

Mastitis Control in Replacement Heifers

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Introduction

Mastitis is the most costly disease of dairy cattle. This disease occurs when bacteria penetrate the teat orifice, colonize teat canal keratin, and gain entry into the mammary gland. In spite of growth inhibitory properties of keratin, bacteria are able to survive in the teat canal and progress into the udder, causing inflammation. Current methods of mastitis control advocate adoption of management practices developed for mature lactating and dry cows, and include teat dipping, dry cow therapy, proper use of functionally adequate milking machines, prompt treatment of clinical cases, and culling of chronically infected animals. However, methods for controlling the disease in heifers were not contemplated in development of these management schemes. Mammary glands of heifers have traditionally been regarded as uninfected, and their mammary secretions are not examined until the first milking or during the first episode of clinical mastitis following calving. The greatest development of milk producing tissue in heifers occurs during the first pregnancy, thus mammary glands must be protected from the harmful effects of mastitis-causing bacteria to insure maximum milk production and reduce the level of infection and somatic cell count (SCC) during the subsequent lactation. This is particularly important in view of the recent decision to lower the SCC legal limit. Effective July, 1993, the new Interstate Milk Shippers' quality standard for raw milk will set the SCC limit at 750,000/ml. Thus, in addition to tightening up standard mastitis control practices in lactating and dry cows, dairymen should carefully consider a mastitis control program for heifers in attempts to conform to the new quality standard.

Prevalence of Heifer Mastitis

Studies conducted at the Hill Farm Research Station were designed to determine prevalence of mastitis in breeding age and pregnant heifers, as well as to determine if intramammary treatment during pregnancy was effective in reducing mastitis and SCC at calving. In an initial herd survey, the prevalence of mastitis in breeding age and pregnant heifers was determined in four dairies. Teat canal keratin and secretion samples were collected from

116 Jersey heifers. Keratin samples were studied because mastitis-causing bacteria will often colonize the teat canal prior to establishing an intramammary infection. Before sample collection, each teat apex was sanitized by scrubbing with cotton balls moistened with 70% ethyl alcohol. To obtain a keratin sample, an ultrafine calcium alginate swab was inserted about 2 mm into each teat orifice and rotated against the wall of the canal. A sample of mammary secretion was then obtained from each quarter. All samples were processed according to standard procedures to determine bacteriologic status. The SCC was performed using a Fossomatic electronic cell counter.

Results of the herd survey revealed that teat canal colonizations were present in 93.1% of heifers and 70.7% of quarters. *Staphylococcus aureus*, one of the most economically important bacteria causing mastitis, was isolated from 16.8% of teat canals. Other organisms isolated from keratin and percent frequencies were *Staphylococcus chromogenes* (42.9%), *Staphylococcus hyicus* (25.2%), *Staphylococcus* species (5.7%), *Streptococcus dysgalactiae* (0.6%), *Streptococcus* species (3.1%), and mixed isolates containing staphylococci and streptococci (5.6%). The teat canal is considered a primary defense against mastitis due to the inhibitory effect of keratin on some microorganisms. However, many microorganisms survive in keratin and many produce harmful substances that are deleterious to the developing milk secretory tissues of the udder. Also, the keratin colonized by these microorganisms may serve as a reservoir for subsequent mastitis.

Intramammary infections were found in 96.9% of heifers and in 74.6% of quarters. Twenty-nine percent of heifers and 15.1% of quarters showed clinical symptoms of mastitis as evidenced by clots, flakes, and blood. *Staphylococcus aureus* was isolated from 14.7% of quarters. This microorganism was also isolated from 25% of quarters with clinical symptoms. *Staphylococcus aureus* causes severe damage to mammary tissue and infections are very difficult to eliminate in lactating cows. Infections caused by this microorganism in heifers are of great concern because of the possible deleterious effect on future milk production. Other organisms isolated from secretions and percent frequencies were *Staphylococcus chromogenes* (43.1%),

Staphylococcus hyicus (24.3%), *Staphylococcus* species (3.6%), *Streptococcus dysgalactiae* (0.4%), *Streptococcus* species (3.3%), *Nocardia* species (0.4%), and mixed isolates containing staphylococci and streptococci (5.1%).

Effect of Infection on SCC and Mammary Development

Milk SCC are considered an important parameter to assess mammary health status in lactating cows, and it is well recognized that milk production decreases as SCC and level of mastitis increases. However, limited data exist on SCC in mammary secretions collected from breeding age and pregnant heifers. In infected heifer quarters, mean SCC was $13,500 \times 10^3/\text{ml}$, while in uninfected quarters, the mean SCC was $5,700 \times 10^3/\text{ml}$. The SCC for quarters infected with *Staphylococcus aureus* averaged almost $20,000 \times 10^3/\text{ml}$, which may be associated with a marked loss in potential milk yield. Those for quarters infected with the coagulase-negative staphylococci, such as *Staphylococcus chromogenes* and *Staphylococcus hyicus*, were also quite high, averaging $13,600 \times 10^3/\text{ml}$, respectively.

Histologic analysis of heifer mammary glands infected with *Staphylococcus aureus* revealed the presence of inflammation. Infected quarters were less developed than uninfected glands, exhibiting less alveolar epithelial and luminal areas and more interalveolar stroma, demonstrating minimal milk secretory activity. Microscopic abscesses were also noted. Quarters infected with the coagulase-negative staphylococci also exhibited greater inflammation and less mammary development compared with uninfected quarters.

