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Review on the Causes of Bovine Mastitis and its Effect in Ethiopia

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Abstract

In dairy industries mastitis remains the most economically destructive diseases usually resulted due to microbial infection. The disease manifested as inflammation of udder, is generally characterized as clinical and sub clinical form. Clinical mastitis is apparent with the sudden onset, alterations of milk quality and quantity with the presence of visible signs of inflammation while, the sub-clinical mastitis lack of visible signs on the udder. The paper was aimed to review causes of bovine mastitis and its effect in Ethiopia and to highlight the available literature reports on its management measures. The most common contagious pathogens to cause bovine mastitis are Staphylococcus aureus and Streptococcus agalactiae whereas, the coliforms particularly of E. coli and Klebsiella spp, are the predominant environmental pathogens reported across the different regions in the country. The management type, herd size, type of bedding material, milking mastitis cow, breed, age, parity, stage of lactation, milk yield, udder and leg hygiene, udder position and tick infestation are the potential risk factors described for prevalence of bovine mastitis in Ethiopia. Mastitis is harms animal health, milk quality, and milk production economics, it resulting in significant financial losses. The economic losses are seen directly and indirectly. Direct loses are Veterinary expenditures, additional labor requirements, rejected milk (during treatment), and reduced milk yield and quality. Indirect expenses, sometimes known as hidden costs, are those that are not necessarily visible to the milk producer. This are decreased fertility, long calving interval, increased risk of culling, and, on rare occasions, mortality. To control and prevent the prevalence of bovine mastitis and the associated economic loses, focus should be given to awareness creating keep biosecurity of the farmer and follow up milking procedures'. We the problem can be solved by regular screening and dry cow therapy.

Keywords: bovine mastitis, Ethiopia, causative agents, economic loses

Introduction

Ethiopia is located in tropical region and livestock production represents a major national resource and forms an integral part of the Agricultural production system and livelihood of the society. The country's economy is highly dependent on agriculture, which involves crop and livestock production in the highland areas and mainly livestock production in the lowland areas. Dairy farming is an important sub-sector of livestock production, and serves as a source of food and income to many resource poor communities in the country [1]. In country dairy farming is mainly under the extensive type of management system, which involves smallholder farmers in rural areas. Currently, there are also emerging semi-intensive and intensive dairy production systems, practiced by farmers who have good access to the markets. Milk and milk products are important source of food consumption for many people and are a rich source of protein. The country possesses the largest number of livestock population in Africa. However, the benefit of the country gains from the sector is far lower as compared to their potential of livestock. The dairy farming suffers from many constraints that limit this potential. The constraints are poor genetic potential, nutrition and diseases. Mastitis is the most common disease of dairy cows that causes low milk production [2]. It is inflammation of the mammary gland, is usually a consequence of a bacterial intra mammary infection. It can be presented with visible or invisible inflammatory responses of the udder. Mastitis with visible symptoms is called clinical mastitis, whereas mastitis without visible symptoms is called subclinical mastitis. Clinical mastitis is recognized by the presence of abnormal milk or udder characterized by discoloration, clots or swelling of the infected quarter [3]. Cows with acute clinical mastitis may show generalized symptoms such as fever, loss of appetite, reduced mobility due to pain in the swollen udder, and systemic shock. Mastitis also threatens animal welfare due to pain, higher mean rectal temperature, increased heart rate, and respiratory rate caused by clinical mastitis. Severe cases of mastitis can even result in the death of the infected animal. Subclinical mastitis refers to inflammation of the mammary gland in the absence of visible symptoms, which can develop into clinical mastitis. This type of mastitis causes an invisible reduction in milk production, changes in milk quality and composition. Severe or chronic inflammation can result in loss of quarter or teats. Cows with blind quarters produce less and are more likely to be prematurely culled than healthy herd mates [3].

Mastitis is a multifactorial disease involving various infectious agents as a causative agent with bacterial pathogens covering the greater share. The pathogens are normally found in feces, bedding materials, water supply, and feed, and transmitted by contact of the udder with those materials. The other form of mastitis is contagious mastitis that which the udder and teats serve as the reservoir of infection. Transmission occurs during the milking process or udder preparation by contaminated hands, udder cloths, and cleaners. The infection develops on the teat surface and in the teat canal. Bacteria can then enter the mammary gland and cause infection. The first one is clinical mastitis that characterized by the presence of gross inflammation signs (swelling, heat, redness, and pains). There are grossly visible changes in the udder and milk [1].

