Mycoplasma Mastitis: Facts Every Producer Should Know

With the ongoing expansion of dairy operations and the rapid transit of heifers across the U.S., *Mycoplasma* mastitis has become a herd health issue that no one can afford to ignore. No effective treatment exists for this form of mastitis and infected cows are considered positive for life. An opportunistic organism, *Mycoplasma bovis* frequently establishes respiratory infections in calves, travels to the developing mammary gland, and lies in wait until freshening. Subclinical cows may shed millions of the infectious organisms in the milk before showing any signs of disease. The introduction of a single infected calf, heifer, or cow has the potential to spread *Mycoplasma* mastitis throughout the entire herd.

To master *Mycoplasma* mastitis and to reduce the risk of an outbreak, producers must rely on prevention. Proper milking procedure, vigilant testing of bulk tank samples and all mastitic cows, establishment of a thorough biosecurity plan, and producer awareness are essential components in the prevention and control of *Mycoplasma* mastitis.

Microbiology 101: Defining the Mycoplasmas

Mycoplasmas are not classified as viruses nor bacteria, but as intermediate organisms somewhere in between. Ranging in size from 0.2 to 1 micrometers, they are the smallest living organisms capable of self-replication. *Mycoplasmas* are grouped under the class *Mollicutes*, meaning "soft skin." This name is in reference to the fact that *Mycoplasmas* do not have the genetic ability to produce a cell wall, a common component of most bacteria. Without a cell wall to provide a rigid structure, *Mycoplasmas* are pleiomorphic—they can easily change shape and may appear pear-shaped or circular *(Figure 3)*.

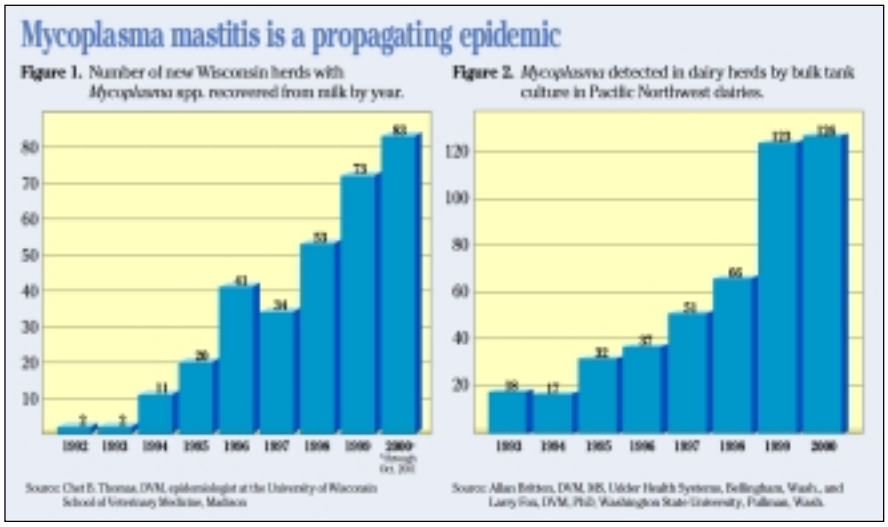
The lack of a cell wall also helps explain why Mycoplasmal infections do not respond well to antibiotic therapy. Commonly used beta-lactam drugs such as penicillin work to inhibit bacterial growth by interfering with cell wall formation. Lack of a cell wall negates the efficacy of such drugs. Another major factor contributing to the drug resistance common to most *Mycoplasma* infections is the organism's ability to change its surface proteins. Normally, the immune system develops antibodies directed against specific proteins on the surface of the organism. If these proteins are altered, new antibodies must be produced

Mycoplasmas are found everywhere in the environment and have been cultured from humans, food animals, companion animals, plants, and soil. To date, unique *Mycoplasma* species have been detected in cattle, sheep, goats, swine, chickens, turkeys, dogs, cats, horses, and rodents. Each species is host specific: a mycoplasmal infection in a horse cannot be transmitted to a cow or vice versa.

Mycoplasmas are opportunistic organisms—not all species cause disease. Many species exist with the normal bacterial flora on the mucus membrane surfaces of the eyes, mammary gland, and respiratory, digestive, and urogenital tracts in healthy animals. Under special circumstances, such as a compromised immune response due to stress or ongoing disease, these organisms may become pathogenic. In general, *Mycoplasmas* produce chronic disease with little mortality. The immunosuppression resulting from mycoplasmal infections, however, does predispose the host to other infections.

