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Bovine Mastitis in Cattle

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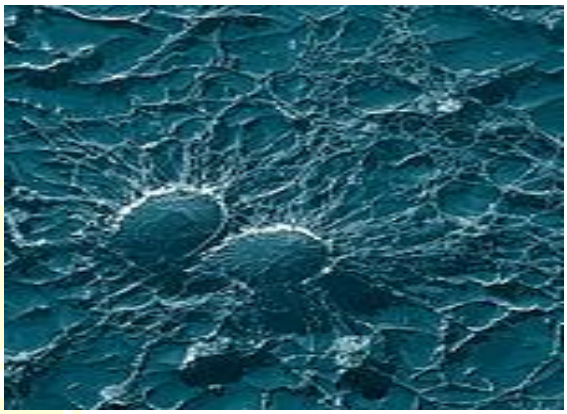
Introduction:



Mastitis is the most common and most costly disease of dairy cattle. In herds without an effective mastitis control program, about 40% of the cows are infected in an average of two quarters. It has been estimated that mastitis costs about $200 per cow per year. Reduced milk production accounts for about 70% of the total loss associated with mastitis.

Definition Mastitis (Mast: breast, itis: inflammation) is defined as an inflammatory reaction of udder tissue to bacterial, chemical, thermal or mechanical injury. Mastitis may be infectious caused by microbial organisms or non-infectious resulting from physical injury to the gland.

Symptoms

Inflammation is characterized by - Gross abnormalities in the udder (swelling, heat, redness, pain). Persisting inflammation leads to tissue damage and replacement of secretory tissues with of the udder with non-productive connective tissues. - Change in composition and appearance of milk. Abnormalities in milk may include flakes, clots or a watery appearance. The flakes in the milk are congealed leukocytes, secretory cells and protein. - A lower milk yield.

Causes

There is a large cohort of microorganism species that are known to cause mastitis. These range from virus, mycoplasma, fungus and bacteria.

Mastitis-causing bacteria

Bacterial cells of Staphylococcus aureus, one of the causal agents of mastitis in dairy cows. Its large capsule protects the organism from attack by the cow's immunological defenses. Bacteria that are known to cause mastitis include:

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- *Pseudomonas aeruginosa*
- *Streptococcus agalactiae*
- *Streptococcus uberis*
- *Brucella melitensis*
- *Corynebacterium bovis*
- *Staphylococcus aureus*
- *Staphylococcus epidermidis*

These bacteria can be classified as environmental or contagious depending on mode and source of transmission.

Development of the disease

Gangrenous mastitis in a cow after 10 days. Green arrow indicates complete necrosis of the teat. Yellow arrows indicate the limits of the gangrenous tissue, but the necrotic area is not well delimited on the upper part of the udder.

Dairy cow with gangrenous mastitis. Rear quarter

Mastitis begins after bacteria pass through the teat duct and enter the cisternal area. Invasion of the teat usually occurs during milking. After milking, the teat canal remains dilated for 1-2 hours while the canal of a damaged teat may remain partially open permanently. This makes it easier for organisms from the environment or those found on injured skin to enter the teat canal. Adherence of bacteria to tissues lining cisterns and ducts may prevent flushing-out during milking and help establish infections. Bacteria eventually enter the glandular tissues where they affect alveolar cells. Toxins produced by bacteria cause death of or damage to milk-secreting epithelial cells, and these cells produce substances to the blood stream that increase blood vessel permeability. This allows leukocytes to move from the blood into the alveolus where they function by engulfing bacteria.

Types of Mastitis

There are several ways of classifying mastitis. A simple classification recognizes mastitis as two major groups:

A-Contagious Mastitis: Caused by bacteria live on the skin of the teat and inside the udder. Contagious mastitis can be transmitted from one cow to another during milking.

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B- Environmental mastitis: Describes mastitis caused by organisms such as Escherichia coli which do not normally live on the skin or in the udder but which enter the teat canal when the cow comes in contact with a contaminated environment. The pathogens normally found in feces bedding materials, and feed. Cases of environmental mastitis rarely exceed 10% of the total mastitis cases in the herd.

