same feed bin.

Cows were fitted with rumination loggers (HR-Tag; SCR, Netanya, Israel) for continuous recording of rumination activity (for a full description and validation, see Schirmann et al., 2009). Infrared identification units, installed above water bins and at the entrance to the milking parlor, were used to transmit data from the logger to the computer.

Every morning, cows in the prepartum pen had their rectal temperatures taken and were checked for signs of calving, injuries, and visible signs of illness, such as dehydration or lameness. Blood BHB was measured weekly (Iwersen et al., 2009). Body condition was scored weekly using a 5-point scale in 0.25 increments (adapted from Ferguson et al., 1994).

Postpartum health checks were performed daily after morning milking and consisted of rectal temperature, rumen auscultation (healthy cattle have 1 or 2 primary rumen contractions per min; Divers and Peek, 2008),