



Extension Extra

ExEx 4028
January 2004
Dairy Science

COLLEGE OF AGRICULTURE & BIOLOGICAL SCIENCES / SOUTH DAKOTA STATE UNIVERSITY / USDA

Contagious vs. Environmental Mastitis

Alvaro Garcia Ph.D., Extension dairy specialist

Mastitis is an inflammation of the udder caused by microorganisms that enter the gland through the teat canal. Once inside the gland, these organisms find ideal conditions in which to multiply and, in turn, to damage the lining of the milk ducts, cistern, and alveoli.

As a result, the cow's immune response is triggered, and white blood cells travel to the udder to fight the infection. This results in increased somatic cell counts.

The organisms responsible for this infection can be broadly classified into two groups: contagious and environmental.

Contagious bacteria

Contagious bacteria are spread from a cow with an infected udder to a healthy cow. Transfer of pathogenic bacteria between cows usually occurs at milking time. Hands, towels, or the milking machine can all act as reservoirs for contagious bacteria.

The major contagious pathogens are *Streptococcus agalactiae* (Strep ag), *Staphylococcus aureus* (Staph aureus), and *Mycoplasma* spp. According to recent research some environmental streptococci can also become contagious.

Some of these bacteria are classified into Gram positives or negatives depending on whether or not they are stained by the "Gram" dye. This distinction has been useful to determine whether mastitis is likely to respond to treatment, as treating for environmental bacteria, which are mostly Gram negative, is usually not effective.

Strep ag (Gram-positive) spreads rapidly through a dairy herd because it has mild clinical signs in infected cows, while a great number of bacteria are shed in milk.

Although *Staph aureus* (Gram positive) spreads more slowly (fewer organisms occur in milk), it can live longer outside of the udder, and multiply in open sores and skin crevices. *Staph aureus* infection results in a typically sub-clinical, chronic inflammation, with periodic flare-ups of clinical symptoms (moderate swelling of the infected quarter). Although difficult to treat in the past, there are now drugs available that show promise to obtain bacteriological cure rates.

Mycoplasma bovis, a highly contagious organism, is usually introduced into a herd when infected animals are purchased. It has a sudden onset with rapid transmission throughout the herd. At the present time there is no cure for this type of mastitis.

Environmental bacteria

Environmental bacteria, as the name implies, come from the cow's environment (bedding, soil, manure, etc.) and thus are highly influenced by management practices. It is therefore impossible to completely eliminate them, as they are endemic to where the animals live, and can only be controlled by improving cleanliness of both the cows and their surroundings.

The most common environmental bacteria are the coliforms (*E. coli*, *Klebsiella* spp, and *Enterobacter*), whose main origin is manure and soil, and the environmental streps (*S. uberis* and *S. dysgalactiae*) that come from the environment but also from infected udders. The fact that this last group is also present in the udder increases the likelihood of them being also contagious.

Environmental bacteria thrive under wet conditions in the presence of the adequate substrate (manure). When the cow lies on soiled bedding, wades through mud, or even

when contaminated water is splashed on the udder (water pools, footbaths, etc.), these bacteria can colonize the udder skin and eventually enter through the teat canal at milking time.

If the skin of the udder is contaminated and then washed and not dried, the water running toward the teat end will transport bacteria. Once the milking unit is attached, bacteria may enter the teat canal while milking proceeds. Washing the udder without drying-out later may actually increase the number of bacteria reaching the teat end instead of decreasing it.

Reusable drying cloths that are not properly cleaned may also be a source of infection. Even when these cloths are initially clean the sequence in which the teats are dried out may result in inadvertently cross-contaminating them. Always clean the far-away teats first. If the closer ones are cleaned first, we can touch them accidentally while trying to reach the ones that are further away.

Coliforms are Gram negative bacteria with no response to treatment. Affected cows can show clinical signs and progress to a per-acute form that can lead to the death of the animal. These cases have sudden onset, with swollen and hot quarters and yellowish, watery milk that contains clots and flakes. Severe cases occur in early lactation, particularly around calving.

Infections with environmental Streptococci, Klebsiella, and Enterobacter occur more frequently early in the dry period. On the other hand, E. coli infections tend to occur immediately before and after calving. It is thus very important for both far-off and close-up dry cows to be kept in lots with dry clean bedding to minimize the risk of new infections.

There are several udder health management strategies recommended for the dry period. These include dry cow antibiotic therapy, teat sealant for dry cows, environmental management, nutritional management, the method of drying off, and vaccination programs. Antibiotic therapy at dry-off helps prevent infections contracted early in the dry period. Vaccination programs have shown effectiveness against infections by E. coli around calving.

Management practices, though, such as maintaining a clean and dry environment at all times, is without doubt among the most cost-effective practices when dealing with environmental mastitis.

Control

The method of mastitis control will depend on whether you are dealing with environmental or contagious organisms. The first step before developing a mastitis control

program is thus to identify the predominant bacteria. One approach is to culture milk from the bulk tank. Although very inexpensive and easy, it should not be considered a stand-alone type test and should not substitute for individual milk cow samples.

Although not always a good predictor of the number of infected quarters in a herd (contagious bacteria), it is useful to assess the degree of exposure to environmental bacteria. High environmental counts in milk from the bulk tank are correlated with hygiene of the cows and their environment. Multiple samples over several days produce more consistent results, particularly due to the variability in shedding of some bacteria (Table 1).

