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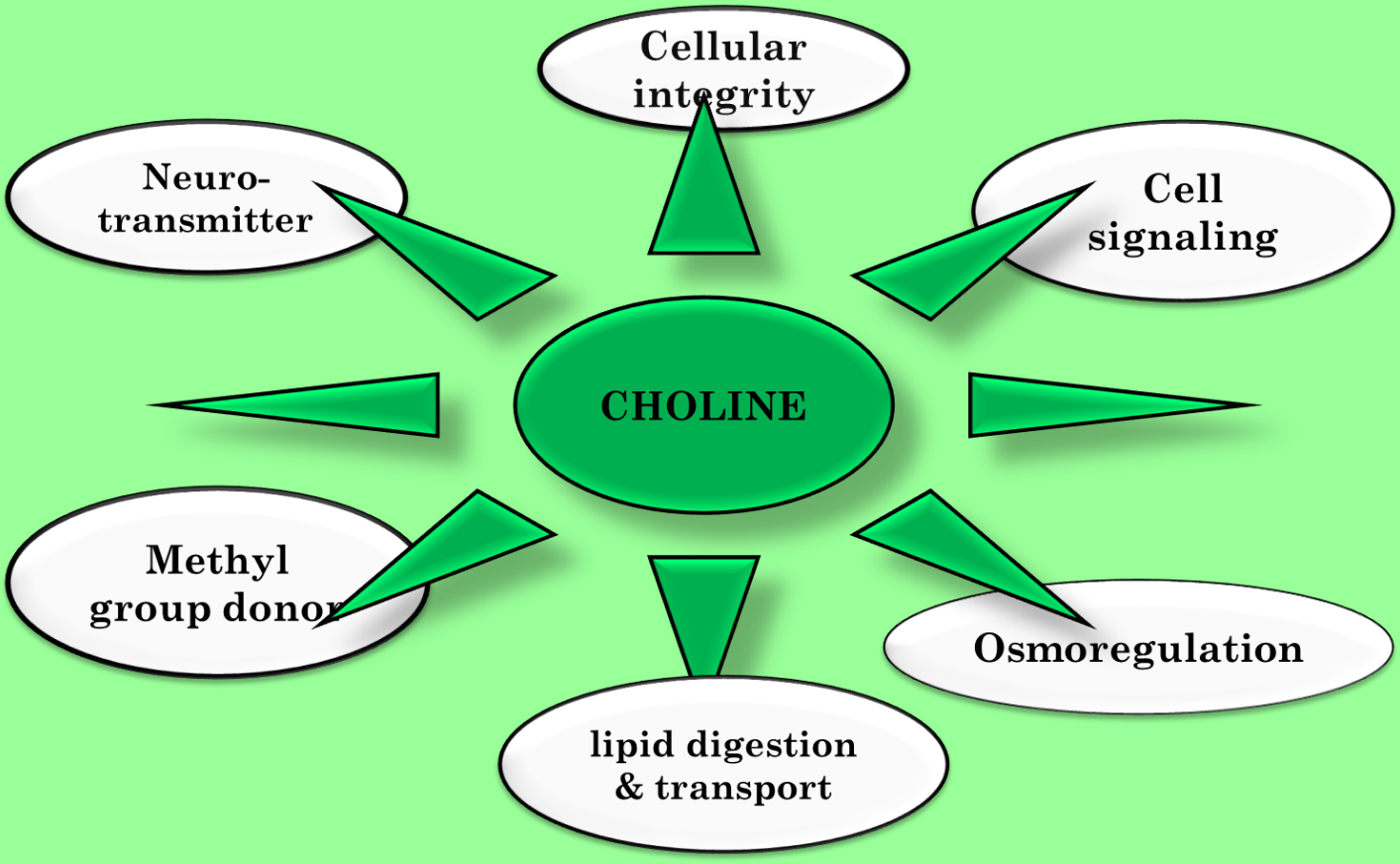

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A note on Mastitis in Dairy Cows

Mahesh.R[1], Joan Jose[2], Dinesh.M[3]

[1]MSc., Biotechnology, Jaya College of Arts and Science, Thiruninravur-602024, Tamil Nadu
[2]MVSc., Animal Genetics and Breeding, COVAS, Mannuthy-680651, Kerala
[3]MVSc., Veterinary Pathology, ICAR-IVRI, Izatnagar-243122, Uttar Pradesh

Mastitis is a disease that affects a large number of dairy cattle throughout the world. A survey conducted in the major milk-producing countries indicates that each year clinical mastitis afflicts 15% to 20% of cows. Mastitis also has a negative impact on the quality and quantity of milk produced and hence great production losses in the livestock sector.

