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Research Article

INNOVATIVE APPROACH FOR DETECTION AND CONTROL OF MASTITIS IN DAIRY ANIMALS

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Abstract: Mastitis is a potent economic disease affecting milk production in dairy cattle all over the world. Many infective agents have been implicated as cause of mastitis in bovines which include bacteria, fungi and algae. Of these, bacteria are found to be the main causal agent. This review enumerates the major bacteria involved in the infection. It also highlights some field applicable methods for sensible detection of intra mammary infection, since most of the sub-clinical cases of mastitis go unnoticed. The major step towards avoiding mastitis would be apt detection, medication (depending on organism involved) and above all, control of incidences. Thus, taking this in view, the control measures have also been discussed in this article. The article in all focuses on the causative agents and detection and control methods of intra-mammary infections in cattle.

Keywords: *Mastitis, SCC, CMT, Pathogens*

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Introduction

Mastitis is nothing but an inflammatory reaction of the tissue of the mammary glands to bacterial, chemical, thermal or mechanical cause [1]. Regardless of the cause, it is characterized by a range of physical, chemical as well as bacteriological changes in the milk leading to pathological changes in the glandular tissues. The inflammatory response consists of an increase in blood proteins and white blood cells in the mammary tissue as well as in milk. The purpose of this inflammatory response is to destroy the etiological agents, repair the damaged tissue and return the udder to normal function.

In a study conducted in the area of Bangalore (Urban and Rural) and Kolar district of Karnataka by Ahmed [2] the overall prevalence in crossbred dairy cows was 22.09% and 4.34% respectively for subclinical and clinical cases of mastitis. The incidences of mastitis were found to be higher in graded HF (28.69%) followed by HF crossbred (19.64%) and Jersey crossbred cows (20.51%). Researchers [3] reported that the annual losses incurred due to mastitis in India, were estimated at Rs. 7165.51 crores out of which loss of Rs. 4151.16 crores (57.93%) were attributed to subclinical mastitis and Rs. 3014.35 crores (42.07%) to the clinical version of the disease.

Major pathogens causing mastitis

All episodes of mastitis of economic importance are caused by microbial infections and many infective agents have been implicated as cause of mastitis in bovines which include bacteria, fungi and algae. Of these, bacteria are found to be the main causal agent as they contribute a majority to the total isolates recovered from udder infections, clinical as well as subclinical ones [4].

The principal organisms associated with bovine mastitis can be classified as contagious (*Staphylacoccus auras* and *Streptococcus agalactiae*) and environmental (*Streptococcus disgalactia, Streptococcus uberis* and *Escherichia coli*) depending on their primary reservoir (environmental versus infected mammary gland quarter) [5]. The organisms found primarily in the cow's surrounding are classified as environmental pathogens whereas those closely associated with cow's mammary gland, udder and teat skin are termed as contagious pathogens [6].

Besides these two groups, a third group comprising microorganisms under the category of normal teat flora or opportunist pathogens has been described. Environmental and contagious pathogens are accountable for approximately 90 per cent economically important mastitis [7].

Contagious pathogens

They are known as common inhabitants of the tissue of cows including mammary gland and teat skin, beside others. Therefore, the infected cow acts as a source of infection to other cows with healthy udders. *Staphylococcus aureus* and *Streptococcus agalactiae* are the important contagious pathogens which are known to be associated with IMI characterized by a pronounced inflammatory response in mammary gland leading to loss of milk production and quality.

Staphylococcus aureus caused mastitis varies from subclinical to acute suppurative, gangrenous or chronic depending on the infecting strains, infective dose and host resistance. It has been emphasized that this organism is not ubiquitous in environment and its elimination is difficult because of the ability of the organism to survive in intracellular site and udder skin for extended periods and also due to greater resistance of organisms to antibacterial which results in higher infection rate. Infected hands and teat cup liners play important role in spread of infections [8].

Environmental pathogens

These are pathogens found in the environment in which the cow lives and intramammary infections occur on exposure of teat ends to these pathogens between milking. Annually 40 per cent cases have been attributed to environmental pathogens [8]. Environmental pathogens are accountable for most mastitis episodes on well managed farms, and majority of cases of IMI caused by environmental pathogens are attributed to coliforms and environmental streptococci [6].

Coliform organisms

Episodes of coliform caused mastitis have been reported world-wide.