Mycoplasmas prefer to grow in the absence of oxygen and survive in damp, dark environments where they are protected by manure and straw. When exposed, they are rapidly inactivated by sunlight and detergents.

Mycoplasmas produce characteristic "fried egg" shaped colonies *(Figure 4, opposite page)*. Although the appearance of these colonies is diagnostic for *Mycoplasma*, it takes seven days for complete growth.



Background of Mycoplasma Mastitis

It is only in the last several decades that producers have recognized the untreatable forms of pneumonia, arthritis, and mastitis caused by various *Mycoplasma* species. The first reported case of *Mycoplasma* mastitis occurred in England in 1960. A year later, in 1961, the first outbreak in the United States occurred in Connecticut, followed by several cases in New York. California documented its first reported cases of *Mycoplasma* mastitis in 1964.

Today, the disease is prevalent in all major dairy regions of the United States, particularly California, New York, Pennsylvania, Florida, Arizona, Idaho, and Washington. Current statistics, estimate that 1% to 4% of all U.S. dairies harbor at least one infected cow.

"I don't think we have an increased incidence of *Mycoplasma* mastitis," says

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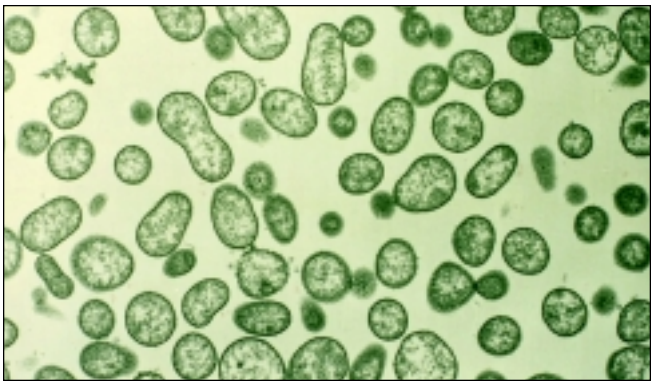

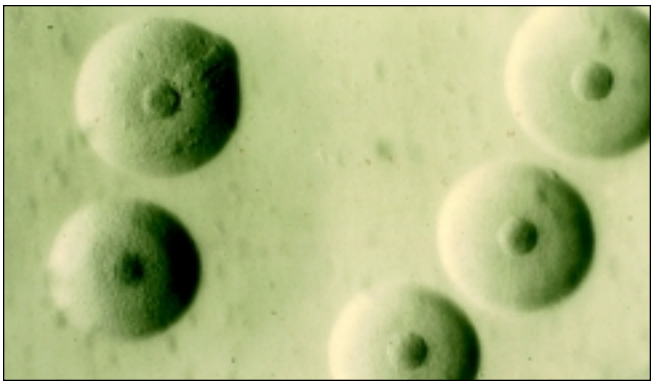

Figures 3 and 4. Viewed under the electron microscope, *Mycoplasma* organisms *(above left)* may vary in shape due to the absence of a cell wall. *Right:* Milk samples positive for *Mycoplasma* will produce characteristic "fried egg" shaped colonies when grown on special media. Photos courtesy of Dr. Ronald Griffith, Iowa State University, College of Veterinary Medicine, Department of Veterinary Microbiology and Preventive Medicine.

Ricardo Rosenbusch, DVM, Ph.D., a professor in the Department of Veterinary Microbiology and Preventive Medicine at Iowa State University's College of Veterinary Medicine. "What we have had is appearance of the disease in zones or in dairy basins where we didn't have it overtly before.

"The structure of the dairy business has changed," explains Dr. Rosenbsuch. "There is a lot of movement of cattle in the dairy industry and a lot of consolidation. Heifers are produced commercially and then sold as replacements all over the U.S. These animals are an open door to bring in *Mycoplasma* infection and other diseases."

A total of 20 different *Mycoplasma* species have been isolated from cattle. Eleven species have been detected in milk. The most important and most frequent cause of *Mycoplasma* mastitis is *Mycoplasma bovis*.

M. bovis is commonly found in the upper respiratory tract of healthy cattle. This organism is often involved in respiratory diseases such as shipping fever and calf pneumonia, as well as arthritis, synovitis, and calf ear infections. Following a respiratory infection in a young calf, *M. bovis* has the ability to move systemically to the mammary gland and cause mastitis when the animal freshens. When *M. bovis* becomes established in the udder, it produces waste products and toxins. These byproducts elicit an inflammatory response in the mammary gland causing edema and decreased milk production or, in short, mastitis. The immune system reacts by recruiting millions of white blood cells to the site of infection. This results in high somatic cell counts (SCCs).

