



Lecture title: Mastitis (Part 1).

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Mastitis (Part 1)

Mastitis, the inflammation of mammary glands, is a complex multi-etiological disease affecting dairy cattle worldwide. Based on the severity, the inflammation can be classified into clinical, sub- clinical, and chronic forms.

- Clinical mastitis is characterized by the presence of obvious signs of infection, including abnormal milk (color changes, the presence of clots and flakes), abnormal mammary gland (tissue color changes, swelling), and changes in the animal's condition, body temperature, appetite, and hydration level.
- Subclinical mastitis is defined by the lack of observable clinical symptoms in the udder or milk, although milk supply is reduced with an elevated somatic cell count.
- Chronic mastitis is an inflammatory disease that develops over several weeks with occasional clinical attacks.

The degree of inflammation depends on:

1. Nature of the causative pathogen.
2. Age of the animal.
3. Animal breed.



4. The immune status of the animal.
5. Lactation stage of the animal.

Mastitis is characterized by physical, chemical and usually bacteriological changes in milk and pathological changes in glandular tissues that affect milk production and quality.

The mammary gland, because of its anatomical position, is exposed to several external factors that influence the physiology and pathology of the mammary parenchyma. Many microbial species, when enter into the udder, have the ability to infect the mammary parenchyma leading to mastitis (Figure 1), e.g. *Staphylococcus aureus*, *Streptococcus agalactiae*, *Streptococcus dysgalactiae*, *Streptococcus uberis*, *Escherichia coli*, *Mycoplasma bovis*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Pasteurella* spp., *Corynebacterium* spp., *Klebsiella* spp., in addition to yeasts and molds.

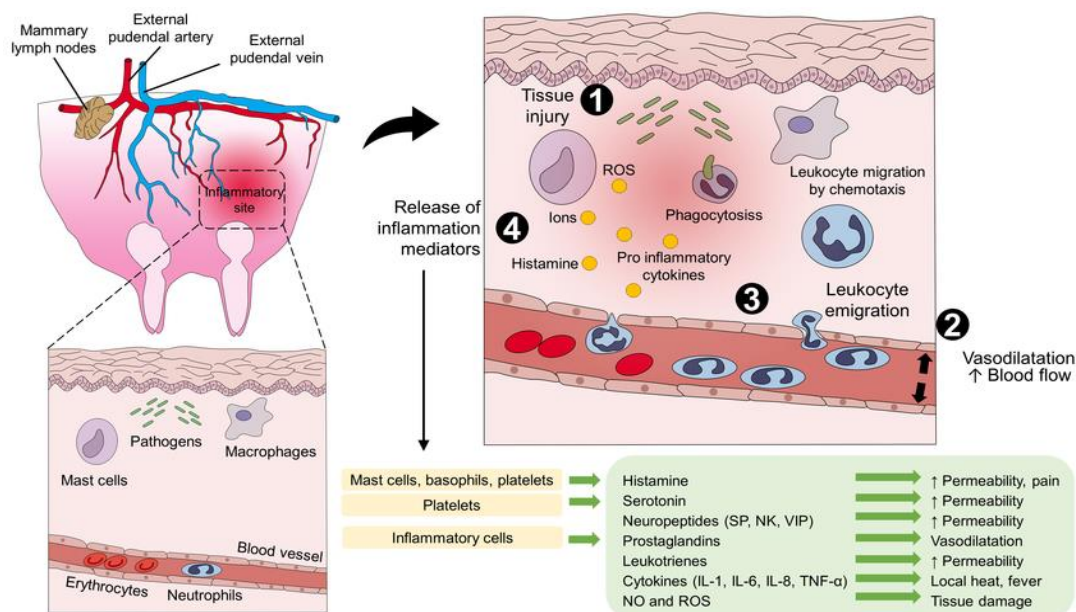


Figure 1: Local inflammatory response in the udder of a cow with mastitis.