The disease has an economic impact on farms, either directly or indirectly, through reduced milk production and quality, high culling rate, decreased reproductive performance as well as treatment and control costs [4]. It is one of the most prevalent diseases of dairy animals. It is the most costly and devastating disease to the dairy industry because it imparts vast economic losses, compromising the health and welfare of animals, and due to its adverse effects on the quality and quantity of milk [5]. It also causes significant losses in milk yield (due to physical and chemical changes in milk), degradation of its nutritional and technical properties, fertility problems, and even systemic sickness, in addition to mammary gland health problems. It causes lower in milk output, milk condemnation, animal replacement, culling, and a drop in quarter-wise productivity [6]. This review gives the current understanding of the causes of bovine mastitis and its economic impact in Ethiopia.

The causes of bovine mastitis and its effect in Ethiopia

Definition about mastitis

Mastitis is defined by physical, chemical, and bacteriological abnormalities in the milk, as well as pathological changes in the udder glandular tissue. It's also known as mammary gland inflammation, which is caused by bacteria and their toxins [7].

Cause and prevalence of mastitis

Major causative agents of mastitis

A wide range of microbes are causative agents of mastitis include both contagious and environmental bacteria, in addition to fungi, algae, and viruses. Evidence-based studies have shown significant variation in the distribution of mastitis and mastitis-causing pathogens among countries, regions, and farms variations are influenced by farm management practices and regional environmental factors. It is widely accepted that bovine mastitis is mainly bacterial in origin especially *staphylococci*, *streptococci*, and *coliforms* are the most common pathogens associated with mastitis. Pathogens that cause mastitis are classified as infectious or environmental [8]. Contagious pathogens exist on and in the mammary gland of cows, where they grow and transfer from cow to cow, usually during milking. *Staphylococcus aureus, Streptococcus agalactiae, Mycoplasma spp., and Corynebacterium bovis* are all contagious pathogens. Environmental mastitis is a broad term that refers to intra-mammary infections caused by pathogens whose major reservoir is the cow's environment. *Streptococci,*other than *S. pneumoniae*, is the most commonly isolated environmental pathogens. gram-negative bacteria such as *Escherichia coli and Klebsiella spp. Agalactiae,* often known as environmental streptococci (typically S. uberis and S. disgalactiae) as well as Enterobacter spp. Environmental pathogens require moisture, favorable pH, and organic material for survival and they enter the gland through the teat canal. Pathogens in the environment can be found in soil, bedding materials, manure, and other organic waste [9].