This includes mastitis caused by organisms of Enterobacteriaceae family (mainly *E. coli, Klebsiella* spp. and *Enterobacter* spp.). These are gram-negative bacilli they are found in intestinal tract of animals but do not cause any discomfort. Environmental components that come in contact with cow's udder are all potential source of infection to cow.

Coliform mastitis is most common cause of fatal mastitis in cattle and complete eradication of coliforms is said to be impossible owing to their widespread presence. Escherichia coli is the most common coliform organism implicated in mastitis of cows and is the most common organism in cow's environment. Klebsiella spp. caused mastitis is the second most common form of coliform mastitis.

Environmental Streptococci

Streptococcus dysgalactiae and *Str. uberis* are members of a group of organisms which cause environmental mastitis and are distinct from Str. agalactiae which is a specific contagious pathogen. Mastitis caused by these streptococci assumes special importance in dairy herds where infections with Str. agalactiae have been greatly reduced or eliminated [9]. These organisms are known to be the common inhabitants of teat skin and are widely distributed in environment.

Among environmental streptococci causing mastitis in cattle, *Str. uberis* remains the most commonly isolated organism [6]. Uncommon infections include *Str. pyogenes, Str. zooepidemicus, Str. pneumoniae* and *Str. bovis*. Mastitis caused by *Str. dysgalactiae* is sometimes acute and severe, while that caused by *Str. uberis* is mild. Infections due to *Str. zooepidemicus, Str. pyogenes* and *Str. pneumoniae* can be severe and vary in acuteness.

Minor mastitis pathogens

Non-haemolytic coagulase-negative staphylococci (CNS) and *Micrococcus* spp. are classified as minor mastitis pathogens. In some cases, they significantly increase the leukocyte count in milk. They are now amongst the most common bacteria found in cultures of milk especially in herds in which major pathogens have been adequately controlled. They are normal teat flora and act as opportunist pathogens as they cause disease under favorable conditions [6].

Coagulase-negative staphylococci group includes *S. epidermidis, S. hyicus, S. intermedius, S. chromogenes, S. hominis, S. warneri* and *S. xylosus*. Of *these S. epidermidis* and *S. hyicus* are commonly isolated from cases of bovine mastitis. The pathogens which cause mastitis less commonly include Bacillus spp. *Pseudomonas* spp. and *Corynobacterium* spp. among others. Among Bacillus organisms, *Bacillus cereus* and *B. subtilis* are saprophytic bacteria found in mix infection and mastitis caused by teat injuries [6].

Detection of Mastitis

There are a number of direct and indirect tests for the detection of subclinical mastitis *viz*. enumeration of somatic cell counts, California mastitis test, modified white side test, bromothymol blue card test, pH of milk, electric conductivity of milk, chloride estimation of milk, N-Acetyl-β-D-Glucosaminidase (NAGase) enzyme activity, cultural isolation and identification of causal agents, ELISA, bacterial identification and isolation *etc*. Some of the commonly used tests are depicted:

Electrical conductivity Meter

This is a method in which the electrical resistance in all the four quarters of the udder is measured. The milk samples taken from the infected quarter has high salt concentration which results in lower resistance. Readings are interpreted quarter wise based on the difference between the highest quarter value and the other value. The difference on and above 50 are considered as positive case of mastitis. Readings between 330 and 360 unit usually considered as healthy quarters. The readings of 250-300 unit can be taken to be normal and quarters as healthy especially when results in a particular cow did not show higher values before. However, if there is a sudden drop in observation *viz*., 250-300 units and that all the previous examination has given higher results *i.e*., over 300 units, then that this particular cow may be at risk of having subclinical mastitis.

Somatic Cell Count (SCC)

SCC has been known to be an important indicator of intra mammary infections (IMI). Somatic cells are always present in milk; they increase due to mammary gland infection. In a healthy udder, the somatic cell count (SCC) in milk range between 50,000 and 1,00,000 cells/ml. if]. High SCC reduces the quality of milk and milk products. When SCC is greater than 2,00,000 cells/ml, the udder is said to be diseased one [10]. Laboratory based SCC or leukocyte count in the mastitis milk is performed to access the degree of infection in the respective quarter. Commonly used field-based SCC techniques are as follows.

