Mastitis Control Program

for

Coliform Mastitis in Dairy Cows

by

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Introduction:

Escberichia coli, Enterobacter aerogenes, Klebsiella pneumoniae and Serratia marcesans are four common forms of Gram negative bacteria that cause mastitis (inflammation of the udder) in dairy cows. All the organisms could be classified under the simple term of coliform mastitis. This bulletin will focus on the source of coliform infections within a dairy herd and suggest useful control and prevention tips for dairy farmers.

Where are coliform bacteria found on the dairy farm?

Coliform bacteria are normal inhabitants of soil and the intestines of cows. They accumulate and multiply in manure, polluted water, dirt, and contaminated bedding. Research has shown that coliform numbers of 1,000,000 or more per gram of bedding increase the likelihood of an udder infection and clinical mastitis.

Klebsiella pneumoniae is common when farmers use sawdust bedding, especially rough-cut sawdust that contains bark or soil. Finer sawdust-especially hardwood sawdust-can increase the risk of coliform mastitis. The initial moisture level of the sawdust, however, has little effect on whether coliform numbers will exceed the 1,000,000 per gram level once the sawdust is used for bedding. E *coli* and other coliforms are normally found in cow feces, and once the bedding (sawdust or other) becomes heavily soiled with cow manure, coliform numbers in the bedding will increase, and so will the chance of a quarter becoming infected with coliform organisms.

When do coliform infections occur?

Many factors are involved in the initiation of a coliform infection. Coliform infections are more prevalent when a cow has a somatic cell count less than 150,000 and no other organisms in the

gland. The same factors would apply on a herd basis; that is, low SCC and few Gram positive infections. Unlike other major forms of mastitis, coliform infections usually are not spread from infected cows to non-infected cows during milking. Coliforms invade the udder through the teat sphincter when teat ends between milkings come in contact with a environmental site that is contaminated with coliform organisms. Coliform numbers that reach one million per gram (454 grams per pound) of bedding greatly increase the risk of a mammary gland infection.

What happens when coliforms enter the mammary gland?

Once coliforms enter the mammary gland, they often multiply rapidly or may remain dormant for several days. As they multiply, coliforms produce endotoxins (poisons), which are subsequently released when the bacteria are destroyed by leucocytes (white blood cells). Once released from the bacteria, the toxins are absorbed into the bloodstream. A cow affected by the toxins will show signs of high fever, depressed appetite, rapid weight loss, abnormal milk and decreased production within a few hours.

Which cows are most susceptible to coliform infections?

The majority of severe clinical infections occur before 60 days into a lactation. Most severe outbreaks of acute clinical mastitis caused by coliforms occur in highest producing, older cows. These cows typically are free of *Strep. ag.*and *Staph. aureus* and have somatic cell counts below 200,000 (DHI linear score 4). About 60 to 70 percent of these cases actually start at the end of the previous dry period or during calving. Some of these early lactation infections are spontaneously cured in a few days. Other coliform infections remain non-clinical for days or weeks until they flare up early in lactation as clinical cases. With acute cases, clinical signs occur in the gland as well as in the cow and may include hard, swollen quarter (s) with grossly abnormal milk (clots or watery), depression, off-feed and an elevated body temperature.

Cows in mid- to late-lactation have a much lower risk of a coliform infection unless the coliform challenge to the teat is great or there is a predisposing teat end injury. Severe challenges often occur during warm, rainy weather and may result in many infections scattered throughout the herd regardless of stage of lactation. Poorly ventilated freestall and confinement barns increase the risk of new coliform infections during the late fall or early winter and spring when environmental conditions fluctuate greatly. Lactating and dry cows that are housed on dirt lots (yards) or bedded (manure) packs are particularly vulnerable to coliform infections.

Periods of hot, humid weather, extensive periods of heavy precipitation, movement of cows into confined facilties and movement of cows to new facilities are often followed by periods of increased incidence of new coliform cases. Herds with low bulk tank somatic cell counts seem to be more susceptible to these situations.

How prevalent are coliform infections?

Coliform bacteria are responsible for a great number of acute clinical mastitis cases in dairy cows. Coliform infections generally occur as isolated or sporadic cases, but within certain herds, 10 to 15 percent of milking cows may become infected within one week to a month. Many clinical cases caused by coliforms may appear to be similar to strep or staph infections as clinical signs are limited to abnormal or watery milk in an otherwise normal appearing cow.

