A REVIEW

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Bovine mastitis and management strategies for its prevention and control

MUNISH KUMAR AND JAGDISH GROVER

ABSTRACT : Mastitis is a complex disease of milk producing animals having huge economic implications world wide. The disease is caused by various pathological agents and has both clinical as well as subclinical manifestations. Economic losses associated with mastitis originate mainly from a decrease in milk yield, discarded milk, veterinary services expenses, cost of veterinary medicines, reduced animal value, labour expenses, deterioration of milk quality and sometimes death of animals. Mastitis leads to significant changes in milk composition and thus, considerable changes in milk fat percentage and solid not fat (SNF) content of milk which renders milk quality deterioration. Management of lactating animals has quite a significant role in prevention of mastitis at a dairy herd. Awareness of dairy farmers can help to regularly monitor and ultimately reduce the number of cases of mastitis resulting in decrease in economic losses due to it, thereby enhancing of overall profitability.

KEY WORDS : Mastitis, Bovine, Prevention, Management

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INTRODUCTION

Mastitis is a multi-etiological and multi-factorial complex production disease of dairy animals, characterized by udder inflammation, swelling, pain and redness along with the reduction in milk production. It is also characterized by physical, chemical and bacteriological changes in milk and pathological changes in glandular tissues (Radostis *et al*., 2000). In addition, the changes in milk composition lead to the formation of clots and flakes in milk. Thus, it impairs the quality of milk and milk products (Philpot, 2003 and Ullah, 2004). Of various clinical manifestations, subclinical mastitis is economically the most critical due to its long term effects on milk yields (Rosetti, 1993; Gogoi, 1997 and Zafalon *et al*., 2007). According to some reports, subclinical mastitis is important due the fact that it is 15 to 40 times more prevalent than the clinical form and generally, it goes unnoticeable because it is difficult to detect (Shearer and Harris, 2003).

Mastitis is one of the most prevalent and common diseases affecting dairy herds worldwide (Halasa *et al.*, 2007) and considered to be a costly production disease of dairy animals, with different levels of economic losses. Economic losses associated with mastitis derive mainly from a reduction in milk production, discarded milk, veterinary services, cost of veterinary treatment, drugs costs, reduced cow sale value, culling of continually infected cows, labour and penalties on milk quality (Seegers *et al.*, 2003).

Indian dairy industry suffers an annual loss of about $1200 millionde to mastitis (Dua, 2001) whereas this loss for the United States of America is nearly

MEMBERS OF RESEARCH FORUM

Address for correspondence :
Munish Kumar, KrishiVigyan Kendra (PAU), FARIDKOT (PUNJAB) INDIA
Email : dr_vodehra@yahoo.com

Associated Authors' :
Jagdish Grover, KrishiVigyan Kendra (PAU), FARIDKOT (PUNJAB) INDIA

$1800million (Bramley *et al.*, 1996). More than $130 million is lost by the Australian dairy industry ($A200/ cow/year) every year due to poor udder health resulting in reduced milk production that is mainly associated with mastitis (Dairy Australia, 2011).

Etiology of mastitis :

Mastitis is caused by many species of common bacteria, fungi, mycoplasmas andalgae (Batavani *et al.*, 2007). Interestingly, 137 species and subspecies of potential pathogens can be associated with infection of the mammary gland (Watts, 1988). However, most udder infectionsis of bacterial origin, with just a few of species of bacteria accounting for most cases. Mastitis pathogensare categorized as contagious or environmental (Kivaria, 2006).

Contagious mastitis is caused by bacterial pathogens which livein and on the cow's mammary glands and are spread from one animal to another primarily during milking. Contagious pathogens are unable to survive for long in the environment and generally are transmitted from one cow to another by the milking machine, hands of milkers, milk-contaminated fomites or the sponge used while milking (Harmon, 1994; APHIS Info sheet, USDA, 2008). Main contagious pathogens are *Staphylococcus aureus*, *Streptococcus agalactiae*, *Mycoplasma* spp. and *Corynebacterium bovis* (Radostis *et al.*, 2000). Among the contagious pathogens, the most common are *Staphylococcus aureus* and *Streptococcus agalactiae*.

