



Research

Changes in lying behavior after abrupt cessation of milking and regrouping at dry-off in freestall-housed cows: A case study

Núria Chapinal^{a,b,*}, Gosia Zobel^b, Kimberly Painter^a, Ken E. Leslie^a^a Department of Population Medicine, University of Guelph, Ontario, Canada^b Animal Welfare Program, University of British Columbia, British Columbia, Canada

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ABSTRACT

The objectives of this case study were to evaluate differences between primiparous and multiparous cows in milk production over the last 10 days before abrupt cessation of routine milking to end lactation and to assess the effect of parity and milk production on changes in lying behavior around the routine on-farm practice of abrupt cessation of milking and regrouping in 1 freestall herd in Ontario (Canada). Lying behavior and milk production were monitored in 33 primiparous and 75 multiparous cows. Cows were dried-off abruptly (i.e., no longer milked) after the afternoon milking, regrouped with dry cows, and switched to high-forage diet. At the time of dry-off, cows were producing more than 20 kg/day on average. However, there was great variability across cows, with some cows producing over 35 kg/day on the day before dry-off. After removing 3 outliers, there was no difference between parities in the slope of the milk decrease over the last 10 days before dry-off. There was a negative association between the milk produced on the day before dry-off and lying time on the day of dry-off (coefficient estimate = -11.6 ± 4.7 minute/day) in primiparous cows only. Multiparous cows increased their daily lying time after dry-off; this increase leveled off 2 days after dry-off (lying time [minute/day] = $750.6 + 47.8 \text{ day} - 9.9 \text{ day}^2$). In contrast, primiparous cows decreased their daily lying time on the day of dry-off; however, daily lying time then increased until day 3 after dry-off (lying time [minute/day] = $641.6 - 11.9 \text{ day} + 19.9 \text{ day}^2$). Overall, the frequency of lying bouts increased on the day of dry-off, decreasing over the next days (lying bouts/day = $9.7 + 0.5 \text{ day} - 0.3 \text{ day}^2$). Although average lying bout duration decreased on the day of dry-off and increased over the subsequent days for all cows, the initial decrease was greater in primiparous cows (lying bout duration [minute] = $82.5 - 0.7 \text{ day} + 1.8 \text{ day}^2$ and $68.0 - 3.2 \text{ day} + 3.6 \text{ day}^2$ for multiparous and primiparous cows, respectively). The lying behavior diurnal patterns illustrated a decrease in lying time associated with each milking session on the 2 days before dry-off. Interestingly, similar patterns persisted after dry-off, although the magnitude of the decrease in lying time associated with each omitted milking was lower. Given that lying is a high-priority behavior in dairy cattle, these results suggest that the welfare of cows around the routine on-farm practice of abrupt cessation of milking and regrouping at dry-off, particularly after their first lactation, may be compromised.

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Introduction

A typical dairy cow production cycle consists of 305–340 days of lactation, followed by a 40–60 day dry period. Often, a combination of practices is used to initiate this dry period (i.e., to dry off the cows) (Dingwell et al., 2002). Although farm specific, many dry-off

protocols will include an abrupt cessation of milking, coupled with antibiotic and teat sealant therapy. Additionally, cows are usually moved to another pen after dry-off, where they are regrouped with other cows and switched to a low-energy diet. Therefore, stress because of regrouping (Hasegawa et al., 1997) and udder distention because of the sudden cessation of milking are potential welfare concerns.

Local changes in the udder (e.g., udder distension and mild inflammatory response) and behavioral changes resulting from reduced milking frequency (e.g., decreases in lying time) suggest that cows are experiencing discomfort or pain when hydrostatic pressure builds in the udder (Davis et al., 1999; Tucker et al., 2007;

* Address for reprint requests and correspondence: Núria Chapinal, DVM, MSc, PhD, Animal Welfare Program, University of British Columbia, British Columbia, Canada V6T 1Z4. Tel: +1-604-822-5715.

E-mail address: nchapinal@yahoo.com (N. Chapinal).

O'Driscoll et al., 2011). Ongoing improvements in genetics and management have resulted in many cows having high levels of milk production at dry-off. The risk of discomfort associated with udder distention at dry-off is likely to be the greatest for high-producing cows subjected to abrupt cessation of milking. First-lactation cows could potentially experience more discomfort because the persistence of their milk production curve is greater (Rowlands et al., 1982; Keown et al., 1986), and the tolerance to hydrostatic pressure could be compromised by the relative immaturity of the mammary gland (Davis et al., 1999). The possibility that abrupt cessation of milking has a negative effect on the welfare of dairy cows makes further investigation of this procedure and potential alternatives (e.g., reducing energy intake or milk frequency before dry-off; Valizaheh et al., 2008; Tucker et al., 2009) essential toward establishing recommended dry-off practices.

Automatic methods of recording milk production and behavior can help make decisions regarding dry-off management. Currently, the automatic recording of individual cows' daily milk production is widespread. Access to daily production data offers producers the opportunity to monitor the declining slope of milk production as cows approach the dry period. There is potential to use this information to decide when and how to dry-off each cow. In addition, lying behavior can be monitored individually and continuously by using electronic data loggers. Lying behavior has been previously used as a tool to assess discomfort caused by udder distension because of milk accumulation (Stefanowska et al., 2000; Österman and Redbo, 2001; O'Driscoll et al., 2011). The objectives of the current case study were to evaluate differences between primiparous and multiparous cows in milk production over the last 10 days before dry-off and to assess the effect of parity and milk production on changes in lying behavior around the routine on-farm practice of abrupt cessation of milking and regrouping at dry-off in 1 freestall herd in Ontario (Canada).