Diagnostic methods:

Basic procedures for diagnosing clinical mastitis include udder and teat palpation and visualization of blood, clots, or flakes in the milk. Subclinical mastitis detection requires more advanced approaches, such as

- Somatic cell evaluation.
- Plate-culture procedures.
- Power of hydrogen (pH).
- Electrical conductivity.
- Enzyme activity.
- Molecular diagnostic tools.
- Biosensors.

1. Clinical diagnostic methods

A physical examination of the mammary gland is important for the successful detection of mastitis. It requires first information about the animal's general condition. It is important to view the shape, size, consistency, and contour of the udder properly. A detailed examination of the teat and teat orifices should be made to assess inflammation, hotness, pain, swelling, and loss of function. Additionally, the firmness of the udder can also serve as an indicator of bovine mastitis.

2. Direct microscopy examination method

The milk sample can be centrifuged, and the deposit can be dyed. Direct microscopic examination is the reference method that can be used to discriminate



between gram-positive and gram-negative bacteria and enables examinations of bacterial morphology.

Limitations:

- a. Time-consuming.
- b. Requires skilled labor.
- c. It is difficult to differentiate between cells and cytoplasmic particles.

3. Conventional Methods

- a. **Strip cup test:** It is one of the side tests and can be used for determining the presence of clinical mastitis through the detection of visible particles in milk. In this test, a plate divided into four strip cups is used, and the bottom of the plate is black in color so that the milk flakes are easily observed.
- b. **California mastitis test (CMT):** It is a common indirect method for measurement of somatic cell counts in the milk sample. The somatic cell population consists primarily of leucocytes 75%, whereas epithelial cells constitute 25%. The CMT qualitatively estimates the number of somatic cells in milk secretions and is performed by mixing 2 ml of milk sample with 2 ml of the CMT detergent, which dissolves cell walls and releases deoxyribonucleic acid (DNA). The more cells in milk, the more DNA is released, and the thicker the mixture, indicating the presence of high SCC (Figure 2). SCC indicates the presence of subclinical mastitis (SCM) in the herd when it counts >400,000 cells/ml for bulk milk, >200,000 cells/ml for individual cows of composite milk (collection of milk samples from all 4 quarters into a single tube), and >50,000 cells/ml for individual quarter. The



main advantages of CMT are that it is quick, cheap, simple, and can be used as a “cow-side” test.



Figure 2: California mastitis test.

- c. **Wisconsin mastitis test (WMT):** It is a different indirect technique that counts somatic cells in the bulk milk tank. WMT is a modification of the CMT developed to increase the objectivity of measuring the viscosity (Table 1). The same kind of reagent is utilized in WMT and CMT. A measured amount of reagent and milk are mixed to perform the test. The contents of the tubes were mixed by tilting tubes back and forth 10 times in about 10 sec in a nearly horizontal position. Viscosity is determined by measuring the height of the column of milk reagent mixture remaining in the test tubes after 15 seconds of outflow through caps with 1.2 mm diameter openings. The tubes were allowed to stand upright for at least 1 min after the inversion. Typically, WMT scores are measured in millimeters and used to estimate the typical number of somatic cells present.



Table 1: Somatic cell count and its relationship to estimated milk losses.

Somatic Cell Counts as They Relate to Estimated Milk Losses				
CMT (Score)	WMT (mm)	Somatic Cell Count (cells/ml)	Milk Loss (%)	Estimated Milk Production Loss Per Cow/Year* (lb)
Negative or Zero	2	100,000	3	400
	5	200,000	6	800
Trace or Slight Gelling	8	300,000	7	1,000
	10	400,000	8	1,200
	12	500,000	9	1,300
1 or	14	600,000		1,400
	16	700,000	10	1,500
	18	800,000	11	1,600
	20	900,000	12	1,650
	22	1,000,000		1,700
2	29	≥ 1,600,000	≥ 12	≥ 1,700