



Mastitis Milk



Introduction

Milk obtained from animals suffering from the infected udder is termed as 'mastitis'. IDF defines mastitis as 'an inflammation of udder, almost always of microbial origin. This milk has higher microbial count and somatic cell count and altered composition accompanied by reduced yield.

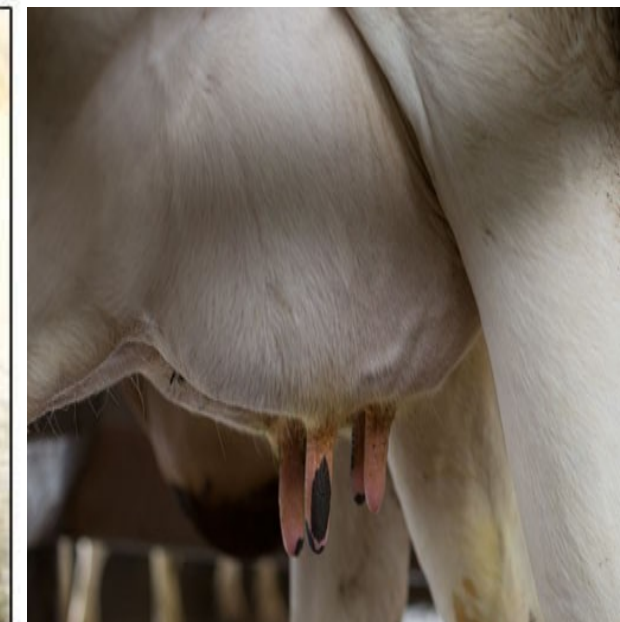
Mastitis is a parenchymal inflammation of the mammary gland that is caused by microbes that invade the udder, multiply and produce toxins, which are harmful to the mammary gland. It is characterized by physical, chemical and usually bacteriological changes in milk and pathological changes in glandular tissues of the host animal.

This deadly disease of milch animals is responsible for heavy economic losses due to reduced milk yield, milk discard after treatment (9%) and cost of veterinary services (7%) as well as adversely affects animal health.

Classification based on symptoms

Swollen, hot, red and painful udders.

- **Acute or clinical:** Macroscopic changes to udder or milk, readily detectable by milker.
- **Chronic:** Little compositional changes with almost complete absence of pain in udder.
- **Sub-acute/ sub-clinical:** Most common form, udder and milk appear normal. Diagnosed by detecting pathogens and somatic cells and change in milk composition



Causative Microorganisms

Mastitis is udder infection with one or more of the causative micro-organisms. These microbes enter through the teat tip into the teat duct, where these get colonized due to the presence of left over milk and subsequently, spread throughout the udder causing infection.

Microorganisms associated with mastitis:

- **Most common causatives are *Staphylococcus aureus* and *Streptococcus agalactiae*.**
- **Coliforms : *Escherichia coli*, *Enterobacter*, *Klebsiella*, *Citrobacter*.**
- **Other Streptococci: *Streptococcus uberis*, *Streptococcus dysgalactiae*, *Streptococcus faecalis* and *Streptococcus pyogenes*.**
- **Other Staphylococci: *S. epidermidis* and *S. albus***
- **Corynebacteria : *C. bovis*, *C. pyogenes*.**
- **Rickettsia: *Coxiella burnetii***
- **Yeast: *Cryptococcus neoformans*, *Candida pseudotropicalis*.**
- **Molds: *Aspergillus spp.***

Classification based on causative microorganisms

Contagious mastitis: *Streptococcus agalactiae* (as natural inhabitant of udder)

Common mastitis: Species of *Streptococcus*, *Staphylococcus* and *Escherichia coli*

Summer mastitis: *Corynebacterium pyogenes*

Environmental mastitis: *Streptococcus uberis*

Compositional Changes in Mastitic Milk

The colonization of mammary glands by mastitis causing microorganisms trigger a series of events that in turn causes major compositional alterations.

- Initial increased level of pathogenic bacteria occurs, which is closely followed by considerable increase in somatic cell count.
- Subsequently, there is a wide range of related effects like impaired synthetic ability of the secretory tissue causing lower milk yield and altered levels of major and minor milk constituents and increased infiltration of blood constituents i.e. serum proteins into milk.

Increased constituents: Total whey proteins (i.e. bovine serum albumin, immunoglobulins), sodium, chloride and other ions like Cu, Fe, Zn, various enzymes and certain glycoproteins increased significantly in mastitic milk. The pH of milk also increases.

