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The effect of premilking udder preparation on Holstein cows milked 3 times daily

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ABSTRACT

Premilking udder preparation (including forestripping and duration of lag time—the time between first tactile stimulation and attachment of milking unit) might influence milking measures such as milking unit on-time, incidence of bimodality, and milk flow rates in Holstein cows milked 3 times daily. Holstein cows (n = 786) from an 1,800-cow commercial dairy herd were enrolled under a restricted randomized design to determine the effect of 9 different premilking routines. Lag times were 0, 60, 90, 120, and 240 s and included forestripping or no forestripping for a total of 9 treatments (no forestripping for 0 lag time); the study was conducted from February to November 2008. All cow-treatment combinations were compared with the control: predipping plus forestripping and drying with 90 s of lag time. Cows were initially assigned to 1 of 3 treatments for a period of 7 d and upon completion of the first 7-d period were reassigned to a different treatment until all treatments had been completed. From one treatment period to the next, cows had to switch stimulation method with no restriction on lag time. Cows did not receive all treatments during the duration of the trial. Early- to mid-lactation cows (EML; 17–167 DIM) and late-lactation cows (LL; 174–428 DIM) were housed in 2 different pens. Milk yield was significantly different between dip + forestrip and dip + dry for 2 of the treatments for EML cows compared with dip + forestrip and 90 s of lag-time (DF90); however, this was not thought to be due to treatment because the significant lag times were very different (60 and 240 s) and neither was an extreme value. Milk yield did not differ with treatment for the LL cows. Milking unit on-time did not differ when comparing all treatments for EML with treatment DF90; however, an increase in milking unit on-time occurred when lag time was 60 s or less for LL cows. The highest incidence of bimodal milk curves was when lag time = 0 and this was independent of stage of lactation; a lag time of 240 s had the second-highest incidence of bimodal milk curves for EML and LL cows. Milk harvested in the first 2 min was lower for lag times of 0 and 240 s when compared with DF90. Increasing the lag time for all cows appeared to improve overall milking time efficiency (although lag time had no effect on EML cows).

Key words: premilking routine, udder preparation, lag time, bimodality

INTRODUCTION

The premilking routine is typically performed manually, and variation in the premilking routine from person-to-person and day-to-day is common. The premilking routine consists of many components designed to improve overall milk quality, proper milk letdown, mammary health, and milking-time efficiency. The premilking routine can involve sanitation of the teat, forestripping, drying, and timing of milking-unit attachment. Many factors (e.g., breed of cow, stimulation method, stage of lactation, and timing of milking-unit attachment) affect milking-time variables. Immediately attaching the milking unit will allow for the harvest of the cisternal milk fraction, which amounts to 20% of the milk volume in the udder. The remaining 80% is alveolar milk that is not readily available for milk harvest until activation of the milk-ejection reflex (Bruckmaier and Blum, 1996, 1998). A form of tactile stimulation and proper prep-lag times are required to harvest the alveolar milk fraction, which is under the control of a neuroendocrine mechanism involving the release of oxytocin (Bruckmaier and Blum, 1996). Prep-lag time is defined as the time from when the first form of tactile stimulation (either forestripping or drying) is administered until milking-unit attachment. The release of oxytocin and its subsequent binding to receptors on myoepithelial cells leads to the expulsion of the alveolar milk fraction.

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A summary of studies from the past 30 yr indicated that stimulation of at least 20 s and a total prep-lag time of 60 s reduced milking unit on-time and increased the average flow rate compared with no stimulation (Reneau and Chastain, 1995). Those studies were performed on cows that were milked twice daily, were crossbred cattle, or had levels of milk production that were lower than today's higher yielding cows. Weiss and Bruckmaier (2005) indicated that a short prestimulation time would increase the cows per milking stall with cows that had a high degree of udder filling and that prolonged stimulation might be beneficial when milking cows with a low degree of udder fill. Decreasing the time spent on the premilking routine also improves cow throughput (cows/milking stall) and increases capital investment (Smith et al., 2005). The latter approach spreads the investment out over more cows and increases the return on investment.