Mycoplasma mastitis may manifest as a clinical or subclinical infection. *M. bovis* can cause severe tissue damage in the infected quarter, as well as enlargement of the supramammary lymph nodes. There are no species-specific clinical signs for diagnosing *Mycoplasma* mastitis. There are some warning flags, however. A common feature of a *Mycoplasma* outbreak is an increase in the number of severe clinical cases of mastitis that are unresponsive to antibiotic treatment. These cows often exhibit very high white blood cell counts, potentially over 20 million cells per milliliter. Oftentimes more than one quarter is involved and there is a sudden decrease in milk production. Acutely infected cows may cease production entirely and develop polyarthritis and pneumonia.

Dr. Ricardo Rosenbusch of Iowa State University focuses on the molecular aspect of mycoplasmal and bacterial infections in ruminants and developing animal models and diagnostic systems for ruminant *Mycoplasma* infections. He has chaired the Ruminant *Mycoplasma* Working Team of the International Research Program on Comparative Mycoplasmology.

Affected cows secrete abnormal milk that may appear serous with a few clumps, or thick and colostrums-like *(Figure 5)*. Chronically infected cows often produce a tan, whey-like secretion containing flaky sediments. These cows may return to near normal production levels but will continue to intermittently shed *Mycoplasma* organisms.

Transmission of *Mycoplasma* Mastitis

The recent increase in mastitis outbreaks caused by *M. bovis* is a result of structural changes in dairy herd management. Today, very few dairy herds are operated as closed facilities. When purchasing new replacements, producers may also unwittingly buy a *Mycoplasma* mastitis problem. The introduction of infected animals to the home herd and failure to follow a strict biosecurity plan can lead to devastating results.

Mark L. Brandt, D.V.M., with Mid-Valley Large Animal Service, Ceres, Calif., has been dealing with *Mycoplasma* mastitis in dairy herds for 15 years. This five veterinarian practice serves 70 herds including 6,000 milking Jerseys. In addition, Brandt operates an in-house milk quality bacteriology lab. The majority of the samples tested are positive for contagious agents such as *Staphylococcus aureus* and *Streptococcus agalactiae.* Dr. Brandt estimates that less than 1% of the samples submitted to his lab each year test positive for *Mycoplasma.* However, early detection of that 1% may be key to preventing a full blown outbreak in infected herds.

Many times the sources of *Mycoplasma* infection are purchased replacements or

heifers that were raised on a separate facility and then introduced to the milking herd. The organism is shed in the milk as well as the nasal and vaginal secretions of positive animals. *M. bovis* can infect cows of any age and any stage in lactation.

The milking parlor is the most common site of *M. bovis* transmission to healthy cattle. *Mycoplasmas* can be carried from cow to cow on the milker's hands and parlor equipment. In addition, the organisms in milk and nasal secretions can become aerosolized and inhaled by susceptible animals. Multi-use treatment devices, including intramammary infusions, provide another route of transmission. Dr. Brandt points out that a bottle of penicillin can easily become contaminated with *Mycoplasma*, as its contents are accessed over and over again. With each cow injected, the producer infects another animal.

Although improper milking procedure and parlor management account for a large proportion of *Mycoplasma* cases, producers must also be concerned about their youngstock.

"Producers need to be aware that many *Mycoplasma* problems begin in calfhood," warns Dr. Brandt. "The most common scenario I see begins as a pneumonia problem in calves. Two years later they freshen with *Mycoplasma* mastitis and shed in high numbers."

This scenario begins with a mycoplasmal infection of the upper respiratory tract in calves and heifers. Infected animals develop pneumonia and typically recover; however, the *Mycoplasma* migrate systemically from the respiratory tract to the mammary gland. After she freshens, the cow develops *Mycoplasma* mastitis and begins shedding organisms in the milk.

"The most common and most dangerous point source of infection is the heifer that freshens with *Mycoplasma* mastitis," says Dr. Brandt. "They're ticking bombs."

At birth, calves can become infected through contact with an infected dam's nasal or vaginal secretions and consumption of her colostrum and milk as well as contact with other infected calves.

Feeding raw hospital milk to calves can be a dangerous practice. Consumption of waste milk from *Mycoplasma*-positive cows introduces a huge load of organisms into the calf's body, which become established in the respiratory tract and causes pneumonia. The organism then has the opportunity to establish infection in the developing mammary gland.