Environmental mastitis is caused by the pathogens called as "coliforms"(Gram negative bacteria) found generally in the digestive tract of cattle or their surroundings such as faeces, soil, bedding material and manure (Jones, 2006). These micro-organisms generally proliferate substantially in bedding. This increases the probability of infection of mammary glands leading to clinical mastitis (Bradley and Green, 1997). Coliforms, particularly *Escherichia coli, Enterobacter aerogenes, Klebsiella pneumonia* and *Serratia marcescens* and a *Streptococcus* sp. *Streptococcusuberis* are the chief organisms known to cause environmental mastitis. Environmental mastitis has previously constituted less than 10 per cent of total mastitis cases, but more recently there has been an increase in the incidence of environmental mastitis (Bradley and Green,1997; Boyer, 1997; Edmondson, 1997; Bradley *et al*., 2007 and Dairy Australia, 2011) particularly associated with *S. uberis* infection. This pathogen is most often associated with chronic mastitis, which does not respond to antibiotic treatment (Jones, 2006).

Because mastitis is a complex disease involving various factors, identifying themain pathogens and risk factors, at herd level, is fundamental to developing proper preventive and control measures.It is important to remember that contagious mastitis prevalence is considerably influenced by the milking procedures followed by milkers. Thus, correct milking procedures such as milking mastitic cows last and proper sanitation of utensils, milker's hands and udder before milking could help to improve the situation. The frequency of isolation of coliforms (*E. coli*, *Enterococcus faecalis*, etc.) and other micro-organisms causing environmental mastitis is usually directly influenced by unhygienic housing conditions (Mekonnen and Tesafaye, 2010). Many studies from Asian countries have reported that *S. aureus* is the chief aetiologicalagent of mastitis in cattle and buffaloes (Sharma *et al*., 2007; Rahman *et al*., 2010; Khan and Muhammad, 2005 and Ali *et al*., 2011).

Alterations in milk composition :

The most significant change in milk of animal suffering from mastitis is the change in Somatic cell count. Somatic cell count (SCC) is used to monitor health of the mammary gland of animals as well as milk quality. Jones (2006) reported that the higher the SCC, the greater is the risk of raw milk contamination with pathogens and antibiotic residues. Furthermore, high SCC raises the suspicion that the raw milk is produced under poor standards of hygiene and from unhealthy animals. Milk from normal uninfected quarters generally contain below 200,000 somatic cells/ml. An elevation of SCC to 300,000 and above is an indication of inflammation in the udder. Somatic cell counts in milk samples from individual animals can be performed using California mastitis test (CMT). For reliable results, tests should be conducted just before milking after stimulating milk let down and discarding the fore milk. Jones (2006) reported that lowering the SCC is beneficial for milk producers and processors. Lower SCC should result in higher milk yields and better milk quality.

Mastitis leads to significant changes in milk composition and considerable changes in milk fat percentage and solid not fat (SNF) content of milk occurs. Milk lactose content also declines along with the milk

proteins. The changes in composition of milk are brought about by direct degradation of milk components within the gland which reflect the degree of damage caused to the cells and to the array of blood capillaries by the pathogenic bacteria (Akhilesh *et al.,* 1998). Casein, the major milk protein of high nutritional quality, declines and due to which quality of dairy product deteriorates. Haenlein *et al.* (1973) reported a significant decrease incasein content when SCC in milk exceeded 500,000/ml. The milk proteins breakdown because of the proteolytic activity in milk of animal suffering from clinical or subclinical mastitis. Due to abnormality of vascular permeability, serum proteins such as albumin, immunoglobulins and transferr in passes into milk. Mastitis increases conductivity of milk and sodium and chloride concentration is elevated. Potassium, normally the predominant mineral in milk, declines and because most of the calcium in milk is associated with casein, the disruption of casein contributes to lowered calciumin milk. The reduced lactose concentration is one important factor for impaired acidification properties of milk with elevated SCC, after adding starter cultures (Schallibaum, 2001). Jones (2006) compared various components of normal milk with that of mastitis milk having high SCC, as described in Table 1.

