

PRE-MILKING COW PREPARATION - SECRET METHODS OF PRODUCING HIGH QUALITY MILK

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Introduction

The production of high quality milk from healthy cows is the primary objective of most dairy farmers. Despite this objective, mastitis remains a significant problem because of numerous opportunities for exposure to mastitis pathogens. Exposure to mastitis pathogens occurs in the cow's environment and during the milking process. The milking process is influenced by cow hygiene, animal handling before, during and after milking, and machine function. The influence of milking machines on the development of mastitis has been recently reviewed (Reinemann, et al., 2003, Mein et al., 2004). Potential direct and indirect mechanisms of mastitis infection related to milking machines include: 1. Facilitating exposure to pathogens; 2. Reducing the ability of the teat canal to resist bacterial invasion by changing characteristics of the teat end or teat canal; 3. Supplying forces to increase penetration of bacteria through the teat canal (vacuum fluctuations or liner slips); 4. Enhancing dispersion of bacteria present in the teat sinus throughout the udder; and 5) The frequency and amount of times that milk is removed (Mein et al., 2004). While these machine related mechanisms exist, only 6-20% of new mastitis infections in an average herd can be attributed to machine issues (Mein et al., 2004). Most new infections are caused by factors other than the milking machine and management of the milking process is a critical control point for prevention of mastitis.

Regardless of herd size, most dairy managers depend on employees or family members to milk and care for cows. The quality of milk is directly dependent upon the ability of the farm manager to motivate employees to use management practices that reduce exposure to environmental pathogens and eliminate transmission of contagious pathogens during milking. The farm image projected to employees will either motivate or discourage employees. Dirty facilities create the perception that hygiene doesn't matter. An emphasis on parlor throughput rather than quality cow preparation sends the message that speed of milking is more important than cow care. Dairy farms are unique because efforts to produce high quality product must occur every day and the task will never be completed. Clear communication of expectations of employees needs to be supported with training and resources to help the employees meet those expectations. Efforts to standardize the milking routine and train employees to consistently meet farm expectations can result in improved milk quality, better job performance and enhanced employee retention. No single milking practice will independently result in improved milk quality in the face of overwhelming exposure to mastitis pathogens. Good milking practices that are consistently applied to clean, well-handled cows will result in the production of high quality milk. Management practices used to improve milk quality are interdependent and the secret of producing high quality milk is to consistently use well-defined milking practices that reduce exposure to mastitis pathogens.

Management of the Milking Process

Statistics from Wisconsin farms that use freestalls and participated in a milk quality program during 2001-2003 (n = 101) indicate that management of the milking parlor is often neglected (Ruegg and Rodrigues, 2004, unpublished). In this dataset, the reported use of recommended milking practices was generally high. Of the farms, 89.1% always wore gloves when milking, 97% applied postmilking teat dips, 98% used predips, and 89% reported that milkers forestripped cows before attaching milking units. On participating farms (average herd size of 377 milking cows), there were approximately 6.4 different people milking cows each month, with a range of 2 to 16 separate individuals working in the parlor throughout the month. Training of milking technicians occurred relatively infrequently. Only 22% of the farms indicated that they held frequent training sessions for their milkers, 49 % indicated that they trained milkers only at hiring and 29% indicated that milkers were never trained. It is difficult to understand how employees are expected to perform adequately because less than half (41%) of the farms reported that they had a written milking routine. Operators of stall barns (n = 78) used less personnel to milk cows (3.0 separate people each month) but few (6.4%) had a written milking routine and 54% indicated that they never trained milkers.

Many milking parlors on large dairy farms are used continuously and farmers often focus on increasing parlor throughput. Data from Wisconsin freestall operations (n = 101) indicate that the largest influences on cows per hour per operator (cows/hr/operator) are training frequency and the presence of a written milking routine (Table 1; Ruegg and Rodrigues, 2004, unpublished). **Frequent training of milking technicians resulted in the fastest milking speeds and the lowest monthly rate of clinical mastitis (table 1).** The use of a complete milking routine (includes forestripping, predipping and drying before unit attachment) also resulted in faster parlor performance. **The combination of a complete milking routine and frequent training resulted in the most efficient parlor throughput.** Cows were milked at a rate of 52 cows per hour per operator when a complete milking routine and frequent training was used in contrast to 38 and 35 cows per hour per operator for herds that used an incomplete milking routine and frequent training or incomplete routine without training, respectively.

