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THIS MONTH'S ARTICLE:

The Dry Period Requirement in Dairy Cattle: New Ideas for an Old Management Practice

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Thank You from the Fabers

Steve and Nancy Faber would like to thank everyone attending or invloved in our retirement party and gift. It was a very enjoyable and memorable evening. We have appreciated all your support in the past nine years at the University of Arizona.

University of Arizona Extension Dairy Website: http://cals.arizona.edu/extension/dairy

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1. *The Milking School*. Utah State University. Spanish and English. 1998. 30 minutes
2. F*itting and Showing Your Dairy Animal...A Winning Experience*. Department of Dairy Science, University of Wisconsin. 1996. 20 minutes
3. *Proper Milking Procedure*. University of Florida. Spanish and English. 1988. 12 minutes
4. *Milking Machine Maintenance*. University of Florida. Spanish and English. 1988. 16 minutes
5. *The Basics of Vacuum and Milking Systems*. DHIA Services. 1991. 53 minutes
6. *Understanding Dairy Cattle Behavior to Improve Handling and Production*. Livestock Conservation Institute. 1992. 23 minutes
7. *Managing Milking/Ordenar Lecheria*. Hoard's Dairyman. Spanish and English. 1999. 33 minutes
8. *Get Milk? Joining A Dairy Crew*. University of New Hampshire. 1999. 45 minutes
9. *What's the Best Milking Routine?* Dairy Management Institute. 1999. 60 minutes

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The Dry Period Requirement in Dairy Cattle: New Ideas for an Old Management Practice

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Abstract
A dry period of 40 to 60 d is a routine management practice in the dairy industry and provides a balance of maximum milk yield and profitability. A dry period less than 40 d reduces milk yield in the subsequent lactation by 5 to 15%. Omitting the dry period completely has resulted in production losses of 20 to 40% in the subsequent lactation as a result of reduced mammary epithelial cell function rather than nutritional status or negative effects of exposure to milking stimulus and galactopoietic hormones during late gestation. There is limited information n a shortened dry period or continuous lactation using today's high-producing dairy cow. Further, the use of new management technologies and practices, such as bovine somatotropin, increased milking frequency, and altered photoperiod may improve mammary functionality in cows subjected to a shortened or omitted dry period. Recent research suggests potential for reducing the dry period requirement to 30 d regardless of parity and for continuous milking in bST-supplemented, multiparous cows without production losses in the subsequent lactation. Further, a reduction in dry period length has resulted in improved dry matter intake in periparturient cows and may improve milk yield and health status of transition cows.

Introduction
The dry period between lactations has been a standard in dairy management practices since the 1800s (Dix Arnold and Becker, 1936). However the optimal length ranged from 10 d to 10 wks. In the early 1900s, an 8-wk dry period became the most widely used because it was believed to result in optimal productivity in the subsequent lactation (Dix Arnold and Becker, 1936). During World War II, the 305-d lactation and 60-d dry period was adopted for both maximal milk production during a time of food shortages and maintenance of genetic progress (Knight, 1998). Since adoption of the 60-d dry period, the dairy industry has undergone many advances in management practices and embraced new technologies, such as artificial insemination, total mixed rations, increased milking frequency (IMF), bovine somatotropin (bST), and altered photoperiod, resulting in production increases of 5000 kg or more per lactation through improved peak milk yields and more persistent lactations. Despite these advances, more than 70% of U.S. dairies are still managing for a 60-d dry period (NAHMS, 1996) and the optimal dry period length has not been reevaluated until recently. Further, previous research on the optimal dry period length in dairy cattle was conducted using cows producing peak milk yields of 25 kg/d or less compared to today's dairy cow capable of reaching peak milk yields in excess of 50 kg/d.

Effects of dry period length on subsequent milk yield
A review of the literature reveals production losses of 10 to 38% in cows subjected to a shortened or omitted dry period (Rémond et al., 1997; Bachman and Schairer, 2003; Annen2 et al., 2004). These data were summarized from both planned experiments and retrospective analyses of dairy records. Analyses of dairy records may be biased by incorrect records, missed breeding dates, multiple births, aborted pregnancies, and mismanagement resulting in a short or no dry period in cows that were being managed for a 60-d dry period. These factors would negatively impact milk yield in the subsequent lactation regardless of dry period length. Results from commercial trials and controlled experiments on shortened or omitted dry periods are summarized in Table 1. From these planned experiments, four hypotheses on the dry period requirement in dairy cattle were proposed. They are 1) replenishment of body reserves, 2) negative effects of galactopoietic and milking stimulus hormones, 3) reduced mammary cell number, and 4) reduction of normal mammary function (Swanson, 1965; Smith et al., 1967; Swanson et al., 1967; Capuco et al., 1997).

