OUR INDUSTRY TODAY

Premilking Udder Hygiene

ABSTRACT

Incidence of intramammary infection is highly correlated to the number of mastitis pathogens on the teat end at milking. The objective of premilking teat sanitation is to reduce the microbial population in order to minimize the probability of mastitis. Milking time hygiene is extremely important due to the potential interaction between milking machine functions and microflora of teat skin. Current recommended procedures for premilking udder preparation range from water hose wash, manual drying, wet paper towel wash plus paper towel dry, to predipping alone plus paper towel dry. Regardless of udder cleaning procedure, manual drying of teats is a significant factor in reduction of total bacteria counts. Predipping with iodine-based sanitizers, .1 to .25% iodine concentration, reduced intramammary infection with environmental pathogens 51% compared with good udder preparation in a field trial on four commercial dairy farms. Infections by coagulase-negative staphylococci were not reduced by predipping. Effective premilking udder hygiene is essential for the production of high quality milk. Bacteria, preincubation and pasteurized milk counts are reduced. Sediment is minimized. Incidence of mastitis is reduced. Proper udder hygiene procedures should be practiced at every milking.

INTRODUCTION

Production of quality milk on dairy farms depends on minimizing bacteria and excluding chemical contaminants. Premilking udder hygiene is a vital component of a total quality milk program and should be evaluated by effects on the quality of milk and on incidence of mastitis.

Bacteria in milk originate from three sources: 1) environment, 2) intramammary infections, and 3) normal udder flora. Environmental sources of bacteria are numerous. High bacteria counts in milk are commonly associated with improper sanitation of milking equipment or poor cooling. Dirty teats and udders are another environmental source of bacteria in milk (3). Contamination of teats and udders can be minimized by proper management of cows between milkings in clean, dry areas. In 1946, Bryan et al. (1) wrote: "Proper stall hygiene is a prerequisite to udder hygiene". A 24-h hygiene program is still mandated to maximize production of quality milk and mastitis control.

Milk quality is also reduced by bacteria that cause mastitis. Total bacteria count can be significantly increased by some mastitis pathogens, particularly Strepococcus agalactiae (11). Milk composition is altered by mastitis pathogens. Fat, lactose, and casein contents are usually decreased, and cheese yields are reduced (17). Proteolytic activity is significantly higher in milk from quarters infected with Strep. agalactiae. This activity persists and continues to reduce milk quality after elimination of the causal organism (17).

The third source of bacteria in milk is the normal udder flora, species of bacteria that commonly live on teat and udder skin. Staphylococcus species, other than Staphylococcus aureus, are the primary group (10). Improper udder preparation prior to milking can increase the numbers of these bacteria in milk (3, 4, 8).

Chemical residues in milk are another aspect of a quality milk program and can be caused by feed, therapy for systemic or local infection, or direct contact of milk with chemicals in milking systems or on teat skin. Only chemical
TABLE 1. Bacterial counts on teat skin associated with various udder preparations (4).

<table>
<thead>
<tr>
<th>Dry towel</th>
<th>Wet towel</th>
<th>Predip</th>
<th>Wash sanitizer</th>
<th>Manual drying</th>
<th>Teat skin bacteria before machine-on(^1) (% change)</th>
<th>Primary factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>-40</td>
<td>Scrubbing</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>-40</td>
<td>Drying</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>-77</td>
<td>Drying</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>-85</td>
<td>Drying</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>-85</td>
<td>Drying</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Percent change of bacteria in milk compared with no preparation.

In the two experiments, methods resulting in the lowest bacterial counts in milk were the use of water hose, wet towel, or premilking disinfectant teat dip followed by manual drying with paper towels (8).

**BACTERIA ON TEAT ENDS**

Premilking hygiene is an important component of a mastitis control program. Incidence of udder infection is highly correlated to the number of mastitis pathogens on the teat end (14, 15). The objective of premilking udder hygiene is to reduce the bacterial contamination on teats to minimal numbers immediately before machine attachment. A number of studies reported effects of reducing bacterial numbers on teat skin by premilking hygiene (8, 9, 12, 13, 18). In a series of studies, Galton et al. (3, 6, 8) reported on effectiveness of various premilking udder hygiene procedures in reduction of bacteria on teat skin. Initial work (3) included the use of automatic preparation stall and a teat washer, without sanitizer, in combination with manual drying of udders and teats with paper towels. Total bacteria counts were determined on teat rinses taken immediately before and after milking. This work indicated that udder surfaces should be dry, and teats should be clean and dry at machine attachment (Table 1).

