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Effect of milking frequency on the behavior and productivity of lactating dairy cows

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ABSTRACT

The objective of this study was to determine the effect of milking frequency on the behavioral patterns and productivity of lactating dairy cows. Twelve freestall-housed, lactating Holstein dairy cows (7 primiparous and 5 multiparous) were exposed to each of 2 treatments (over 21-d periods) in a replicated crossover design. Treatments were milking frequency of 2×/d (at 0600 and 1800 h) or 3×/d (at 0600, 1400, and 2200 h). Milk production, feeding, lying, and rumination behavior were monitored for each animal for the last 7 d of each treatment period. Milk samples were collected for the last 3 d of each period for milk component analysis. The results indicated that cows milked 3×/d produced 2.9 kg/d more milk than those milked 2×/d. Primiparous cows consumed 3.9 kg/d less dry matter (DM) than did multiparous cows. The extra time (14.6 min/d) required for milking 3×/d altered the distribution of cow behavioral activity throughout the day. Although this did not affect total daily lying or rumination time, we observed a tendency for cows milked 2×/d to spend less time (224.6 vs. 237.5 min/d) feeding and, thus, those cows tended to consume their feed at a faster rate (0.13 vs. 0.12 kg of DM/min) than cows milked 3×/d. For multiparous cows, the increase in feeding activity was facilitated through having longer (40.1 vs. 36.8 min/meal) and numerically larger meals (4.8 vs. 4.6 kg of DM/meal) when milked 3×/d. Alternatively, primiparous cows consumed smaller (2.9 vs. 3.2 kg of DM/meal) and more frequent meals (9.1 vs. 7.7 meals/d) throughout the day when milked 3×/d, resulting in a tendency for greater DM intake (24.7 vs. 23.6 kg/d) compared with primiparous cows milked 2×/d. These results indicate that under 3×/d milking schedules, primiparous cows will positively adjust their feeding behavior to achieve similar production increases as multiparous cows. In summary, milking 3×/d can be used to improve production; however, greater milking frequency elicits varying effects on the behavior of primiparous and multiparous cows, suggesting that grouping and management of cows based on parity may be beneficial.

Key words: dairy cow, milking frequency, behavior

INTRODUCTION

Increased milk yield and improved production efficiency can be achieved by milking cows more frequently (Erdman and Varner, 1995; Cabrera et al., 2010). Milking frequencies greater than 2×/d can increase milk yield by 10.4 to 21% (Bar-Peled et al., 1995; Klei et al., 1997; Smith et al., 2002), and greater milking frequencies in early lactation can increase milk yield persistency (Bar-Peled et al., 1995; Hale et al., 2003; Dahl et al., 2004). Cows milked 3×/d have shown significantly decreased milk fat percentages compared with those milked 2×/d (Sapru et al., 1997; Smith et al., 2002); however, milk fat yield is not affected by milking frequency (Barnes et al., 1990). Milking 3×/d is associated with small increases in FCM and ECM (Barnes et al., 1990; Smith et al., 2002) and greater technical efficiency on farm (Cabrera et al., 2010). Increased milking frequency has also shown a reduction in SCC and a tendency for reduced SCC throughout lactation (Smith et al., 2002; Dahl et al., 2004).

Increased milk production comes at a significant energy cost (Bar-Peled et al., 1995); therefore, increased milking frequency must be supported by a greater plane of nutrition (Varner et al., 2002). Unfortunately, the time required for extra milkings to occur at greater milking frequencies can greatly reduce the time available for other activities, such as feeding, rumination, and lying behaviors. These behaviors are critical for the maintenance of energy balance, efficient digestion, and cow health and welfare, and to allow the cow to meet her production demands. Because lying has been shown to have priority over feeding when cows have been simultaneously deprived of the ability to do both (Metz, 1985), and return from milking is a significant stimulus