In India, annual loss due to mastitis is around Rs. 16,702 million which can be ascertained from the estimation that mastitis reduces milk by 21% and butterfat by 25%. Subclinical mastitis is prevalent in India varying from 10 – 50% in cows, and 5-20 % in buffaloes as compared with clinical mastitis 1 - 10 %. The susceptibility of this infection is highest in purebred Holsteins and Jerseys and lowest in local cattle and buffaloes. India is the second largest milk producer in the world, but the per capita availability of milk still remains half of the world average, demanding strategic intervention.

In addition to the economic loss, the consumption of mastitis affected milk is harmful to man hence, a major public health hazard to the whole humanity. It is vital to prevent and treat the affected animals so that economic losses to the farmers can be prevented.

Types of Mastitis

Mastitis is a complex disease caused by a variety of pathogens and has different levels of intensity. It may be classified as clinical, subclinical, chronic depending on the degree of inflammation. It is important to recognize the type of mastitis in order to decide what preventive measures or treatments to use.

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. It divided into three groups namely,

- Clinical Mastitis
- Subclinical Mastitis
- Chronic Mastitis

Clinical Mastitis: Characterized by the presence of gross inflammation signs like swelling, heat, redness,

pains. Depends upon its severity and duration of appearance of signs it has been divided into the following type.

Peracute mastitis: Characterized by signs of gross inflammation, disrupted functions (reduction in milk yield, changes in milk composition) and systemic signs (high fever, depression, shivering, loss of appetite), swollen, red, painful quarter, milk passes with difficulty and seizing of lactation.

Acute Mastitis: Similar to peracute mastitis, fever above 39°C, weak and dejected animal, lack of appetite and drastic drop in milk yield. Often follows calving and less seriously, after cow goes dry.

Sub-acute Mastitis: In this type of mastitis, the mammary gland inflammation signs are minimal and no visible systemic signs. Animals appear healthy without any apparent change in the udder, only presence of flaky particles in milk during initial ejection can be found.

Sub-clinical Mastitis: This form of mastitis is characterized by a change in milk composition with no signs of gross inflammation or milk abnormalities although it is characterized by reduced milk yield and altered milk composition. Changes in milk composition and the presence of inflammatory components and bacteria in milk can be detected by special diagnostic tests.

Etiology	Location	Manifestation
Streptococcus agalactiae	Resides inside the cow's udder and survives for a short time outside the mammary gland	Reduced milk yield and altered milk composition
Streptococcus dysgalactiae	Resides in cow's environment	Pronounced swelling of one or more quarters. Milk highly abnormal. High fever in serious cases
Streptococcus uberis	Unclean and muddy bedding and udder	Pronounced swelling of one or more quarters. With a high fever. Abnormal Milk.
Staphylococcus aureus	Lives inside and outside the udder on the teat skin.	Quarter swells and turns purple. Udder hardens aqueous secretion, eventual atrophy of the quarter. Intermediate form produces granular secretion. Milk hotter than normal.
Escherichia coli	Dirty calving stall, lack of bedding, inadequate udder washing.	Loss of quarter with a high fever. Thin yellow secretions, with a granular texture resembling bran
Pseudomonas aeruginosa	Found in soil-water environments in dairy farms.	Severe mastitis with toxemia and high mortality. The bacteria can persist in the glands for up to five lactations
Mycoplasma Spp	Found in bedding and environments in dairy farms and Carrier animals	Leads to a dramatic drop in productivity. Observe a granular flaky substance in the secretion
Yeasts and molds	Introduced during the preparation of infusions	Severe infection, high fever limited inflammation may lead to destructive mastitis

Chronic Mastitis: An inflammatory process that exists for months, and may continue from subsequent lactations. Chronic mastitis exhibits periodical flare-ups sub-acute or acute form, which may last for a short period of time. Repeated mild clinical at-

tacks are generally without fever but many times it has clumpy milk and swollen quarters. The quarter may become hard due to fibrous indurations. Antibiotic treatments often do not work. The severity of mastitis may lead to gangrene of the affected quarter (blue and cold to the touch) with progressive discoloration from the tip to the top. Sluffing off necrotic parts and eventually, the death of the animal can take place in untreated animals.