"It's a vicious cycle," warns Dr. Brandt. "If you feed waste milk, pasteurize it." Pasteurization has been proven to kill the *Mycoplasma* organism.

An important aspect influencing the degree of severity of a *Mycoplasma* outbreak is the degree of seronegativity *(resistance to the agent)* in the herd.

Mycoplasma "is a clear-cut transmissible disease," explains Dr. Rosenbusch of Iowa State. "The worst situation is a completely seronegative herd that comes into contact with one or more shedders of a hot strain. If you have a highly protected herd where all cows are seronegative and then introduce a nasal shedder, you have a powder keg in your hands." Such cases often result in waves of dissemination of *M. bovis* infection.

"The best situation," says Rosenbusch, "would be to have a herd with a strain of *M. bovis* of very low pathogenicity in the nose of every animal so they're all seropositive and protected against polyarthritis. That's the situtation where you would see the minimal amount of clinical disease."

Mycoplasma bovis: Two Producers' Story

In April of 2001, Scott and Mike Wickstrom, Hilmar, Calif., first encountered *Mycoplasma bovis*. Arthritis and head tilts provided the first indication that something was wrong. Many of the milking cows developed stiff joints primarily in the front legs, while a few of the calves exhibited inner ear infections and a resultant head tilt. Neither respiratory disease in the youngstock nor mastitis had previously been a problem.

A diagnosis of *Mycoplasma bovis* infection was confirmed when a positive bulk tank sample returned from the creamery. *M. bovis* was also cultured from the joints of infected cows submitted for necropsy.

To begin controlling the problem, the Wickstroms collected individual milk samples from all cows in the milking herd and submitted them to a lab where they were cultured for *mycoplasma*. All positive cows were then culled. The Wickstroms milk 1,200 Registered Jerseys. Overall, 60 of the milking cows and 25 replacements aged two to five months were culled from the herd. They continued to sample milk from each cow after freshening as well as milk from clinical cows in the hospital string.

"We have been essentially a closed herd for many years," says Mike. "We took individual milk samples of all fresh and clinical cows for several years. We did, however, stop this practice a few years back after not seeing any *Mycoplasma* or *Staph* cows. We probably would have caught the outbreak much sooner and reduced the spread had we still been sampling all cows at freshening or coming out of the milk string."

A *Mycoplasma* outbreak "can happen to anyone," says Mike Wickstrom, pictured with brother Scott *(back)*.

With regard to the economic impact of the *M. bovis* outbreak, total production decreased as a result of the culled cows. Reduced milk fewer animals moval of infected replacements left place the lower to sell or reproduction cows that normally would have been culled. It also meant an increase in labor for sampling, isolation, and transportation.

"The reality is this can happen to anyone," says Mike. "Hopefully our experience can help others in either stopping ongoing mycoplasma infections or reducing the severity."

Fortunately, the control strategies employed at Wickstrom Brothers Dairy appear to have succeeded. For the past three months, there have been no positive bulk tank samples and the owners are hopeful that *M. bovis* has been completely eliminated from the herd.

Prevention and Control

Treatment is *never* an option for cases of *Mycoplasma* mastitis. Prevention and proper management strategies are the keys. Establishing a good biosecurity plan with regard to the introduction of new animals, following proper milking procedure, and becoming aware of how *Mycoplasma* infections are transmitted are essential components of any prevention and/or control program.

To prevent purchasing a *Mycoplasma* problem when selecting replacements, producers should become familiar with the herd of origin. Legally, sellers are not required to divulge information about the *Mycoplasma* status of their herds. Dr. Mark Brandt recommends producers review three consecutive bulk tank cultures in order to help rule out a potential *Mycoplasma*, *Staph. aureus*, or *Strep. agalactiae* problem. Any cow exhibiting mastitis should also be cultured for *Mycoplasma* before purchase. Newly purchased youngstock should be tested five (5) to seven (7) days after freshening or after colostrum production has ceased.

Brandt urges producers to establish an active surveillance program in their dairies. "Ideally, you should culture every cow that comes in for mastitis," says Dr. Brandt. "This gives your veterinarian a database to work with if you develop future problems such as increased somatic cell count."

In addition, producers should submit bulk tank samples for culture. Dr. Rosenbusch advises large operations which frequently purchase new replacements to culture the bulk tank every week. Small dairies that do not introduce as many new animals to the herd should culture at least once a month.