California mastitis test (CMT)

It is an easy, economical, quick and valuable tool for cow-side evaluation. It is a semi-quantitative SCC measure in which DNA out of disturbed cells reacts with reagent to form viscous jelly mass. Immediately after mixing equal amount of milk and CMT reagent must be scored within 15 seconds, because weak reaction will disappear. Results are interpreted as:

CMT Score	Somatic Cell range	Interpretation
N (Negative)	0-200,000	Healthy Quarter
T (Trace)	200,000-400,000	Early Subclinical Mastitis
1	400,000-1,200,000	Subclinical Mastitis
2	1,200,000- 5,000,000	Clinical Mastitis
3	Over 5,000,000	Sever Clinical Mastitis

Automatic Somatic cell counter: for confirmation of SCC in more precise and accurate way, test is to be carried out by digital somatic cell counter. It is a strip test in which a drop of milk is added at the reaction center, kept for 45 min- colour change is read in a digital reader which gives the total SCC per ml of milk. Digital counter reads the minimum value of 50,000 cells/ml and maximum of 3,000,000 cells/ml.

Bacteriological culturing and identification

Identification of potent pathogens in cow milk through bacteriological culture is the definitive diagnosis of mastitis infections. In most clinical laboratories, identification methods are based on microbiological culture of milk and biochemical tests on the bacteria isolated. Advantages of microbiological culture are that the causative bacteria can be identified and that antimicrobial sensitivities can be determined, thus providing information on which antibiotics should be administered for treatment of clinical cases or for dry cow therapy.

However, there are several shortcomings coupled with microbiological culture. It is inadequate by the dynamic nature of infections. Another issue is that subclinically infected cows shed organisms intermittently and may cycle through low and high shedding patterns. Milk culture may not yield bacteria from subclinically infected animals because of low numbers of bacteria at the time of sample collection. Negative cultures may also be due to the presence in submitted samples of residual therapeutic antibiotics that may inhibit bacterial growth in vitro. The presence of leukocytes in milk samples from cases of clinical mastitis and in milk samples with high SCC may also potentially inhibit growth of bacteria. Hence the recent innovative techniques include PCR based bacterial identification.

Prevention of Mastitis

Prevention of mastitis can be achieved by some key managmental practices mentioned below

Proper milk hygiene: Teats should be cleaned and dried before milking. If milk is filtered, the presence of particles in the filter indicates insufficient cleaning of teat during udder preparation or a lack of hygiene during attaching and removing of milking unit.

Teat Dipping: Research indicates that the rate of new infection may be reduced by more than 50% when a suitable disinfectant is used to fully immerse or spray the tests pre-dip as well as post-dip for 30 seconds and wipe with clean cotton towel. Post milking teat dipping is most effective against *Staphylococcus aureus* and *Streptococcus agalactiae*, the most contagious mastitis- causing bacteria. Teat dipping does not affect existing infection.

This explains why in the short term many farmers do not see the positive effect of teat dipping. To achieve a rapid decline in the level of infection, it would be necessary to eliminate infected cows in the herd

Treatment of all quarters of all cows at drying off: The effective use of a long term antibiotic infused in each quarter of the udder at the last milking of lactation reduces the incidence of new infection during the dry period. In addition, dry cow therapy is the best way to cure chronic and subclinical mastitis that can rarely be treated successfully during lactation.

Timely and proper treatment of Clinical cases: Adequate therapy must be decided by the veterinarian and the cow should be handled accordingly to avoid the risk of spreading disease.

Proper Nutrition: Deficiencies of selenium and vitamin E in the diet have been reported to be associated with an increased rate of new infection. Hence, balanced ration is necessary to maintain the proper health and production performance in high yielding cows.

Other managemental practices: This includes feeding the cow immediately after milking so that they remain standing for at least one hour before they lie down. This helps the sphincter muscles to close properly before the teats are exposed to ground.

Control of Subclinical mastitis

As there are no signs and symptoms in subclinical mastitis, it is not possible to do symptomatic treatment. Based on somatic cell count and antimicrobial test, treatment of typical cases of subclinical mastitis is possible with specific therapy. In general, it is suggested to control subclinical mastitis with following measures:

Maintenance of strict hygienic conditions in the herds including strict monitoring of newly introduced animals for subclinical mastitis.

Providing balanced ration to the animals

Monthly checkup for somatic cell count

Culling of animals with re-occurrence of subclinical mastitis.

Hence, the appropriate measures for prevention and control of subclinical mastitis under field conditions will enhance the profitability of dairy farming.

Application of research: This is a review article emphasizing an economically important disease of dairy industry. It highlights the etiology and control prevention of the disease

Research Category: Animal husbandry, Veterinary

Abbreviations: SCC- Somatic Cell count, CMT- California Mastitis Test

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Cultivar / Variety / Breed name: HF crossbred, Jersey crossbred cows

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