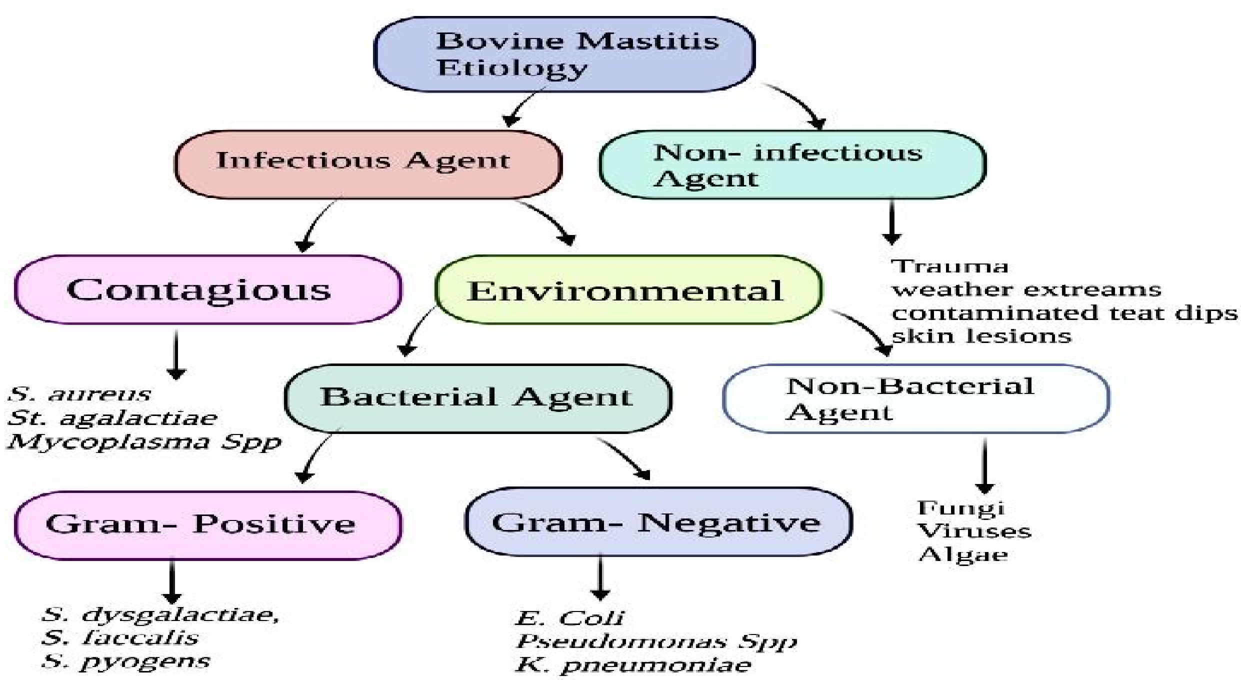

Figure 1 causative agents of mastitis [9]

Prevalence of mastitis in Ethiopia

Dairy farms in Ethiopia are not registered, and therefore, information on the exact number and distribution of dairy farms is lacking. However, reports indicated that the numbers of farms are increasing yearly although it does not commensurate with human population growth in the country. The number of herds, which are indicated below, is retrieved from prevalence studies carried out in different Regions. Most studied farms are similar in average herd size, milk production and farming practices. In addition, most farms are hand-milked, and cows are managed under zero-grazing conditions. However, the differences observed in prevalence of mastitis between studies might be explained by the differences between individual farm management, environment, and breed of the animals. The variability in prevalence of clinical mastitis among different studies conducted at different areas of the country might be attributed to differences in management practices, environmental conditions in the study areas and other factors. Unlike other countries, no longitudinal studies have been performed on clinical mastitis in Ethiopia. Consequently, the incidence and average duration of clinical mastitis cases are unknown [10].

