

Prevalence, diagnosis and management of mastitis

in dairy cattle under field conditions

N Chand¹, S Kumar², Y K Soni³, Megha Pande⁴, Naresh Prasad⁵ and S Saha⁶

ICAR-Central Institute for Research on Cattle, Meerut Cantt 250 001, Uttar Pradesh

Mastitis is a serious problem in dairy animals as it is an economically devastating disease causing immense economic losses to the dairy industry in India. Sub-clinical mastitis (SCM) is a major cause of economic loss in dairy herds. It is more prevalent than the clinical mastitis, it reduces milk production and adversely affects milk quality. Sub-clinical mastitis causes more economic losses than clinical mastitis. The prevalence of mastitis in dairy cows is highly variable, with an incidence ranging from 5 to 50%. Subclinical mastitis causes 10-25% loss in milk production whereas in clinical mastitis there may be total loss of milk. Production of high quality milk requires an efficient mastitis control programme. Herds with a high prevalence of mastitis are incapable of producing high quality milk until the inflammation and infection in the udder are brought under control. Effective control of mastitis in dairy animals includes prompt treatment of clinical cases of mastitis, use of cow-side diagnostic test to diagnose subclinical cases of mastitis in dairy herd, use of post-milking teat dips, dry therapy, maintenance of cleanliness and hygiene in the animal premises and adequate nutrition to the dairy animals.

Key words: Dairy cattle, Diagnosis, Farmer FIRST Programme, Mastitis, Quality milk

MASTITIS defined as the inflammation of the mammary gland characterized by physical and chemical changes in milk, is caused by physical injury, chemical agents and micro-organisms. It may occur in two forms, clinical and subclinical. The clinical mastitis is characterized by the presence of increased volume, colour (redness) and pain of the mammary gland. Subclinical mastitis (SCM) shows no gross inflammatory change in udder, hence remains unnoticed unless investigated by laboratory tests. Mastitis has been considered as the most important and costly type of health problem in dairy cattle. It stands second to Foot and Mouth Disease as most challenging disease in high yielding dairy animals in India. This is evidenced from the report where annual economic losses incurred by the dairy industry in

India on account of udder infections have been estimated about ₹ 6053.21 crore. Out of this, loss of ₹ 4365.32 crore (70-80 % loss) has been attributed to subclinical form of udder infections. The present article describes the prevalence, causes and management of mastitis in dairy animals.

Causative agents

Mastitis in dairy herds is generally of two types: environmental mastitis and contagious mastitis. Environmental mastitis is caused by pathogens found generally in the surroundings in faeces, soil, bedding material and manure. Coliforms—particularly *Escherichia coli*, *Enterobacter aerogenes*, *Klebsiella pneumonia* and *Streptococcus* sp., are the chief organisms found to cause environmental mastitis. Contagious

mastitis is caused by bacterial pathogens that thrive on the udder skin and lesions of teat. The pathogens mainly associated with contagious mastitis are *Staphylococcus aureus* and *Streptococcus agalactiae*. They are transmitted from one cow to another by the hands of milkers, the milking machine, milk contaminated fomites or the sponge used while milking. *Mycoplasma* species also cause contagious mastitis. *Mycoplasma bovis* is the predominant species sometimes leading to severe problems like sudden onset, rapid transmission and reduction in milk yield and lack of response to treatment. In addition to *Staphylococcus* sp., *Corynebacterium* sp. constitutes some of the emerging pathogens causing bovine mastitis. The fungi commonly associated with mastitis are *Candida* sp., *Trichosporon*

sp., *Saccharomyces* sp. and *Aspergillus* sp.

Factors affecting the susceptibility to mastitis

A large number of predisposing factors that contribute to the occurrence of mastitis in dairy cattle may be physiological, genetic, pathological or environmental.

Age of the cow: It has been demonstrated that the occurrence of mastitis in infected quarters increases with age in cows, being highest at 7 years of age. This may be due to an increased cellular response to intra-mammary infection or due to permanent udder tissue damage resulting from the primary infection. Efficient innate host defense mechanisms of the younger animals are one possibility that makes them less susceptible to infection.