The nutritional hypothesis was disproved in an experiment using identical twins to test the effects of dry period length on body weight during late gestation and the subsequent lactation (Swanson, 1965). The twins had equivalent milk yields during their first lactation, at the end of which one twin was dried 60 d prior to their expected parturition date and the other twin was milked continuously (no dry period; CM). Body weight (BW) was measured weekly throughout the experiment. The CM twins produced only 75% and 62% as much as controls (60-d dry period) during their second and third lactations, respectively. The CM twins maintained heavier BWs than controls throughout the experiment, indicating nutrition was not the limiting factor to milk yield in the subsequent lactation. If nutrition had been the limiting factor, the higher BWs reported for CM cows should have supported higher, not lower, milk yields than controls. After the third lactation all twins were given a 60-d dry period. There were no notable carryover effects of continuous milking during the fourth lactation, as the twins that were previously CM had a tendency to produce more milk than the control twins. The absence of a carryover effect from continuous milking has also been demonstrated by Coppock et al. (1974) and Rémond et al. (1997). A half-udder model was used to further negate the nutritional hypothesis (Smith et al., 1967). In this model, one udder half is dried for 60 d and the other half milked continuously. Variation between experimental units is reduced because all factors other than lactation status are common to the udder halves, including nutritional and endocrine factors. Despite common nutrient supply to both udder halves, CM halves produced 77% as much milk as 60-d dry halves in the succeeding lactation. Endocrine hormones associated with the milking stimulus and galactopoiesis were also common to both halves, but 60-d dry halves produced higher milk yields in the next lactation indicating that exposure to these hormones during the dry period did not limit milk yield in the halves given a dry period (Smith et al., 1967). Autocrine and paracrine hormones in the mammary gland may play a role in milk yield reductions in CM halves, but have not been investigated.

In cows given a 60-d dry period, mammary gland involution occurs during the early dry period and is characterized by 1) increased programmed cell death (apoptosis), 2) increased intramammary pressure and udder distention, 3) regression of secretory function of mammary epithelial cells (MEC), and 4) low levels of MEC proliferation (growth; Holst et al., 1987; Capuco and Akers, 1999; Annen1 et al., 2003). Concurrent pregnancy and advanced lactation at the time of milk stasis (dry-off) in dairy cows results in a rapid, but small increases in MEC apoptosis during involution and maintenance of alveolar structure and integrity occur throughout the dry period (Annen1 et al., 2003). By 25 d after dry-off, mammary DNA content (cell number) and luminal area of the alveoli are at a minimum and stromal components of the mammary gland are at a maximum, suggesting mammary involution is complete (Capuco et al., 1997). This time point also appears to correspond to initiation of the process to replace MEC that were removed by apoptosis and/or contributes to continued mammary development. After the gland has been dry for 25 d, an increase in MEC proliferation occurs and the rate of proliferation increases throughout the remainder of the dry period. By d 53 of the dry period (1 wk prepartum in cows managed for a 60-d dry period), MEC proliferation has nearly doubled compared to values on day 7 of the dry period (Capuco et al., 1997). The second stage of lactogenesis, when MEC proliferation is greatest and differentiation into a secretory phenotype occurs, also takes place during the last week of gestation (Akers, 2002). Interestingly, maintenance of lactation during the last 60 d of gestation in CM cows alters these patterns of MEC proliferation (Capuco et al., 1997). In both half-udder and between animal experiments in dairy cows, mammary DNA content and parenchyma mass was the same in dry and CM glands (no change in total MEC number; Swanson et al., 1967; Capuco et al., 1997), but MEC proliferation is reduced in CM glands (Capuco et al., 1997). Maintenance of total cell number despite dramatic reductions (80%) in MEC proliferation, suggests an alteration in mammary cell turnover that would result in less replacement of old or senescent MEC during late gestation. If old MEC have reduced secretory and mitotic capacity (Capuco and Akers, 1999), this change in MEC turnover which increases carryover of old MEC into the subsequent lactation may be the causative factor of reduced mammary functionality in CM cows (Capuco et al., 1997). An increase in MEC carryover into the next lactation has been demonstrated in CM rats (Pitkow et al., 1972).

