

Herd Mastitis Problems Caused by Unusual Pathogens

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Until recently most mastitis was caused by two species of bacteria—*Streptococcus agalactiae* and *Staphylococcus aureus*. Today, these two bacteria are controllable in most herds by combined regimens of teat dipping and dry cow treatment. However, these control methods are less efficacious against other pathogens which may become, or appear to become, more important as the prevalence of *Str. agalactiae* and *S. aureus* is reduced. Usually such problems are caused by bacteria endemic in the cows environment, the so-called environmental pathogens. Occasionally a point source of infection may develop that leads to an outbreak of disease caused by a single unusual organism. In this paper, we will consider current thinking about environmental mastitis and then discuss herd mastitis problems caused by *Pseudomonas aeruginosa* and *Serratia marcescens*.

Streptococcus agalactiae and *S. aureus* are both contagious bacteria,¹ and they share epidemiologic features that make them controllable. Both organisms are spread from infected to uninfected cows, and transfer is predominantly at milking time. Thus, with effective milking time hygiene, the new infection rate can be markedly reduced. In addition, the infected udder is the primary reservoir of these organisms. As the number of infected quarters is reduced, the exposure of uninfected cows is also reduced. If all infected quarters are eliminated, then it should be possible to maintain the herd free of that infection. This can be achieved with *Str. agalactiae*, but possible sources of *S. aureus* other than the udder may make total elimination of this organism difficult.

In contrast, the environmental pathogens are more difficult to control because they occur naturally in the cow's environment and cannot be completely eliminated.² Secondly, exposure is not limited to a defined period but can occur at any time to both lactating and dry cows. The environmental organisms that commonly cause mastitis include several species of streptococci (*Streptococcus uberis* and various enterococci) and several gram-negative species (*Escherichia coli*, *Klebsiella* species, and others).

In practice, both contagious and environmental types of mastitis are present in most herds. Of particular interest, however, are those herds in which the contagious organisms have been controlled or eliminated, but which continue to have significant problems with clinical mastitis.³ Such herds often have:

- a. low bulk tank somatic cell counts (200,000 cells/ml or less).
- b. low prevalence of chronic subclinical infection (5% of quarters or less).

Such herds present a special diagnostic problem, and the bacteriological herd survey is unlikely to define the situation in the herd. A more effective method in these herds is to collect samples for culture from all clinical cases before treatment is given. These samples can be stored frozen until delivered to a laboratory. Culture of clinical cases as they occur will often reveal a quite different pattern of pathogens than will a survey of an entire herd or of selected cows.

Prevention of environmental mastitis in the dry period

A characteristic of environmental mastitis is a high incidence of clinical mastitis in the first month of lactation. In a recent field study of clinical mastitis, more than 40% of clinical cases caused by both environmental streptococci and coliform bacteria occurred in the first month of lactation.³ We believe that many, perhaps most, of these clinical cases were caused by infections that were established in the dry period. Hence, prevention of these cases will require effective methods for protection of dry cows.

Up to 40% of all udder infections occur during the dry period.⁴ The times of greatest risk are the period immediately after drying off and the period immediately before calving. Exposure to environmental pathogens continues throughout the dry period, and because the hygienic practices associated with milking are not practiced, exposure may be greater than in lactation.

At present, the most effective method for reduction of environmental infections in the dry period is antibiotic treatment of all quarters of all cows at the beginning of the dry period.⁴ With respect to environmental mastitis, prevention of new infection is of more benefit than elimination of existing infection; maximum preventive effect can only be achieved by treatment of all quarters of all cows. Present regimens of dry cow therapy do have shortcomings, however. Treatment at the beginning of the dry period provides measurable protection against environmental streptococci in the early dry period but not in the precalfing period. With present products, no protection against new coliform infections has been demonstrated.⁵ Neither

germicidal nor barrier type teat dips have been shown effective in reducing environmental infections in dry cows.⁴

Prevention of environmental mastitis during lactation

Postmilking teat dipping with effective germicidal products will reduce infections by environmental streptococci but will have little effect on coliform infection rate.⁶ Barrier type teat dips have been reported to reduce coliform infections in lactating cows.⁷ However, they appear to be less effective than germicidal dips in control of streptococcal and staphylococcal mastitis. We recommend barrier type teat dips only in herds where coliform infection is known to be the major mastitis problem.