Management strategies for its prevention and control :

Mastitis is a complex production disease of dairy animals. Although, mastitis cannot be fully eliminated from the dairy herds but with adequate management, these losses can certainly be reduced or nullified. Care and management of lactating animals is of utmost importance in prevention of mastitis in the dairy herd. Farmers' awareness about the disease and their knowledge about measures such as pre and post-milking hygiene procedures, correct milking methods, use of teat dips, disinfectants use and dry cow therapy etc., which can reduce incidence of infection at the farm, has a significant role in controlling this disease. Mooventhan *et al.* (2017) observed that the instructional video on mastitis management succeeded in the dissemination of mastitis management practices among tribal community of Chhattisgarh state. Kivaria (2006) stated that one of the major concerns related to mastitis in Tanzania is that farmers and herd attendants need to improve their level of knowledge, attitude and motivation towards udder health. Farmers were asked whether they had ever seen udder diseases in lactating cows and it was recorded that 80 per cent of farmers were aware of clinical mastitis in lactating cows and 83.7 per cent of the farmers were also aware that mastitis not only reduces the quantity of milk but also its quality. But lack of awareness of sub-clinical mastitis was apparent among the owners: only 5 per cent of the owners interviewed were aware of the presence of sub-clinical mastitis. Further, risky management practices were recorded, as 33.3 per cent of the farmers did nottreat the mastitis cases and 96 per cent did not use dry cow therapy because they believed that if they used it, the cow would produce less in the subsequent lactation.Other important risky behaviours, which contribute to antibiotic resistance, were the lack of observance of the full course of antibiotic treatment or the habit of changing therapy, in an inappropriate manner, if the clinical cases did not improve fast enough (Kivaria, 2006). Apart from knowledge and awareness

Table 1: Comparison of values (%) of normal milk with that of mastitis milk having high somatic cell count

Constituent	Normal milk (%)	Mastitis milk with high SCC (%)	Difference
Fat	3.5	3.2	Decrease
Lactose	4.9	4.4	Decrease
Total protein	3.61	3.56	Decrease
Total casein	2.8	2.3	Decrease
Whey protein	0.8	1.3	Increase
Serum albumin	0.02	0.07	Increase
Lactoferrin	0.02	0.1	Increase
Immunoglobulin	0.1	0.60	Increase
Sodium	0.057	0.105	Increase
Chloride	0.091	0.147	Increase

Source: Jones (2006)

about the disease, regular monitoring of the disease at a dairy herd is very beneficial as it guides the dairy farmer about the udder health. The diagnostic measure to detect mastitis begins with the visual examination of the udder and of the milk through the fore stripping, which is an important part of udder preparation (Reneau, 2001). Any physical change in udder or abnormality in milk leads to clinical mastitis.

There is a considerable body of evidence suggesting that the normal dairy cow milk has a regular level of 100,000- 150,000 somatic cells/ml and higher SCC point to secretory disturbance rather than any disease (Hillerton, 1999). The somatic cell count for the composite milk for an udder with four healthy quarters should not exceed 100,000 cells/ml (Ma *et al.*, 2000). A value of SCC exceeding above 200,000 cells/ml in a composite sample of a cow is abnormal with 60 per cent probability of inflammation in one or more quarters of the udder (Mellerberger, 1999).

The clinical management of mastitis has become a concern to the veterinarians, as the conventional antibacterial therapy through intramammary route is largely associated with failures. The selection of antibiotics for treatment of mastitis should be made on the basis of sensitivity testing and pharmacokinetics characteristics of the drug (Srivastava, 2000). Moreover, the efficacy of antibiotic following intramammary administration is governed by factors like lipid solubility, tissue protein binding, pH and presence of inflammatory exudates. On the basis of observations done, it has been concluded that parenteral antibacterial therapy following cultural sensitivity testing may be recommended as the immediate therapeutic measure to save udder damage (Malik and Mir, 2004). In India, it is important to educate the farmers regarding the risk factors of mastitis and also about teat dipping as a preventive measure to be practiced regularly by dairy farmers (Kavitha *et al.*, 2009). In the premise, for the effective management of the mastitis we need to focus our efforts on improving environmental management and also to approach the management of mastitis in a more holistic manner by ensuring optimal nutrition, minimizing stress and encouraging farmers to pay attention to various awareness programmes in detail (Green and Bradley, 2001). Knowledge and awareness of risk factors and characteristics of mastitis causing pathogens involved are essential to control the wide spread of the disease at farmlevel (Fao, 2014).

Conclusion :

The dairy industry globally suffers huge economic losses due to mastitis and hence, bovine mastitis is very important disease to manage by virtue of its large financial implications. Also due to its complex nature, the disease poses lots of challenges to milk producers and animal healthcare professionals. The impact of mastitis on health of the milk producing animals is immense, therefore, there is a need to develop effective and sustainable measures for its prevention and control. Thus, emphasis should be given on increasing awareness of dairy farmers regarding proper milking methods, improved hygiene and sanitation, effective use of teatdipping, dry period therapy and disinfection milking area and milking utensils. Dairy farmers should plan to regular monitor udder health of dairy bovines for having a fair judgment and assessment of the disease at their dairy farms.