Inherited features: Various genetic traits may also have a considerable impact upon the susceptibility of the animal to mastitis. High milk yielders with higher than average fat content are reported to be more susceptible to mastitis. Cows with elongated teats are more vulnerable to mastitis infection than cows with inverted teat ends. Broad udders, lower hind-quarters and teats placed widely help the infectious agent. Supernumerary teats provide additional reservoirs for potential pathogens leading to the manifestation of mastitis.

Stage of lactation: The incidence of mastitis is reported to be higher immediately after parturition and early lactation, especially the first 2-3 weeks due to probably increased oxidative stress and reduced antioxidant defense mechanisms during early lactation.

Milking machine: Extraneous factors such as the milking habits of farmers and faulty milking machines favour the pathogens to gain access to mammary gland leading to mastitis. It is important to maintain physiologically optimal pressure because pressure in excess may lead to injury in the teat. Fluctuations in the pressure due to inadequate vacuum reserve must be avoided to prevent the occurrence of mastitis. Proper installation, as well as correct maintenance of milking machines, is

important to avoid an inadequate vacuum level, teat and tissue damage, and incomplete milking. The vacuum level created by the vacuum pump is another important factor for complete and high quality milking.

Nutrition: Vitamin E and selenium are the important supplements in dairy feed to boost the immune response of cows as it has been reported to enhance the neutrophil function as well as the phagocytic properties of neutrophils after parturition. Beta-carotene and Vitamin A have also been found to be effective in preventing the occurrence of mastitis, most probably due to their antioxidant and immune-enhancing properties and contribution in mucosal surface integrity of the mammary gland. Zinc and copper are also important nutritional elements that contribute to mammary gland health.

Weather and climate: Heat, humidity, cold and draught are the important predisposing factors. A higher incidence of mastitis has been reported to occur particularly during summer-rainy months. As heat and humidity increases, so do the bacteria and pathogens in the environment multiply. Conversely, an alternative study has reported a higher incidence of coliform mastitis during the cold months of the year when the temperature was reported to be less than 21°C.

Diagnosis

Clinical mastitis may be diagnosed by the signs of inflammation and visible alterations in milk consistency, colour and appearance, etc. For subclinical mastitis, a variety of diagnostic tests are available. Among these, Bromothymol blue (BTB) card, California mastitis test (CMT) and Electrical conductivity (EC) tests are simple, economical and can be performed as cow-side tests at the field level.

Bromothymol blue card test: It is based on the principle that in mastitis, the pH of milk rises due to entry of bicarbonate salts from the blood into milk. Depending upon the milk pH, the colour of the dye changes from yellow (normal) to greenish-yellow (+), green (++) and

blue (+++) when a drop of quarter milk is placed on the card.

California mastitis test: It is based on the principle that reagent ruptures somatic cell releasing cellular proteins (DNA) that result in gel formation. Thus, this test gives the indirect estimate of milk somatic cell count. To conduct the test, 2-3 ml of milk sample from each quarter is taken separately into the cups of CMT paddle. The reagent is added in equal quantity and mixed by rotating the paddle. The reaction is scored while mixing the contents and by tilting the paddle in between. The reaction is scored as 0, Trace, 1, 2 and 3 depending upon the degree of gel formation.

Electrical conductivity test: The ions (sodium, chloride and potassium) in milk conduct electricity and any change in concentration of ions is reflected as a change in conductivity. The EC is moderately influenced by milk constituents such as protein and fat, which reduces the conductance of ions. Overall, based on mean values, it is observed that there is a difference in conductivity of 0.5 to 1.5 mS/cm between the healthy and mastitis quarters. The absolute value of EC for healthy quarters in crossbred cows varied from 4.5 to 5.5 mS/cm.