Table 1. Influence of Milking Routine on Performance for Wisconsin Freestall Farms (n = 101)

Variable		Cows per Hour per Operator	P value	Monthly Rate of Clinical Mastitis	P Value
Written Milking Routine	Yes	46.9	<0.001	5.0%	0.25
	No	35.6		7.1%	
Training Frequency	Never	33.6	0.006	9.6%	0.04
	At Hiring	41.6		4.8%	
	Frequently	49.4		5.8%	
Complete milking routine ^a	Yes	40.8	0.15	5.5%	0.01
	No	35.3		10.3%	
Forestrip	Yes	40.9	0.09	5.8%	0.08
	No	32.9		9.4%	

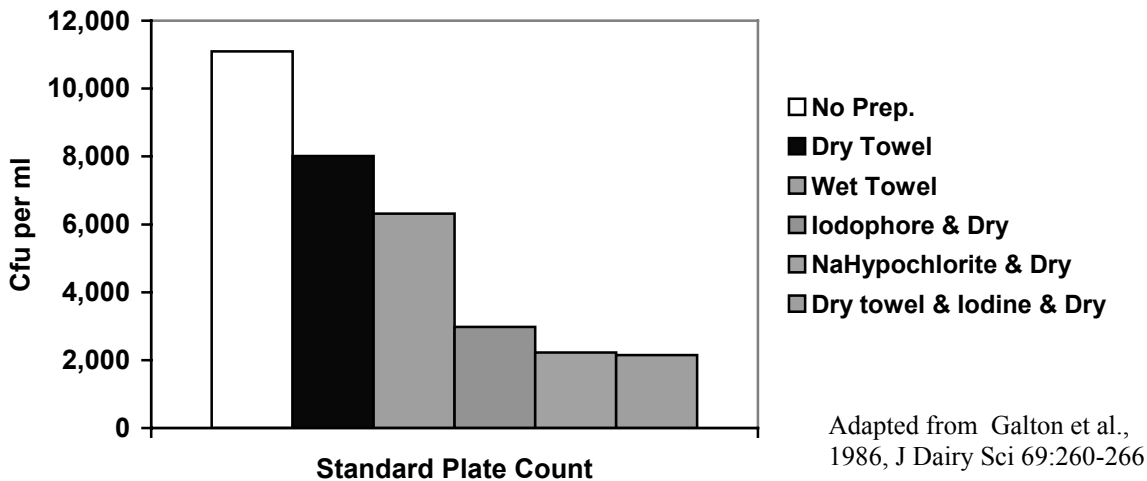
^aroutine includes forestripping, predipping, drying before unit attachment

Essential Aspects of the Milking Routine

Consistent implementation of a milking routine that includes *forestripping*, *predipping*, *adequate drying*, *timely application of the milking unit* and *effective post-milking teat disinfection* should be the goal of all dairy farms.

Effective Predipping. Methods of premilking teat preparation have been extensively studied (Galton et al., 1982, Galton, et al., 1984, Galton et al., 1986, Pankey, 1989, Ruegg and Dohoo, 1997). There is no question that the most effective method to disinfect teats is to predip using an approved disinfectant. The use of pre-dipping using iodine has been demonstrated to reduce standard plate counts and coliform counts in raw milk by 5 and 6 fold, respectively as compared to other methods of premilking udder preparation (Figure 1; Galton, et al., 1986).

Figure 1. Effect of Udder Preparation on Bacterial Counts in Milk



Effective predipping also contributes to improvements in food safety. Predipping has been shown to reduce the risk of isolation of *Listeria monocytogenes* from milk filters obtained from New York dairy herds by almost 4 fold (Hassan et al., 2001). It is important to recognize that sufficient time and contact of the disinfectant with the teat is necessary for effective reduction in bacterial numbers. Teat dips need to be properly formulated, completely applied to debris free teats, and allowed sufficient time (30 seconds) for action before removal.