Premilking hygiene is considered important in control of environmental mastitis.⁸ Effective hygiene will reduce bacterial numbers on the teat skin before the milking unit is applied. This will reduce the likelihood that bacteria on the skin will be forced into or through the teat duct during milking. Teats should be *clean* and *dry* before milkers are applied. Water should be used sparingly in prepping cows, and if udders are reasonably clean, only the teats should be washed. An individual paper towel should be used to dry each cow.

Use of a germicidal teat dip before milking, (*predipping*) has been reported to reduce environmental infections in some but not all studies. Additional research on predipping is needed to define the most effective methods and the conditions under which it will be successful.

Reduction of bacteria in the environment

Other methods to reduce environmental mastitis depend on reducing the cow's exposure to these bacteria during both lactation and the dry period. With present trends towards larger herds and confinement housing, this becomes increasingly difficult. Some points to consider are:

- a. *Bedding.* Because cows spend a considerable part of their time lying down, bedding is in prolonged contact with the teat ends.¹⁰ Some beddings are capable of supporting very high populations of environmental bacteria including both streptococci and coliforms. Sawdust bedding, in particular, has been associated with outbreaks of coliform, especially *Klebsiella*, mastitis. Other organic beddings, for example manure solids, also support large populations. Conditions that favor bacterial growth are high temperature, moisture and small particle size of the bedding material. Bacterial populations can be reduced by attempting to keep bedding materials as clean and dry as possible. If possible, avoid very fine sawdust. Removing all bedding from the back of each free stall daily and replacing with fresh bedding will reduce the number of bacteria. When bedding is totally replaced, bacteria can increase very rapidly, and after two or three days bedding that still appears fresh and clean can have high bacterial

numbers. With respect to coliform mastitis, shavings are probably better than sawdust and straw better than shavings. Inorganic materials like sand or crushed limestone do not support high coliform numbers and their use does not appear to reduce coliform infections.

- b. *Temperature and humidity.* Coliform outbreaks in confinement housing seem most likely to occur during periods of warm humid weather.³ These conditions appear to favor bacterial growth and may also decrease resistance of the cows.⁵ Adequate ventilation to reduce temperature and humidity should be provided.
- c. *Hollowed out free stalls* are difficult to clean and may provide favorable sites for bacterial growth.
- d. *Cows on pasture*, including dry cows and heifers, have less exposure to environmental bacteria than cows in confinement housing. However, under pasture conditions, avoid bare and muddy places as around feed bunks and under shade trees.
- e. *Wet environments* favor environmental mastitis. In confinement housing, avoid pools of stagnant water. Under pasture conditions, fence off ponds and marshy areas.
- f. There is some evidence that the *teats of lactating cows* are dilated and susceptible to bacterial penetration for several hours after milking.¹¹ Providing feed after cows leave the milking parlor may keep them on their feet and reduce exposure.
- g. *Springing cows and heifers* are susceptible to new mastitis infection. It makes good sense to provide them with a clean environment. Avoid sawdust bedding in maternity stalls. In good weather, calving in a clean, grassy area where cows can be watched and assisted if necessary may be desirable.