Chief pathogens causing Mastitis and their manifestation

There are a great number of microorganisms on and in cow udders. There are 137 or more species and subspecies of microbes that can be associated with the mammary gland affections. Several of them are part of the normal flora and, with few exceptions, do not cause mastitis. On the contrary, they may protect udders from an infection caused by pathogenic bacteria.

In order to understand mastitis pathobiology, the mammary gland has been studied with respect to its anatomy, physiology, and the genomics. The cow has the simplest mammary gland system. The interior of each quarter is composed of teat cistern, gland cistern, milk ducts, and glandular tissue. The secretary portion known as the glandular tissue contains millions of microscopic sacs called alveoli. Each alveolus is lined with milk-producing epithelial cells and is surrounded by muscle cells which contract and squeeze milk from the alveolus during milking. Blood vessels bring nutrients to each alveolus where the epithelial cells convert them into milk. Milk accumulates in the alveolar spaces, milk ducts and cisterns between milkings. It is through the teat ducts that the accumulated fluid is removed during milking.

Environmental and contagious microorganisms invade the udder through the teat cistern or blood in cases of septicemia. They then multiply in the udder where they are attacked by neutrophils. While damaging the epithelial cells lining the alveoli, with subsequent release of enzymes like NAGase (N-acetyl-beta-D-glucosaminidase) and LDH (Lactate Dehydrogenase). The epithelial cells also secrete anti-microbial compounds. Considerable tissue damage is observed once the immune effector cells begin to combat the invading pathogens. The introduction and multiplication of pathogenic microorganisms leading to serious events like reduced milk synthetic activity, compositional changes and elevated somatic cell count and it pave the way for Mastitis.

Impact of Mastitis

1. The temporary or permanent loss in milk production.
2. Poor milk quality, resulting in dairy products with less favorable organoleptic properties and keeping the quality.
3. Reduction in price due to high somatic cell count.
4. Loss due to the discarding of milk

after the antibiotic treatment.

5. Increased costs for surveillance of milk quality and disease status among rest of the herd.
6. Premature culling or reduced productive-life of cattle.

Diagnosis

To diagnose mastitis, it is necessary to know how to distinguish between the signs of the various types of mastitis infection. The key points in diagnosis are as follows:

A. **Monitor the milk**: a Routine examination of the milk using a filter cup (to extract the first three squirts before washing and before milking) is the best way to diagnose mastitis. The presence of lumps, flakes, blood, etc. if present must be noticed.

B. **Palpate the udder**: Detection of swelling and fibrous, hard or injured tissue by palpating particularly after milking helps to detect mastitis.

C. **Be attentive**: Observe other evident signs such as fever, redness, etc.

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. Early diagnosis of mastitis with reliable tests facilitates successful treatment and control. The different diagnostic techniques for mastitis includes Modified California Mastitis (MCMT), bromothymol blue (BTB), modified white side test, trypsin inhibition test.

Most tests estimate the Somatic Cell Counts (SCC) of a milk sample. A level of 50,000 cells/ml of milk is usually used as a beginning point for closer observation.

Somatic cell count (SCC)

This type of test includes counting of all somatic cells, including white blood cells (leucocytes) and epithelial cells. When swelling occurs, the cow's immune system reacts by sending leucocytes to destroy the foreign bodies. The somatic cell count in the milk may thus indicate the defense mechanism of the animal against mastitis. The somatic cell count remains an important and practical tool for measuring the general health of a herd or individuals.

California mastitis test (CMT)

This assay indirectly measures the SCC in milk samples. A bromocresol-purple-containing detergent is used to break down the cell membrane of somatic cells, and the subsequent release and aggregation of nucleic acid form a gel-like matrix with a viscosity that is proportional to the leukocyte number.