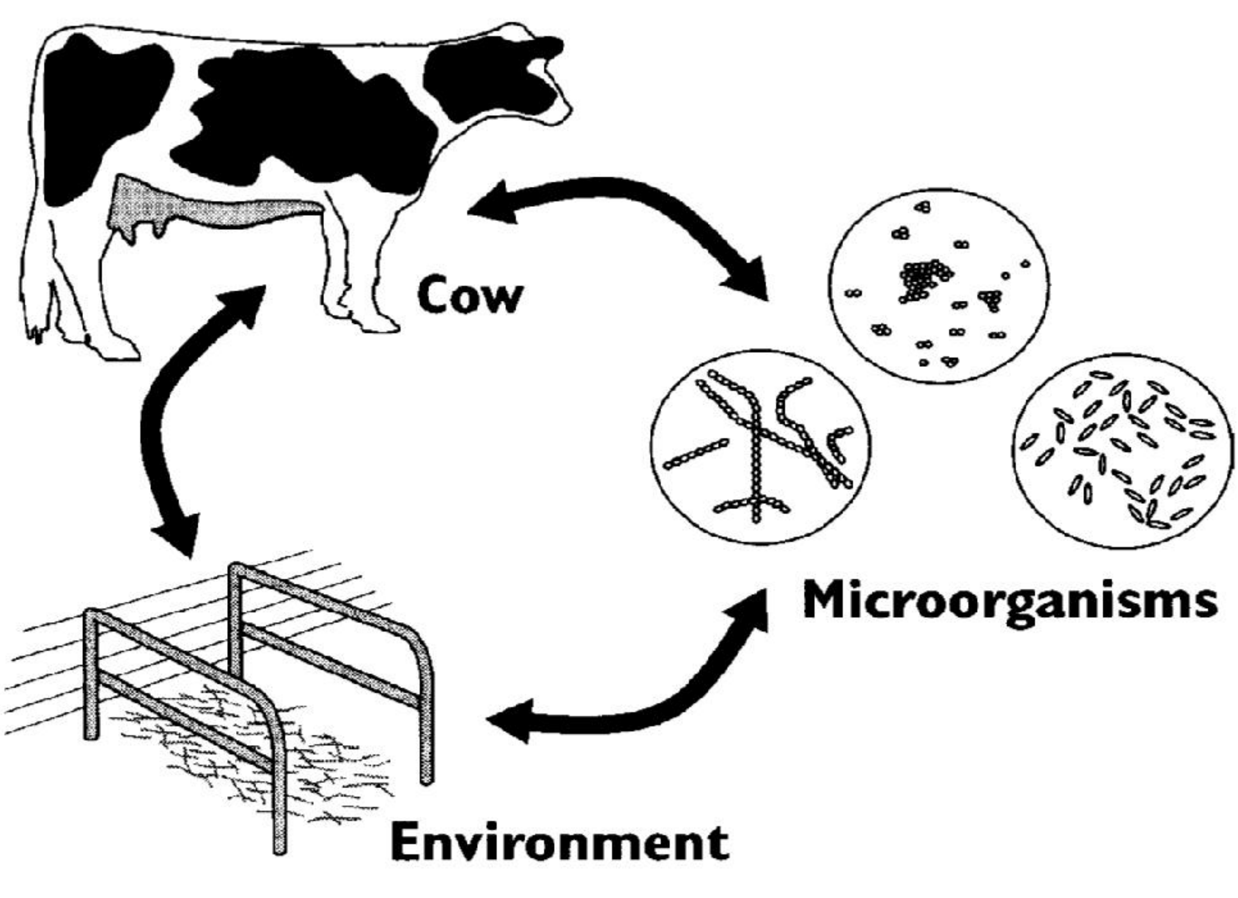

Figure 2 : Relation of mastitis and environment [10]

Types of mastitis

Mastitis, which is the inflammation of the udder and teats, exists in two primary forms: clinical and subclinical mastitis. Clinical mastitis, which is less prevalent, is characterized by systemic signs in the cow and visible abnormalities in the udder and milk. In contrast, subclinical mastitis is more common and results to reduced milk production without observable clinical signs or abnormalities in the udder or milk. For this reason, subclinical mastitis is challenging to diagnose, persists longer in the herd, and is associated with higher losses compared to clinical mastitis [11].

According to the Clinical Symptoms

Sub clinical mastitis

Mastitis can be classified as acute or chronic according to how long the infection lasts. Acute mastitis is defined by quick onset, whereas chronic mastitis is defined by an inflammatory process that lasts months and culminates in the progressive formation of fibrous tissue. Subclinical mastitis (SCM) is one of the most economically important diseases affecting the dairy industry. The SCM does not cause visible changes in the udder or physical changes of the milk as compared to clinical mastitis [9].

Clinical mastites

This is a kind of mastitis that has visible signs, such as clots in the milk or discoloration. Only flakes or clots develop in the milk in mild clinical mastitis (CM), whereas severe cases are accompanied by fever, edema and coloring of the udder, as well as irregular discharge. Systemic responses, such as fever and loss of appetite, can occur in severe CM. There also signs of Milk discoloration, contain clots, flakes, and the udder becomes hot, painful and disturbance of function of the udder [10].

Chronic inflammation

It can result in loss of quarter or teats. Cows with blind quarter's produce less milk. It is an inflammatory process that exists for months, and may persist from one lactation stage to another. It exists for the most part as subclinical, and may flare up periodically as sub-acute or acute form for a short period of time. The results are hard lumps in the udder from the walling off of bacteria, and the forming of connective tissue [7].

According to mode of transmission of pathogens

Mastitis can be categorized into contagious, and environmental mastitis [9].