Efficacy of Intramammary Therapy

In a second study, the efficacy of intramammary treatment of unbred heifers and those in early pregnancy was determined. Thirty-five of the 116 heifers were randomly selected to receive intramammary treatment. Teat ends were sanitized, and a dry cow antibiotic formulation containing 1,000,000 units of penicillin and 1 gram of dihydrostreptomycin was infused into all 4 quarters using the partial insertion technique. After treatment, each teat was dipped in a barrier teat dip. Thirty-eight heifers served as untreated controls. At calving, mammary quarters of all heifers were sampled to determine bacteriologic status and SCC. Samples collected from treated heifers were assayed for antibiotic residues using the Delvotest P-Mini.

Results of intramammary therapy showed that in animals designated to receive antibiotics, 97.1% of heifers and 73.2% of quarters were infected just prior to treatment. At calving, infected heifers and quarters in the treatment group were reduced to 40% and 34%, respectively. Only 2.9% of quarters had antibiotic residues at time of calving, and all were negative after 5 days. In the untreated control group, 100% of heifers and 71.2% of quarter secretions were infected at initial sampling. At calving, the prevalence of mastitis in control heifers was reduced only slightly to 97.4%. *Staphylococcus aureus* was isolated from 11 quarters of 6 treated heifers before antibiotic infusion (45.8%), but at calving, this organism was isolated from only 1 quarter of 1 heifer (4.2%). In the control group, 18 quarters of 10 heifers were infected with *Staphylococcus aureus* at time of treatment (45%); at calving 6 of the control heifers still had *Staphylococcus aureus* mastitis in 11 quarters (15%). Heifers treated during the second trimester of pregnancy, compared with those treated during the first or third trimester, demonstrated the best response to the treatment in terms of reduced prevalence of mastitis and lowered SCC at the time of calving.

Research station scientists have found that in lactating cows, about 30.4% of animals and 25% of quarters with *Staphylococcus aureus* mastitis are cured after antibiotic therapy. In this study, 83.3% of heifers and 90.9% of quarters were cured, thus antibiotic therapy with the penicillin/streptomycin product in heifers was highly effective in controlling mastitis compared with lactating cows. Reasons for this phenomenon are unclear. The relatively small udders of the heifers may have limited microorganisms to areas of mammary tissue in which the antibiotic would be present in adequate concentrations to eliminate infection. In addition, scar tissue, common in *Staphylococcus aureus* infections, may not have formed, which may have permitted the antibiotic to reach the microorganisms. The SCC at freshening was also reduced by antibiotic treatment. In treated heifers, SCC decreased from $12 \times 10^6/\text{ml}$ at treatment to $3 \times 10^6/\text{ml}$ at calving. In the control group, SCC decreased from $11 \times 10^6/\text{ml}$ to $6 \times 10^6/\text{ml}$. Antibiotic therapy in heifers is advantageous over treatment of lactating cows because treatment can be performed before calving, and the risk of antibiotic residues at calving are minimal.

Prepartum Treatment of Heifers

More recent studies with prepartum heifers using a cephalosporin-based antibiotic have also been very successful. One group of heifers, either naturally or experimentally infected with *Staphylococcus aureus*, were infused intramammarily at 8 to 12 weeks prepartum with one dose of a commercially prepared product containing 300 mg cephapirin benzathine. Another group of animals with *Staphylococcus aureus*-infected quarters served as untreated controls. Results demonstrated that 90% of naturally occurring infections and 100% of experimentally induced *Staphylococcus aureus* infections were eliminated in treated animals by calving, and cured quarters remained infection-free for at least 2 months into lactation. Another antibiotic infusion, SCC in infected quarters decreased from $15 \times 10^6/\text{ml}$ to $4 \times 10^6/\text{ml}$ 1 week later and to $700 \times 10^3/\text{ml}$ at calving. In contrast, none of the untreated *Staphylococcus aureus*-infected quarters had spontaneously cured by the time heifers calved. Treated heifers in which

Staphylococcus aureus infections were cured produced over 10% more milk than untreated controls during the first 2 months of lactation. Quarters remaining infected at calving were treated with a lactating cow product containing 200 mg cepharpirin benzathine; cure rate was 50%. Antibiotic concentrations in mammary secretions of heifers treated prepartum remained elevated above the minimum inhibitory concentrations of the drug necessary to kill bacteria for 4 weeks after infusion. These treated quarters were free of antibiotic residues at freshening.

Prevalence of Mastitis in Heifers Nationwide

A national survey on the prevalence of mastitis in heifers is currently underway in California, Louisiana, Vermont, and Washington. To date, results of a survey involving over 200 heifers in four commercial herds in Louisiana demonstrated that level of infection ranged from 54% to 87.5% of heifers or 37.3% to 70.8% of quarters. Prevalence of infection appeared slightly higher in Jerseys than Holsteins. The most prevalent isolates were the coagulase-negative staphylococci (35% to 75% among herds). The

percentage of heifers infected with *Staphylococcus aureus* ranged from 13% to 47%. A greater percentage of heifers was infected with *Staphylococcus aureus* in herds that did not practice fly control.

Conclusions

Thus, prevalence of mastitis, particularly that caused by *Staphylococcus aureus*, was higher in breeding age and pregnant heifers than previously realized. Management practices such as fly control, use of individual calf hutches to avoid suckling among calves (particularly those fed mastitic milk), and segregation of pregnant heifers from dry cows may help to control mastitis in heifers. Antibiotic treatment prior to breeding or during pregnancy was highly effective in reducing the overall prevalence of mastitis, the number of *Staphylococcus aureus* infections, and SCC at calving. Protecting the developing milk-producing tissues of heifers from bacterial invasion is important for maintaining low SCC levels and to insure optimum milk yield in the future.

