The Feeding and Ruminating Behaviors of Dairy Cows

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Despite its relatively simple appearance, the term “feeding behavior” is rather ambiguous and can be strongly influenced by the extent to which is it defined. For example, it may simply refer to the time a cow spends at the feed barrier over the course of a pre-set period. An estimation of this can be achieved by scan sampling the feed bunk to establish the presence or absence of specific cows (Mitlohner et al., 2001). Rather than a gross estimate of time, feeding behavior can also be broken down into specific meals. This technique requires the measurement of the intervals between visits to the feeding system, which results in a distribution of visits with two peaks (which is the frequency of long and short intervals; Tolkamp et al., 2000). The intersection of this distribution determines the separation between “within-meal visits” and “between-meal visits” (Tolkamp et al., 2000). Calculation of meals requires the recognition that a meal is not necessarily a continuous event, but one that will be interrupted for brief periods to engage in complementary behaviors, such as drinking, or antagonistic behaviors to maintain feeding space.

The cow’s ability to achieve these parameters of feeding behavior is dictated by factors that are driven by a) characteristics of the cow, b) management decisions, c) physical characteristics of the barn, and d) stage of lactation and health status. Each of these is discussed in detail in the following paragraphs.

Effect of Feed Delivery on Feeding Behavior. Changing the time and frequency of the delivery of a total mixed ration (TMR) influences the feeding behavior of lactating dairy cows. Cows increased their feeding time by 12 percent per day when feed was delivered 6 hours after milking compared to the delivery of fresh feed coinciding with the return from milking (DeVries and von Keyserlingk, 2005). This increase was driven primarily by an increase in feeding behavior upon delivery of fresh feed that was greater than the reduction resulting from not having fresh feed following milking (DeVries and von Keyserlingk, 2005). The alteration of feeding behavior did not affect biological function as dry matter intake and milk production did not differ between feed delivery schedules (DeVries and von Keyserlingk, 2005). Increasing the frequency of feed delivery (either from one time to two times daily or from two times to four times daily) increased the total time cows spent feeding and reduced the time spent feeding following TMR delivery (DeVries et al., 2005). In farms milking three times daily, increasing feed delivery to three times daily increased dry matter intake, relative to two-time or one-time daily feedings (Hart et al., 2014). Despite the increased dry matter intake, neither milk production nor feed efficiency were altered (Hart et al., 2014). Despite these differences, the majority (70 percent) of farms enrolled in a survey of feeding practices in Minnesota fed a TMR once daily to its herd (Endres and Espejo, 2010).

Commingling of Cows of Different Parities on Feeding Behavior. The commingling of primi- and multiparous cows within a pen can alter feeding behavior. Early work by Kongaard and Krohn (cited in Grant and Albright, 2001) demonstrated that for commingled heifers the feeding time and dry matter intake were reduced by roughly 10 percent. On pasture, cows in a mixed group (multi- and primiparous) tend to spend less time grazing than multi- or primiparous cows housed alone (Phillips and Rind, 2001). Contrary to previous work, primiparous cows mixed with multiparous cows spent more time feeding, fed at a greater rate, and consumed fewer meals than primiparous cows housed alone in a system utilizing a robotic milker (Bach et al., 2006). This work should be interpreted with caution as the pens were not replicated. Evaluating the feeding behaviors of mixed pens of primi- and multiparous cows fed three times, two times or once daily confirmed that primiparous cows consume smaller meals at a slower feeding rate, relative to mulitparous cows within the pen (Hart et al., 2014). Furthermore, primiparous cows consumed between 25 and 50 percent less dry matter, relative to the multiparous cows, during their first meals following the first two milkings of the day (Hart et al., 2014). These inherent differences in feeding behavior suggest that primiparous cows may need special consideration to meet their behavioral needs within commingled pens.