Even though coliforms may cause a high percent of all acute clinical cases, these organisms are responsible for less than 5% of the total infected quarters within a herd at any one time. In addition, usually only one quarter per cow is clinically infected at a time.

What are the results of a coliform infection on milk production?

Results of infections range from death of a cow to near-normal recovery of milk production. The extent of recovery often depends on how rapidly the clinical cases are detected and treated. In about 50% of coliform cases, infected cows may survive, but subsequent total milk production for the affected quarters will be below normal for the lactation. Some surviving cows may undergo a long illness, characterized by a poor appetite and weight loss. These cows should bc sent to market after antibiotic residues are cleared. In about 10 percent of clinical coliform mastitis cases, cows die within one to two days after the infection becomes apparent, in spite of aggressive veterinary care. In the remaining instances (about 40 percent), cows recover quickly and return to substantial milk flow. Cows kept for another lactation usually return to near-normal production if swelling of the infected quarter returns to normal within 24 to 36 hours after the onset of clinical signs.

Few infections become chronic, and those that do are usually very mild. In rare instances, coliform bacteria have been found to cause non-clinical problems on a herd basis.

What are the signs of a coliform infection in a cow?

In a typical case, an individual cow with a severe coliform infection will suddenly go off feed with absence of rumen function. Signs of severe depression such as lying down while other cows are eating, dull sunken eyes, or drooping cold ears are readily apparent within a few hours after the coliform and then leucocyte (SCC) numbers increase in the mammary gland.

Secretion from the affected quarter will appear watery or serous-like. Body temperature of the cow may rise to 104 degrees F or higher. Within a few hours to a day after onset, an infected quarter generally will become edematous (swollen) and sensitive to touch, and will sometimes secrete a small amount of serum-looking fluid. At this point, the infected cow will be weak and dehydrated, and may have a subnormal temperature (99 degrees F or less). Because the infection may result in a decreased level of blood calcium, an infected cow may appear to have symptoms of hypocalccmia (milk fever).

What are the potential herd signs of a major coliform mastitis problem?

- A high proportion of clinical (several severe) mastitis cases that occur in the first 60 days after calving, often at the peak of lactation.
- Majority of clinical infections are in older cows with high production and low SCC (<LS 4).
- Clinical infections last for a few hours or a few days.
- Intramammary antibiotic therapy has little, if any, effect on the clinical mastitis
- There is often an increase in cases noted after bedding such as sawdust, gin trash, or other fine organic bedding materials are added to stalls or after dirt lots are scraped in closeup or fresh pens.
- There is a distinct seasonal pattern of clinical infections. Depending on the geographical region, new infections rates may be associated with high temperatures, heavy rainfall and unstable weather condtions.

Are DHIA somatic cell counts helpful to identify coliform infections?

Not usually. DHIA somatic cell counts tend to identify clinical and non-clinical mastitis infections of relatively long duration. Coliform infections are very short in duration (a matter of a few hours to a few days).

An infected cow's SCC may be low on test day, but can rise to several million within a few hours to a few days. Subsequently, since SCCs are usually taken at monthly intervals, cows that recover from a coliform infection could havc a normal SCC by the next test day. However, herds in which 85 to 90 percent of cows have linear scores of 4 or lower may be more likely to develop coliform infections than herds with higher SCCs. Thus, use of the somatic cell count is more helpful to the herdowner in identifying cows that are "at risk" in developing coliform infections than in identifyng coliform infected cows. However, in herds using the CMT for early detection of infections (after 4^{th} milking) or doing milk cultures in early lactation, some non-clinical coliform infections may be detected prior to development of clinical signs.

Does culturing milk samples from infected cows help to identify coliform cases?

Before treating clinically infected cows, aseptically collect a milk sample from the infected quarter so that the organism responsible for the mastitis infection can be identified. A milk sample cultured from a clinical case may help to identify the type of organism responsible for

the infection. However, be aware that coliform bacteria are not reliably cultured from milk of clinically infected quarters. The numbers of coliform organisms in a milk sample from a clinically infected quarter quickly may fall below the minimum detectable limit. This makes recognition of early clinical symptoms much more important in helping to ensure that proper treatments are initiated quickly to save the cow and her production. Identifying the organism may also help you to diagnose and choose the proper treatment method for subsequent coliform infections in other cows.

What about treating coliform cases?