Forestripping. The examination of milk before attaching milking units is necessary to ensure that all abnormal milk is diverted from the human food chain and should be a standard practice on ALL farms. Similar to predipping, the use of forestripping has been shown to significantly reduce (2.5 times less likely) the risk of contamination of bulk tank milk with *L. monocytogenes* (Hassan et al., 2001). Teat cistern milk contains the highest concentration of bacteria of any milk fraction. Forestripping is adequately performed when 2-3 streams of milk are expressed and is the most effective means to ensure adequate milk letdown.

When both predipping and forestripping are practiced, there is no data that indicates that the order that the steps are performed will affect milk quality. In a subset of our data from Wisconsin freestall operations, milking performance was equal for herds regardless of which premilking procedure was performed first (Table 2).

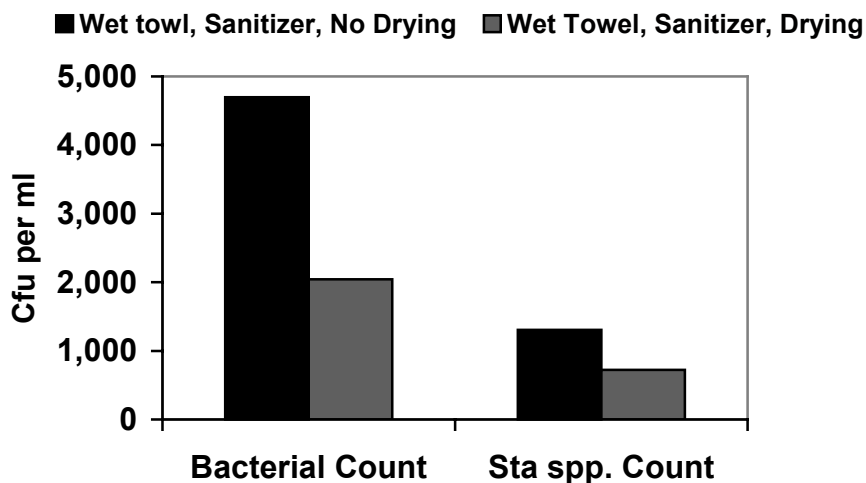
Table 2. Influence of Premilking Cow Preparation on Milking Performance for Wisconsin Freestall Herds that Perform both Practices (n = 88 herds)

Variable	Forestrip then Predip	Predip then Forestrip	P value
Cows per hour per operator	42.6	39.9	0.37
Monthly rate of clinical mastitis	5.7%	5.4%	0.83
Monthly rate of New subclinicals	11.0%	9.8%	0.36
Milk per cow per day (lb)	71.8	72.1	0.86

On a practical basis, when teats are clean, it may be best to forestrip before teat end disinfection to reduce the opportunity to re-contaminate teat skin. In milking parlors, cows can be forestripped onto the floor but the appearance of the milk should be noted to identify cows with mild cases of clinical mastitis. In stall barns, milk should never be forestripped onto cow beds. The use of gloves by milking staff is recommended to reduce the potential spread of mastitis pathogens by contaminated hands.

Adequate Drying. Effective drying of teats is probably the most important step in hygienic premilking preparation. A study reported that herds that dried teats had bulk tank SCC values 44,000 cell/ml lower than herds that did not utilize this practice (Moxley, et al., 1978). In another study, drying reduced bacterial counts of teat ends from 35,000 – 40,000 cfu/ml for teats that were cleaned but not dried to 11,000-14,000 cfu for teats that were dried using a variety of paper towels (Galton et al., 1986). In Wisconsin freestall operations, 65% reported the use of 1 cloth towel per cow, 27% used 1 disposable paper towel per cow and 8% used 1 paper or cloth towel to dry udders on 2 cows. The use of a single towel to dry udders on more than 1 cow was reported by 18% of stallbarn operators and was associated with a higher monthly rate of clinical mastitis (7.8% for herds that used 1 towel/cow versus 12.3% for herds that used towels on >1 cow; $P = 0.03$). There are a wide variety of paper and cloth towels that are used to dry teats and recently the use of *wet towels to dry teats* has become popular. Moisture is an important growth requirement for bacteria and wet towels do not adequately remove moisture (Figure 2).