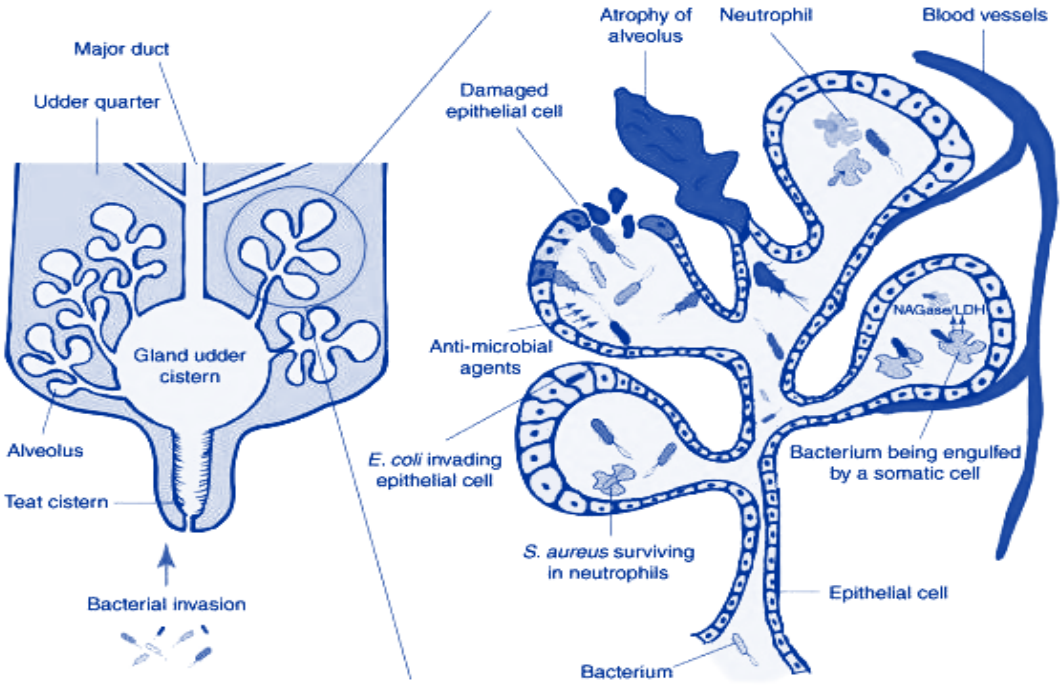
Advantages: cost-effective, rapid, user-friendly and can be used 'on-site' or in the laboratory.

Disadvantages: can be difficult to interpret and has low sensitivity.

Portacheck

This assay uses an esterase-catalyzed enzymatic reaction to determine the SCC in milk.

Advantages: cost-effective, rapid and user-friendly.



(Source: TRENDS in Biotechnology)

Disadvantage: low sensitivity at low SCCs.

Fossomatic SCC

This counter operates on the principle of optical fluorescence. Ethidium bromide penetrates and intercalates with nuclear DNA, and the fluorescent signal generated is used to estimate the SCC in milk.

Advantages: rapid and automated.

Disadvantages: the device is expensive and complex to use.

Delaval cell counter

This counter operates on the principle of optical fluorescence, whereby propidium iodide is used to stain nuclear DNA to estimate the SCC in milk.

Advantages: rapid and the device are easily transportable.

Disadvantage: relatively expensive.

Electrical conductivity (EC) test

This test measures the increase in conductance in milk caused by the elevation in levels of ions such as sodium, potassium, calcium, magnesium, and chloride during inflammation.

Advantage: can be used 'on-site'.

Disadvantage: non-mastitis-related variations in EC can present problems in diagnosis.

Culture tests

Laboratory-based tests use selective culture to identify different microorganisms involved in causing mastitis.

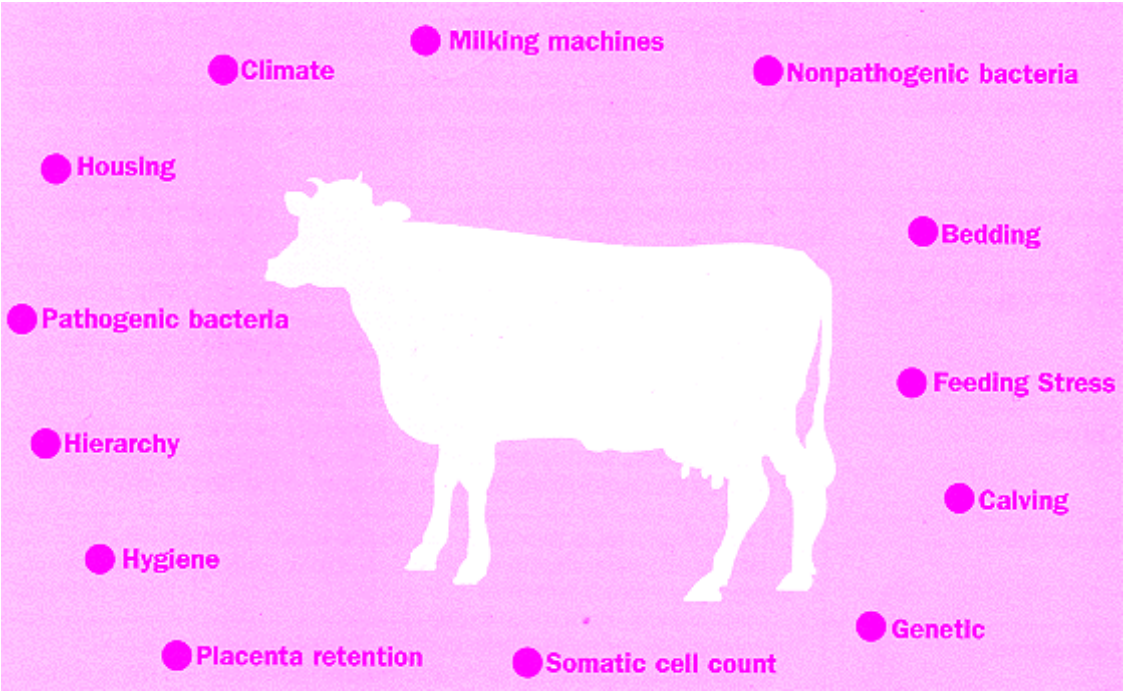
Advantage: identifies specific pathogens causing mastitis.