Most coliform cases require immediate professional veterinary treatment, which is likely to include use of broad spectrum antibiotics, IV fluid therapy such as a hypertonic saline solution, antiprostaglandins, steroids, antihistamines and calcium treatment. Broad spectrum antibiotics often are used to combat secondary complications since they have little effect on the outcome of the toxin-induced clinical signs. Water should be readily available for cows treated with a hypertonic saline solution. Aspirin is a potent antiprostaglandin that can be administered to infected cows by the herdowner, but this should be done upon the advice of the veterinarian.

A very important procedure in treatment of coliform mastitis infections involves frequent milking of the infected cow to remove leucocytes, bacteria and toxins from the mammary gland. Hourly milkings could be very helpful. An injection of oxytocin close to the end of milking will also aid in removal of residual milk that contains toxins.

Rapid identification of clinical cases of mastitis caused by coliform is critical to the outcome of the infection. Administration of treatment to infected cows within 6 to 8 hours after the onset will increase the likelihood of full recovery of milk production within a few days.

Management steps to take in the face of a coliform outbreak.

- Immediately clean up all areas that could be a source of bacterial growth. This may include poorly cleaned or dug out free stalls, an overused calving pen, a muddy lot, or an overcrowded shelter area used during hot or cold weather.
- Immediately remove sawdust bedding or other fine beddings such as ground com cobs, gin trash or chopped straw from stalls of high producing cows. Avoid bedding dry cows and springing heifers within two to three weeks of calving or during calving on these materials. In addition, do not use manure packs as a housong or bedded area for dry cows, closeup cows or springing heifers.
- Increase space per cow by providing a clean area, such as a pasture, so cows can avoid manure contamination. There should be one free stall for every cow. Lactating cow numbers should not exceed 10 percent of free stalls available.
- Keep cows on their feet for an hour after milking by providing fresh feed for them to eat. This will allow the teat sphincter to regain its normal patency (closure status) after milking which should help prevent bacterial penetration through the teat end.
- If not in place, develop standard operating procedures for maintenance of clean comfortable stalls. If already in place, review procedures for maintenance of bedding in the critical housing areas. Identify individuals that are responsible for bedding

maintenance and review their duties. Explain the importance of their job in relationship to mastitis prevention and control.

- Avoid housing dry cows, prefresh cows and springing heifers where they have access to round bale feeders and portable feeding devices. Concentration of cows and heifers under single shaded areas or at a muddy watering site or wet wooded areas will increase new infections caused by all coliforms.

Can any new coliform infections be related to milking?

Despite the fact that the majority of new coliform infections occur between milkngs, milking time infections can occur. A rise in the occurrence rate of new infections can be influenced by the following milking factors:

- Wet milking of cows following the use of excessive water with no drying at prep time
- Excessive liner slippage at the end of milking on dirty, wet teats
- Using badly worn inflations

In addition, the combination of malfunctioning pulsators with any of the above problems can increase the chance that teat damage will occur, which in turn could increase the probability of

To help avoid these problems, teats should be clean and dry at the time of machine attachment. After milking, tum off the vacuum before removing teat cups to avoid liner slippage. Milking equipment should be checked by a responsible dealer on a regular basis. Note, too, that the use of automatic backflushing units will not control coliform infections since most infections occur between milkings and iodine is not affective against Gram (-) bacteria.

What effect does dry cow antibiotic therapy have on coliform infections?

Dry cow treatment will not prevent new coliform or environmental streptococci infections in the last two weeks of the dry period or at the start of the next lactation. Dry cow therapy has little effect on coliform infections that are present at dry off. Only good housing management at dry off, during the dry period and three weeks before and continuing through calving will prevent the majority of new coliform infections that tend to occur during the early postpartum period.

Can coliform infections be prevented or limited?

Yes. A long-term prevention program should be part of any mastitis control program. For best results in the fight against coliform mastitis:

- Maintain and replace free stall bedding frequently (weekly) to prevent the "hollowing out of bedding" that allows milk, manure and urine to accumulate. An adequate amount of bedding should be maintained in confinement stall barns to provide a dry, confortable bed for the cows. Daily grooming of stalls will prevent the buildup of manure and urine.
- Freestalls and comfort stalls should be correctly designed for the size of the cows that will be housed in them. Properly sized stalls will help prevent teat injuries which reduces the chances of coliform infections occurring. Tables 1 and 2 outline proper cow stall platform sizes and free stall dimensions. For more information on dairy housing guidelines, ask your county Cooperative Extension Service agricultural,agent

where you can get Midwest Plan Service (MWPS) publication #8, "Freestall Housing for Dairy Cows" (5th ed., 1997).

