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Review Article

Bovine Subclinical Mastitis in Ethiopia, its Clinical Management and Economic Importance: A Review

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Summary

Bovine mastitis, especially the subclinical form is considered as the most common and economically significant disease in dairy animals in Ethiopia. Losses occur from decreased milk production, treatment and labor costs, risk of culling or death of the cow and reduced milk quality and milk price. Furthermore, milk from subclinical mastitis cow can contain pathogens and their toxins, which may have hazardous effects for human health. This paper aims to summarize the elements related to Subclinical mastitis and its impact on the various performances of affected animals, as well as detection methods and management strategies. Particular attention has to be paid to management techniques that could be useful in reducing subclinical mastitis incidences in dairy cows in the country. It's reasonable to predict that dairy herdsmen will probably continue to struggle with subclinical mastitis, despite the fact that many measures have been studied to lessen incidence of the disease.

Keywords: Subclinical mastitis; Dairy animals; Pathogens, Management strategies

Introduction

Africa's largest cattle population is found in Ethiopia. An estimated 53.9 million cattle are in the country; of these, female cattle make up roughly 55.4 percent. Local breeds account for about 98.95% of all cattle; hybrid and foreign breeds make up the remaining percentage [1]. Despite the country's great potential for dairy development, the industry has not reached the anticipated level of development. The predicted yearly growth rate of the human population is 3%, however the growth rate of milk production is only 1.2 percent. Due to a variety of circumstances, the nation has a low milk consumption habit, with an annual per capita consumption of 19 kilograms [2]. Reduced production and consumption of milk can be attributed to various reasons, including diseases of the mammary glands known as mastitis [3]. Mastitis is characterized as an inflammatory response of the mammary gland caused when pathogenic microorganisms in the udder develop toxins that are detrimental to the mammary gland [4]. It is mostly brought on by bacterial infections and is a significant source of financial loss in the production of dairy cattle. The inflammatory response modifies the composition of milk by reducing the synthesis of caseins, lactose, and fat, both in terms of quantity and quality additionally, mastitis reduces the shelf life of liquid milk products by adversely affecting the quality of milk and manufactured milk products [5].

Subclinical mastitis is more dangerous and causes the dairy business to suffer a larger loss. It is long lasting, difficult to detect, and 15 to 40 times more common than the clinical form [6]. Breeders suffer huge losses as a result, which affects a country's national income. Economic losses include decreased milk yield, throwing away abnormal milk and milk withheld from cows given antibiotics, declining milk quality and price because of a high bacterial or somatic cell count, higher labor costs and veterinary care, a higher risk of mastitis later on, replacing the herd, and issues with antibiotic residues in milk and its products [7]. Apart from the financial implications, there exists a risk that the bacterial contamination of milk derived from afflicted cows could make it unfit for human consumption by resulting in food poisoning or, in extreme circumstances, offering human disease pathways. This is one way that streptococcal sore throat and tuberculosis can spread [8]. Based on the information that was available, one of the most common diseases affecting dairy cows in Ethiopia is subclinical mastitis [9]. The prevalence of clinical and subclinical mastitis in Ethiopia ranges from 1.2 to 21.5% and 19 to 46.6%, respectively. Nevertheless, complete information about subclinical mastitis in this country under various treatment and environmental circumstances is lacking [10].

Therefore, the objectives of this review are:

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- To review about subclinical mastitis in Ethiopia
- To highlight the causes, diagnosis and management options for subclinical mastitis
- To know about the pathogenesis control and prevention options for subclinical mastitis

Literature Review

Etiology

Even though the intramammary gland of cows contains more than 140 different microorganisms, the majority of illnesses are brought on by Staphylococci, Streptococci, and Enterobacteriaceae [11]. The most common organism is Staphylococcus aureus, which can cause acute suppurutive, gangrenous, or chronic mastitis depending on the strains that cause it. Streptococcus species, such as S. agalactiae and S. dysagalactiae, are the most commonly isolated species. Certain pathogens and the type of disease are known to be correlated. Examples of bacteria that are thought to be the primary causes of clinical mastitis include S. uberis, Escherichia coli, Klebsiella spp., Pseudomonas aeruginosa, and pyogenic bacteria. However, subclinical mastitis is linked to S. agalactiae, CNS, and Enterococcus species. S. aureus, however, has been identified as the causal agent of both clinical and subclinical mastitis [12].