Disadvantages: cannot be used 'on-site' and the waiting time for results can be days.

pH test

The rise in milk pH, due to mastitis, is detected using bromothymol blue.

Advantages: user-friendly, cost-



effective and rapid.

Disadvantage: not as sensitive as other tests.

Enzymes assay

Assays are used to detect enzymes, such as NAGase and LDH.

Advantage: assays are rapid.

Disadvantage: assays might be laboratory-based.

Control of Mastitis

Awareness of the economic losses associated with mastitis is resulting in a desire for mastitis control programs. Control programs are focused on detection of mastitis (by the above methods), identification of the causative agent(s) and prevention of transmission by removing the source of the agent (milk contaminated fomites, bedding, persistently infected cows, *etc.*).

Knowledge of mammary anatomy and physiology, mammary defense mechanism, microbial habitats, microbial virulence factors, milking machine function, and antibiotics/ germicides is important in achieving effective mastitis control.

Control of Contagious Mastitis

Contagious mastitis can be effectively controlled through a rigorous program of teat dipping and dry cow antibiotic treatment. Teats must be dipped in germicide after each milking (this decreases the incidence of the disease). Each quarter must be treated with dry cow antibiotics at end of lactation (this decreases the prevalence of the disease). Cows with contagious mastitis should be milked last or a separate milking claw used for the infected cows. Milking claws should be flushed with hot water or germicide after milking infected cows (called backflushing). Individual cloth/paper towels should be used to wash/dry teats.

Milkers should have clean hands and wear latex gloves. New additions

to the herd should be cultured and persistently infected cows should be culled. Teat lesions should be minimized (from chapping, frostbite, stepped-on teats, lacerations, or machine damage).

Control of Environmental Mastitis

Environmental pathogens are more difficult to control than the contagious pathogens. Many of these organisms are resistant to germicides in teat dip and antibiotics in dry cow therapy. Identification of the source and removal (bedding, ponds, mud) is the key to control. Udders can be clipped to minimize the amount of manure clinging to the glands. Only clean dry teats should be milked. Teats should be pre-dipped with germicide before milking. Cows should be kept standing after milking (offer them feed). Sterile single-dose infusion products should be used and sterile infusion techniques (alcohol swab) should be used. The milking area should be kept clean.

Conclusion

Bovine Mastitis is an important multifactorial and complex disease which difficult to treat and control. It is responsible for heavy economic losses with public health importance. The most important factors accounting for the occurrence of the disease are poor hygiene of the farm, lack of regular veterinary checkup and supervisions, lack of use of dry cow therapy and refuse of culling of cows with chronic mastitis. From this conclusion the following recommendations are forwarded:

Check up for mastitis at certain intervals with a screening test, if possible isolation, identification of pathogen and drug sensitivity test.

Treatment of mastitis of a cow(s) with antibiotics on the basis of drug sensitivity test should be conducted.

Strict hygiene should be kept with regard to milking practices, milkier hygiene, and effective teat dipping, constant removal, and disposal of manure and the provision of adequate quality bedding.

Culling of chronically infected cows with or without blind quarter eliminates the potential source of the pathogen and to avoid loss of economic and transmission of zoonotic disease.

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