Much of the focus historically has been placed on milk yield and milking unit on-time as the key variables of interest. More recently (with advancements in milk flow-meter technology), the ability to measure milk-flow curve characteristics more accurately has increased. The incidence of bimodal milk curves and percentage of milk harvested in the first 2 min are newer parameters to evaluate milking routines. A recent study of Italian Holstein-Friesian cattle found that 35% of milk flow curves were bimodal (which suggests poor premilking routines; Sandrucci et al., 2007). Automated milking of cows has the ability to measure milk flow characteristics at the level of the quarter and not the udder. Automated milking systems allow for the analysis of milking characteristics at the level of the quarter, and Bava et al. (2005) reported no difference in the incidence of quarter-level bimodal milk curves for 3 milking intervals (3.2, 1.1, and 2.2% for milking intervals of <9 h, 9–11 h, and >11 h, respectively).

Our objective was to determine the effect of the premilking routine (which included forestripping, lag time, and their interaction) on milk yield, milking unit on-time, and milk-flow characteristics of high-producing Holstein cows in a commercial herd with various DIM and milked 3 times daily.

MATERIALS AND METHODS

Cows and Treatments

Holstein cows (n = 786) from a 1,800-cow commercial dairy herd were enrolled in a restricted randomized design, such that cows had to switch method of stimulation from one period to the next but not lag time. Cows were housed in a 6-row freestall barn and bedded with a combination of kiln-dried sawdust and drywall gypsum. Cows were fed a TMR that met or exceeded the NRC requirements (NRC, 2001). The 305-d mature-equivalent yield of the herd was 13,378 kg/lactation with a median lactation number of 2. Cows were milked 3 times daily on a 50-bail rotary parlor. Cows had milking intervals of 8 h and were milked at 0800, 1600, and 2400 h. The experiment was conducted from February through November of 2008. Early- to mid-lactation cows (**EML**; 17–167 DIM) and late-lactation cows (**LL**; 174–428 DIM) were housed in separate pens for the study. Pen size was 200 and 220 cows for EML and LL cows, respectively. All cows had to be ≤400 DIM at the time of enrollment in the study. All cows had to have 4 functioning quarters and could not have had a case of clinical mastitis during the current lactation. The treatments involved 2 forms of stimulation and 5 lag times. The stimulation methods were predipping plus drying (**D**) and predipping plus forestripping and drying (**DF**). Forestripping required the removal of 2 streams of milk from each teat. Cloth towels were used for drying of the teats. Application of predip, forestripping, drying, and attachment of the shortest lag times during each period was performed by milkers from the dairy, whereas undergraduate research workers attached milking units to the cows with the longest 2 lag times during each period. All milkers went through a milker training routine prior to the start of the experiment, and the experimental milking protocol was located in the milking center. Lag time was timed from first form of tactile stimulation (either forestripping or drying) and continued until milking-unit attachment and was 0, 60, 90, 120, or 240 s. This resulted in 9 total treatments: **D0**, **D60**, **D90**, **D120**, **D240**, **DF60**, **DF90**, **DF120**, and **DF240** (there was no DF0 treatment because it was not possible to have immediate attachment with no stimulation; Table 1). Cows were randomly assigned via computer-generated list to 1 of 3 treatments initially. Cows were balanced for milk yield, unit on-time, milk yield in the first 2 min, DIM, and parity. A treatment lasted for 7 d with the first 3 d (9 milkings), representing an adaption period and the last 4 d (12 milkings), representing the data collection period, and the study took place between February and November 2008). A maximum of 3 treatments were administered during any period. Upon completion of a 1-wk period, cows were reassigned to another treatment but had to switch method of stimulation from one period to the next. There was no restriction on lag time other than a cow never repeated the same treatment combination (no cows received all 9 treatments). A mutual agreement was reached before the initiation of the experiment as to the level of participation required by the producer; thus, an informed-consent agreement was reached between the dairy producer and Cornell