Contagious mastitis can be divided into three groups:

1. Clinical mastitis
2. Sub-clinical mastitis
3. Chronic mastitis

1-Clinical mastitis

Characterized by the presence of gross inflammation signs (swelling, heat, redness, pains). Three types of clinical mastitis exist.

1.**1- Per acute mastitis** Characterized by gross inflammation, disrupted functions (reduction in milk yield, changes in milk composition) and systemic signs (fever, depression, shivering, loss of appetite and loss of weight).

1.2- **Acute mastitis** Similar to per acute mastitis, but with lesser systemic signs (fever and mild depression).

1.3- **Sub-acute** mastitis in this type of mastitis, the mammary gland inflammation signs are minimal and no visible systemic signs.

2- Sub-clinical mastitis

This form of mastitis is characterized by change in milk composition with no signs of gross inflammation or milk abnormalities. Changes in milk composition can be detected by special diagnostic tests.

3-Chronic mastitis

An inflammatory process that exists for months, and may continue from one lactation to another. Chronic mastitis for the most part exists as sub-clinical but may exhibit periodical flare-ups sub-acute or acute form, which last for a short period of time. Only relatively few udder infections result in “clinical mastitis” in which the udder is noted to be abnormal and the quality of milk secreted is altered. The vast majority of mastitis is “subclinical”. The number of somatic cells in the milk, an indicative of the inflammatory response, may be elevated and

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bacterial can be cultured from the milk. For every case of clinical mastitis, there are 20-40 times as many cases of subclinical mastitis.

Identification

This disease can be identified by abnormalities in the udder such as swelling, heat, redness, hardness, or pain (if it is clinical). Other indications of mastitis may be abnormalities in milk such as a watery appearance, flakes, or clots. When infected with sub-clinical mastitis, a cow does not show any visible signs of infection or abnormalities in milk or on the udder

The quarter with Gangrenous mastitis

Detection

- A plastic paddle used in the California mastitis test. Cattle affected by mastitis can be detected by examining the udder for inflammation and swelling, or by observing the consistency of the milk, which will often develop clots or change color when a cow is infected.
- Another method of detection is the California mastitis test, which is designed to measure the milk's somatic cell count as a means for detecting inflammation and infection of the udder.
- The pH value of mastitic milk is higher than that of normal milk. On mixing 5ml of milk with 1 ml of bromothymol blue, the appearance of blue green colour indicated mastitic milk which has a pH of 6.8 or more as against the grass green colour produced by normal milk that has a pH of 6.6.
- Normal milk has a chloride content of 0.08 to 0.14% whereas abnormal milk has more than 0.14%. The chloride content of milk can be estimated by addition of silver nitrate solution and 2 to 3 drops of potassium chromate as an indicator, a yellow color indicates that the milk is abnormal.

Catalase test is also used to detect catalase which is present only in mastitis milk.

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Resazurin rennet test is based on the disturbance in the salt balance and increase in leucocyte content in mastitis milk. Coagulation of milk by rennet is sowed down due to disturbed salt balance and leucocytes reduce resazurin dye faster. Mastitis samples give delayed coagulation but faster resazurin reduction compared to normal milk.

Effects on milk composition

Serous exudate from udder in E. coli mastitis in cow (left); in comparison to normal milk (right) Mastitis can cause a decline in potassium and an increase in lactoferrin. It also results in decreased casein, the major protein in milk. As most calcium in milk is associated with casein, the disruption of casein synthesis contributes to lowered calcium in milk. The milk protein continues to undergo further deterioration during processing and storage. Milk from cows with mastitis also has a higher somatic cell count.

Diagnosis of Mastitis

The first step in treating mastitis is to identify the causative agent. The presence of a pathogen and the inflammatory response of the udder signify an infection. The inflammatory response, which results in abnormal milk, is usually detected by the dairyman. Because mastitis is frequently subclinical "hidden", a number of tests have been developed for detecting mastitis. Most tests estimate the Somatic Cell Counts (SCC) of a milk sample. There is no one somatic cell count at which a cow is free from mastitis. A level of 50,000 cell/ml of milk is usually used as a beginning point for closer observation. A variety of tests are available to determine the presence or absence of clinical and subclinical mastitis. The majority of these tests primarily indicate inflammation in the udder. They do not measure infection or bacterial presence.

