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Short communication: Decrease in rumination time as an indicator of the onset of calving

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ABSTRACT

The aim of this study was to investigate whether rumination time (RT) is affected by the onset of calving. The relationship between both feeding time and dry matter intake (DMI) to the onset of calving was also examined. In addition, the correlation between feeding behavior characteristics, described here as RT, feeding time, and DMI, was evaluated. Under test conditions, the feeding behavior of pregnant Holstein cows was recorded from the time when they were moved into calving pens (usually 7 to 5 d prepartum) until the onset of calving. Feeding time and DMI were recorded by automatic feed bins; RT was measured continuously by a measuring halter based on electromyography (DairyCheck; BITSz Engineering GmbH, Zwickau, Germany), which constitutes a new approach regarding feeding behavior detection. Data analysis related to the final 72 h, before the onset of calving, which were divided into twelve 6-h blocks. The last 6 h (one 6-h block) before calving were compared with the 72- to 7-h time frame (11 times 6-h blocks) before calving, which was defined as the reference period. For this time period, feeding behavior data for 17 cows was fully available, which was the precondition for data analysis. In the final 6 h before imminent birth, RT was significantly reduced. During this time, it was found that the mean minimum RT was 69.9 ± 28.5 min/6 h compared with the mean RT of 95.5 ± 30.8 min/6 h in the reference period. The average decrease in RT was 27% (25.6 min/6 h). In addition, feeding time and DMI were significantly reduced. The average decrease in feeding time was 57% (20.8 min/6 h), and in DMI it was 56% (1.9 kg/6 h). High correlation coefficients between feeding behavior characteristics were only found between feeding time and DMI. Values of feeding behavior among cows were characterized by high variability. Recording RT can serve as a useful tool for predicting the timing of birth for dairy cows, but further research is necessary.

Key words: birth, feeding behavior, management support, measurement system

Short Communication

The process of calving constitutes a critical stage for both dam and calf (Schuenemann et al., 2013). Prolonged calving, delayed parturition, or severe assisted extraction of the calf at birth can result in a difficult birth, which has been defined as dystocia (Mee, 2004; Lombard et al. 2007). Primary causes of dystocia are fetal-maternal size mismatch (Berger et al., 1992), fetal malpresentation (Meijering, 1984), dam-related causes such as uterine torsion (Frazer et al., 1996), and hypocalcemia (Curtis et al., 1983). Dystocia can lead to a range of consequences for the dairy cow and the calf, including an increased incidence of stillbirth (Meyer et al. 2000), calf mortality within 30 d postcalving (Lombard et al., 2007), an increased likelihood of both cow and calf respiratory and digestive disorders, and retained placenta and uterine disease of the cow (Lombard et al., 2003; Sheldon et al., 2009). Dystocia is also associated with economic losses due to a possible decrease in milk yield, decline in reproductive performance, and the risks for an increase in cow and calf morbidity and mortality (Dematawewa and Berger, 1997; Rajala and Gröhn, 1998). Prevention of dystocia in dairy cows should, therefore, be a high priority in farm management. Calving management practices for dairy personnel need to be adjusted to create optimal surveillance and care of the cow and calf during parturition. Wehrend et al. (2006) concluded from their results, which showed only minor differences between the behavior of cows with eutocia and dystocia, that the difference in behavior of cows and heifers during the first stage of labor should not be misconstrued as signs of dystocia. Therefore, recognition of benchmarks and reference times for normal births as well as for difficult births is essential for determining the appropriate time for intervention under field conditions (Schuenemann et al., 2013). This requires, if possible, an exact knowledge about the onset of birth. Thus, identification of the onset of birth is a crucial parameter for the prevention of dystocia.