Contagious Mastitis

Among infectious agents, bacterial pathogens are major threat to mammary gland of dairy cattle. These microorganisms are often contagious, widely distributed in the environment of dairy animals and thus increase t h e prevalence rate of intra-mammary. The sources of contagious mastitis are infected cows and transmission is from cow to cow, mainly at milking time through milking equipment, the milker's hands, and contaminated wash cloths. The principal contagious pathogens are *Streptococcus agalactiae, Staphylococcus aureus, Corynebacterium bovis, and Mycoplasma* spp. Among these, *S. aureus*, is currently the most frequently isolated contagious pathogen both in subclinical and chronic bovine mastitis. Incidence of contagious mastitis depends on the dose and type of microbes to which a cow is exposed as well as physical barriers, and the innate and acquired defense mechanisms. Among the bacteria, *Staphylococcus aureus, Streptococcus agalactiae,* and *Streptococcus dysagalactiae* have been recognized as the main causes of bovine contagious mastitis. *Staphylococcus aureus* is generally considered to be the most prevalent cause of intra-mammary infection in cows. It has been estimated that depending on the breed and geographical location of the herd, between 7-40% of all cows are infected with *S. aureus* at any given time [10].

Environmental mastitis

It is caused by organisms that do not normally live on the surface of the skin or in the udder, but enter the teat canal when the cow comes into contact with a contaminated environment. The primary source of environmental pathogens is the surroundings in which a cow lives. Those pathogens causing environmental mastitis (*Streptococcus uberis, Str. dysagalactiae,* coliforms, etc.) are present in the environment (bedding, flooring, droppings), and are generally transmitted in any time of cow's life: during milking, between milking, during the dry period, especially atfirst calving, in heifers. The cows confined in sheds have a greater risk to environmental mastitis as compared to cows, which are sent for grazing on pasture. Further, bedding materials serve as an important source for environmental microbes. It is reported that infection with environmental bacteria, such as *Enterobacter*, *Klebsiella* and *Streptococcus* is more frequently observed during early stage of dry period. On the other hand, *E. coli* infections tend to occur immediately before and after calving. It is thus very important for both far-off and close-up dry cows to be kept in lots with dry clean bedding to minimize the risk of new. Environmental mastitis is caused by potential pathogens found generally in the digestive tract of cattle [12].

Diagnosis and risk factors

Risk factors

Mastitis is a multifactorial disease. Identification of risk factors and characteristics associated with the likelihood of the disease, can lead to better control of mastitis. Different herd, cow, and quarter characteristics associated with pathogen specific [13].

Breed

In Ethiopia an increasing trend in the prevalence of Mastitis with increasing exotic blood levels. Accordingly, the prevalence is the highest in pure breeds followed by crosses; and indigenous zebu being less frequently affected than others. The increase in prevalence in exotic breeds as opposed to local indigenous zebus could be the indigenous zebu are low in milk production and Higher yielding cows are more susceptible to Mastitis. There are several reasons that contribute to higher yielding cows more susceptible to Mastitis. For instance, Production level, production systems under which the animals are kept. The risks of clinical and subclinical Mastitis increase significantly with increasing age of cows [12].

Lactation stage

Early stage and the period of involution (late stage) of the mammary glands were the most susceptible stages. This is possibly due to absence of dry cow therapy regime that is considered major factor contributing to high prevalence at early lactation [7].

Parity

The likelihood of Mastitis is higher in multiparous cows having four or more calving's compared with primiparous cows as studies conducted in Ethiopia shows. This partly, might be associated with the position of udder in older cows. Thus, all of the older cows particularly those with four or more parity had pendulous udder and it has also stated that cows with the most pendulous quarters appear to be the most susceptible to mammary infections. Prevalence of Mastitis is significantly associated with milking hygienic practice. Cows at farms with poor milking hygiene standard are severely affected than those with good milking hygiene practices. This might be due to absence of udder washing, milking of cows with common millers' and using of common udder cloths, which could be vectors of spread especially for contagious Mastitis. Again, the prevalence is also high in animal with udder or teat injury than those with no injury [4, 14].

Diagnosis

Physical Examination of the Udder

The presence of obvious indications of inflammation and abnormal milk led to the diagnosis of clinical mastitis. A quarter of the udders were found to be warm, swollen, and painful upon probing, indicating acute clinical mastitis [3, 15]. The viscosity and appearance of each quarter's milk discharge were also checked for clots, flakes of blood, and watery secretion. In cases of acute mastitis, the rectal temperature was checked to see if the infection had spread throughout the body. Chronic mastitis, on the other hand, was defined as atrophied, misshaped, hard, and fibrotic quarters. Tick infestation and any wounds in the udder were checked because they are both possible risk factors for future mastitis development, even in otherwise healthy udders [11, 16].

