Milking Cows Four and Six Times per Day (4X-6X) and its Impact on Animal Performance

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Abstract

Increasing the frequency of milk removal increases absolute milk output in cows during an established lactation. Recent studies indicate that high frequency of milking in the first three weeks of lactation can produce lasting increases in persistency after the milking frequency returns to 2 or 3X. This approach reduces the labor requirement of continuous frequent milking. However, a number of management factors need to be considered to effectively implement increased milking frequency. This paper presents evidence of the response, describes collateral effects and discusses possible limitations to implementation.

Introduction

Increasing the frequency of milk removal is a common practice in the dairy industry to increase milk yield and production efficiency.[4,9,15] Indeed, the number of herds and cows milked three or more times each day continues to expand annually (Figure 1). Greater milking frequency is also characterized by improvements in udder health, notably reductions in somatic cell counts.[9,14]

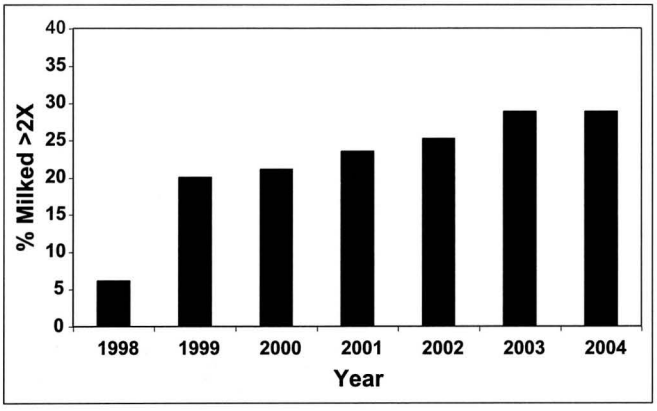

Figure 1. Percentage of cows on DHIA testing milked more than twice daily (2X). Data summarized from <http://aipl.arsusda.gov/publish/dhi/part.html>

Of course, an extra milking each day increases the relative labor cost and that is a disadvantage of 3X milking. Although it is expected that the higher milk yield resulting from increased milking frequency would require greater dry matter intake to support it, summary of a number of studies comparing 2X to 3X milking shows no difference in intake between groups. However, those studies were often of relatively short duration and did not extend through the entire lactation, when differences in intake would be magnified.[5,9] Even considering a modest increment in feed intake and additional labor costs, the returns related to milk yield and health associated with 3X milking typically make this a profitable management intervention relative to 2X.

Recent studies suggest that increased milking frequency has carryover effects when initiated in early lactation. In contrast to 3X milking, however, this approach consists of doubling the normal milking frequency for a brief period immediately after calving and then reducing the frequency. Bar-Peled *et al*[1,2] observed that multiparous cows milked six times daily (6X) from days 1 to 42 of lactation and then milked 3X produced more milk throughout lactation than contemporaries milked 3X from day 1 (Table 1). In a similar study under field conditions in the eastern US, Henshaw *et al*[13] reported that cows milked 6X for 42 days produced an average of 6.4 lb (2.9 kg) per day more milk over 40 weeks of lactation than those milked 3X from parturition. But 42 days does not appear to be needed to produce the effect, as we have observed the persistent milk yield response with only 21 days of the increased milking frequency.[6]

Increasing milking frequency from 2X to four times daily (4X) from parturition also leads to a persistent increase in yield for the 4X cows. Hale *et al*[12] milked cows 4X for the first 21 days after calving and then 2X for the rest of lactation. Relative to cows milked 2X from calving, the 4X cows produced an average of 7.0 lb per day (3.18 kg) more milk from weeks 1 to 44 of lactation.[12] We found similar responses over 100 DIM for cows milked 4X for 21 days and then only 2X.[8] Collectively the evidence supports a positive, persistent effect of higher milking frequency in the immediate postpartum period, but there are management considerations that must be made to ensure a robust response.

Table 1. Daily milk, components and lactation yield of cows milked 3X or 6X for the first 42 days of lactation and then 3X for the remainder of 305-day lactation. Daily yields were recorded during treatment (weeks 1-6) and after treatment for 12 weeks (weeks 7-18). Complete lactation records were from DHI testing (305 days). Data from Bar-Peled *et al.*[1]

	3X	6X
Milk, week 1-6, lb	77.8	94.0[a]
Fat %, week 1-6	3.28	3.16
Protein %, week 1-6	3.13	3.07
Milk, week 7-18, lb	82.5	93.7[a]
Fat %, week 7-18	2.80	2.81
Protein, week 7-18	2.76	2.79
Milk, 305 d, lb	19,832	23,100[a]

[a]Significantly greater than 3X controls, P<.05

General and Milking System Management

The first point a producer must evaluate is the availability of labor to accomplish an additional two or three milkings each day. It is important to remember that only a small proportion of the herd will be milked those extra times, but there is a labor requirement nonetheless. Another critical factor is milking system capacity. Can the additional milking be completed within the schedule in place, or is there insufficient time to run the parlor an extra two, three, or more turns each day? If the answers to these questions are positive, then the foundation is appropriate to increase milking frequency.