Reduced mammary functionality and possibly reduced MEC number in cows subjected to a shortened or omitted dry period could potentially be alleviated by use of management practices that improve these factors, thus altering the dry period requirement in today's dairy cows. There are three dairy management practices that alter mammary gland functionality and/or cell number: 1) bST, 2) IMF, and 3) altered photoperiod. Recent research, some of which incorporates bST supplementation and IMF, has demonstrated potential for reducing dry period length in high-producing cows. Several studies have recently demonstrated that a 30-d dry period is equal to a 60-d dry period with (Gulay et al., 2003; Annen3 et al., 2004) or without (Bachman, 2002; Rastani et al., 2003) bST supplementation during late gestation and early lactation. Bachman (2002) evaluated the decline in replacement of senescent MEC and reduced milk yield in the subsequent lactation using a shortened dry period (30 d) and estrogen injection at milk stasis to attempt to hasten involution. Results demonstrated that 305-d ME milk yields in the subsequent lactation were equal in 30-d dry and 60-d dry groups (Table 1). Estrogen treatment did not alter 305-d ME regardless of dry period length. Because mammary involution is complete by 25 d of the dry period (Capuco et al., 1997), a 30-d dry period may be adequate time for involution to occur without estrogen treatment. These data also indicate that a 30-d dry period may be adequate to alleviate reduced MEC proliferation observed in CM glands. Gulay et al. (2003) examined the effects of a 30-d dry period, estrogen treatment at milk stasis, and low-dose (143 mg/14 d compared to the FDA approved dose 500 mg/14 d) administration of POSILAC® (bST) during the last 28 d of gestation and first 60 d postpartum on subsequent milk yields. Milk yield was not affected by shortening the dry period or estrogen treatment during the 21-wk study (Table 1). Milk yield was increased by 8% in bST treated cows, but there was no interaction between dry period length and bST supplementation. Further, 30-d dry cows tended to have improved dry matter intake (DMI) and lost less body condition than traditionally managed cows (60- d dry period). Body condition was not influenced by bST. In a commercial trail, an evaluation of POSILAC® supplementation (500 mg/14 d) according to label instructions (label=bST started at 57 to 70 DIM to end of lactation) and a 30-d dry period revealed subsequent milk yields equal to 60-d dry cows in primiparous and multiparous cows (Table 2; Annen3 et al., 2004). A shortened dry period was further suggested to be sufficient by equal milk yields in cows given a 28-d dry period (without bST supplementation or estrogen treatment) and 56-d dry period and 21% greater DMI in 28-d dry cows compared to 56-d dry cows (Rastani et al., 2003).

The effect of continuous milking throughout late gestation on subsequent milk yields has also been examined recently. Annen3 et al. (2004) examined the effects of continuous milking with label (CMLST) and continuous bST (CMCST) supplementation during late gestation and early lactation (1 to 17 wk). Milk yield for CMLST and CMCST multiparous cows was equivalent to 60-d dry cows (Table 2). Cows in the primiparous CMLST and CMCST groups had substantial production losses of 20 to 25% (Table 2). Income generated from additional days of milk produced during late gestation in addition to sustained postpartum milk yields resulted in improved profitability ($50/cow) in CMLST and CMCST multiparous cows over controls during the first 17 wk of the next lactation. Production losses in CMLST and CMCST primiparous cows negated additional milk income generated during late gestation and resulted in negative net margins by wk 17 of the subsequent lactation. From these results, we hypothesize that continuous milking impedes continued mammary development in primiparous cows, where as multiparous cows no longer have a mammary growth requirement. Rastani et al. (2003) also evaluated the effects of omitting the dry period, but without bST supplementation. The CM cows had a 14% reduction in daily milk yield in the succeeding lactation, but prepartum DMI was improved by 30% when compared to controls (56-d dry). The results from these continuous milking studies suggest a role for bST in improving mammary functionality and milk yield in CM cows, especially multiparous cows. Further, data from shortened dry period and continuous milking studies, suggest improved prepartum DMI which may reduce health risks associated with the periparturient period. The animals in these shortened dry period or continuous milking studies (Bachman, 2002; Gulay et al., 2003; Rastani et al., 2003; Annen3 et al., 2004) had milk yields representative of today's dairy cow and further supports the need for continued research on the optimal dry period length with current production levels and management strategies in the dairy industry.

The effects of CM combined with bST and IMF was examined in two experiments conducted simultaneously by our lab. Both studies utilized the half-udder model to increase the number of experimental units (udder half) while decreasing between animal variation. The first experiment was designed to evaluate the effects of bST and continuous milking on milk yield and MEC number and turnover during the dry period and early lactation (E.L. Annen, A.C. Fitzgerald, and R.J. Collier, unpublished). The study used eight primiparous, Holstein cows; four were bST supplemented throughout the experiment and four were not treated with bST. The experiment was conducted during the last 60 d of gestation and first 30 d of the subsequent lactation and all cows were milked twice daily

(2X) both pre- and postpartum. One udder half was dried 60 d prior to expected parturition date and the other half was CM. Subsequent milk yields were reduced by 48% in CM, no bST halves and 56% in CM, bST halves. Visible reductions in the size of CM halves, add merit to the hypothesis that CM impedes mammary growth and/or functionality in primiparous cows. Further, these results suggest CM may reduce MEC number in primiparous cows, similar to that observed in other species (rats and goats; Paape and Tucker, 1969; Fowler et al., 1991). Lower milk yields in bST-treated, CM halves during early lactation were unexpected. Negative energy balance dynamics during early lactation may have limited the milk yield response to bST. Diminished responses to bST have been demonstrated in early lactation cows (Vincini et al., 1991) and energy restricted cows (McGuire et al., 1995).