Pseudomonas mastitis

Mastitis caused by *Pseudomonas aeruginosa* is relatively uncommon but is troublesome because it is resistant to therapy and frequently leads to culling of the cow. Although it is usually sporadic, herd outbreaks, often associated with contaminated water systems, have been described.¹²

Over the last three years we have encountered four Pennsylvania dairy herds with high incidence of *Pseudomonas mastitis*. In each of these herds, *Ps. aeruginosa* was isolated in high concentration from the wash water used to prepare cows for milking. Each of these herds was parlor-milked, and in each of them an iodophor germicide was added to water used to prepare cows for milking.¹³

This observation led us to compare the frequency of isolation of *Ps. aeruginosa* from wash water in parlors in which iodophor was used with that from parlors using no germicides. There was no known *Pseudomonas mastitis* in any of the 25 herds selected for the study. *Ps. aeruginosa* was isolated from water systems in 8 of 8 parlors in which

iodophors were used and from 7 of 17 in which no germicides were used. Iodine concentrations in running (freshly iodinated) and standing (at least 6 hours since iodination) water were determined. In running water, iodine concentration was greater than 20 ppm in only 2 of 8 parlors. In standing water, iodine concentration was less than 5 ppm in 7 of 8 systems. It is apparent that in some parlor systems, iodine concentrations are below recommended levels (25 ppm) much of the time.

In our experience, the organism can most readily be found by culturing the water remaining in the hoses in the period between milkings. Plating of 0.1 ml of composite samples of standing water from 2 or 3 hoses will reveal the bacteria if it is present in significant numbers. Culture of swabs from the inner surfaces of wash hoses is also useful as some hoses appear to be heavily colonized. However, in a given parlor, some hoses may be colonized while others are not.

In several herds, preheater systems used to extract heat from milk for warming udder wash water were contaminated and appeared to be an important source of exposure for the cow.

When *Pseudomonas* is found in water of a herd with *Pseudomonas* mastitis, we make the following recommendations:

- If iodine is used in wash water, adjust concentration to 25 ppm.
- Replace colonized wash hoses and nozzles.
- Flush water out of the system before washing cows.
- If a contaminated preheater or water storage tank is identified, attempt to clean it up with hypochlorite or exposure to high temperature.
- If necessary, discontinue use of hoses to wash cows.

***Serratia marcescens* mastitis**

Serratia marcescens mastitis traced to a contaminated teat dip caused a severe problem in one and possibly in several other herds. This product was said to contain 0.5% chlorhexidine gluconate and an unspecified amount of lanolin as an emollient. Our attention was drawn to this product by a practitioner^a who called about a cow with *S. marcescens* mastitis. Knowing that this organism had previously been found in a teat dip,¹⁴ we suggested that he culture the teat dip. He did so and found *S. marcescens*. He then gathered a number of samples of this product from his practice area and found most of them to be heavily contaminated. *Serratia* was the predominant organism, but other gram-negative bacteria were present in some samples.

^aWe are grateful for the interest of Dr. Chris Barton, Salunga, PA 17538.

Subsequently, in another part of our state, a herd which had previously participated in a field investigation began to have a mastitis problem. This herd was first cultured in June 1985 as a low cell count herd. At that time no *Strep agalactiae* or *S. aureus* were found, and only a few quarters were infected with environmental pathogens. By late fall, cell counts and the incidence of clinical mastitis were increasing. Reculture of the herd was undertaken in December, and 13 of 34 lactating cows had *Serratia* infections. Investigation revealed that the herd had begun to use this same chlorhexidine teat dip in July of 1985. Culture of the dip revealed heavy growth of *S. marcescens*. In a subsequent herd culture in January, 1986, 15 of 40 cows were found infected. In all, a total of 18 cows were known to be infected. After 10 months, 7 of these had been culled; 6 were still infected; 3 had lost the infection, perhaps as a result of dry period treatment; and 2 were dry and their infection status was unknown.

This experience has several important lessons. One is that a chlorhexidine teat dip may support high populations of *S. marcescens* and possibly other gram-negative bacteria, but the conditions under which this can occur have not been defined. This is not unique to chlorhexidine; *Serratia* contamination of a quaternary ammonium teat dip has previously been reported.¹⁴ Second, the high rate of new infection that can result from postmilking dipping in a bacterial suspension was demonstrated. And finally, it became apparent that *S. marcescens* can cause troublesome mastitis that is persistent and difficult to treat.

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