The Effect of Regrouping on Feeding Behavior. The movement of cows between pens within a dairy may also influence feeding behavior. Cows moved into a new pen spent less time feeding following the delivery of fresh TMR and were displaced two-and-a-half times more often on the day they were moved compared to their established baseline (von Keyserlingk et al., 2008). Unfortunately, there are little available data on this cow movement, despite how often it occurs as part of routine management. Management of cows may be improved by increased understanding of regrouping strategies. The time of day (after morning milking versus after evening milking) that primiparous cows were introduced into a commingled pen altered their behavior. Cows introduced in the morning spent more time feeding, but experienced greater social aggression from resident cows (Boyle et al., 2012). There were no differences between the groups in productivity or lying behaviors (Boyle et al., 2012).

Changes in feeding behavior due to disease. The use of pre- and postpartum feeding behavior as a means of predicting illness has been an active area of research. Cows diagnosed with clinical and subclinical metritis spent less time feeding throughout the trial as well as during the post-calving phase (day 2 to day 19; Urton et al., 2005). Increased technology has a role in this recent interest, and use of automated feeding systems allows researchers to further refine the relationship between feeding behavior (in pre- and postpartum periods) and postpartum health. Huzzey et al. (2007) observed that decreases in feeding time and dry matter intake during the prepartum period resulted in a three-fold increase (per 1 kilogram loss of dry matter intake) in the risk of developing metritis following parturition.

Feeding behavior can also have a predictive effect on subclinical ketosis. Cows who decreased their feed intake, feed bunk attendance, and feeding time in the week before and the two weeks following parturition were at a greater risk for developing subclinical ketosis (Goldhawk et al., 2009).

For diseases more common beyond the transition period, there were still behavior changes evident. Lameness affected feeding time (Gomez and Cook, 2011). Non-lame cows spent 21 minutes more per day feeding compared to slightly lame cows and 1.04 hours more per day than moderately lame cows (Gomez and Cook, 2011). Additionally, lameness alters meal size and length (Palmer et al., 2012). In early lactation (approximately 60 days in milk), there was a relationship between dry matter intake and locomotion score, but not in later lactation (approximately 120 days in milk; Palmer et al., 2012). The onset of mastitis, induced by intramammary infusion also decreased feeding time over the first 12 to 24 hours (Fogsgaard et al., 2012; Zimov et al., 2012). Some of this may be alleviated by drug therapies. The use of a nonsteroidal anti-inflammatory increased the dry matter intake of cows during the 24-hour period following an intramammary challenge (Yeiser et al., 2012). However, by 48 hours after the challenge the effect was gone (Yeiser et al., 2012).

Effect of Overstocking on Feeding Behavior. Though it is a highly variable relationship, overcrowding at the freestalls tends to result in overcrowding at the feed bunk. This relationship is highly dependent on the barn design (four-row versus six-row) and severity of the freestall overcrowding.

For the last three decades, researchers have examined the effects of spatial allowance at the feed bunk of lactating dairy cows (Friend et al., 1977; DeVries et al., 2004; Huzzey et al., 2006). The earliest research established that reducing feed bunk space per cow to less than 10 cm per cow reduced feeding time (Friend et al., 1977). The behavioral effects of providing either 0.5 m, slightly less than the 0.6 m commonly recommended, or 1 m of bunk space per cow were reduced the number of aggressive interactions per cow and increased the percentage of cows feeding during the 90 minutes following the delivery of fresh total mixed ration (DeVries et al., 2004). At stock densities ranging from 75 to 300 percent, feeding time decreased and aggression increased as stocking density increased (Huzzey et al., 2006).

One potential coping strategy that was observed was the shift in feeding times, which may be problematic if the ration is sorted by the first cows to feed. Feed availability was also demonstrated to be a key management consideration related to the impacts of stocking density. A comparison of 24 vs 14 hours per day of feed availability in conjunction with 100 or 200 percent stocking densities observed that the reduction of time that feed was available reduced dry matter intake while stocking density did not (Collings et al., 2011).