Epidemiology

Subclinical mastitis pathogens can be classified as infectious or environmental based on their epidemiology. An infected udder serves as the main reservoir for infectious bacteria, while a contaminated environment is the main source of germs that cause environmental mastitis [13]. Typical infectious pathogens include Streptococcus agalactiae, Staphylococcus aureus subsp. aureus, and Mycoplasma spp. Environmental pathogens typically include Enterobacteriaceae, Coagulase-Negative Staphylococci (CNS), and so-called environmental streptococci (streptococci other than S. agalactiae such as Streptococcus uberis; enterococci) [14]. Farms with bigger herd sizes tend to have a higher prevalence of bovine mastitis than those with smaller herd sizes [15]. Additionally, the frequency is higher in early lactation than in mid-lactation in cows with skin lesions and tick infestations on the udders, teats, and skin than in cows without these characteristics [16]. Research from throughout the world indicates that subclinical mastitis prevalence ranges from 21.1% to 86.2% [17].

Predisposing risk factors: Three primary factors work together to cause mastitis: the host, the environment, and the agent elements. Environmental variables that can enhance exposure include dirty maternity stalls or calving quarters, poorly managed housing and bedding, messy free stalls, and a general lack of hygiene and sanitation on farms [11]. Bedding materials are a significant source of exposure of the teat end to environmental bacteria. The number of germs in bedding is influenced by temperature, moisture content that is available, and contamination. Reduced pathogen levels are frequently associated with dryer bedding materials. In warmer climates, pathogens multiply more quickly, but in colder climates, their proliferation is typically hindered [18].

It has been found that host characteristics such as age, parity, and lactation stage have a substantial impact on the occurrence of bovine mastitis. Young adult and adult cows had infection rates of 65% and 93.2%, respectively. Cows with more than five calves had a greater infection rate than those with fewer or moderate-sized calves, and the early lactation stage had a higher infection rate (87.2%) than the mid-lactation stage (65.4%) and late-lactation stage (73.1%) [19]. Another risk factor for cows with pendulous udders is the infection rate of mastitis, which makes the teat more susceptible to injury and makes it easier for infections to attach to the teat and penetrate the gland tissue. Cows with teat lesions have a higher risk of infection than cows with healthy teats. Compared to low- to medium-yielding cows, high-yielding cows had a higher frequency of SCM [20]. Compared to lactation, the dry season has a higher frequency of new intramural infections caused by environmental streptococci and coli types. This is due to the fact that changes in the mammary gland that take place during the dry season have an impact on the cow's resistance to bacterial infection [3].

The microbial factors that influence the occurrence of mastitis include resistance to phagosytosis and antibacterial substances in the udder, including antibiotic resistance, ability to colonize the teat duct, ability to adhere to the mammary epithelium and not be flushed out with the milk flow, degree of invasiveness, and resistance to phagosytosis [21]. The components that inflict tissue damage, facilitate bacterial adhesion to host cells, and protect the germs from medications and the host's immune system are the three functional groups into which virulence factors can be divided [22].

Transmission : Mastitis can be classified as infectious or environmental based on the mode of transmission. Contagious mastitis is spread from cow to cow during milking season by contaminated wash cloths, milking equipment, and milkers' hands. Infected cows are the primary sources of the disease. Streptococcus agalactiae, Staphylococcus aureus, Corynebacterium bovis, and Mycoplasma species are the main infectious pathogens [23]. Out of all of them, S. aureus is the infectious bacterium that is most commonly isolated globally for subclinical and chronic bovine mastitis. Procedures that stop the transmission of germs during milking, including as adequate udder cleanliness, milking techniques, and post-milking teat disinfection, can effectively manage these bacteria. During the early dry season, the use of dry cow therapy can help prevent new infections and help eradicate current ones [24].

When a cow comes into contact with a contaminated environment, organisms that don't ordinarily exist on the skin's surface or in the udder enter the teat canal and develop environmental mastitis [11]. The habitat a cow lives in is the main source of environmental infections. The environmental infections (Streptomyces uberis, Streptomyces dysgalactiae, coliforms, etc.) that cause environmental mastitis can spread to cows at any point in their lives: during milking, in between milkings, throughout the dry season, particularly during the first calving in heifers [25].