California Mastitis Test

California Mastitis Test was carried out for sub-clinical mastitis. In a horizontal plane, a drop of California Mastitis Test reagent was put to 4 cups of California Mastitis Test paddle, to which an equal amount of milk from the proper cow dung was added and carefully stirred (gentle circular motion was applied to the mixture in a horizontal plane for 15 seconds. Then test result was interpreted based on the thickness of the gel formed by the California Mastitis Test reagent and milk mixture and scored as negative (0), trace (T), + (weakly positive), ++ (distinctive positive), and +++ (strongly positive). Quarters with a CMT score of + or above were taken as positive. Cows were considered positive for CMT when at least one quarter is found to be positive for CMT. A herd was considered positive for CMT when at least one cow in a herd was tested positive for CMT. The prevalence of sub-clinical mastitis was calculated by subtracting the total number of blind teats and those with clinical infection from the total number of teats. The cows' age groups, parity, stage of lactation, milk yield, and body condition were grouped based on the classification used earlier by others. California Mastitis Test (CMT) positive milk samples were cultured and bacteria isolated. The isolated bacteria were checked for their antimicrobial susceptibility using Kirby-Bauer disk diffusion method [10].

Milk sample collection for bacteriology

Quarter milk was collected aseptically from the teat into a sterile tube according to the procedure described by National Mastitis Council (NMC). Milk collection was done early in the morning before milking. The veterinarian's hands were washed, disinfected and a new pair of gloves was worn before milk collection from each cow. The cow's udder, especially teat, was thoroughly washed with clean running water and dried with disposable paper towels. Later, the teats were disinfected with cotton wool soaked in 70% ethanol and allowed to dry. A ball of separate cotton wool was used for each teat. The first few streams of milk were discarded, and approximately 10mL of milk were directly stripped from teats into pre-labeled screw-capped sterile plastic tubes. The samples were transported at +4˚C in a cool box and stored at -20˚C in the Laboratory for emerging infectious diseases, then goes to Isolation and identification of bacteria [3,15].

Isolation and identification of coliforms and other bacteria

Each quarter milk sample was cultured for bacterial isolation using standard procedures. An aliquot of 10μl of milk sample was inoculated by streaking on MacConkey agar. Each frozen milk sample was thawed only once at room temperature and mixed vigorously. Unless otherwise stated, all incubations were done at 37˚C for 24–48h. Colonial morphology, lactose fermentation and Gram reaction aided identification. Gram-negative bacteria were subcultures on eosin methylene blue for presumptive identification of *E. coli*. For bacteriological examination milk sample collection is required. While taking sample from cow teats towards sample collection were sampled first and then the far side ones. The first 3 to 4 streams of milk were discarded as it may complicate the diagnosis. After collection, the sample is subject to bacterial culture and isolation within 7 to 10 days. As described by aseptic procedures for collecting quarte rmilk samples were followed. The time chosen for milk sample collection was before milking. Udders and especially teats were cleaned by antiseptic's and water and dried before sample collection [17].

The polymerase chain reaction is a molecular technology that can be used to identify pathogens as an alternate test. PCR is a technique for detecting DNA sequences that are particular to a species or a group of bacteria. As a result, the presence or absence of bacterial DNA in both live and non-viable organisms may be confirmed. The invention of a PCR assay to detect mastitis-causing microorganisms was prompted by the need for a quick and accurate diagnostic. Even though the PCR assay is a promising diagnostic technique for mastitis diagnosis and control, it has some limitations, including the lack of specific guidelines or cut-off points for the definition of sample contamination, unlike BC; and its use in developing countries is limited in comparison to developed countries (economic reasons), the potential for false-positive results due to milk carryover (defined as the transfer of a small amount of milk from one cow sample to the next at the time of collection due to the presence of residual milk in the milking unit, milk meter, or milk sampler), the applicability of pre-sampling procedures, and the inability to distinguish between viable and nonviable bacterial cells [18].

Epidemiology

Epidemiological Aspects of Mastitis Breast/udder health depends on a balanced interaction between host and its micro biota, which may contain microorganisms ranging from probiotic to potentially infectious [19].