The second experiment was identical to the first experiment, except eight primiparous, Holstein cows were milked 2X until parturition, then milked four times daily (4X) at unequal intervals (4, 8,4, 8 h) for the first 30 d of the next lactation. Early-lactation IMF may be an approach to minimize or recoup milk losses observed in primiparous cows. Thus, the second experiment was formulated to determine the effects of bST and IMF on MEC turnover dynamics in CM and control udder halves (A.C. Fitzgerald, E.L. Annen, and R.J. Collier, unpublished). The percent reduction in milk yield from CM halves was 34 and 36% in 4X, bST and 4X, No bST cows, respectively. As observed in experiment 1, visible differences existed between the udder halves implying reduced mammary growth in CM halves. Bovine ST supplementation improved milk yield by 2.4 kg/d in CM halves and 3.1 kg/d in 60-d dry halves. In summary of these two experiments, continuous milking resulted in substantial reductions in subsequent milk yield, but reductions in 4X, CM halves were much less than those observed in 2X, CM halves with or without bST treatment.

Effects of dry period length on milk composition and colostrum production

Many milk pricing plans and quota systems pay the dairy producer for quantity of milk sold, but also for the composition of that milk. Thus, the effect of continuous milking and short dry periods on milk composition is an important factor to consider. Further, alterations in milk composition could have implications at the consumer level and pose issues regarding saleable milk. Due to the importance of colostrum quality on calf morbidity and mortality, changes in colostrum composition are another important factor to consider.

Milk fat and protein content in CM cows follow similar temporal patterns during late gestation. Both increase over the last 2 mo of gestation (Wheelock et al., 1965, Rémond et al., 1992; 1997, Annen3 et al., 2004; Annen et al., unpublished; Fitzgerald et al., unpublished) until 7 to 10 d before parturition and then remains elevated through parturition (Wheelock et al., 1965). Postpartum milk fat percent is unchanged by dry period length (Wheelock et al., 1965; Rémond et al., 1992; 1997; Annen3 et al., 2004), but the composition of milk fat may be altered. Rémond et al. (1997) reported a decrease in long chain fatty acids (LCFA) in milk from CM cows. Improved energy balance from reduced milk yield or improved DMI during the transition period in CM cows may have decreased mobilization of adipose tissue. Since LCFA in milk are from preformed sources (adipose tissue, diet), this effect may have reduced LCFA incorporation into milk fat and increased de novo synthesis of short and medium chain fatty acids. Postpartum milk protein percent was greater (Rémond et al., 1992; 1997; Annen3 et al., 2004) or unchanged (Smith et al., 1967; Annen et al., unpublished; Fitzgerald et al., unpublished) in CM cows when compared to controls. An increase in milk protein percent may be the result of improved energy and or protein balance in CM cows; thereby sparing amino acids and energy for protein synthesis (Rémond et al., 1997). The increased milk protein percent observed by Annen3 et al. (2004) was largely explained by breed variation. Milk protein was unchanged in Holstein cows, but was increased in Brown Swiss cows. A biological explanation for this breed by dry period length interaction is not available.

In lactating, late gestation cows, Wheelock et al. (1965) observed a decrease in the potassium (K) to lactose ratio which was accompanied by an increase in sodium (Na) and chloride (Cl) concentrations. It was suggested that these changes were caused by the very low milk yields in late gestation and a shift from a primary secretion of milk to a primary secretion that has a composition similar to plasma (Wheelock et al., 1965). This primary secretion is similar to dry cow secretions which are almost devoid of lactose and had sodium, potassium, and chloride concentrations similar to extracellular fluid (Maule-Walker, 1984). Leaky tight junctions in the mammary epithelium allowing more extracellular fluid into alveolar lumens may result in the change in mammary secretion from normal milk to a plasma-like substance (Linzell and Peaker, 1974). Additionally, tight junctions are known to be leaky during pregnancy and close around the time of parturition (Nguyen and Neville, 1998). It is not known whether the degree of permeability increases as pregnancy advances, but an increase in tight junction permeability has been reported to be accompanied by a decrease in secretion rate. The interaction of advanced-gestation and decreased secretion rate on tight junction permeability has not been investigated in CM cows. Very low milk yields in some CM cows immediately prior to parturition may result in a secretion that is more similar to dry secretions than milk. These changes may alter the appearance and consistency of milk. Further, these changes suggest a decrease in metabolic activity of MEC because maintenance of the normal K gradient between intracellular fluid and the alveolar lumen is an energy dependent process (Wheelock et al., 1965). Postpartum levels of K, Na, and Cl in milk were not altered by dry period length (Wheelock et al., 1965; Smith et al., 1967). These changes in the physical properties and composition of prepartum mammary secretions also raise questions of salable milk and warrant further research.