Figure 2. Effect of Drying on Bacterial Counts of Milk

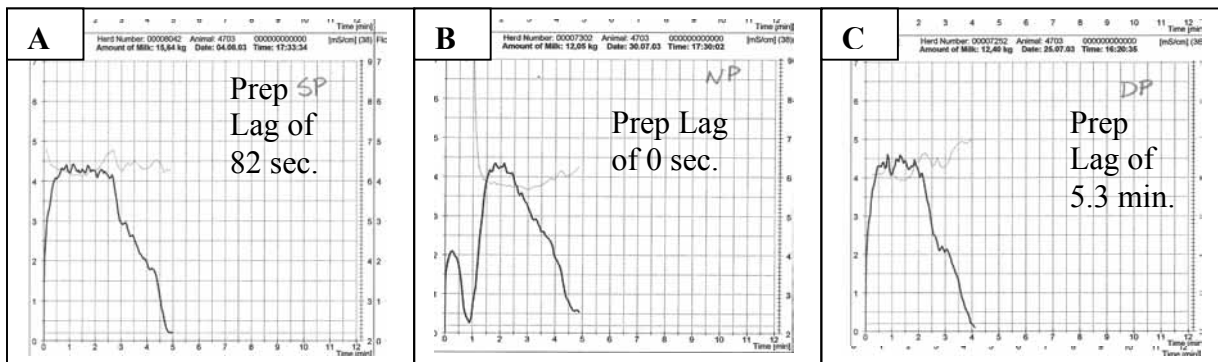


Adapted from Galton et al., 1984, J Dairy Sci 67:2580-2589.

Cloth towels have the advantage of being more absorbent than paper towels but should be disinfected by washing with bleach or very hot water and drying at high temperature in an automatic dryer (Fox, 1997). Cloth towels should be of adequate size, monitored for wear and replaced when worn. The buildup of chemical residues on some towels made of synthetic fibers can reduce the absorbency and effectiveness of the towel.

Timely Application of the Milking Unit. The time period between stimulation of the cow and unit attachment is often referred to as the “prep-lag” time. One objective of the milking routine is to attach the milking unit to well-stimulated cows that have achieved milk letdown, thus maximizing milk flow (Figure 3A).

Figure 3. Milk flow curves of 1 cow milked using 3 prep-lag times (0 sec., 82 sec., 5.3 min.)



A number of studies have been performed to determine the optimal prep-lag time (Rasmussen et al., 1992, Reneau and Chastain, 1995). It is well recognized that the need for stimulation varies depending on yield, stage of lactation and breed (Reinemann, et al., 2004). A prep-lag time of 45-90 seconds is generally recommended, but negative consequences (reduced milk yield) have not been reported until lag times have exceeded 3 minutes (Rasmussen et al., 1992). The absence of adequate milk letdown will often result in bi-modal milk flow (Figure 3 B) and the application of the milking unit without stimulation or immediately after stimulation should be discouraged. It appears that prep-lag times longer than 90 seconds will not be uniformly detrimental (Maroney and Ruegg, 2004). The use of 3-4 cow territorial work routines in parlors will generally result in adequate prep-lag times.

Effective post-milking teat disinfection. Post-milking teat dipping is one of the most highly adopted practices in the dairy industry and it is the final hygienic defense against infection after milking is completed. The use of teat dipping reduced SCC values by 70,300 cells/ml in Quebec dairy herds (Moxley, et al., 1978). While teat dipping is universally recognized as a useful practice, effective implementation of teat dipping is often variable. Continued education of specialized milking staff about the principles of mastitis control is necessary to maintain excellent hygienic standards and minimize mastitis.

Conclusion

Many dairy farms produce high quality milk and there are no secrets regarding how they achieve it. The consistent implementation of standardized milking practices such as forestripping, predipping, the use of single towels to dry teats and well-defined milking routines are essential aspects of quality milk production. Implementation of these practices is dependent on the ability to clearly communicate the value of these practices and to motivate milking personnel to consistently apply them. The managerial tasks of running a dairy farm must include the development of written milking procedures and must value continual training for milking personnel. The only secret of producing high quality milk is to continue to develop and motivate the people that milk the cows.

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