USE OF SANITIZERS IN PREVENTING INTRA-MAMMARY INFECTIONS

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In "Current Concepts of Bovine Mastitis" (9) we read, "The purpose of any sanitary program is to prevent or minimize the spread of organisms from infected to non-infected cows and to reduce the chance of infection by organisms inhabiting the immediate environment or skin of the cow." For a sanitary program to be effective we must have a clear idea as to where these organisms come from, and since staphylococcal mastitis is the chief concern in most areas today, we will concentrate mainly on it. Excluding the interior of the udder, the two main reservoirs of mastitis staphylococci are the skin of the teats and the teatcups of milking machines (17), with the milkers' hands a third important source. The number of these organisms transferred from the teat skin to the inflation is often extremely high. Newbould and Barnum (13) recovered over 50,000 per inflation by swabbing after dipping them for an unstated period in 250 ppm hypochlorite! Naturally, the chances of infection increase as the number of bacteria entering the teat duct increases. This is clearly shown in Table 1. So while no program of sanitation can guarantee complete destruction of mastitis organisms, it is surely common sense to try to keep their numbers down to a minimum.

**TABLE 1. EXPERIMENTAL INOCULATION OF TEAT DUCTS WITH STAPHYLOCOCCUS AUREUS**

<table>
<thead>
<tr>
<th>Approx. no. S. aureus</th>
<th>No. of ducts inoculated</th>
<th>No. of quarters from which staphylococci were isolated from foremilk for the following number of milkings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>100</td>
<td>24</td>
<td>6 5 2 4</td>
</tr>
<tr>
<td>1000</td>
<td>31</td>
<td>3 9 7 6 6</td>
</tr>
</tbody>
</table>

*Small numbers of S. aureus were inoculated into the outer 4 mm of the teat duct once only, immediately after the evening milking.


**RECOMMENDED SANITARY PROCEDURES**

To minimize the transfer of mastitis organisms from diseased to healthy udders, four steps are currently recommended: (a) disinfection of milkers' hands, (b) udder washing and disinfection, (c) disinfection of teatcups, and (d) teat dipping after milking. Each of these will now be considered separately, although they work together in a complete mastitis program.

**Disinfection of Milkers' Hands.**

Mastitis organisms, especially staphylococci, can nearly always be isolated from the skin of the udder and teats of infected cows. It has been estimated that 50% of the cows in the United States are infected with pathogenic organisms in an average of two quarters (9). Obviously it is good practice to handle the skin as little as possible. It is not generally appreciated by the producer that skin is extremely difficult to sterilize, even when the hands are immersed in an efficient disinfectant solution. Nevertheless, this practice should reduce to a marked degree the number of mastitis organisms on milkers' hands and thus lessen the chances of infection being spread. The detergent/sanitizers found most suitable for washing and disinfecting udders should be equally effective here (10).

**Udder Washing and Disinfection.**

This operation should remove dirt from udder and teats, remove or destroy a high percentage of mastitis organisms present, and stimulate "let-down" of milk. Unfortunately, as commonly carried out, this operation is more likely to spread mastitis organisms than to control them. Too often a paltry of sanitizing solution of an unsuitable type, or just plain water, is used to wash far too many cows. Using the same cloth or sponge to wash a series of cows is a sure way of spreading mastitis organisms, yet the 1964 survey by Hoard's Dairyman (3) revealed 40.6% of over 2,000 dairy farms using a household rag, and another 37% a sponge for this purpose! No wonder some authorities question the desirability of washing udders.

Properly carried out, udder washing can aid in controlling mastitis. First, a suitable product should be chosen. For many years a strong hypochlorite
solution was widely recommended, presumably because hypochlorites are effective sanitizing agents in the absence of organic matter. Controlled studies in Canada (12, 13) and in England (5, 6) have shown chlorhexidine, and an iodophor, to be very much more effective in destroying mastitis organisms, while both are less sensitive to the presence of organic matter and less irritating to the skin. The iodophors, having excellent detergent properties along with their well-known germicidal potency, are particularly well suited to udder washing. That this is widely recognized is shown by the fact that over 44% of the dairymen reported using an iodine product for this purpose in 1963 in the Hoard’s Dairyman survey (3).

The sanitizing solution should be made up according to the manufacturer’s directions, and applied with either a paper towel or individual sterile cloth. After washing the udder and teats thoroughly, the towel or cloth should be wrung out and the udder and teats dried as well as possible. If udders are very dirty, they should be washed first in warm water before washing with the sanitizer. The solution should be changed when it becomes dirty and its germicidal effectiveness is reduced.

Teat Dipping.