In the next set of experiments, Galton et al. (8) examined bacterial numbers in teat rinses following procedures that prepared the teats with and without the use of sanitizer or germicidal dips (1% iodine). Results reiterated the need to manually clean and dry teats to minimize bacteria counts at the time of machine attachment.

In a separate experiment, teats only were prepared for milking by either wet towel, water hose wash, or predipping with 1% iodine teat dip. The same bacteriological tests were conducted on composite milk samples as in the first experiment. Lowest SPC, coliform, and staphylococcal counts were again associated with manual drying in conjunction with prior cleaning of teats.
TABLE 2. Summary of new intramammary infections with environmental pathogens in predip studies in four commercial farms.

<table>
<thead>
<tr>
<th></th>
<th>Number eligible quarters</th>
<th>Infected quarters</th>
<th>Qtr. Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(no.)</td>
<td>EPS&lt;sup&gt;1&lt;/sup&gt;</td>
<td>CO</td>
</tr>
<tr>
<td>Predip</td>
<td>619</td>
<td>18&lt;sup&gt;2&lt;/sup&gt;</td>
<td>21&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>553</td>
<td>31</td>
<td>41</td>
</tr>
</tbody>
</table>

<sup>*P</sup>&lt;.001.
<sup>1</sup>EPS = Esclulin-positive streptococci, CO = coliforms, Qtr. = quarter.
<sup>2</sup>Reduction of 48.2% (<sup>*P</sup>&lt;.025).
<sup>3</sup>Reduction of 54.0% (<sup>*P</sup>&lt;.005).

In subsequent studies, Galton et al. (6) evaluated udder preparation procedures using two different brands of paper towels to determine effects on bacteria counts from teats. Two towel types were used in the experiment. No difference was determined in bacterial numbers recovered from teats after drying with either type of paper towel.

**UDDER INFECTIONS**

The basis for mastitis control is to minimize mastitis pathogen population on the teat end, because incidence of udder infection is positively correlated with the number of bacteria on the teat end (14). Germicidal activity is a function of concentration and contact time (2). Higher concentrations require less contact time to be effective. In 1984, Bushnell (2) reported on the practice of immersing teats prior to milking in commercial teat dips in an effort to control coliform mastitis. Bushnell (2) stated that 1% iodine dips were more bactericidal than udder washes but tended to adhere to teat skin, which increased the risk of teat irritation and residues in milk. These potential problems were ameliorated by the use of low concentration dips. Manual drying of teats with paper towels was considered essential to prevent residues in milk (2).

Controlled field studies were conducted by Pankey et al. (16) to determine efficacy of predipping. Three iodine-based teat dip formulations were evaluated as predips on four, well-managed, commercial dairy farms. Iodine content of the three products ranged from 0.1% to 0.25%. The same product used to predip was also used as the post-dip within each herd. Predipping plus good udder preparation (GUP), was compared with GUP alone. Good udder preparation included: 1) wash teats with paper towel wet with udderwash; 2) forestrip; and 3) dry teats with single service towel. Predipping with GUP included: 1) wash teats with paper towel wet with udder wash; 2) forestrip; 3) predip, allow a minimum of 30 s contact; and 4) dry teats with single service towel. All cows received dry cow therapy. The study was conducted for approximately 12 mo in each of three herds and for 6 mo in one herd. Udder infections caused by environmental pathogens (coliforms and nonagalactiae streptococci) were reduced 51.5% (<sup>*P</sup>&lt;.001) (Table 2) in cows that were prepared by GUP with predipping. Udder infections caused by *Staphylococcus* spp. other than *Staph. aureus* were not reduced by predipping compared with GUP alone. No published research data are available on evaluation of predipping on incidence of mastitis caused by contagious pathogens such as *Staph. aureus* and *Strep. agalactiae*.