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LITERATURE CITED

Akhilesh, K., Rajora, V.S., Panchauri, S.P. and Gupta, G.C. (1998). Milk profiles in clinical mastitis. *Indian J. Anim. Sci.*, **68** (5) : 467 - 468.

Ali, M.A., Ahmad, M.D., Muhammad, K. and Anjum, A.A. (2011). Prevalence of sub-clinical mastitis in dairy buffaloes of Punjab, Pakistan. *J. Anim. & Plant Sci.*, **21**(3): 477–480.

APHIS (Animal and Plant Health Inspection Service). Info sheet, USDA(2008) Prevalence of contagious mastitis pathogens on U.S. dairy operations, 2007.

Batavani, R.A., Asri, S. and Naebzadeh, H.(2007). The effect of sub-clinicalmastitis on milk composition in dairy cows. *Iranian J. Veterinary Res.*, **8** (3) : 205–211.

Boyer, P.J. (1997). Outbreak of clinical mastitis in dairy cows following 'blitz' therapy. *Vet. Rec.*,**141**: 55.

Bradley, A.J. and Green, M.J. (1997). Clinical mastitis in dairy cows after 'blitz' therapy. *Vet. Rec.*,**141**: 179-180.

Bradley, A.J., Leach, K.A., Breen, J.E., Green, L.E. and Green, M.J. (2007). Survey of the incidence and aetiologyof mastitis on dairy farms in England and Wales.*Vet. Rec.*, **160**: 253-258.

Bramley, A.J., Cullor, J.S., Erskine, R.J., Fox, L.K., Harmon, R.J., Hogan, J.S., Nickerson, S.C., Oliver, S.P., Smith, K.L. and

Sordillo, L.M. (1996). The mastitis problem.Current concepts of bovine mastitis. (4th Ed.), Madison: National Mastitis Council.

Bramley, A.J., Cullor, J., Erskine, R., Fox, L., Harmon, R., Hogan, J., Nickerson, S., Oliver, S., Larry, Smith K. and Sordillo, L. (2003). Current concepts of bovine mastitis. 4th Ed. 421 S. Nine Mound Rd. Verona, WI: National Mastitis Council Publications.

Dairy Australia (2011). Dairy Australia Strategic Plan 2011-2015.

Dua, K. (2001). Incidence, aetiology and estimated loss due to mastitis in India- An update. *Ind Dairy Man*, **53** : 41-48.

Edmondson, P.W.(1997). Clinical mastitis in dairy cows after 'blitz' therapy. *Vet. Rec.*, **141**: 108.

FAO (2014). *Impact of mastitis in small scale dairy production systems.* Animal Production and Health Working Paper.No. 13. Rome, Italy.

Gogoi, J. (1997). Public health importance of *Staphylococcus aureus* isolated from cases of bovine mastitis and milkers. MVSC Thesis, Assam Agricultural University, ASSAM (INDIA).

Green, M. J. and Bradley, A.J. (2001). Should you be using sand for dairy cow cubicles?In: *Proceedings of the British Mastitis Conference, Garstang and Lancashire*. pp. 91-2. Institute of Animal Health, Compton.

Haenlein, G.F.W., Schultz, L.H. and Zikakis, J.P. (1973). Composition of proteins in milk with varying leukocyte contents. *J. Dairy Sci*., **56** : 1017.

Halasa, T., Huijps, K., Osteras, O. and Hogeveen, H. (2007). Economic effects of bovine mastitis and mastitis management: a Review. *Vet. Quarterly,* **29** (1) : 18-31.

Harmon, R.J. (1994). Physiology of mastitis and factors affecting somatic cell counts. *J. Dairy Sci.,***77** : 2103-2112.

Hillerton, J. E. (1999). *Balancing mastitis and quality*.Proc. British Mastitis Conference, Stonelergh, UK.pp. 31-36.

Jones, G.M. (2006). *Understanding the basics of mastitis.* Virginia Cooperative Extension, Publication No. 404-233, Virginia State University, USA, 1-7.

Kavitha, K.L., Rajesh, K., Suresh, K., Satheesh, K. and Syama, Sundar N. (2009). Buffalo mastitis - risk factors.*Buffalo Bull*., **28** (3) : 134-137.

Khan, A.Z. and Muhammad, G. (2005). Quarter-wise comparative prevalence ofmastitis in buffaloes and crossbred cows. *Pakistan Veterinary J.*, **25**(1) : 9-12.

