Review on Impact of Bovine Mastitis in Dairy Production

Mersha Asfaw and Ayalew Negash

University of Gondar, College of Veterinary Medicine, Gondar, Ethiopia

Abstract: Mastitis means inflammation of the parenchyma of mammary gland regardless of the cause. It is characterized by physical, chemical and usually bacteriological changes in milk and by pathological changes in the glandular tissues. Bacterial infections are considered the primary cause of mastitis in domestic animals. *Staphylococcus aureus*, *Streptococcus* species and members of the *Enterobacteriaceae* are among the most important agents in cows and other animals. The occurrence depends on the interaction between the host, agent and environment. Forms of mastitis can be categorized in to two major forms; clinical mastitis is a form of mastitis detected grossly by signs of flakes or clots in the milk and slight swelling of infected quarters when it is mild signs and subclinical mastitis. It is the most common and costly disease in milk production, causing loss yield and treatment cost for dairy farmers. With mastitis there is a danger that the bacterial contamination of milk from affected cows may render it unsuitable for human consumption by causing food poisoning and provides a mechanism of spread of disease to humans through consumption of raw milk. The presence of residue in milk following treatment of mastitis is a major public health concern that adversely affects the dairy industry, the practicing veterinarian and the safety of milk for human consumption. The fundamental principle of mastitis control is carried out either by decreasing exposure of the teat ends to potential pathogens or by increasing resistance of dairy cows to infection as the control techniques that will be carried in dairy farm by itself has its own contribution in decreasing loss as brought from mastitis along with treatment and preventive option so it is recognized as one factor that would help in relieving the economic impact due to the disease in dairy farms.

Key words: Mastitis • Human Consumption • Dairy Cows • Residue in Milk

INTRODUCTION

The world’s cattle population has been estimated 1,287,520,000 head with dairy cows accounting for 225,502,000 heads. In Africa, it has been estimated 192,180,000 heads of cattle exist, of which 34,057,000 are accounted by dairy cows. In Ethiopia, cattle’s population 41,527,142 has been estimated 9,307,582 are accounted by dairy cows [1].

Mastitis means inflammation of the parenchyma of mammary gland regardless of the cause. It is characterized by physical, chemical and usually bacteriological changes in milk and by pathological changes in the glandular tissues [2].

Mastitis is one of the most complex disease of dairy cows that generally involve an inter play between management practices and infectious agents, having different causes, degrees of intensity and variations in duration and residual effect [3].

Mastitis is considered as a multifactor disease closely related production system and environment that the animal is kept [4]. Bacterial infections are considered the primary cause of mastitis in domestic animals. *Staphylococcus aureus*, *Streptococcus* species and members of the *Enterobacteriaceae* are among the most important agents in cows and other animals [5].

From the etiological point of view the pathogenic microorganisms have been classified in to two groups, namely, contagious and environmental pathogens based on distinct characteristics of distribution and interaction with teat and duct [6]. The causes of contagious mastitis which are dominant include *Streptococcus agalactiae* and *Staphylococcus aureus* [7] while, *Streptococcus dysagalactiae*, *streptococcus uberis* and Coliforms like *E. coli* are examples of causes of environmental mastitis.

Even though great technological advances have been made, mastitis continues to be as major economic issue for dairy producers [8]. It is the most common and costly
disease in milk production, causing loss yield and treatment cost for dairy farmers. The disease in milk yield per cow due to the clinical and subclinical prevalence of mastitis is usually recognized as the main pathway in causing the economic losses due to the disease [9].

With mastitis there is a danger that the bacterial contamination of milk from affected cows that may render it unsuitable for human consumption by causing food poisoning and provides a mechanism of spread of disease to humans through consumption of raw milk. Many farm families simply consume raw milk because it is a traditional practice and it is less expensive to take milk from the bulk tank than buying pasteurized retail milk. Some believe that raw milk has a higher nutritional value than pasteurized milk. The bacteria that are transmitted through milk and cause disease problems in man are bacteria causing mastitis in cattle and transmissible to man when man uses raw milk from infected udder. Example of such type of bacteria includes Mycobacterium, Brucella, Staphylococcus, streptococcus, Campylobacter and Listeria species [10].