At Dr. Brandt's milk quality lab, milk samples from individual cows and the bulk tank are streaked on two types of agar: one that will isolate *Staphylococcus, Streptococcus*, and *Coliform,* and one plate which will isolate *Mycoplasma. Mycoplasma* requires seven days for growth. Presence of the characteristic "fried-egg" shaped colonies *(Figure 3)* indicates a positive culture. Any cows that test positive should be culled and slaughtered. If it is not economically feasible to remove these animals from the herd, they must be isolated from healthy individuals at all times.

In the milking parlor, employees must follow correct milking procedure and equipment should be routinely checked for proper function. "Milkers should wear gloves at all times," advises Dr. Brandt. Besides preventing the mechanical transmission of *Mycoplasma* from cow to cow, use of gloves can prevent transmission of *Staph. aureus* on human hands into the teat canal. Cows should be pre-dipped and post-dipped with a 1% iodine solution and single-use paper towels should be used to dry teats.

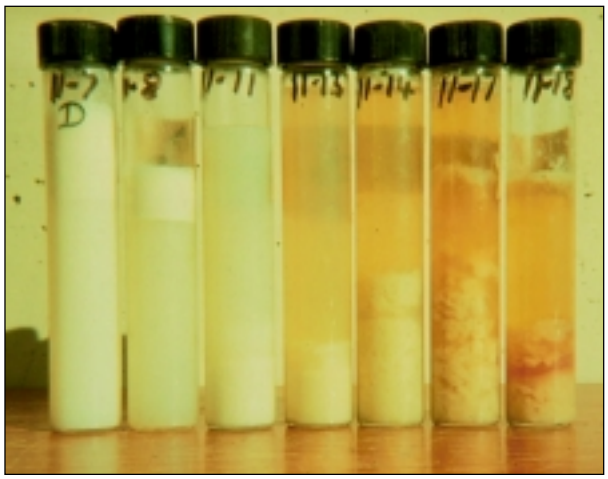

Figure 5. Milk secreted by cows with *Mycoplasma* mastitis may vary from serous and watery in appearance to thick and colostrum-like.

Extreme caution must be exerted when milking cows known to be *Mycoplasma* positive. These animals must be isolated from the rest of the herd and milked last. The risk of transmitting infection to healthy herdmates by aerosolization, milking equipment, and milker's hands is very high.

Finally, when treating animals in the hospital pen, producers should only administer commercially prepared antibiotic preparations. Homemade preparations and multi-use treatment devices are prime sources of *Mycoplasma* infection.

A Note on Vaccines

The Animal Plant Health Inspection Service (APHIS) has issued conditional U.S. Veterinary Biological Product Licenses to Texas Vet Lab, Inc. of San Angelo, Texas, and to Biomune Inc., Lenexa, Kans., for vaccines against *M. bovis*.

Conditional licenses are issued by the USDA "in order to meet an emergency condition, limited product, local situation, or other special circumstance." To receive conditional licensure, products must have proven safety, purity, and a reasonable expectation of efficacy. Conditionally licensed vaccines usually have not yet completed a full vaccination and challenge study. To receive a full license, the manufacturer must complete such a study and the vaccine must pass the USDA potency test.

The vaccine developed by Texas Vet Lab is directed against *Mycoplasma* respiratory disease in calves. Biomune's product is intended for use in heifers and is meant to prevent *Mycoplasma* mastitis. Availability of such vaccines varies from state to state. Some states such as California do not allow the use of these conditional licensed vaccines. In some locales, a prescription is required by the herd veterinarian, while in other states may require blanket approval by the state veterinarian.

At Iowa State, Dr. Rosenbusch and his research team have developed and tested similar vaccines. Based on the physiology of the mammary gland and lungs, he predicts that it will be easier to protect against a mammary infection rather than pneumonia. When animals react to the vaccine, there is an influx of neutrophils into the site of infection. The mammary gland has a mechanism to discharge these cells via milk flow. The lung, however, does not possess any mechanism to remove neutrophils.

An Ounce of Prevention *is* Worth a Pound of Cure

Restructuring of the dairy industry with regard to herd expansion and rapid transport of animals across the country has contributed to the increased number of clinical outbreaks of *Mycoplasma* mastitis. Antibiotics will not provide a cure to this problem, but proper herd management and biosecurity can help control existing infections and prevent new outbreaks from occurring. Herd veterinarians are invaluable sources of information to producers interested in establishing an active mastitis surveillance program. By enforcing good biosecurity, vigilant milk testing, and proper herd management, all dairy operations can mount a strong line of defense against *Mycoplasma* mastitis.

Editor's note: A resource guide for information on Mycoplasma *is available on the website at www.USJersey.com, or by calling 614/861-3636, ext. 319.*