Colostral immunoglobin (Ig) and protein content are reduced in CM cows (Rémond et al., 1997). In humans, an overlap of breast-feeding and late pregnancy also resulted in reduced Ig concentrations in colostrum (Marquis et al., 2003). Colostrogenesis and accumulation of secretions in the mammary gland prior to parturition result in enhanced protein and Ig concentrations in colostrum harvested during the first 24 to 48 h postpartum (Wheelock et al., 1967; Rémond et al., 1997). The absence of this accumulation period in CM cows may result in reduced colostrum quality. Rémond et al. (1997) reported that cows given a dry period of 1 to 10 d produced colostrum with Ig concentrations that were 60 to 88% of colostrum from cows given a 60-d dry period. Annen3 et al. (2004) reported no effects of a 30-d dry period or continuous milking on colostrum IgG content. Because some cows undergo spontaneous dry-off prior to parturition, a number of cows in both no dry period treatments had brief dry periods (2.9 d and 1.8 d; CMLST and CMCST, respectively), which may have reduced any treatment effect. A retrospective analysis of IgG content based on number of days dry (0 d, 1-10 d, 11-20 d, 21-30 d, 31-45 d, and >45 d dry) suggested that IgG concentration was reduced by 50% in cows dry 0 d. However, cows with even a very short dry period (1-10 d) had IgG levels equal to cows dry greater than 45 d. Further research is needed to verify the effect of continuous milking on colostrum IgG levels.

During a traditional lactation cycle, SCC is high at parturition, reaches nadir at peak milk and mid lactation, and gradually rises during late lactation (Peters, 2002). Rémond et al. (1997) reported the effects of omitting the dry period on SCC using data from several studies (controlled and commercial field trials) conducted by their lab. Similar to a typical lactation, SCC increased during the last 60 d of gestation with a more substantial increase occurring during the last 4 wk of gestation. In subsequent lactations, SCC tended to be elevated in milk from cows given a shortened or omitted dry period, but cases of clinical mastitis were not increased. In these experiments 60-d dry cows were all given intramammary antibiotic treatment at the time of milk stasis, while no preventative therapy was used in CM cows or in many of the shortened dry period cows (Rémond et al., 1997). Similar to these results, Annen3 et al. (2004) reported increased somatic cell linear score (SCLS) in cows given a shortened or omitted dry period, without an accompanying increase in clinical mastitis. Breed and parity interactions with dry period length revealed no apparent changes in SCLS in CM or 30-d dry Holstein cows regardless of parity, but CM or 30-d dry multiparous, Brown Swiss cows had increased SCLS compared to 60-d dry cows. Results from the half-udder studies conducted by our lab (Annen et al., unpublished data; Fitzgerald et al., unpublished data), resulted in no change in SCLS in CM udder halves compared to control halves, regardless of bST supplementation or milking frequency.

Effects of dry period length on transition cow management

During the last 60 d of gestation traditionally managed cows (60 d dry) undergo two transition periods, both of which are associated with increased health and culling risks (Gröhn et al., 1998; Drakeley, 1999). The first transition period occurs during the early dry period when the mammary gland undergoes involution. Udder engorgement combined with cessation of bacterial flushing, which normally occurs during milk removal, are associated with increased risk of mastitis during involution (Smith et al., 1985), as well as discomfort to the animal. High milk yields at the time of milk stasis and dramatic diet changes amplify these stressors associated with the early dry period. The other transition period occurs from 3 wk prepartum to 3 wk postpartum (Grummer, 1995). Parturition and the onset of copious milk secretion in the face of decreasing DMI are associated with increased risk of metabolic disease (i.e. ketosis, milk fever, retained placenta, and displaced abomasums) and are also complicated by an abrupt diet change. A 30 to 35% reduction in DMI typically occurs during the last 2 wk of gestation (Grummer, 1995). Numerous studies measuring DMI across a range of prepartum diets report an average DMI of 10 to 12 kg/d during the last 3 to 4 wk of gestation (Bertics et al., 1992; Grum et al., 1996; Vasquez-Anon et al., 1997; Dewhurst et al., 2000; Greenfield et al., 2000; Hayirli et al., 2002; Rabelo et al., 2003; McNamara et al., 2003). Decreasing DMI during the final weeks of gestation combined with increasing nutrient demands for conceptus growth and the onset of lactation, create a state of negative energy and possibly protein balance by the last wk of gestation and during early lactation (Bell, 1995; Grummer, 1995). Negative energy and protein balance is accompanied by an increase in mobilization of body reserves and predisposes the animal to metabolic diseases (Goff and Horst, 1997). Thus, preventing or minimizing this decrease in prepartum DMI and improving DMI during early lactation would reduce or possibly eliminate this period of negative energy/protein balance. An improvement in energy/protein balance during early lactation would likely decrease the time to reach peak milk yield, increase peak milk yield, and reduce health risks. Continuous milking may improve DMI and energy/protein balance during the final wks of gestation and early lactation because it would remove many of the stressors (involution and diet changes) of both of the dry-off and periparturient transition periods and keep the cow metabolically and physiologically adapted to lactation. In the half-udder studies previously described (E.L. Annen et al., unpublished; A.C. Fitzgerald et al., unpublished), DMI was measured both pre- and postpartum. As long as the CM half was milking, cows were fed a high-energy lactating diet. Cows that spontaneously dried the CM half before parturition were switched to a close-up, dry cow diet (moderate energy) until parturition occurred. During the last 3 wk of gestation the decline in DMI was minimized to only 9% in bST treated cows and 14.5% in no-bST cows, compared to 30 to 35% reductions typically observed in prepartum DMI. Further, both treatment groups maintained DMI above 16 kg/d during the last 4 wk of gestation. All treatments, regardless of bST treatment or milking frequency, averaged 22.4 kg/d of DMI during the first 4 wk of the next lactation. As previously discussed, others have also demonstrated improved DMI in cows given a shortened or omitted dry period (Gulay et al., 2003; Rastani et al., 2003). Dry matter intake was improved in both 28-d dry and CM cows compared to 56-d dry cows (Rastani et al., 2003) and in 30-d dry cows compared to 60-d dry cows (Gulay et al., 2003). Using continuous milking or shortened dry periods as an alternative management practice for transition cows may prove promising due to the potential for improved DMI in minimizing negative energy balance nadir and reduce risk of metabolic disease during early lactation.