Even though the teatcups are sterile, and the udder and teats have been thoroughly washed, as soon as milk from an infected quarter comes in contact with them they are all set to transmit infection. Using laboratory-infected inflations, Newbould and Barnum (12) obtained a reduction in numbers of staphylococci of over 90% by a 15-sec treatment in warm (110°F) “Iosan” solution (50 ppm Available Iodine) without pre-rinsing with warm water. Chlorhexidine at 400 ppm, without a pre-rinse, took over 30 seconds for a similar reduction, as did “Diversol” and “Antibac” at 250 ppm and “Pfanstiehl 20”, a quaternary ammonium compound, at 300 ppm, even when a pre-rinse was employed with the last three products. On farm trials, however, lower reductions in numbers were observed.

Various other workers have studied experimentally the effectiveness of different sanitizing solutions for dipping teatcups. Most of them have recognized the difficulties in obtaining good results on the average farm, where sufficient contact time is rarely allowed for adequate destruction of mastitis organisms; where milker rubberware is frequently deteriorated, providing safe hiding places for these organisms; and where proper care is not always taken to avoid airlocks with long-tube milkers, or to rinse off residual milk before disinfecting. Consequently, workers at the National Institute for Research in Dairying at Shinfield, England (5), and at the Ontario Veterinary College at Guelph, Canada (16) have since about 1980 been advocating “pasteurization” of teatcups as the most certain way of killing mastitis bacteria. While circulation of water at 185°F for 5–8 seconds through the teatcup cluster might not be difficult in a parlor, it would be much more cumbersome in a stanchion barn, although English workers have been doing this successfully for years (11). As Newbould (10) put it, “The problem is not, therefore, whether clusters can be sterilized effectively between cows, but rather of waiting for development of practical apparatus by agricultural engineers.” Until such apparatus is developed, the correct use of a suitable sanitizing solution, preferably using two pulluls, will go a long way in reducing the numbers of mastitis organisms on teatcups. Even though more bacteria remain than with “pasteurization”, “half a loaf is much better than no bread!”

Teat Dipping.

Since Moak (4) in 1916 reported remarkable success in reducing mastitis by teat dipping, many others have advocated this practice. Of the various disinfectants tried, chlorhexidine and iodophor have given the best results. Newbould and Barnum (14) reported a significant (P = <0.01) reduction in count of staphylococci using Iosan at 100 ppm, while chlorhexidine produced variable, ineffective results even up to 800 ppm. In a later paper (16) they used an iodophor with 10,000 ppm iodine, and obtained a much lower mean count with teats dipped and teatcups not pasteurized that where teats were not dipped but teatcups were pasteurized. Chlorhexidine at full strength (1.6%) also gave a good kill, but caused cracking and scaling of the teat skin. When tests were repeated using 0.5% solution the reduction in count was much less pronounced. At the National Institute for Research in Dairying (6) a chlorhexidine solution (0.5%) was also found effective in reducing the numbers of Staphylococcus aureus on teat skin but caused chapping.

Hickman and Logan (2) have reported that neither dipping teats in an iodophor solution, nor massaging all external teat tissue with a disinfectant hand lotion (Dettol) widely used in hospitals, had any detectable value in reducing the infection rate among 12 cows over a three-month period. On the other hand, recent reports from herds enrolled in the Ontario Mastitis Control Program showed a marked improvement where teat dipping with an iodophor or chlorhexidine was a major change in the milking procedure.

During the past few years, two quite extensive field trials have been conducted by workers in England (6) to evaluate a “full hygiene” program in which all factors were included. In the first, 14 herds,
comprising over 700 cows, were divided into two groups. In the one on a full hygiene program, milkers wore smooth rubber gloves, udders were washed with 100 ppm solution of chlorhexidine digluconate using individual sterile cloths or paper towels, teatcup inflations were “pasteurized” by circulating 185 F water through to the receiver jar for 5-8 seconds between cows, and teats were dipped in a 5,000 ppm solution of chlorhexidine immediately after milking. For the other group, the control, udders were washed with warm water only, teatcups were not disinfected between cows and teats were not dipped. They reported (7) that, “there were uncontrolled factors affecting the new infection rate within the two groups of herds that had a greater influence than the experimental treatment. Nevertheless, the total of new infections in the hygiene herds appears to have been reduced by 50% compared with the control herds, and when cross-infections are eliminated the reduction was 60%.”

When this experiment was completed, another was started which was designed to compensate for the uncontrolled factors found in the first field trial (8). Three groups of herds were established, with five in each. Each group was on one of three programs for a six month period, then switched to a second, and six months later to a third. The three treatments were; full hygiene—the same as in the previous trial, except that udders were washed and hands disinfected with an iodophor solution (100 ppm) and teats were dipped after milking in the iodophor solution at 5,000 ppm; partial hygiene—the same as full hygiene except that teatcups were not pasteurized between cows; control—as in the first trial. This second trial was completed in November 1965; preliminary results are shown in Table 2. Here it is evident that although Full Hygiene treatment gave better control of infection than Partial Hygiene, the latter was a vast improvement over the Control treatment.