Kivaria, F.M. (2006). Epidemiological studies on bovine mastitis in smallholderdairy herds in the Dar es Salaam Region, Tanzania. Doctoral Thesis, Utrecht University, The Netherlands.

Malik , H. U. and Mir, A.Q. (2004). Clinical and therapeutic management of bovine mastitis.*Indian J. Vet. Med*., **24** (2):120.

Ma, Y., Ryan, C., Barbano, D. M., Galton, D. M., Rudan, M. A. and Boor, K. J. (2000). Effects of somatic cell count on quality and shelf-life of pasteurized fluid milk. *J. Dairy Sci*., **83** : 264-274.

Mekonnen, H. and Tesafaye, A. (2010). Prevalence and etiology of mastitis andrelated management factors in market oriented smallholder dairy farms in Adama, Ethiopia. *Revue de Medecine Veterinaire*, **161** (12) : 574–579.

Mellenberger R.W. (1999). Milking procedures that assure milk quality. Proc. Regional NMC Meeting, Waterloo, Ontario: 24-29 pp.

Mooventhan,P., Kadhian, K.S., Senthil Kumar, R., Kumaresan, Manimaran, A. and Sakthivel Selvan A. (2017). Effectiveness of Mastitis management instructional video on knowledge of tribal farmers in northern hills zone of Chhattisgarh. *Indian J. Anim. Sci.*, **87** (3): 391–395.

Philpot, W. N. (2003). A backword glance- A forward look. In: Proc. 42nd Natl. Mastitis Counc., Inc., Annual Meeting, Taxas, USA. pp. 144-155.

Radostis, O.M., Gay, C.C., Blood, D.C. and Hinchkliff, K.W. (2000). Veterinary Medicine: *A textbook of the diseases of cattle, sheep, pigs, goats and horses*. 9th Ed. ELBS &BaillierTindall. See pp. 563–660.

Rahman, M.M., Islam, M.R., Uddin, M.B. and Aktaruzzaman, M. (2010). Prevalence of sub-clinical mastitis in dairy cows reared in Sylhet District of Bangladesh.*Internat. J. Bio Res.,* **1** (2) : 23-28.

Reneau, J.K. (2001). *Somatic cell counts: measures of farm management and milk quality.* In: Proc., National Mastitis Council Ann. Mtg. p. 29-37.

Rosetti, C.A. (1993).Prevalence of subclinical mastitis caused by Staphylococcus aureus in the Buenos Aires Dairy area and its susceptibility to antibiotics. *Vet. Argent.,***10**: 323-326.

Schallibaum, M. (2001). Impact of SCC on the quality offluid milk and cheese.Proc. 40th Annual Meeting, National Mastitis Council, Madison, USA.pp. 38-46.

Seegers, H., Fourichon, C. and Beaudeau, F. (2003). Production effects related tomastitis and mastitis economics in dairy cattle herds. *Veterinary Res.*, **34**: 475–491.

Sharma, N., Maiti, S.K. and Sharma, K.K.(2007). Prevalence, etiology and antiobiogram of micro-organisms associated with sub-clinical mastitis in buffaloes in Durg, Chhattisgrh State (India). *Internat. J. Dairy Sci.,* **2** (2) : 145–151.

Shearer, J.K. and Harris, B. Jr. (2003). Mastitis in dairy goats.Anim. Sci. Dept. Florida Coop. Ext. Serv. Inst. Food Agri. Sci; Univ. Fl. Gainesville, USA. pp.1-6.

Srivastava, A.K. (2000). *Recent concepts on the use of antimicrobials in the treatment of mastitis.* In: Mastitis. Verma, R. and Mamtani, A.P. (eds.), pp.62-83.

Ullah, S. (2004). Effect of mastitis on milk composition in buffaloes under field conditions. M.Sc. (Hons.) Thesis, Deptt. Vet. Clinical Medicine and Surgery, Univ. Agri., Faisalabad, Pakistan.

Watts, J.L. (1988). Etiological agents of bovine mastitis. *Vet. Microbiol.*, **16**: 41-66.

Zafalon, L.F., Nader Filho, A., Oliveira, J.V. and Resende, F.D., (2007). Subclinical mastitis caused by *Staphylococcus aureus*: cost benefit analysis of antibiotic therapy in lactating cows. *Arq. Bras. Med. Vet. Zootec.*, **59**: 577-585.

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