This case study is intended to be an initial step toward identifying the welfare implications of the dry-off management practices commonly used in a commercial setting.

Materials and methods

Housing and management

This study was conducted on a commercial farm located in southwestern Ontario (Canada). The herd was composed of approximately 350 lactating cows. Cows were housed in a 4-row, sand-bedded, freestall barn (4.6 m long × 1.25 m wide × 1.3 m high head-to-head freestalls). Primiparous and multiparous milking cows were housed in separate pens with 88 and 116 stalls, in groups of up to 90 and 150 cows, respectively. Cows were milked 3 times/day in the parlor starting at approximately 0500, 1300, and 2100 hours. Primiparous cows were milked before multiparous cows. Dry cows were housed in 1 pen with 44 stalls, in a group of up to 50 cows.

Before dry-off, all cows were fed a 66% forage total mixed ration, consisting of 37.4% corn silage, 23.8% haylage, 5.2% hay, and 33.6% concentrate and mineral mix on a dry matter (DM) basis (DM: 49%; crude protein: 17.9% DM; acid detergent fiber: 19.6% DM; neutral detergent fiber: 30.5% DM). At dry-off, cows were switched to a 99% forage diet consisting of 31.6% corn silage, 48.0% haylage, 19.4% wheat straw, and 1.0% mineral mix on a DM basis (DM: 47.1%; crude protein: 12.2% DM; acid detergent fiber: 32.4% DM; neutral detergent fiber: 47.0% DM). Both diets were available ad libitum with fresh feed delivered once daily between 0500 and 0800 hours. Water was freely available from self-filling troughs, with no restrictions at dry-off.

Cows were routinely dried off twice a week on the farm, at approximately 60 days before expected calving date. The list of

cows to dry-off was generated by the producer. After the afternoon milking on the day of dry-off, dry cow antibiotic (CEFA-DRI; Boehringer-Ingelheim, Burlington, Ontario, Canada) and teat sealant (Orbseal; Pfizer Inc., Kirkland, Quebec, Canada) therapy were administered, and cows moved to the dry cow pen, where they remained until the next lactation.

Data collection

The data collection took place between June and December 2009. The study was approved by the University of Guelph Animal Care Committee. All work with animals was done according to the guidelines set by the Canadian Council on Animal Care (2009).

All cows that dried-off during the study period ($n = 134$; up to 5 cows/week) were eligible. At least 2 days before dry-off, animals were fitted with data loggers (HOBO Pendant G, Onset, Cape Cod, MA). The loggers were attached to 1 hind leg and programmed to record position of the cow (lying or standing) in 1-minute intervals from day -2 to 5 relative to dry-off (day 0). These measurements were used to calculate frequency of lying bouts, their duration, and the total daily and hourly lying time (Ledgerwood et al., 2010). Daily milk production for the last 10 days before dry-off was retrieved from the Afifarm computerized milking and management software system (SAE Afikim, Kibbutz Afikim, Israel).

Cows that calved more than 100 days ($n = 2$) or more than 40 days ($n = 1$) after dry-off or cows that did not calve in the herd ($n = 4$) were discarded for further analysis. Because of technical problems, data from 19 cows were discarded. Complete data were available for a total of 33 primiparous (mean \pm standard deviation; days in milk [DIM] = 319 ± 47) and 75 multiparous cows (parity = 3.6 ± 1.6 , range = 2–9; DIM = 335 ± 50). Cows calved on average 60 ± 7 days after dry-off (range = 43–90 days).

Data management and analysis

Differences between primiparous and multiparous cows in daily milk production over the last 10 days before dry-off were tested using a mixed model (PROC MIXED; SAS, version 9.2; SAS Institute Inc., Cary, NC) that included the linear effect of day relative to dry-off as a repeated measure over cow, DIM at dry-off as a covariate, parity and month of dry-off as fixed effects, and the interaction between parity and day relative to dry-off. A Toeplitz covariance structure was selected based on the lowest Aikake's information criterion.

For the lying behavior data analysis, experimental days were adjusted to start at 1500 hours (the time by which all cows were dried off after the afternoon milking and moved to the dry pen) before summarizing the data by day. Exploratory analyses showed that changes in lying behavior happened within the first 4 days after dry-off, and therefore only data from day -2 to 3 relative to dry-off (day 0) were considered in the final analyses. Data from day -2 and -1 were very similar and averaged to get 1 baseline value per cow for each lying behavior variable. Lying time was also summarized by hour, and diurnal patterns were plotted for descriptive purposes. Diurnal patterns on day -2 and -1 , and on day 1–3 were very similar, and therefore diurnal patterns were summarized in 3 periods: (1) baseline (day -2 and -1), (2) day of dry-off (day 0), and (c) days immediately after dry-off (day 1–3).

Univariable analyses were first performed to assess the association between lying behavior outcome variables (daily lying time, daily frequency of lying bouts, and average lying bout duration) and 3 milk production variables: (1) milk production on the last day before dry-off (i.e., sum of the last 3 milkings), (2) average daily milk production over the last 10 days before dry-off, and (3) the slope of the milk production over the last 10 days before dry-off

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