While no reason was given for the switch from chlorhexidine to an iodophor in the second series of trials, in the first series reference was made to “the high incidence of chapped teats in the hygiene herd which had not been anticipated” (7). Newbould and Barnum (9) also have reported that chlorhexidine is irritating to the skin of the teat.

Presumably because the full hygiene procedure may be too involved for the average producer, the English workers are not recommending it, but are trying to improve the partial hygiene procedure. At a recent Mastitis Teach-In (1) some 500 producers heard them describe the results of their second field trials. One producer, milking 120 cows, commented that after a few months on the program chapped and sore teats had completely disappeared, while the use of antibiotics had nearly ceased.

It should be emphasized that a sanitation program in itself, no matter how complete it may be, is not the complete answer to the mastitis problem. The roles of good milking equipment and proper milking procedure cannot be ignored. Furthermore, it is not possible to take only a part of the program, such as teat dipping, by itself and expect to control infection. Milkers’ hands, udder cloths and teatcups can all convey infection from diseased to healthy cows, hence all must be included in an effective program. Few people milking cows appear to appreciate that mastitis is an infectious disease, and that the various steps outlined above are all necessary if the spread of the disease is to be curtailed. Here is where the fieldman and sanitarian can do a lot of good in emphasizing the importance of a complete program of sanitation in mastitis control. The English results show how effectively such a program can reduce infection and clinical mastitis on commercial dairy farms. We need more studies of this nature under North American conditions to confirm their findings.

### Table 2. Influence of Various Procedures on Mastitis Infections* (Each of 15 Herds Spent 6 Months on Each Procedure)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total new infections</th>
<th>Staph.</th>
<th>Strep.</th>
<th>Clinical mastitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>757</td>
<td>390</td>
<td>320</td>
<td>409</td>
</tr>
<tr>
<td>Full hygiene</td>
<td>298</td>
<td>139</td>
<td>95</td>
<td>217</td>
</tr>
<tr>
<td>Partial hygiene</td>
<td>425</td>
<td>187</td>
<td>123</td>
<td>231</td>
</tr>
</tbody>
</table>


*Control: Cows’ udders washed with warm water only; no disinfection of teatcups between cows and no teat disinfection after milking.

*Full hygiene: Milker wears smooth rubber gloves for milking and disinfests gloved hands and udders with an iodophor solution (100 ppm available iodine) using paper towels or individual sterile cloths for each cow. Teatcup clusters pasteurized before milking each cow with circulating hot water (185 F for 5-8 seconds). Cows’ teats dipped immediately after milking in iodophor (5,000 ppm available iodine).

*Partial hygiene: Similar to full hygiene except that teatcups are not disinfected between cows.

### References

FDA REGULATIONS COVERING FORTIFIED FOODS

The Food and Drug Administration has designated eight classes of foods to which specified amounts of certain vitamins and minerals may be added to improve nutritive value.

The eight classes increase the number of foods (such as evaporated milk, enriched flour and bread, enriched corn meal, and margarine) already covered by "Definitions and Standards of Identity" that permit adding vitamins and minerals. The eight classes include processed cereals, fruit juices and fruit drinks, infant formulas, infant fruit products, alimentary pastes, whole fluid and powdered milk for drinking, fluid skim milk and fluid low fat milk for drinking, and salt.

The "Definitions and Standards of Identity" for Vitamin and Mineral Fortified Foods state which vitamins and which minerals may be added to each of the eight classes and specify the conditions. They apply only to added vitamins and minerals, however, and not to the natural composition of the foods. For example, cereal grains are known to be good sources of Vitamin B₁, Vitamin B₂, Niacin, and Iron. These four nutrients may be added to enriched flour under another Food Standard. They may be added to processed cereals under the new "Definitions and Standards of Identity" when processing has resulted in more than a 25 percent loss in potency of natural grain for the particular nutrient.

The name of each food to which vitamins and/or minerals have been added shall be immediately accompanied by a statement which spells them out. Processed cereals with all four permitted nutrients added will bear the statement "Fortified with Vitamin B₁, Vitamin B₂, Niacin, and Iron." Any of these fortified foods will be illegal, however, if the labeling or advertising contains any statements or pictures implying:

- that the food is adequate or effective for the treatment or prevention of any disease or condition;
- that a diet of ordinary foods will not supply adequate amounts of vitamins and minerals;
- that significant segments of the United States population are suffering or are in danger of suffering from a deficiency of vitamins or minerals.

In establishing the "Definitions and Standards of Identity" for Vitamin and Mineral Fortified Foods, FDA adopted the Statement of General Policy in regard to the Addition of Specific Nutrients to Foods issued in 1961 by the Food and Nutrition Board, National Research Council, National Academy of Sciences, and the Council on Foods and Nutrition, American Medical Association. This statement urges that nutritional needs be met by using an adequate variety of foods and establishes the ground rules for adding nutrients to foods.