Management of late-gestation, lactation cows

Some challenging aspects of managing late-gestation, lactating cows are: 1) housing facilities for lactating cows in the final 4 wk of gestation, 2) changes in the appearance and consistency of mammary secretions near parturition (previously discussed), and 3) potential impact of continuous milking on the dams blood and colostral IgG concentrations. Continuously milked cows that calved in lactating pens resulted in increased risks to both newborn calves and fresh cows being placed in high risk areas (i.e. calves born in flush lanes) and in the care of employees that were not trained to assist dystocias, evaluate health status of fresh cows, and administer colostrum to calves. If continuous milking becomes a management practice, a close-up, lactating pen that 1) provides a comfortable place for cows to calve, 2) is safe for calves, and 3) is located in an area on the dairy that focuses on fresh cow and calf management would be recommended. Additionally, prepartum colostrum production or changes in the primary secretion from milk to a transudate of plasma resulted in some cows being misidentified as having mastitis in our experiments (Annen3 et al., 2004; Annen et al., unpublished; Fitzgerald et al., unpublished). Therefore, we also suggest that milkers should be able to identify CM cows (color-coded leg bands) and receive training on potential changes in the physical properties and appearance of milk near parturition.

Summary

Recent research reveals new potential for shortening or omitting the dry period in multiparous cows without production losses, especially in bST-treated cows. Due to continued mammary growth requirements, reducing dry period length to 0 d in primiparous cows results in substantial production losses that are not alleviated by the use of bST or IMF. A 30-d dry period has been demonstrated as equal to a 60-d dry period, regardless of parity, by several recent studies. Shortened dry periods and continuous milking may provide an improved management alternative for transition cows (especially multiparous cows). Further research is needed to investigate other management practices (alter photoperiod) or combinations of galactopoietics and management practices (bST, IMF, altered photoperiod) that may recover reduced milk yields in CM, primiparous cows and the effects of continuous milking on milk and colostrum quality during the final weeks of gestation.

Table 1. Summary of experiments examining the effects of a shortened dry period or continuous milking (CM) subsequent milk yields. (Adapted from Annen[2] et al., 2004)

Reference	Dry period length	Results
Swanson, 1965	CM	• 25% reduction in milk yield in the second lactation • 38% reduction in the third lactation • Improved body weight throughout the study • No carryover effect of CM on milk yield in the fourth lactation
Smith et al., 1967	CM	• 23% reduction in milk yield in CM glands
Coppock et al., 1974	20, 30, 40, and 50 d	• 20 d, 30 d, 40 d dry periods reduced milk yield by 10%, 7%, and 1% • Dry periods greater that 40 d did not alter subsequent milk production • No carryover effect of CM after a dry period is allowed
Lotan and Alder, 1976	30 d	• Reduced milk yield for 2 mo postpartum, but no difference in 305-d FCM yield
Sørensen and Enevoldsen, 1991	4 wk	• 4-wk dry period reduced subsequent milk yield by 10%
Rémond et al., 1992	CM	• Reduced milk yield by 4 kg/d (17% of average daily milk)
Bachman, 2002	30 d	• No difference in 305-d milk yield
Gulay et al., 2003	30 d	• No difference in daily milk yield or 3.5% FCM yield with or without bST supplementation • 8% increase in milk yield in bST supplemented cows
Annen[3] et al., 2004	30 d and CM	• No production losses in 30DD[1], CMLST, or CMCST multiparous cows or 30 DD primiparous cows • 20 to 25% production losses in CMLST and CMCST primiparous cows
Rastani et al., 2003	28 d and CM	• No difference in daily milk yield between 56-d dry and 28-d dry cows • 14% reduction in daily milk yield in CM cows