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Generally, the onset of birth is recognized by monitoring behavior changes or external changes in the dam, either visually or by video observation (Miedema et al., 2011). Birth can also be monitored by measuring feeding behavior, such as feeding time and DMI (Lukas et al., 2008; Schirmann et al., 2013). Feeding time and DMI are reasonable and helpful indicators in the early recognition of animals that have deviated from their normal conditions (Beauchemin and Yang, 2005; De Vries et al., 2009; Burfeind et al., 2010). Monitoring short-term feeding behavior may particularly assist in the early identification of disorders (González et al., 2008). In dairy cows, a gradual depression in feeding time and DMI usually happens from a few days until a few hours before calving (Maekawa et al., 2002; Hansen et al., 2003). A decline in feeding behavior around calving may also be useful as potential indicator of dystocia (Proudfoot et al., 2009). Measuring feeding time and DMI on commercial dairy farms is laborious, dependent on human observation and is susceptible to human error (Lukas et al., 2008). In contrast, the measurement of individual rumination time (**RT**), which also belongs to feeding behavior characteristics, is more suitable for automatic, sensor-based recording. Rumination time is associated with feeding time and DMI (Yang and Beauchemin, 2006; Adin et al., 2009), lying time (Beauchemin, 1991; Schirmann et al., 2012), and time of estrus (Reith and Hoy, 2012). Recent studies also indicate a relationship with the onset of calving (Soriani et al., 2012; Schirmann et al., 2013). Contrary to feeding behavior, RT is simpler to record and, therefore, easier to use for monitoring dairy cows. As a result, numerous methods for automatically measuring, assessing, and analyzing individual RT of dairy cows have been developed up to now (Ungar and Rutter, 2006; Schirmann et al., 2009; Burfeind et al., 2011).

The overall objective of this study was to investigate whether an obvious decrease in RT exists shortly before calving. The aims were to (1) measure the individual RT in the last 72 h before calving and (2) determine if RT might be a useful indicator for predicting the timing of birth. Furthermore, feeding time and DMI were recorded to assess their relationship with calving time and RT.

The study was conducted under test conditions at the Saxony-Anhalt State Institute for Agriculture, Forestry and Horticulture (Iden, Germany) from June to August 2013. A total of 55 multiparous Holstein cows were tested. The cows used varied in lactation number (3.8 ± 1.9; mean $\pm$ SD) and age (62.9 ± 22.2; mean $\pm$ SD). From 7 to 5 d before the expected date of calving, a maximum of 12 cows were held in a straw-bedded calving pen with a size of 5.4 m^2 per cow. Most of the cows used calved on their own; 18% were assisted during the calving process. The cows had free access at any time to 5 feed bins (Bavarian State Institute for Agriculture, Freising-Weihenstephan, Germany). When a cow approached the feed bin, an antenna detected its unique neck collar-mounted transponder and lowered the barrier, allowing the cow access to the feed. Dairy cows were given a TMR ad libitum once per day at approximately 1000 h comprising 34.0% lucerne grass silage, 44.2% corn silage, and 21.8% concentrate and mineral mix on a basis of 45.0% DM. Feeding time and DMI were recorded by using automatic feed bins from the day of being moved into the calving pen until the onset of calving. The equipment was serviced once per year by trained staff. The automatic feed bins were validated at least once each year by external specialized staff (Bavarian State Institute for Agriculture). The RT of each cow was measured by a measuring halter (DairyCheck; BITSz Engineering GmbH, Zwickau, Germany). The investigated cows were used to wearing these halters at least 5 d before they were moved to the calving pen, but without data recording. When the cows were moved to the calving pen once per week, measurement halters were applied again. The effect of regrouping was not measured during this study. After calving, cows were moved to the fresh milking pen and measurement halters were removed. The RT was recorded from the day of halter application until a few hours after calving. The onset of calving was recognized by human observation of changes in the cows' behavior or on the basis of external changes, or both. Cows were observed at least once per hour by 1 of 5 different trained observers. The main changes in behavior which were determined were signs of lifting the tail and restlessness. From this point, the amount of feed intake and duration of feeding time and RT were analyzed for the previous 72 h. During analysis, measurement values recorded within these 72 h were divided into twelve 6-h blocks. The reference period was defined as the last 66 h (11 times 6-h blocks) before the last 6 h (one 6-h block) before the onset of calving. And the onset of calving was defined as the hour when the first stage of the expulsion period was detected by visual observation. Data relating to 17 of the 55 cows tested were available for this study. Only fully generated data sets of feeding behavior could be considered for the analysis. The main reason for the lack of data from 38 of the dairy cows was the incidence of premature delivery after being moved into the calving pen, which meant that it was not always possible to use the measuring halter for the 3 d necessary for this study. A further reason was due to the fact that some of the rumination and feed bin data were missing.

For the automatic recording of RT, an electromyography (**EMG**)-based system labeled as DairyCheck (BITSz Engineering GmbH) was used. The continuous