There are other milking system factors that need to be considered. Of particular importance is the relationship between the lag between milkings and the ability of the cow to initiate milk ejection, or "letdown". As little as two hours between two milkings has been shown to produce the persistent milk response.[6,12] However, oxytocin release will be less robust as milking interval is reduced, so full "letdown" may require a later application of the milking unit to prevent overmilking, i.e. 90 seconds after stimulation rather than 45-60 seconds.[3] At the end of milking the flow rate to trigger automatic takeoff systems should not be too low as that again may result in overmilking and teat-end damage.

Feed Consumption

Dry matter intake typically increases in response to interventions that increase milk output. It is interesting that review of a number of studies comparing 2X to 3X milking fails to show greater overall intake in cows milked 3X. Those studies, however, require some caution regarding interpretation because of relatively short duration of observation and low animal numbers. In contrast to continued 3X milking, acute increases in milking frequency in early lactation, that is 4X and 6X milking, do appear to increase feed consumption. Bar-Peled *et al*[1] observed greater DMI in cows milked 6X relative to 3X during the 6X treatment and after those cows had returned to 3X. Regarding 4X in early lactation, we observed a transient increase in DMI compared with 2X milking when the cows were milked 4X, but this difference was gone after 3 wks in lactation.[5]

Cows should adjust intake to meet energetic demands, though further increasing production may be associated with greater mobilization of body tissue reserves. Indeed, Bar-Peled *et al*[1] observed a significantly greater concentration of NEFA in cows milked 6X vs. 3X, and that was associated with greater loss of bodyweight and body condition score. We observed that cows milked 4X had shifts in milk fatty acid profiles consistent with higher adipose mobilization relative to 2X cows. However, cows milked at the higher frequencies will continue to consume more DM to replace energy output. If the ration fed to early lactation cows is appropriately balanced, there should not be a need to reformulate with greater milking frequency. With regard to other management interventions that may increase energetic demands, i.e. bST, it is of interest that cows milked 6X in early lactation respond to bST with a 9-12 lb (4.1-5.4 kg) per day increase in milk yield.[7] Although not measured directly, it is likely that those cows increased DMI to meet the increased energetic demand.

Time Constraints

Beyond absolute DM availability, the time available for consuming that DM may also become a challenge if not managed properly. Cows have a number of activities that need to be accomplished each 24 hours, with lying and resting time comprising the majority of their time.[10,11] The addition of two to three extra milkings each day is expected to add at a minimum 30 to 45 minutes of "unproductive" time to a cow's schedule. Other unproductive activities that should be minimized include duration of time in the holding pen and transit time to and from the parlor. Simply walking or standing for milking two or three additional times each day may decrease time available for lying or feeding, so accommodation should be made to minimize time away from the stalls and move cows as quickly and efficiently through the parlor as possible. Consider grouping cows to fill sides evenly within the parlor, moving cows in smaller groups, and placing cows in pens closest to the parlor. Although those changes may increase labor re-

quirements in the short term, the improvement in cow movement should yield better performance regardless of milking frequency.

Stocking density issues and behavioral conflicts may also result from inadequate planning for transition cow housing, and those problems may be exacerbated by greater milking frequency. For example, if stall space is limited by overstocking and cows have to compete for lying time, a further reduction in the amount of time available to lie down would likely result from more frequent milking. Behaviorally, cows will determine a dominance order when re-grouped,[10,11] so additional commingling of transition cows when milking frequency is reduced could cause increased behavioral stress. Again, additional time spent in agonistic behavior is an effective increase in unproductive time, so careful grouping and re-grouping of cows should be the goal.