Galton et al. (7) conducted an experimental challenge trial to evaluate three udder preparation procedures: 1) no udder preparation, 2) wet towel wash plus drying, and 3) predipping with a 0.1% iodine teat dip plus drying. All teats were dipped after milking with a 0.25% iodine product. All teats of the cows were immersed in a culture of *Streptococcus uberis* (ATCC 27958) approximately 3 h prior to milking to simulate teat contamination with an environmental mastitis pathogen between milkings. Compared
with no udder preparation, wet towel plus drying and predipping plus drying reduced udder infections by 43.3% ($P<.05$) and 66.3% ($P<.025$). Predipping plus drying reduced infections 41% ($P<.07$) compared with wet towel washing with drying.

These are the only two controlled studies reporting on effectiveness of predipping on incidence of udder infections. Additional studies are needed to evaluate effectiveness of predipping on incidence of udder infection by environmental and contagious pathogens.

**RESIDUES**

Contamination of milk with chemicals must be avoided to assure consumer safety. The potential for residues from premilking udder preparation is only one area of concern, but it is a very controversial area because sanitizers are placed on teats immediately before milking. Every effort must be made to remove all residues from teats prior to machine attachment, including soil, water, manure, and sanitizers.

The effects of pre- and postmilking teat dipping on iodine residues in milk were reported by Galton et al. (5, 8). Initial studies were on effects of premilking teat treatments with .5% and 1% iodine concentration teatdips (8). Iodine in milk was not increased by predipping, drying plus no postdipping compared with no predipping but postdipping. Both of these treatments resulted in lower iodine concentrations in milk than two other treatments: 1) predipping, drying then postdipping and 2) predipping, no drying, no postdipping. Drying of teats after predipping was imperative to minimize iodine concentration in milk. A .5% iodophor teat dip contributed less iodine to milk than a 1% iodophor under the same use conditions (8).

The next series of studies concentrated on effects of different concentrations of iodophor teat dips on iodine residues in milk when used on commercial dairy farms for pre- and postdipping (5). Eighty cows in each of seven herds were used. Treatment groups within each herd were postdipped with .1 or 1% iodophor, two groups were not predipped, and two groups were predipped with the same concentration as the postdip. Predipping was followed by manual drying of teats with paper towels prior to machine attachment. Predipping and postdipping with .1% iodophor did not significantly increase iodine in milk above postdipping with .1% iodophor. Postdipping with a 1% iodophor significantly increased iodine in milk over the use of .1% iodophor as a pre- and postdip. Adding 1% iodophor predipping significantly increased iodine residues over predipping with .1% iodine. Again, concentration of predip and postdip affected the residue in milk (5).

In summary, predipping plus drying with paper towels did not increase iodine residues compared with no udder preparation and contributed significantly less to milk iodine residues than postdipping with either concentration of iodine. Iodine residues increased significantly when predipping with drying and postdipping were used together (either concentration) compared with predipping alone or no udder preparation. Predipping without drying resulted in iodine residues significantly higher than all other treatments, reemphasizing the necessity to dry teats after application of a premilking teat sanitizer.

Residue data are not available for noniodine sanitizers and for iodine teat dip components other than iodine. Microanalytical techniques have not been applied successfully for analysis of the parts per billion for these components. Iodine concentrations have been determined, because methods of analysis are relatively easy to conduct. Milk is contaminated by application of any sanitizer, either before or after milking. The issue is "residues" and "safety". Teat dip components generally include: 1) active germicide, 2) emollients and skin moisturizers, and possibly 3) other ingredients such as surfactants, stabilizers, food grade dyes, or viscosity regulators. All can cause residues in milk but, most importantly, should be "safe" (not harmful) to consumer, cow, and operator. In many cases, all ingredients in a teat sanitizer have been cleared or approved by FDA as direct or indirect food additives, or designated as substances "generally recognized as safe" (GRAS). The "ideal" teat dip would be formulated with FDA-"cleared" or GRAS ingredients that effectively reduce incidence of udder infection. Teat dip manufacturers should develop residue and efficacy data and use FDA-approved ingredients to assure safe and effective teat sanitizers for dairy farmers, and farmers should demand these data before using a product.
CONCLUSIONS

Premilking udder hygiene is an essential part of a quality milk program. Sanitation of teats before milking reduces bacterial contamination of milk, enhances milk quality, and aids in the control of mastitis. The major objective of premilking udder preparation is to milk clean and dry teats. Prevention of chemical residues in milk is equally important. The procedure of manually washing and drying teats minimizes sanitizer contamination and maximizes mastitis control.

REFERENCES