[1]30DD=30-d dry period, label bST, CMLST=no dry period, label bST and CMCST=no dry, continuous bST supplementation

Table 2. Least-squares means and standard errors[a] for daily milk (kg/d) produced during the last 8 wk of gestation and weeks 2 through 17 of the subsequent lactation. (Adapted from Annen[3] et al., 2004)

	Treatment[b]				
	60DD[c]	30DD	CMLST	CMCST	SE
Primiparous					
Daily milk last 8 wk of gestation (kg/d)	0.0[§]	5.1[£]	21.0[*]	18.9[*]	1.2
Daily milk for weeks 2-17 of the subsequent lactation (kg/d)	43.1[*]	40.1[*£]	32.2[§]	34.5 [£§]	1.8
Multiparous					
Daily milk for last 8 wk of gestation (kg/d)	0.0[£]	3.2[£]	16.8[*]	12.5[*]	2.6
Daily milk for weeks 2-17 of the subsequent lactation (kg/d)	47.3	45.6	41.9	45.5	3.8

[a]LS means ± SEM

[b]60DD=60-d dry period, label bST supplementation, 30DD=30-d dry period, label bST, CMLST=no dry period, label bST and CMCST=no dry, continuous bST supplementation.

[c]Means within a row with different superscripts differ ($P < 0.05$)

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HIGH COW REPORT
SEPTEMBER 2004

MILK

Arizona Owner	Barn#	Age	Milk	New Mexico Owner	Barn #	Age	Milk
* Mike Pylman	1012	3-04	42,280	* Providence Dairy	8827	3-10	38,580
* Mike Pylman	6161	4-05	41,090	* Providence Dairy	3738	6-01	37,850
* Saddle Mountain Dairy	2336	5-00	39,280	* Providence Dairy	4080	5-05	37,770
* Mike Pylman	1008	3-11	38,850	* Providence Dairy	4852	3-11	37,490
* Mike Pylman	1010	4-08	38,590	* Providence Dairy	4415	4-09	37,300
* Mike Pylman	540	2-00	38,200	* Providence Dairy	9179	3-10	36,950
* Saddle Mountain Dairy	2374	6-02	38,050	* Providence Dairy	4828	3-11	36,710
* Mike Pylman	6206	4-05	37,760	* Providence Dairy	4230	5-01	36,560
* Dutch View Dairy	106	6-00	37,460	* Pareo Dairy	54	6-06	36,440
* Stotz Dairy	12059	7-00	36,980	* New Direction Dairy	1181	8-02	36,426

FAT

* Shamrock Farm	5184	3-04	1470	* Pareo Dairy	1547	10-10	1390
* Mike Pylman	5877	4-09	1420	* Pareo Dairy	1758	5-03	1384
* Mike Pylman	1359	3-10	1393	* Pareo Dairy	1402	6-00	1374
* Shamrock Farm	J614	8-00	1383	* Pareo Dairy	1999	5-05	1352
* Mike Pylman	5062	6-00	1378	* Pareo Dairy	906	7-07	1345
* Saddle Mountain Dairy	2336	5-00	1346	* Tallman Dairy	1412	7-08	1323
* Stotz Dairy	16809	3-05	1328	* Providence Dairy	8827	3-10	1307
* Mike Pylman	540	2-00	1324	S.A.S. Dairy	2625	9-04	1307
* Danzeisen Dairy	4182	4-04	1324	* Pareo Dairy	1360	6-10	1295
* Mike Pylman	4912	6-04	1319	* Do-Rene Dairy	5933	4-03	1284

PROTEIN

* Saddle Mountain Dairy	2336	5-00	1221	* Providence Dairy	8827	3-10	1222
* Mike Pylman	1010	4-08	1200	* Providence Dairy	3738	6-01	1145
* Mike Pylman	540	2-00	1194	* Providence Dairy	8873	4-00	1124
* Mike Pylman	1012	3-04	1178	Ken Miller	911	4-03	1106
* Saddle Mountain Dairy	2307	5-04	1168	* Pareo Dairy	1402	6-00	1102
* Mike Pylman	1206	5-06	1143	* Providence Dairy	4665	4-03	1093
* Mike Pylman	1714	5-00	1103	* Providence Dairy	9179	3-10	1082
* Mike Pylman	1175	4-05	1100	* Providence Dairy	4828	3-11	1082
* Mike Pylman	37	3-04	1097	* Tallmon Dairy	1412	7-08	1076
* Mike Pylman	7395	3-08	1091	* Providence Dairy	8567	4-02	1072
				S.A.S. Dairy	4179	5-11	1072