- Avoid placing round bale feeders or feed wagons in dirt lots for dry cows and springing heifers. The cattle will lay in the manure-ladened hay that is pulled from the feeders.

- Use washed sand instead of sawdust or recycled manure solids as a bedding material, for dry cow, pre-fresh cows and heifers and early-lactation cows. Cows that are more than 90 days into a lactation, however, may be housed with any type of bedding. It is critical that the back 2 to 3 feet of each stall be cleaned and leveled two to three times per day. A weekly bedding schedule will insure the stalls remain full of bedding.
- Note that properly prepared, recycled manure can be successfully used as a freestall bedding material in arid areas However, recycled manure bedding may be problematic in more humid areas.
- Calving (maternity) pens should be bedded with 4-6 inches of sand, coarse limestone or other porous materials covered with long straw. Straw should be removed after each calving if cows are housed in the calving pens for for than one day

Can I just add lime to the back of the stall to prevent coliform infections?

Research at the University of Vermont and other universities has indicated that this is a short-term solution at best. Using sand would be preferable to adding lime to sawdust bedding. Lime may cause drying and excessive chapping of teat skin.

What type of freestall materials are preferred?

Freestalls with a concrete base and a 4 inch slope from front to back, no back curb and a grooved surface, will decrease the labor cost of maintaining free stalls. A minimum of 6 inches of bedding must be maintained in these stalls to minimize feet and leg injuries. It is difficult to maintain 6" of bedding in a concrete-based stall. Adding a mattress to concrete-based stalls is a good management decision. Bedding (not sand) should be placed on the mattress to a depth of 1-3 inches. However, some of the mattress materials are very abrasive and may increase the incidence of knee and hock abrasions.

The preferred stall design and bedding for cow comfort and reduced risk of coliform infections would be a freestall with all sand. The washed sand would be 8-12 inches deep in the stall. Daily maintenance of the sand-based freestall limits coliform numbers on the teat ends. "Bank run" sand such as that dug out of the hillside is not acceptable as it normally contains too much dirt, stones and other organic material.

Are there other management factors to consider in a coliform control program?

Yes. Consider adding these steps to your preventive maintenance list:

- Avoid overcrowding of freestall or loafing areas so that cows will not rest in alleyways and around feeders.

- Provide well-ventilated and lighted housing areas to prevent environmental stress. Barns that are “closed up” in the wintertime to keep manure from freezing will increase the incidence of pneumonia and coliform mastitis.
- Change feed rations and cow routines gradually to prevent stressful periods.
- Attach milking machines only after teats are clean and dry.
- Train all dairy personnel to recognize clinically infected cows between milkings and impress upon them the benefits of rapid recognition and treatment.
- Milking 3x daily may decrease new coliform infections and perhaps shorten the time from onset of an infection to recognition of a clinical case and subsequent therapy.
- All dry and lactating cows and heifers should receive in their base ration on a daily basis 1000 to 2000 IU of vitamin E, 6 mg of selenium as well as adequate amounts of zinc, copper and other minerals in their dairy ration. Studies have indicated that deficiencies of vitamin E and selenium can contribute to an increase in the incidence of environmental mastitis.
- Keep cows clean and dry between milkings to avoid exposure of teat ends to dirt and manure.

How about post-milking teat dips and vaccines against coliforms?

Germicidal teat dips are not effective against gram-negative organisms such as coliforms. In addition, care must be taken to prevent contamination of teat dips with bacteria such as *Serratia marcesans*. An outbreak of clinical mastitis following the use of a new teat dip suggests the need to culture the dip. If you use your farm water to mix the dip, the water should

also be cultured. The is no evidence to support the use of barrier teat dips after each milking to prevent or reduce new coliform infections. This is particularly true for cows past 90 days in lactation.

J-5 and similar vaccines have proven to be very beneficial in limiting the clinical signs of coliform infections. To maximize effectiveness of the vaccines, label directions should be followed. Keep in mind that these vaccines do not prevent new infections and are not a substitute for proper management of housing areas.

This is one in a series of bulletins on mastitis control in dairy herds. Contact your county Cooperative Extension Service office for information on other forms of mastitis and how to control them.