Factors Influencing Susceptibility to Mastitis

- **Type of bacteria**: Some bacteria are more virulent than others in causing mastitis.
- **Physiological status of cow**: Although infection can occurs at any time, most of the new infections take place during the first three weeks of the dry period and during the first month after parturition, suggesting that level of milk production is not directly related to mastitis.

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- **Age of the cow:** The incidence of mastitis increases with age. Nevertheless, it is possible for the udder of the first-calf heifer to be infected at parturition.
- **Level of milk production:** Not directly related to incidence of mastitis. However, other factors, which affect milk, yield such as milking rates; pendulous udders may be related to mastitis incidence. Inherited features of the cow: Length of the leg in proportion to the udder size and relative strength of the udder attachment are examples.
- **Milking machine**: Improper use of milking machine (irregular fluctuation of vacuum level, over-milking, and incomplete milking) is related to tissue irritations and incidence of mastitis.
- **Environment:** Mastitis often increases when cows are turned onto pastures. Chilling of the udder in cold ground in the spring or fall. Housing as it relates to the degree of udder and teat injury.

Control of Mastitis

Prevention is the key in mastitis control. A control program should emphasize factors that reduce the rate of new infections. A combination of preventive measures and therapeutic use of antibiotics will markedly reduce the incidence of mastitis.

The prevention of mastitis can be achieved by:

- **Proper milking hygiene.** Bacteria transmit to the uninfected from the contaminated hands of the milker. Thus, the milker's hands should be washed thoroughly with disinfected soaps before milking and clinically infected cows should be milked last.
- **Milking machine.** Should function and operate properly. Vacuum level in the milking unit should be between 275 and 300 mm of mercury with little fluctuation.
- **Dipping the teats after milking**. Teat dipping does not reduce existing infection. However, the rate of new infection can be reduced by up to 50% when suitable disinfectant is used to immerse or spry the teats.
- **Dry treatments**. Incidence of mastitis during the dry period can be considerably reduced by effective use of antibiotic infused in each quarter of the udder at the last milking of lactation.
- **Culling of chronically infected cows**. This is an effective method because in most herds only 6-8% of all cows account for 40-50% of all clinical mastitis.

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- **Nutrition.** Deficiencies of selenium and vitamin E in the diet have been associated with an increased rate of new mammary infections.

The udder should be washed thoroughly in a sanitizing solution with individual paper towels and after milking, the teats should be immersed in appropriate teat-dip solution.

Treatment

- First aid once mastitis has been detected involves applying ice cubes on the udder surface. The infected milk from infested teat should be drained out thrice a day and safely disposed. A composition of 5% phenol can be included to the infected milk to ensure hygienic disposal.
- While milking the herd, strict attention must be paid to first milking healthy, non-infected cows and subsequently those infected.
- The infected and non-responsive quarter should be dried up, permanently. Calves should be prevented from suckling on the infected teat. A certified veterinary doctor must be consulted, and a course of antibiotic treatment must commence immediately.
- For more measures for treating mastitis, refer the article on “Dry Cow Therapy” below.

Prevention

It is better to prevent mastitis before it becomes a problem. The below measures can go a long way in prevention:

- Provide clean, dry and adequate bedding for cows to lie
- Cows should be clean while entering the milking area
- Use different cloth or paper towel for cleaning the teats on each cow
- Teats should be completely dry and clean before milking
- Use germicidal teat dips after milking
- Feed the cows after milking so that they don’t lie down immediately. This prevents the entry of microorganisms into teat canals that are still open from milking.

A good milking routine is vital. This usually consists of applying a pre-milking teat dip or spray, such as an iodine spray, and wiping teats dry prior to milking. The milking machine is then applied. After milking, the teats can be cleaned again to remove any growth medium for bacteria.

A post milking product such as iodine-propylene glycol dip is used as a disinfectant and a barrier between the open teat and the bacteria in the air. Mastitis can occur after milking

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because the teat holes close after 15 minutes if the animal sits in a dirty place with feces and urine.