The presence of residue in milk following treatment of mastitis is a major public health concerns that adversely affects the dairy industry, the practicing veterinarian and the safety of milk for human consumption [11].

The fundamental principle of mastitis control is carried out either by decreasing exposure of the teat ends to potential pathogens or by increasing resistance of dairy cows to infection as the control techniques that will be carried in dairy farm by itself has its own contribution in decreasing loss as brought from mastitis along with treatment and preventive option so it is recognized as one factor that would help in relieving the economic impact due to the disease in dairy farms [2]. To avoid underestimating the consequences of mastitis in evaluations of economic-loss it is important to account for all of the cost factors involved and also in some countries including Ethiopia economic estimates are not focused or limited research have been conducted with disparate methodologies. Therefore, the main objective of this paper was to review economic and public impact of bovine mastitis.

Specific Objectives:
- Present recent information’s on impact of bovine mastitis on the public health.

Economic Effects of Bovine Mastitis: Mastitis occurs sporadically in all species; it assumes major economic importance in dairy cattle and may be one of the most costly diseases in dairy herds. Mastitis results in economic loss for producers by increasing the costs of production and by decreasing productivity; the premature culling of potentially profitable cows because of chronic mastitis is also significant loss. The components on economic loss can be divided in two; loss of milk production, discarded milk from cows with clinical mastitis and monitoring, veterinary services for treatment and for control program. There are additional costs such as antimicrobial residues in milk from treated cow, milk quality control, dairy food, manufacturing nutritional quality of milk, degrading milk supply due to high bacteria or SCC and interference of genetic potential of some cows from early involuntarily culling because of chronic mastitis [2].

Production Losses of Bovine Mastitis
Effects on Milk Quality: Good quality milk production is one of the main objectives in dairy farming, in either large or small scale farms; this is because milk of good quality is desirable and hence saleable to the processors and acceptable by the consumer. Good quality milk and milk products as measured by consumer is wholesome of good appearance good predictable taste and flavor, maintaining original nutritional qualities, safe from harm full microorganisms, drugs and chemical residues and has a long shelf –life [12]. Mastitis not only reduces dairy producer profits but also results in important and costly losses to processors due to poor quality milk. Reduced quality is detected with hard milk at 400,000cells/ml. A variety of dairy products are affected, including cheese [12].

Estimated Costs of Mastitis
Cost of the Drugs: Drugs necessary to treat infected animals are a direct cause of economic damage, owing to their costs. The cost of drugs varies between countries, depending on the legislation and the infrastructure of the country [13]. This part of the mastitis cost is easily calculated from the invoices of purchases of drugs on the farm. A similar calculation may be done for the expenditure on the treatment of individual cases [14].

Discarded Milk: Economic damage due to discarded milk is comparable with that from decreased milk production. However, there is one difference: the discarded milk is
actually produced by the cows, which means that feeding costs for that amount milk have to be taken into account in the calculations. The economic damage of 100 kg of discarded milk is therefore larger than for 100 kg of decreased production. Although it is not advisable from a veterinary point of view; discarded milk is often fed to calves instead of milk replacer, thereby saving the cost of that milk replacer [13]. Because of treatment of a clinical case, milk has to be discarded during the treatment days and waiting time. In general, it is assumed that milk had to be discarded for 6 days: 3 days treatment and 3 days withholding period [15].

**Veterinary Service:** The veterinary time and consultation fees can vary considerably in a mastitis control program. These services are charged on an hourly basis, per-cow-per year basis, or other methods. They can be applied to the individual cow, a group of cows or a whole herd. Veterinary time for the treatment of individual cows with clinical mastitis usually involves the cost per cow can be calculated from the invoices [16].

Besides delivering drugs (In many countries), the veterinarian might have to spend time on diagnosis of a (Clinical) mastitis case [13]. Veterinary services may be mandatory for each (Clinical) mastitis case, if required by national legislation, or is only provided upon request by the farmer.