Prevalence of subclinical mastitis in villages selected

A total of 440 milk samples were collected from 110 apparently healthy dairy cows from three villages (Chandana, Jhirkari, Chhabaria) in Sardhana tahsil of Meerut, U.P. adopted under Farmer FIRST Programme (FFP), ICAR-CIRC. At the time of milk sample collection, the breed, age, parity, milk yield, stage of lactation, pregnancy status and health status of the mammary glands were recorded. During the collection of milk sample, teats were washed, dried and sterilized with cotton soaked in 70% ethyl alcohol. The first 3-4 streams of milk were discarded. Around 3 ml of milk was taken from all the four teats directly in the CMT paddle. An equal volume of the CMT reagent was added to each cup and mixed thoroughly by a gentle circular motion of the paddle. The results of the CMT were

reflected by the degree of precipitation or gel formation and they were scored as follows: Negative when the consistency of the mixture is homogenous, liquid and not associated with visible changes; 1+ when a distinct precipitate was formed but with no tendency toward gel formation; 2+ when the mixture was thickened immediately with a suggestion of gel formation; 3+ when a distinct gel was formed, tended to adhere to the bottom of the paddle and during swirling a distinct central peak was formed.

The overall prevalence of SCM in lactating cows was 41.81%. The highest prevalence of SCM was 54.34% in cows aged above 7 years. In terms of parity, the prevalence of SCM was higher in cows of above second parity (58.82%). The prevalence of SCM was highest (55.26%) in cows having more than 10 litres of milk production. Quarter-wise prevalence of SCM was 38.18 % in Left Front (LF), 43.63% in Left Hind (LH), 34.54% in Right Front (RF), and 52.72% in Right Hind quarters by CMT.

Treatment

Clinical cases of bovine mastitis should be treated as quickly as possible. The milk sample should be invariably taken and sent to culture sensitivity before starting therapy, so that the therapy may be changed if needed. Currently, there is a wide range of antimicrobials that can be used in the treatment of both clinical and subclinical bovine mastitis, such as benzyl-penicillin G, cloxacillin, ampicillin, enrofloxacin, cephalosporins, neomycin, gentamicin, streptomycin dihydrostreptomycin, and chloramphenicol. For taking specific therapy, clinical mastitis is generally divided into three forms, viz. peracute, acute and chronic form.

Peracute mastitis: In this form, the cow may appear normal at one milking and at the next milking shows pronounced signs including anorexia, rise of temperature, depression, shivering and rumen stasis. Frequent milking should be done to remove bacteria, toxins and inflammatory exudates from the

Table 1. Prevalence of subclinical mastitis in lactating cows based on age, parity, milk yield and pregnancy

Variable	No. of cows tested	No. of cows in each group	No. of positive cows	Prevalence
Age	110		46	41.81
	3.5-7yrs	64	21	32.81
	>7 yrs	46	25	54.34
Parity	1-2	59	16	27.11
	>2	51	30	58.82
Milk Yield	<5	20	5	25.00
	5-10	52	20	38.46
	>10	38	21	55.26
Pregnancy Status	Pregnant	43	21	48.83
	Non Pregnant	67	25	37.31

Table 2. Quarter-wise prevalence of subclinical mastitis in lactating cows

Quarter	No. of tested cow	CMT positive, No (%)			
		1+	2+	3+	Total
RF	110	20(18.10)	14(12.72)	4(3.63)	38(34.54)
LF	110	30(34.90)	10(9.10)	2(1.81)	42(38.18)
RH	110	34(40.00)	18(16.36)	6(5.45)	58(52.72)
LH	110	26(23.63)	18(16.36)	4(3.63)	48(43.63)
Total	440	110(25.00)	60(13.63)	16(3.63)	186(42.27)

mammary gland. Appropriate antibacterial therapy to start with systemic administration that may be later (after 12-24 h) supplemented with a suitable intra-mammary infusion. Fluid therapy to restore vital body fluids, dilute toxins and counteract acidosis. Dexamethasone @ 1-3 mg/kg IV or IM once or may be repeated after 8-12 h. Calcium borogluconate @ 500 ml IV to counteract hypocalcaemia induced by endotoxin. Anti-inflammatory, antihistaminic drugs and multivitamins.