Diagnosis of Subclinical Mastitis

California Mastitis Test (CMT): The SCC of the milk sample is measured by the California Mastitis Test. The reagent is a detergent that breaks down somatic cells in milk, releasing DNA (often 3% sodium lauryl sulphate). This causes the milk to visibly gel by precipitating with fat particles, other serum components, and the CMT reagent [11]. The test process is easy to understand: four plastic plates are placed on a paddle, and a few streams of (front) milk from each quarter are milked into them after the stripping milk is disposed of. The surplus milk is then drained by tilting the paddle almost vertically. A plastic squeeze bottle containing an equal volume of the reagent is introduced. The two components are swirled together and the

formation of precipitation is monitored; if no precipitation the milk is normal [26].

Modified white side test: The leukocytes that cause precipitation to form when sodium hydroxide is added appear to be directly related to the white side test. The test method is to mix the milk for 20 seconds after adding 5 drops of 4% sodium hydroxide, then wait for precipitation. If there is no precipitation, the milk is normal; otherwise, the degree of infection correlates with the amount of precipitate [11].

Somatic cell count: White blood cells that have invaded the mammary gland as a result of trauma or infection, as well as milk-secreting epithelial cells that have been shed from the gland's lining, make up somatic cells. Leukocytes, the primary type of somatic cells present in milk, are primarily responsible for eliminating infections and mending injured tissues. Somatic cells can be used to track the degree or incidence of subclinical mastitis in herds or individual cows, and they are indications of cows' susceptibility to and resistance to the disease [11].

In order to assess aspects of milk quality, hygiene, and mastitis control, SCC is a crucial component. SCC is a useful predictor of intra-mammary infection, and bacterial infection can cause it to increase to levels above 100,000 cells/ml. An infection is assumed when a specific concentration (typically 100,000 cells/ml of milk) is exceeded. A cell counts of 200,000 cells/ml or more indicates subclinical mastitis, a clear sign of inflammatory response, and indicates that the quarter is probably infected [27].

Flow Cytometry: It is a technique that allows measurements of the chemical and physical properties of particles or cells as they pass a sensor point while suspended. This technique was created lately to measure the number of somatic cells in milk, and it works very well to find subclinical mastitis [28].

Culture method: Mastitis is precisely diagnosed by isolating and characterizing any pathogenic bacteria that may be present in the milk. Numerous other determinative tests in addition to cultural methodologies can be used to accomplish this. Contamination and bias should be prevented by using secure and accurate methods in order to produce accurate data. In a similar vein, work protocols and standard operating procedures should be established for routine mastitis testing [21,29].

Treatment

Due to its low efficacy and high cost, antimicrobial treatment for subclinical mastitis is typically not cost-effective during breastfeeding. The overall bacteriological cure rate for antimicrobial treatment was 75% in studies with a large number of subclinical mastitis cases, and 68% in cases where no treatment was administered. The marginal benefit only applied to mastitis caused by streptococci; antimicrobials had no effect on mastitis caused by Staphylococcus aureus. The incidence of mastitis in the herd won't change if subclinical mastitis is treated without also taking other preventive steps. Research has typically demonstrated that treating cows with high somatic cell counts has little effect on milk output [30]. In herd difficulties caused by particularly infectious bacteria such as S. aureus or Streptococcus agalactiae treatment of subclinical mastitis with appropriate antibiotics is indicated [31].

Prevention and Control

The intricate interplay of three elements (host, agent, and environment) determines the incidence of mastitis; therefore, the goal of any control program should be to address the mastitis issue related to these three epidemiological components. Among these methods are milking diseased animals last and keeping them from collapsing after milking. To guarantee that they are standing for a minimum of half an hour, feed them right away after milking. This ought to provide the teat orifice ample time to close properly [32]. Removal of the current illness by using appropriate milking, while the majority of Ethiopian households milk their cows by hand and do not wash their udders or teats before to milking, this could put dairy cows at risk for infections [33]. The implementation of control techniques should encompass all aspects and procedures of dairy farming, starting with upholding proper environmental hygiene standards. It's important to maintain the holding yards or stalls dry and clean. Ample and coliform-free water is required, and equipment needs to be cleaned and maintained in between milkings. Other recommended practices include dry cow therapy, maintaining accurate records, and reviewing the udder health management program on a regular basis [11]. As people's concerns about the treatment of farm animals grow, animal welfare is playing a bigger role in the contemporary dairy industry. The UK's Farm Animal Welfare Council has established "the five freedoms" of animals, which highlight concerns about how animals should be managed and treated. By putting such quality control measures in place, dairy cows would benefit from being free from stressful environments, injuries, pain, hunger, and discomfort. This would support the health of their udders overall and their immune systems in particular [34].