**Labour Cost:** There appear to be 2 main approaches in the literature for dealing with the expenditure on labour for mastitis treatment. The 1st one is to consider the labour time as a direct cost of the disease and include it in the calculations [17]. The 2nd approach is to calculate the labour cost if a farm specifically employs additional labour to manage treatment, segregation, or other aspects of mastitis control [9]. Opportunity cost of labour in agriculture is often difficult to assess and is likely to differ between farms [13].

**Culling:** The term culling describes the removal of an animal from a herd. A significant part of the economic cost of mastitis is related to culling losses [18] of cows that have or have had clinical mastitis or elevated SCC and the increased expenditure associated with their replacement.

CM increases the risk of culling [19] as well as mortality [20]. The extent to which CM affects the risk of culling depends on lactation stage at clinical onset [21]. It is also influenced by reproductive status and open cows are at greatest risk of being culled due to CM if they are diagnosed in early lactation, whereas, pregnant cows are subjected to a relatively similar risk of being culled because of CM irrespective of when in lactation they are diagnosed [21]. Once cows are pregnant, the risk of being culled as a consequence of CM drops sharply [22]. SCC above 300,000 cells/ml has been reported to increase the risk of culling in primiparous cows [23].

The cost associated with involuntary culling as a consequence of mastitis is an important component of the total cost of mastitis. Like milk loss, increased risk of culling imposes a hidden cost, which is not always obvious to the farmer. Involuntary culling is associated with replacement costs and hence includes costs of rearing or buying a heifer. If a heifer is not available at the time a cow is culled, capacity utilization is reduced as a stall will be empty while the fixed costs remain the same. Further economic loss can be expected as milk yield of primiparous cows is lower than that of multiparous cows and because there is a risk that the yield level of a heifer might be disappointing [13]. On the other hand, 2 additional returns from meat are obtained if a mastitis cow can be sold to slaughter.

Economic assessment of the impact of increased risk of culling is not straightforward. Culling results from management decision taken by the farmer is based not only on presence or absence of mastitis but also on milk yield, pregnancy status, parity, stage of lactation and presence of other diseases [22].

**Material and Investment:** Mastitis management includes the use of materials and commodities that cost money. These materials can either be renewable (For instance disinfectants and drugs could be seen as specific types of renewable materials) or non-renewable (For instance anew milking parlour). The purchase of renewable materials has short term economic consequences and the costs can easily be calculated. The purchase of non-renewable materials has long-term consequences. Purchase costs have to be divided over various years by depreciation. Moreover, because capital is tied up by such purchases interest rates have to be calculated as well. Finally most non-renewable materials require maintenance and this also generates costs.

**Diagnostics:** Diagnostics costs that are relevant to mastitis must be included in the calculations, for instance costs of technicians and bacterial cultures [24].

**Other Diseases:** The factors described above (Milk production losses, drugs, discarded milk, veterinary services, labour, materials and investments, diagnostics and culling) are the economic consequences of clinical and subclinical mastitis. Besides these direct costs, cows with mastitis are a constant source of infection due to the shedding of bacteria [25]. The causal relation, however, is
difficult to determine. When the risk of other diseases is increased by mastitis, the economic damage of other disease cases attributable to mastitis can be seen as economic damage due to mastitis.

**Other Effects:** Any kind of pathology involves some degree of poor animal welfare [26]. Mastitis is a very painful condition and is one of the major welfare problems of dairy cows [27, 28]. Even mild cases of CM cause increased responsiveness to pain and affected cows become hyper sensitized to stimuli normally considered innocuous [29].

**Fatality:** Menzies et al. [30] reported that severe cases of mastitis can lead to the death or euthanasia of the affected cow. The cost of a fatality is greater than simply the value of the cow in the market, as it includes the lost margin from the incomplete portion of its lactation. Worldwide, higher mortality rates caused by mastitis are seen in specific situations with a high prevalence of Gram-negative infections; particularly coli form mastitis [31].