Acute mastitis: In this form, there is no systemic reaction and primarily changes are observed in milk, which may contain flakes, become watery or thick, and sometimes may contain blood. The udder may become swollen and hard. The line of treatment includes use of antibacterial drugs plus calcium and multivitamin therapy. The combination therapy i.e. intra-mammary plus parenteral works well than the lone parenteral or intra-mammary.

Chronic mastitis: Treatments may not be effective in chronic mastitis, such cases should be isolated from the milking herd or the affected quarter may be permanently dried-off by producing chemical mastitis. It can be done by infusing 30-60 ml of 3% silver nitrate solution or 20 ml of 5% copper sulphate solution in the teat. If a severe local reaction occurs,

the quarter should be milked out and stripped frequently until the reaction subsides. If no reaction occurs, the quarter can be stripped out 10-14 days later. Two infusions may be given.

Prevention and control

Mastitis control includes good milking, environmental hygiene, use of properly functioning milking equipment, application of teat dipping, proper identification and treatment of mastitis cows, use of dry cow therapy and sound nutritional program. Proper washing of udder, cleanliness of milker's hands/milking machine clusters in between each milking and post-milking, and teat dipping in germicidal solution will reduce the infection to a great extent. The surroundings should be kept clean by frequent removal of dung, proper drainage, adequate milking and feeding space should be provided.

Dry cow therapy: The cow is at the greatest risk of acquiring new intra-mammary infections during the dry period. Antibiotics are administered towards the end of lactation and may remain in the udder in concentrations high enough to kill pathogenic bacteria for 20-70 days, depending upon the kind of formulations that are used.

Teat sealer: The development of internal and external teat sealants for

use during the dry period is promising progress towards control of mastitis. Bismuth subnitrate combined with cloxacillin as dry cow therapy demonstrated a reduction in both clinical and subclinical cases of mastitis.

Teat dipping: The teats of all the lactating cows and dry cows (during the first 10-14 days of dry period) should be dipped regularly after every milking in a germicidal solution. The recommended teat dips are

1. Povidone iodine solution (5%) + glycerine @ 20% of iodine solution
2. Chlorhexidine (0.5%) solution + glycerine @ 06% of chlorhexidine solution

Effectiveness of teat dips in the preventing mastitis

Farmers in the villages adopted under Farmer FIRST Programme, were trained to diagnose mastitis in

subclinical stage with the help of California mastitis test and awareness was created among farmers to use this cow-side test for prevention of mastitis. Farmers were also trained to use teat dips after every milking for prevention of mastitis in dairy animals. There was reduction in the occurrence of subclinical mastitis cases in cows after the adoption of the SCM detection, prevention and control methods. The same animals (those examined for the study on prevalence of sub-clinical mastitis) were again screened for subclinical mastitis by CMT after 3 months of practice/adoption of CMT and teat dipping. The subclinical mastitis decreased to 6.36% from pre-adoption prevalence of 41.81% in the lactating animals. This indicates that mastitis prevention and control technology in dairy cattle was highly effective.

Increasing the udder resistance:

Future trends in mastitis control are aimed at increasing the immunity of udder to mastitis pathogens by use of non-specific (cytokines/proper nutrition) and specific (vaccination) immunomodulators.

Conclusion

Subclinical mastitis is a major cause of economic loss in dairy herds that shows no gross inflammatory changes in udder, hence remains unnoticed unless investigated by laboratory tests. The subclinical mastitis decreased from the pre-adoption prevalence in the lactating animals by regular use of post milking teat dipping and California mastitis test indicating that mastitis prevention technology in dairy cattle was highly effective.

¹Principal Scientist, ^{2,6}Principal Scientist, ^{3,4}Scientist, ⁵Scientist. Corresponding author's e mail: n_chand75@rediffmail.com