Examples and Economics

Given the previous discussion, it is useful to develop some examples for the decision process producers may encounter as they consider a management shift from 2X to another milking scheme. First, let's examine a herd of 100 cows, where all labor is provided by the owner and the family, a typical situation on many dairy farms in the upper Midwest and Canada. Parlor size is sufficient to support additional throughput of cows, and feed resources are adequate for more cows or greater intake of cows already on the farm. With a desire to optimize cash flow and production efficiency, the question becomes should they go from 2X to 3X or 2X/4X fresh cows? Or, should more cows be added? Critical areas to review for the decision are housing and labor. In the case of housing, the barn has 100 freestalls, so even though additional cows could likely be accommodated in the parlor, overstocking would be necessary in the barn. Labor is the larger issue, as there is no extra labor to assist with the third milking, and even with hiring a milker the revenues of 2X/4X are expected to be about 70% of all cows being milked 3X (Table 2). Therefore, 2X/4X is likely to be the choice for this producer over 3X, even though the daily cost of the extra milkings in early lactation is not profitable. That is because the cost is recovered from milk revenues after frequent milking ends at 21 days, whereas 3X milking requires sustained input throughout lactation.

Next, let's look at a herd of 600 cows milked in a double 20 parlor. Cows are currently milked 2X, but the herd size will be doubled over the next 12 months to better utilize the facilities on hand. Milking parlor capacity is in excess now, and a good labor force is available. As indicated in Table 3, the best option now is to milk 3X and even milk fresh cows at the higher frequency (i.e. 6X for 21 days) because facilities are overbuilt and that scenario maximizes cash flow and efficiency. However, parlor capacity will be limited after expansion to 1200 cows (i.e. it will take 7.5 hours to complete each milking), so 3X/6X would not be an option after expansion. In addition, animal movement and time away from stalls may become a negative factor after expansion because of the relatively low parlor throughput, and that would potentially limit the effectiveness of the additional milkings in early lactation.

Table 2. Comparison of predicted milk response and potential economic benefit derived from milking all cows 4X for the first 21 days of lactation, or milking all cows 3X for the entire 305-day lactation, in a 100-cow herd. Note that labor and supply costs are presented on a "per day" of treatment basis (i.e. for 21 days in 2X /4X), but are spread over 305 days for the calculation of lactation returns.

	2X/4X Day	2X/4X 305 Day	3X Day	3X 305 Day
Additional milk/cow, lb	4	1220	8	2440
Labor[a], $	.42	17.50	.20	61.00
Feed[b], $	.14	42.70	.28	85.40
Supplies, utilities[c], $	.12	2.52	.06	18.30
Milk revenue[d], $	.44	134.20	.88	268.40
Marginal profit/cow[e], $	-.24	71.48	.34	103.70
Marginal profit/farm[f], $	-24.00	7,148	34.00	10,370

[a] Labor cost of $10/hour and 4 turns/hr; 2 parlor turns/d for 2X/4X of 12 cows, 8 turns/d for 3X of 100 cows.
[b] Dry matter at $.07/lb; 0.5 lb DM for each lb of milk increase.
[c] Cost for supplies for an extra milking including dip, sanitizer, towels, utilities, and detergent.
[d] Milk at $11.00/cwt.
[e] Estimate is for each day of a typical 305-day lactation, during and after milking frequency treatment is imposed.
[f] Calculated from profit/cow for 305-day lactation for 100-cow herd.

Table 3. Comparison of predicted milk response and potential economic benefit derived from milking all cows 4X for the first 21 days of lactation, or milking all cows 3X for the entire 305-day lactation, in a 600-cow herd. Note that labor and supply costs are presented on a "per day" of treatment basis (i.e. for 21 days in 2X /4X), but are spread over 305 days for the calculation of lactation returns.

	2X/4X Day	2X/4X 305 Day	3X Day	3X 305 Day
Additional milk/cow, lb	4	1220	8	2440
Labor[a], $	.19	3.94	.07	21.35
Feed[b], $	.14	42.70	.28	85.40
Supplies, utilities[c], $	.12	2.52	.06	18.30
Milk revenue[d], $	.44	134.20	.88	268.40
Marginal profit/cow[e], $	-.01	85.04	.47	143.35
Marginal profit/farm[f], $	-6.00	51,024	282.00	86,010

[a] Labor cost of $10/hour and 4 turns/hr; 6 parlor turns/d for 2X/4X of 80 cows, 15 turns/d for 3X of 600 cows.
[b] Dry matter at $.07/lb; 0.5 lb DM for each lb of milk increase.
[c] Cost for supplies for an extra milking including dip, sanitizer, towels, utilities, and detergent.
[d] Milk at $11.00/cwt.
[e] Estimate is for each day of a typical 305-day lactation, during and after milking frequency treatment is imposed.
[f] Calculated from profit/cow for 305-day lactation for 600-cow herd.

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