**Public Health Importance:** Milk either raw or processed is well known vehicle of a number of human pathogens. There is a danger that the bacterial contamination of milk from affected cows may render it unsuitable for human consumption by causing food poisoning or in rare cases provide in a mechanism spread of disease to humans. Tuberculosis and streptococcal sore throat may be spread in this way [32].

Producer’s discarded mastitis milk can also pose a threat to human health with severe clinical mastitis gross abnormalities are readily observed in the milk. Such milk normally would not enter the food chain but, with sub clinical mastitis milk accidentally mixed in to bulk milk changes in the milk may be visible [12].

Some mastitis milk carries bacteria that can cause human illness, although pasteurization is likely to destroy all human pathogens, there is concern when raw milk is consumed or when pasteurization is faulty, some strains of *S. aureus* may produce heat resistance enter toxins and TSST-1, which cause serious food poisoning [12].

Milk born *S. agalactiae* infections are usually acquired by drinking milk from infected cow the organisms enter through the teats canal and cause inflammation of the teats and udder the infected cow secrets with the milk viable organisms which eventually reach the consumers [33].

Another public health concern regarding mastitis is antibiotic residues in milk, which can initiate severe reactions in people allergic to antibiotics and at low levels can cause sensitization of normal individuals and development of antibiotic resistance strains of bacteria. Compliance recommended with holding times helps to minimize the risk of antibiotic in milk and meat. This is the producer’s responsibility [34].

**Prevention and Control of Mastitis:** The occurrence of mastitis depend on the complex interaction among three factors; host, agent and environment. Hence, any mastitis control program must be designed towards correcting mastitis problem associated with those three epidemiological components. The elimination of infection is achieved by through proper milking hygiene, pre and post teat dipping, dry cow therapy, treatment of clinical cases and culling of chronically infected animals. The prevention of new infection could be maintained via good milking management, environmental and nutritional management. Furthermore the monitory of udder health by indirect tests, milk culturing from individual quarters for proper therapy are use full [35].

Several control options including improvement are available aiming at reducing the rates of new infections and or the duration of in existing infections. The adoption of these control options factors as well as other factors that limit milk production efficiency [36].

Hygienic procedures: milkers should wear rubber gloves. Fore strip 5 powerful squirts milk from each quarter and check for abnormal milk or flakes. Knock dirt off teats. If teats are very dirty, wash them with a sanitizing solution; use low volumes of water; do not use a common cloth or sponge pre dip with a tested disinfectant applying with a dipper or cup not spraying and allow 30 seconds contact time use a separate paper or cloth towel to dry teats and scrub teats five times or 20 seconds. Examine teat ends for chaps, cracks, or lesions that harbor mastitis causing bacteria [37].

**CONCLUSIONS**

Mastitis is the most important factor that contributes for reduced milk production and increasing losses in dairy farm in different expenses which will be in charged for treatment cost, labour, veterinary and other cost that could affect the profitability of the dairy farms business and the economy of the country itself. In line with this following recommendations are forwarded.

- There should be framework which provide for future studies on economics of mastitis with the basis for analysis of factors that should be considered.
- Mastitis control measures should be largely under taken to reduce bacterial contamination of milk from the udder.
Education of public at large about hazards of raw milk consumption and the possible control and preventive measures through heat treatment should always be encouraged before milk is consumed. Milk producers should be educated about risks associated with antimicrobial residues as result of failure to respect the with drawl period.

The government should help in preventing and control of the disease and adopting the proper drugs so as to block the economic impact of mastitis in dairy farm.

ACKNOWLEDGEMENTS

First of all, I would like to praise the almighty GOD for his endless mercy and my heartfelt gratitude to my advisor Dr. Ayalew Negash for his unreserved crucial comments, valuable encouragement and provision of necessary material and sacrifice of his time to correct this manuscript.

I would like to address special thanks to the seminar coordinator Dr. Sileshe Nigatu and Dr. Samson Leta for their excellent provision of information how to write scientific paper.

REFERENCES