Prevalence of Sub clinical Mastitis in Ethiopia

Ethiopia has paid little attention to mastitis as a disease, particularly to its subclinical form, which is mostly caused by Staphylococcus aureus. Only treating clinical cases has been the focus of efforts. It is evident that this is a significant factor limiting dairy output due to the significant financial implications and the unavoidable existence of latent infection [35]. A number of nationwide investigations found that the prevalence of subclinical mastitis ranged from 23% to 85% [20,36], the prevalence of clinical mastitis from 2.6% to 62.9%) [37], and the prevalence of mastitis at the quarter level in both small and big dairy farms from 12.3% to 80.88% [38]. Mastitis generally has a significant financial impact on all dairy farmers as well as the nation's agro-pastoral and pastoral dairy production systems [33].

Economic Importance of Subclinical Mastitis

The subclinical type of mastitis in dairy cows is significant because it is hard to identify, occurs long before the clinical form, and is 15-40 times more common than the clinical form. It is contagious, which means that it lowers milk supply, degrades milk quality, and acts as a reservoir for bacteria that could harm other animals in the herd [39]. In addition to drastically reducing milk yield, the subclinically afflicted animals continue to infect other members of the herd. Long-term infections have the potential to create a fibrous tissue barrier that blocks the organisms' access to antibiotic formulations and reduces their effectiveness [12].

Public Health Importance

In addition to making milk unfit for human consumption, it has zoonotic significance and acts as a conduit for the spread of illnesses such sore throat, brucellosis, leptospirosis, Q-fever, and tuberculosis [23]. S. aureus infections in milk and other dairy products happen often. The primary source of enterotoxigenic S. aureus with animal origins is milk from infected animals.

For instance, some strains of S. aureus develop heat-resistant enterotoxins, which when consumed by humans can result in nausea, vomiting, and cramping in the abdomen. These enterotoxins are the source of outbreaks of staphylococcal food poisoning. Antibiotic residues in milk are a public health problem related to mastitis, as the condition is treated and controlled with antibiotics on a large scale. Antibiotic residues in food can sensitize healthy persons to antibiotics and, at low concentrations, can result in the emergence of antibiotic-resistant bacterial strains and severe reactions in those who are allergic to antibiotics [40].

Conclusion and Recommendations

Despite significant research efforts to increase the frequency of mastitis and provide new control measures, the condition's subclinical presence still poses a serious threat to dairy farmers. Poor milking hygiene, the contagious nature of pathogens, the lack of dry cow therapy, a lack of knowledge about the disease, a lack of strategic control measures against the disease, inadequate surveillance, a lack of strict hygiene maintenance, and a lack of a hygienic environment are all contributing factors to subclinical mastitis in dairy cattle in Ethiopia.

Therefore, based on the above conclusion the following recommendations have forwarded;

- Milking affected animals and their corresponding quarters, as well as routinely checking the udder's infection status.
- As a preventative approach, routine CMT can be used to identify subclinical mastitis early on.
- The optimal antibiotic to combat a particular kind of bacteria should be determined by identifying the causative agent.
- Farmers are responsible for maintaining and improving the general hygienic conditions of their farms, as well as for ensuring strict personal hygiene and animal hygiene.
- Milk and cows are screened for both symptomatic and subclinical mastitis.
- Dry cow therapy ought to be implemented.
- It is recommended to implement extension services and training programs that focus on raising awareness among smallholder dairy producers about the significance of preventing subclinical mastitis.

Author Statements

Author's Contributions

Conceptualization, writing-original draft preparation, T.M. Writing-review and editing, T.M

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