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for cows to feed (DeVries et al., 2003a; DeVries and von Keyserlingk, 2005), feeding behavior patterns are likely to be altered when milking frequency is increased. Greater time spent milking has been associated with less time feeding (Gomez and Cook, 2010), but little research has been done to directly examine the effect of milking frequency on feeding behavior patterns and how dairy cows alter their behavioral patterns to compensate for the restrictions imposed by such a management practice. O'Driscoll et al. (2010a,b) studied the effect of milking 1× or 2×/d on the behavior of pastured dairy cattle. These researchers noted that, even though milking 2× versus 1×/d altered the distribution of grazing and lying behavior throughout the day, cows were able to adjust their behavior patterns to maintain similar durations of grazing and lying behavior. It is unknown, however, if dairy cattle milked more frequently than 2×/d and housed and fed indoors would be able to similarly adjust their behavior patterns to compensate for the extra time required for milking. To our knowledge, no studies to date have compared the behavioral responses of dairy cows milked 3×/d versus 2×/d.

Thus, the objective of this study was to determine the effect of milking frequency on the behavioral patterns and productivity of lactating dairy cows. We hypothesized that increasing milking frequency from 2× to 3×/d would result in increased feeding activity, particularly after milking, resulting in a more uniform distribution of feeding activity throughout the day, and thus alter the distribution of lying and ruminating behavior patterns throughout the day. Given reports of greater production response in primiparous cows to increased milking frequency (Gisi et al., 1986; Barnes et al., 1990), we also hypothesized that these behavioral effects would be magnified in primiparous cows.

MATERIALS AND METHODS

Animals and Housing

Twelve lactating Holstein dairy cows, including 7 primiparous and 5 multiparous (parity = 3.0 ± 1.0; mean ± SD), were used in this study. The animals were 149.5 ± 31.3 DIM and were producing 37.6 ± 8.1 kg of milk at the beginning of the trial. The cows were housed 6 at a time in a freestall research pen located at the University of Guelph, Kemptville Campus Dairy Education and Innovation Centre (Kemptville, ON, Canada). Cows had access to 6 freestalls with waterbeds (DCC Waterbeds, Advanced Comfort Technology Inc., Reedsburg, WI). The waterbeds were topped with wood shavings, and bedding was replaced as needed. Manure was manually scraped to within reach of the alley scrapers 2×/d at 0600 and 1800 h. The experiment was conducted from January 27 to April 27, 2012. The average environmental temperature during the experimental period was 1.5 ± 7.3°C. Use of cows and experimental procedures were approved by the University of Guelph's Animal Care Committee. Cows were managed according to the guidelines set forth by the Canadian Council on Animal Care (2009).

Experimental Design

The number of animals required per treatment was determined through sample size and power analysis (Morris, 1999) for the primary outcome variables, including behavior, DMI, sorting, and milk production and composition. Cows were divided into 2 groups of 6, which were balanced according to DIM, milk production, and average parity. Within each group, cows were randomly exposed to each of 2 treatments in a replicated crossover design (with groups replicated over time), with 21-d treatment periods. The treatments were milking frequency: (1) 2×/d (at 0600 and 1800 h) and (2) 3×/d (at 0600, 1400, and 2200 h). Cows were milked using a robotic milking system (Lely A3 Next, Lely Industries N.V., Maassluis, the Netherlands). At the specified milking times, cows were moved from the research pen into a small holding area adjacent to the robotic milker, from where they were milked individually and sequentially. Only the cows that were scheduled for milking, according to treatment, were moved into the holding area. Therefore, at 0600 h, all 6 cows were moved into the holding area, and at each subsequent milking time (specific to each treatment), only 3 cows were moved into the holding area. Cows did not receive any supplemental feed from the robotic milking system while being milked. Each 21-d treatment period included 14 d for adaptation to each treatment followed by 7 d of data collection.

Feeding Procedure

Cows were individually assigned to one roughage intake feed bin (Insentec B.V., Marknesse, the Netherlands) to measure individual feed intake and feeding behavior, as validated by Chapinal et al. (2007). Cows received 3 d of training before the start of the experimental period to learn to access their own unique feed bin. Cows were fed a base TMR formulated to meet the nutrient requirements of a cow producing 39 kg of milk according to the NRC (2001) nutrient recommendations for high-producing lactating dairy cows. The TMR consisted of 30.4% grass/legume silage, 30.0% corn silage, 3.6% grass/alfalfa hay, 10.5% high moisture corn, 11.3% protein concentrate, and 14.3% robotic pellet supplement on a DM basis (Table 1).