Table 1. Bulk tank testing reliability

Organism	Single sample	Three-day sample
		%
Streptococcus agalactiae	70.6	97.3
Staphylococcus aureus	59.1	93.1
Mycoplasma spp.	33	70

If the bulk tank sample is positive for Strep ag and/or Staph aureus and the samples were handled properly, this means that at least one quarter of one of the cows had an infection with that pathogen.

Negative results do not necessarily mean the herd is clean. These organisms can be shed intermittently, and that is why it is important to include at least a three-day milk sample when submitting bulk tank milk for culture. If coliforms are found, the question to ask is: Where did they come from?

High coliform counts may be associated with:

- Improper cleaning of the units
- Milking wet udders
- Organic soil buildup in the milk line
- Cracked gaskets and inflations
- Improper milking procedures
- Inadequate cooling of milk
- Intra-mammary infection

Although culturing every quarter of every cow would be the ideal method for early detection of mastitis in fresh cows the approach would not be practical or cost efficient.

The “old” California Mastitis Test (CMT) is currently in use by some dairies to screen every fresh cow and thus culture, detect, and treat early mastitis cases. The CMT is a quick, inexpensive, and easy test. A similar amount of

Table 2. Interpreting the CMT result

Symbol	Suggested meaning	Visible reaction	Approximate SCC count
N	Negative	Mixture liquid. No evidence of thickening.	-
T	Trace	Slight thickening in bottom of cup. Tends to disappear with continuous rotation.	-
1	Weak positive	High viscosity but no tendency to gel formation. May disappear after rotating more than 20 seconds.	SCC greater than 500,000
2	Distinct positive	Mixture thickens with tendency to gel formation. Upon rotation it tends to move towards the center of the cup.	SCC greater than 1,000,000
3	Strong positive	Gel is formed (surface elevated like yolk of fried egg) and remains after paddle rotation stops.	SCC greater than 5,000,000

milk (1/2 teaspoon) from each quarter is mixed with CMT reagent in each of the four paddle cups. The paddle is rotated for 10 seconds and the results are read.

Another useful tool of recent development is the University of Minnesota’s “Easy Culture System.” The culture consists of a bi-plate, which allows the growth of gram-positive organisms on one side and Gram-negative organisms on the other. Milk is inoculated with a cotton swab on both sides of the plate.

If gram-negative colonies develop, we are dealing with environmental organisms, and thus management (environment/cow cleanliness/dry cow vaccination programs) rather than treatment is the logical approach to control mastitis. If gram-positive colonies grow, further testing of individual cows/quarters to identify bacterial species and sensitivity to antibiotic treatment would be the right approach.

Controlling mastitis involves taking all possible steps to avoid cow-to-cow spreading of bacteria. The source, means of spread and control measure to deal with contagious and environmental organisms are in Table 3.

Summary

1. Contagious organisms spread from cow to cow at milking time.
2. Contagious mastitis can be controlled best by adhering to strict and consistent, sound milking practices and by milking order.
3. Controlling environmental mastitis involves maintaining clean and dry environment and cows as well as following proper milking protocols.
4. Dry cow treatment and post-milking teat dipping are more effective to control contagious than environmental mastitis.
5. The California Mastitis Test can be an inexpensive and quick tool to screen fresh cows.
6. The University of Minnesota Easy Culture System can help determine if contagious or environmental mastitis organisms are present.
7. Individual cow milk cultures are still necessary to determine drug sensitivity to insure positive responses to treatments.

Table 3. Mastitis: infection, means of spread, and control measures

Bacteria	Source	Means of spread	Control measures
<u>Contagious organisms</u>			
Strep ag	Infected udders of other cows	Cow-to-cow, contaminated milking utensils	Dry teats with separate towels; teat dip; treat dry cows; use gloves
Staph aureus	Infected udder, contaminated bedding, etc.	Cow-to-cow from contaminated udders, milking equipment	Dry teats with separate towels; teat dip; treat dry cows; cull chronic, infected cows; milking order; use gloves
Mycoplasma spp.	Various (inhabitant of respiratory tract, vagina, mucous membranes), infected udders.	Cow-to cow from contaminated utensils/hands.	No treatment. Use gloves/disinfectants between cows; milking order/clean clusters; teat dip; culling
<u>Environmental organisms</u>			
Non-ag Strep	Cow environment	Environment to cow by wet, dirty lots/bedding, milking wet cows, poor cow prep, milking machine problems (reverse flow at teat end)	Improve barn and lot sanitation; milk clean cows; avoid air leaks and liner slips; change bedding frequently
Coliforms	Cow environment	Environment to cow by wet, dirty lots/bedding, milking wet cows, poor cow prep, milking machine problems, teat injuries; hot humid weather	Improve barn and lot sanitation; milk clean, dry cows; keep cows standing 1-2 hours after milking; avoid air leaks and liner slips; change bedding frequently
Staph species	Normal inhabitants of skin, some bedding	Poor teat dip coverage, poor cow prep, soiled bedding	Teat dip; adequate cow prep; change bedding frequently



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the USDA. Larry Tidemann, Director of Extension, Associate Dean, College of Agriculture & Biological Sciences, South Dakota State University, Brookings. SDSU is an Affirmative Action/Equal Opportunity Employer (Male/Female) and offers all benefits, services, and educational and employment opportunities without regard for ancestry, age, race, citizenship, color, creed, religion, gender, disability, national origin, sexual preference, or Vietnam Era veteran status.

ExEx4028, 2004. Access at <http://agbiopubs.sdstate.edu/articles/ExEx4028.pdf>