Diurnal Patterns to Feeding Behavior. Cows display a distinct diurnal pattern to feeding behavior (DeVries et al., 2003). Feed bunk attendance was at its maximum during the day and early evening hours and its minimum during the night and earlier morning (DeVries et al., 2003).

The Ruminating Behavior of Dairy Cows

Grant (2004; Table 1) estimated that cows spent 7 to 10 hours per day ruminating. This is supported by the work of Dado and Allen (1994), who determined that cows spent an average of 7.6 hours per day ruminating with a variation of 16 percent. The neutral digestive fiber (NDF) content of the diet had a major role in total rumination time (Dado and Allen, 1994). Cows spent approximately 66 minutes ruminating for each kilogram of NDF consumed (Dado and Allen, 1994).

The allocation of concentrate can alter the time cows spent ruminating. Increasing the allocation of concentrate from 0.33 to 0.82 to 1.44 per kilogram of diet fed resulted in a linear decrease in ruminating times (Robinson and McQueen, 1997). In diets containing a 40:60 forage-to-concentrate ratio, 50:50 or 60:40, a positive linear effect on ruminating time (min/d) was evident (Maekawa et al., 2002). This change in rumination drove a linear change in saliva production (Maekawa et al., 2002). The manipulation of the particle length of the alfalfa portion of the diet altered ruminating times and ruminal pH (Kononoff and Heinrichs, 2003). Diets contained short particle length alfalfa, long particle length alfalfa, and two intermediates containing a mix of both resulting in a quadric change in ruminating time (the lower intermediate had the greater rumination time; Kononoff and Heinrichs, 2003). The rumination response causes a similar quadric change in ruminal pH (Kononoff and Heinrichs, 2003). Altering the particle length of the corn silage did not affect rumination times or ruminal pH (Kononoff et al., 2003). Finally, there was a tendency for rumination to decrease when the physically effective fiber (peNDF) content of a corn silage-based diet (peNDF was manipulated through particle length of corn silage) increased (Beauchemin and Yang, 2005). However, there was a linear effect on the total time spent chewing per day in response to increasing peNDF content (Beauchemin and Yang, 2005).

Beyond dietary factors, rumination behavior can be altered by the state of the cow and management strategy. For example, the onset of estrus reduces daily rumination times and the diurnal pattern of rumination (Pahl et al., 2015). Changes in rumination were also indicative of calving events (Pahl et al., 2014; Buecher and Sundrum, 2014; Schirmann et al., 2013). Feeding frequency, despite altering dry matter intake, did not affect daily rumination times (Hart et al., 2014). Finally, there were indications that mastitis may cause changes in the diurnal pattern of rumination (Chapinal et al., 2014; Fitzpatrick et al., 2013).

Effect of Changes in Rumination on Productivity

As previously discussed, stocking density alters the rumination behavior (Batchelder, 2000) or location of rumination (Hill et al., 2007), but there has not been a clear effect on milk quality, assessed by the percentage of milk fat. Hill et al. (2007) observed a suppression of milk fat in response to increased stocking density treatments (100 to 142 percent). Milk fat was suppressed in response to a dietary treatment of short particle length (mean silage length equaled 2 mm), long particle length (mean silage length equaled 3.1 mm), and an intermediate composed of equal portions of both (Grant et al., 1990). This treatment reduced ruminating time by 2.5 hours per day, which resulted in a lower ruminal pH (Grant et al., 1990). In a manipulation of particle length and forage-to-concentrate ratio (two methods for lowering the peNDF of a diet without altering its nutrient composition), a much stronger effect of forage-to-concentrate ratio was evident (Yang and Beauchemin, 2009). Increasing the ratio from 35:65 to 60:40 resulted in a lower dry matter intake, increased milk fat, increased rumination time, a higher mean ruminal pH, and less time spent at the pH (5.8) associated with subclinical ruminal acidosis (Yang and Beauchemin, 2009).

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