Microbial Factors

The mammalian ecosystem is hospitable, or at least receptive, to many microorganisms including most of the bacterial groups that have potential to cause mastitis. The evolutionary process has led to state of mutual acceptance or tolerance. However, upon disturbance localized or disseminated invasive infections can occur. Unfortunately, the exact causal events leading to the transition from colonization to infection still are ill defined in vivo. The ability to colonize and, eventually, infect a host depends on several microbial characteristics, including the expression of several virulence factors, In relation to different staphylococcal species [2].

Host Factors

In cattle, older animals with 3 or more lactations have a higher prevalence of subclinical and clinical mastitis during middle and late lactation. In contrast, primiparous cows have a higher incidence and prevalence of clinical mastitis immediately after parturition [2, 20].

Nutritional status

under nutrition, reduced plasma levels of micronutrients, including zinc and vitamin A, and antioxidants including selenium and vitamin E are associated with subclinical mastitis. Limited availability of the same antioxidants is a known risk factor for clinical and subclinical mastitis in dairy cattle. Dairy cows produce more milk than needed for their offspring, and as a result, major nutritional imbalances can be observed particularly at the onset of lactation leading to a higher risk for mastitis. Cows around parturition and during early lactation often experience negative energy balance. This status is caused by a reduced dry matter intake and increased energy expenditure in fetal growth and milk synthesis [8].

Pathogenesis

Pathogenesis of mastitis is the key for the development of appropriate detection techniques. The primary cause of mastitis is a wide spectrum of bacterial strains; however, incidences of viral, algal and fungal-related mastitis. Normally, the teat canal is tightly closed by sphincter muscles, preventing the entry of pathogens. The teat canal is lined with keratin, a waxy material, which prevents the migration of bacteria. However, the efficiency of keratin is restricted. Fluid accumulates within the mammary gland as parturition approaches, resulting in increased intra-mammary pressure, and mammary gland vulnerability is caused by the dilation of the teat canal and leakage of mammary secretions. Additionally, during milking, the keratin is flushed out, and there is distention of the teat canal. The sphincter requires approximately 2 hrs to return back to the contracted position. Once inside the teat, bacteria must also elude the cellular and humeral defense mechanisms of the udder. If they are not eliminated, they start multiplying in the mammary gland. They liberate toxins and induce leukocytes and epithelial cells to release chemo attractants, including cytokines such as tumor necrosis factor-a (TNFα), interleukin (IL)-8, IL-1, eicosanoids (like prostaglandin F2α (PGF2α)), oxygen radicals and acute phase proteins (APPs) (e.g. haptoglobin (Hp) serum amyloid A (SAA). This attracts circulating immune effector cells, mainly poly morpho- nuclear neutrophils (PMNs), to the site of infection. PMNs act by engulfing and destroying the invading bacteria via oxygen-dependent and oxygen independent systems. They contain intracellular granules that store bactericidal peptides, proteins, enzymes (such as myeloperoxidase) and neutral, and acidic proteases (such as elastase, cathepsin G, cathepsin B and cathepsin D). The released oxidants and proteases destroy the bacteria and some of the epithelial cells, resulting in decreased milk production, and release of enzymes, such as N-acetyl-b-D-glucosaminidase (NAGase), and lactate dehydrogenase (LDH). Destruction of most of the PMNs takes place by apoptosis once their task is fulfilled. Subsequently, macrophages engulf and ingest the remaining PMNs. The dead and sloughed off mammary epithelial cells, in addition to the dead leukocytes, are secreted into the milk, resulting in high milk SCCs. When the infection persists, there is internal swelling in the epithelium of mammary gland. The mammary gland alveoli become damaged and start losing anatomical integrity. The blood-milk barrier is breached, causing extracellular fluid components, such as chloride, sodium, hydrogen, potassium and hydroxide ions, to enter the gland and mix with the milk. When extensive damage to the blood-milk barrier has occurred, blood might be detected in the milk. This leads to visible changes on the udder, such as enhanced external swelling and reddening of the gland. Changes also occur in the milk, including increased conductivity, increased pH, raised water content, and the presence of visible clots and flakes [5].