*all or part of lactation is 3X or 4X milking

ARIZONA - TOP 50% FOR F.C.M.[b]
SEPTEMBER 2004

OWNERS NAME	Number of Cows	MILK	FAT	3.5 FCM	RR
* Stotz Dairy West	2,114	25,978	947	26,584	45
* Red River Dairy	4,593	24,925	900	26,129	31
* Mike Pylman	4,276	24,201	864	24,470	36
* Triple G Dairy, Inc.	4,436	24,416	856	24,433	38
* Stotz Dairy East	1,143	24,416	856	24,433	24
* Treger Holsteins, Inc.	616	24,027	854	24,233	32
* Danzeisen Dairy, Inc.	1,459	23,305	847	23,807	37
* Arizona Dairy Company	5,907	23,313	824	23,438	35
* Del Rio Holsteins	814	23,015	816	23,179	37
* Withrow Dairy	5,341	24,053	778	23,012	29
* Saddle Mountain Dairy	2,841	23,821	767	22,733	33
* Butler Dairy	626	23,310	778	22,691	23
* Shamrock Farm	8,345	23,012	781	22,610	27
* DC Dairy, LLC	1,056	22,285	798	22,572	28
Paul Rovey Dairy	403	22,193	794	22,467	39
* Dairyland Milk Co.	2,867	22,492	764	22,110	29
* Zimmerman Dairy	1,182	21,690	780	22,023	27
* Hillcrest Dairy	2,296	22,248	745	21,696	39
* RG Dairy, LLC	1,335	21,734	755	21,636	30
Lunts Dairy	572	21,286	764	21,589	30
* Goldman Dairy	1,921	21,461	749	21,421	38
* Parker Dairy	4,294	20,594	746	20,998	27
* Yettem Dairy	2,954	17,781	812	20,851	29
* Dutch View Dairy	1,605	20,720	721	20,647	30
* Jerry Ethington	608	19,933	712	20,161	34

NEW MEXICO - TOP 50% FOR F.C.M.[b]
SEPTEMBER 2004

OWNERS NAME	Number of Cows	MILK	FAT	3.5 FCM	RR
* Pareo Dairy #1	1,448	26,155	940	26,769	26
* Tallmon Dairy	472	26,247	870	25,457	240
* Hide Away Dairy	2,137	26,527	828	24,897	183
Ken Miller	400	24,998	865	24,836	33
* Providence Dairy	2781	26,400	824	24,777	25
* Milagro	3380	24,453	875	24,762	27
* McCatharn Dairy	1012	24,943	825	24,164	39
* Do-Rene Dairy	2330	23,913	816	23,572	40
* Pareo Dairy #2	3,108	23,218	830	23,499	26
* New Direction Dairy 2	1780	22,494	829	23,169	28
Prices Roswell Farm	2723	23,081	805	23,034	182
* Goff Dairy 1	4315	22,540	812	22,914	221
* Halfliger Dairy	2,024	22,225	817	22,859	183
Rio Leche	1949	22,246	798	22,560	35
* New Direction Dairy 1	36	21896	800	22,441	46
* Baca Linda Dairy	1208	22,968	765	22,337	30
Vaz Dairy	1,719	22,543	773	22,283	35

* all or part of lactation is 3X or 4X milking

[b] average milk and fat figure may be different from monthly herd summary; figures used are last day/month

ARIZONA AND NEW MEXICO HERD IMPROVEMENT SUMMARY FOR OFFICIAL HERDS TESTED SEPTEMBER 2004

		ARIZONA	NEW MEXICO
1.	Number of Herds	51	30
2.	Total Cows in Herd	81,708	53,628
3.	Average Herd Size	1,602	1,788
4.	Percent in Milk	84	87
5.	Average Days in Milk	212	201
6.	Average Milk – All Cows Per Day	55.1	60.1
7.	Average Percent Fat – All Cows	3.6	3.5
8.	Total Cows in Milk	67,989	46,422
9.	Average Daily Milk for Milking Cows	61.9	69.4
10.	Average Days in Milk 1st Breeding	83	73
11.	Average Days Open	162	151
12.	Average Calving Interval	14.1	14.1
13.	Percent Somatic Cell – Low	87	80
14.	Percent Somatic Cell – Medium	8	19
15.	Percent Somatic Cell – High	5	5
16.	Average Previous Days Dry	62	63
17.	Percent Cows Leaving Herd	31	32
		STATE AVERAGES	
	Milk	21,481	22,910
	Percent butterfat	3.62	3.49
	Percent protein	2.93	3.06
	Pounds butterfat	782.9	804.1
	Pounds protein	643.5	702.8

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UPCOMING EVENTS:
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Tempe, Arizona
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