Decreased constituents: Lactose, fat, total casein (alpha and beta fractions) decrease but gamma fraction increase, some whey proteins (alpha-lactalbumin and beta globulin), potassium and other minerals like calcium, magnesium and phosphorus decreased. Mastitic milk has a lower SNF, fat, casein and lactose and higher serum proteins, chloride ions and pH.

Constituent(s)	Normal	Mastitic
Fat (%)	3.45	3.2
Protein (%)	3.61	3.56
Lactose (%)	4.5 to 5.3	3.3-4.9
Bovine serum albumin (mg/ml)	0.82 to 1.29	4.3-21.5
Lactoferrin (mg/ml)	0.1 to 0.2	6.2
Sodium (mg/100ml)	57.0	104.6
Potassium (mg/100ml)	172.5	157.3
Chloride (mg/100ml)	80 to 103	7250
pH	6.65	6.9-7.0
Somatic cell (x 10 ² /ml)	20 to 1000	100-5000
Catalase (μM O ₂ /min/ml)	0.08	1.84
Lactic dehydrogenase (milliunits/ml)	300 to 500	Up to 5525
Alkaline phosphatase (units/ml)	191	712
Acid phosphatase (μM/ml)	0.063	0.081
Lysozyme (μg/ml)	0.0	5.6

Significance of Mastitic Milk

- Mastitis in lactating animals affects the yield, quality and public health aspects of milk.
- With severe clinical mastitis, abnormalities of milk are easily observed and milk is discarded. Such milk normally would not enter the milk chain. But when milk of cows with sub-clinical mastitis, i.e. with no visible changes, is accidentally mixed into bulk milk, it enters food chain and can be dangerous to consumer.
- Incomplete or faulty pasteurization is of major concern.
- Milk and other dairy products are frequently infected with *S. aureus*. Milk of infected animals is the main source of enterotoxigenic *S. aureus* of animal origin. Certain *S. aureus* strains produce heat-resistant enterotoxins that cause nausea, vomiting and abdominal cramps, when ingested by humans and are responsible for staphylococcal food poisoning. Toxins are produced due to improper cooling of milk, during cheese making from raw milk and also due to post-processing contamination. These toxins cannot be destroyed by heating. The bovine mammary gland can be a significant reservoir of enterotoxigenic strains of *S. aureus*.

S. agalactiae is an important bovine pathogen, especially as a cause of both clinical and sub-clinical mastitis in dairy animals.

Mastitis constitutes a source of economic loss for the dairy industry due to its effects on milk quality. It not only lowers the quality of cheese and other milk products and decreases milk yield. It also reduces nutritive value of milk due to the changes in its composition, increases processing problems and off-flavours. It also decreases the shelf-life of fluid milk products, due to the growth of spoilage causing bacteria.

S. agalactiae is considered a major cause of increased somatic cell counts as related to standards in bulk tank milk.

Another public health concern regarding mastitis is antibiotic residues in milk due to extensive use of antibiotics in the treatment and control of disease. Antibiotic residues in foods can lead to severe reactions in people allergic to antibiotics at low levels, cause sensitization of normal individuals and development of antibiotic-resistant strains of bacteria.

Milk yield: The milk yield and also the productive life of milch animal are adversely affected due to mastitis.

Milk quality: The quality of milk is lowered due to a number of compositional changes.

Suitability for fermented dairy products: In cheese making, lower product yield which might be due to increased fat losses in whey and reduced starter activity. Poorer product quality as rennet clotting time is increased causing decreased curd firmness and a loose final texture of cheese. Lack of adequate flavor development due to retarded starter activity.

Other fermented products: Mastitic milk is not suitable for preparing fermented milks like dahi, yoghurt, cultured butter milk, kefir etc. where product quality is directly dependent on starter cultures. The starters are affected in terms of their growth and activity (acid and flavor production) in sub-clinical mastitic milk. Eg., both lactobacilli and lactic streptococci are inhibited in milk from Streptococcal and Staphylococcal cases of clinical mastitis. Both the rate of acid production and final acidity attained in mastitic milk are lower than that in normal milk. Aroma, taste and consistency of end product are adversely affected. Diacetyl production by *L. lactis* ssp. *lactis* biovar *diacetylactis* is lower in mastitic milk.

Public health significance

Some of the mastitis causing microbes which are excreted in milk is also pathogenic to humans.

Certain strains of Staphylococci associated with mastitic milk cause food poisoning due to enterotoxin production.

The storage of mastitic milk under favorable temperatures leads to elaboration of enterotoxins that are not inactivated even during pasteurization and spray drying of milk.

Other pathogens and food poisoning causing bacteria like *Salmonella* spp. and enteropathogenic strains of certain coliforms (*E. coli* and *Klebsiella* spp.) might also be associated with public health hazards through mastitic milk.