Control and prevention

Doing improved milking procedures like milk clean, dry teats, keep liner slips to a minimum, teat teat dip with an effective germicidal teat dip and maintain the milking system. Eliminating infections by treat all quarters of all cows at drying-off with antibiotic products specifically designed for dry-cow therapy and cull chronically infected cows. To prevent Environment by Keep the cow environment as clean and dry as possible, prevent sows from having access to manure, mud or pools of stagnant water, know that the dry-cow environment is as important as the lactating-cow environment, keep the calving area clean and properly design and maintain free stalls. Culling cows for mastitis is effective in eliminating mastitis in the herd. Cows that have been treated many times in a single lactation are prime candidates for culling because they no longer may be profitable as the result of discarded milk and antibiotic costs. Carrying out preventive mastitis control procedures and culling only old, chronic cows usually is more profitable than trying to control mastitis by routine culling [21].

Effect of mastitis in Ethiopia

Economic losses of clinical and sub-clinical mastitis in Ethiopia

The huge financial losses are attributed due to mastitis globally. Milk and its outputs are economically significant farm supplies, and livestock farming is a good investment option as it plays a major role in feeding pastoral as well as non-pastoral communities in Ethiopia (Abegaz, 2022). In contrast, some authors in human literature consider Mastitis as either an infectious or non-infectious disease. Mastitis is the most serious problem in the dairy industry, causing enormous economic losses. Milk production, milk quality, and treatment, labor, and maintenance costs all rise. The slaughter of a severely affected cow also results in significant economic losses. Changes and abnormalities in the physical and chemical properties of milk occur in the mammary gland [21].

Milk production losses

Intramammary infection, even at subclinical levels, has been shown to have a deleterious impact on milk production. Physical injury to the breast parenchyma of the damaged mammary gland is mostly to blame for the decrease in milk output. Milk output is reduced in both clinical and sub-clinical mastitis. Furthermore, the reduction in milk production does not occur only during the mastitis case; even after the mastitis case is treated, the cow's milk production remains lower. Because this is milk that was never produced and thus never seen, the producer is unaware of the loss in milk production. The financial impact of decreasing milk production per cow is determined by the farming business's structure. Milk must be removed on treatment days and waiting periods due to the treatment of a clinical case. The cost of therapy is divided into two parts: veterinary expenses and drug costs. These two costs differ by country [3].

Conclusion and Recommendations

Mastitis-causing pathogens can be grouped into Gram-positive or Gram-negative based on their Gram-staining characteristics or major or minor pathogens based on potential damage they cause to the host or contagious or environmental based on their mode of transmission. Contagious mastitis pathogens are in the infected mammary gland of the host, and mainly spread from infected to uninfected udders during milking. The cow's environment is the main source of infection for environmental mastitis causing pathogens. Their number can be high in soil, manure, bedding, or contaminated water. Staphylococci, Streptococci and coliforms are the most common causes of bovine mastitis. Antibiotic use and success can be influenced by combinations of multiple factors such as host, environment, and management.

Unsuccessful treatment of the disease leads to economic losses and decline of production. Thus, awareness creation for farm owners about regular testing for subclinical mastitis, pre- and post-milking udder washing, and proper sanitation of bedding should be applied to dairy farms to overcome the problem in the study area. In addition, there should be a regular pattern of diagnosis of mastitis in order to minimize the disease prevalence and cull chronically infected animals.

Based on the above conclusion the following recommendations are suggested to overcome the current scenario for milk and dairy products and their supply chain.

• Regular screening for early detection and treatment, follow up of chronic case, and control of subclinical Mastitis are recommended to alleviate the problem.
• The sub clinical Mastitis which is highly prevalent and economically important should gain attention. In this regard awareness should be created on the importance of this type of Mastitis to farmers. Poor milking, environmental and personnel hygiene should be avoided in order to prevent cross contamination and increased chance of infection.
• Hygiene of the workrs, milking equipment, and cows in the milking and husbandry system should be considered in attempt to reduce the occurrence of mastitis in the study area.
• Culling of chronically affected and old cows, screening the cows for clinical and subclinical mastitis should be practiced.
• Extension services and training programs focused at the creation of awareness at significance and prevention of subclinical mastitis in dairy farms and small stockholders, milking infected animals and respective quarters, at last, is recommended.

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