Review on Mastitis and Its Economic Effect

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Abstract: Mastitis has long been recognized as one of the most costly diseases affecting dairy cows, worldwide. Mastitis is a disease that occurs in two main forms: clinical and sub-clinical mastitis. Clinical mastitis produces obvious clinical signs that call for the dairy farmer’s attention and prompt veterinary care. Sub-clinical mastitis on the other hand often goes unnoticed and can only be detected if specific tests are performed on a milk sample. Sub-clinical mastitis has an erosive effect on the economy of dairy farms as it causes a direct loss in milk quantity and quality in affected cows/farms. The clinical manifestations are increase in white blood cells and decrease in ion balance and also inflammation of the udder. To diagnose this methods are California mastitis test, clinical examination, somatic cell count and measurement of pH. Mastitis is the most important reason for the culling of cows and a major cause of economic loss in the dairy industry. Treatment is possible with long-acting antibiotics, but milk from such cows is not marketable until drug residues have left the cow's system. Antibiotics may be systemic (injected into the body), or they may be forced upwards into the teat through the teat canal (intra mammary infusion). Mastitis control strategies include creating awareness of people on the management practices like milking and housing hygiene need to be initiated and promoted.

Key words: California Mastitis Test • Clinical Mastitis • Control Strategies • Somatic Cell Count • Sub-Clinical Mastitis

INTRODUCTION

Mastitis has been known to cause a great deal of loss or reduction of productivity, to influence the quality and quantity of milk yield and to cause culling of animals at an unacceptable age. Most estimates have shown a 30% reduction in productivity per affected quarter and a 15% reduction in production per cow/lactation, making the disease one of the most costly and serious problems affecting the dairy industry worldwide. The disease generally involves interplay between management practice and infectious agents. Among various infectious agents, bacterial pathogens (the greatest share of these organisms) have been known to be widely distributed in the environment of dairy cows, constituting a threat to the mammary gland. Moreover, a single quarter infected for one lactation may reduce milk production of the cow to 10% to 12% in that lactation [1].

The disease is worth to study as it incurs financial losses attributed to reduced milk yield, discarded milk following antibiotic therapy, early culling of cows, veterinary costs, drug costs, increased labor, death in per acute septicemia/rare cases and replacement costs [2]. For this reason, more and exact knowledge from expended epidemiological analysis of mastitis, needed for creating better control program.

Very little attention is given to mastitis in Ethiopia. Efforts have only been concentrated on the treatment of clinical cases. In Ethiopia, even though the disease of mastitis has been known locally, it has not been studied systematically; making information available on the prevalence of disease and associated economic loss inadequate [3]. And therefore the objectives of this review paper are to highlight the knowledge concerning the effect of mastitis on productivity of dairy cows and to review major mastitis pathogens, risk factors and its economic importance.

Definition: The term mastitis generally refers to an inflammation of the mammary gland, regardless of the cause. The classic meaning of the word mastitis is derived from the Greek word “Matos” meaning breast or udder and the suffix “itis” meaning inflammation. It also defined as an inflammation of the mammary gland, almost
invariably due to the effects of bacterial or mycotic pathogens. It is characterized by a physical, chemical and usually bacteriological change in the milk, as well as pathological changes in the glandular tissue [4].

**Etiology:** Mastitis occurs when white blood cells (leucocytes) are released into the mammary gland, usually in response to an invasion of bacteria of the teat canal. Milk-secreting tissue and various ducts throughout the mammary gland are damaged due to toxins by the bacteria. Bacteria are the most common cause of mastitis in dairy cows. Reports indicate that more than 137 microbes are incriminated as etiological agents of mastitis [5]. The microbial causes of mastitis include a wide variety of micro-organisms (aerobic and anaerobic bacteria, mycoplasmas, yeasts and fungi). The most important microorganisms of bovine mastitis are streptococci, staphylococci, Escherichia coli and other coliforms [6]. The degree of importance of a specific agent, as a cause of mastitis in dairy cows, is largely dependent on the nature of the organisms, the pathogenicity of the agent, the challenge dose required to cause infection and is influenced by management practices. Because most pathogens involved in mastitis are ubiquitous, mastitis can be managed but not eradicated.

Common mammary pathogens grow well in milk. This generally requires them to be able to use lactose as a source of carbon and have sufficient proteolytic activity to ensure an adequate supply of nitrogen (N) for the hydrolysis of casein. Once inflammation has developed, leakage of plasma into the milk and increased proteolytic activity in the milk produce compositional changes, which per se are likely to stimulate bacterial growth by providing readily available N. The vitamin requirements of bacteria may be a factor in their growth in milk and therefore in pathogenicity, particularly if vitamins required are unavailable for them because such vitamins are associated with binding of proteins in milk [4]. Mastitis can also occur as a result of chemical, mechanical, or thermal injury.

**Occurrence:** Mastitis is a disease that affects a large number of dairy cows throughout the world. In most countries surveys of the incidence of mastitis, irrespective of cause show comparable figure as about of 40% morbidity rate amongst dairy cows & a quarter infection rates as measured by an indirect test of about 25% [1]. An annual basis 3 of every 10 dairy cows have clinically apparent inflammation of the mammary gland of the affected cattle, 7% are culled and 1% dies as a sequence of the disease [7].

**Source of Infection:** Contagious microorganisms are usually found on the udder or teat surface of infected cows and are the primary source of infection between uninfected and infected udder quarters, usually during milking. *Staphylococcus aureus* is the species most frequently isolated from bovine mastitis, a disease responsible for significant economic losses all over the world [8]. The organisms that fit into this category include: *Staphylococcus aureus* (coagulase positive staphylococci), *Streptococcus agalactiae* and the less common sources of infection caused by *Corynebacterium bovis* and *Mycoplasma bovis* [9]. Environmental pathogens are found in the immediate surroundings of the cow, such as the sawdust and bedding of housed cows, the manure of cattle and the soil. Bacteria include streptococcal strains other than *S. agalactiae*, such as *Streptococcus dysgalactiae*, *Streptococcus uberis* and *Streptococcus bavis*, *Enterococcus faecium* and *Enterococcus faecalis* and coliforms such as *Escherichia coli*, *Klebsiella pneumonia* and *Enterobacter aerogenes* [10].

Mastitis caused by environmental organisms is essentially opportunistic in nature and becomes established if the immune system of the host is compromised or if sanitation and hygiene is not adequately practiced [11].

Opportunistic pathogens result in mild forms of mastitis and include coagulase-negative staphylococci. The coagulase test correlates well with pathogenicity and strains that are coagulase-negative are generally regarded as non-pathogenic [9]. These staphylococci occur commensally and may be isolated from milk but usually illicit a minor immune response in cattle and infections caused are slight. They include *S. epidermidis*, *S. saprophyticus*, *S. simulans* [12] and *S. chromogenes*.

Many other bacteria and even yeasts may be responsible for causing mastitis, but are less common and occur if conditions in the environment change to increase exposure to these organisms. A condition known as “summer mastitis” occurs mostly in European countries in the summer months when wet, rainy conditions prevail. The source of infection is usually traced to an increase in exposure of the cows to flies in pastures that transmit infecting *Arcanobacterium pyogenes* and *Peptostreptococcus indolicus* strains and is more common in non-lactating cows [13]. Mastitis caused by *Pseudomonas aeruginosa* is often traced to contaminated water sources and will result in a condition similar to coliform mastitis infections where endotoxemia occurs. *Nocardia asteroides* causes severe cases of mastitis resulting in fibrosis and permanent damage to mammary
tissues [9]. Treatment is usually ineffective and has a high mortality rate occurs. The source of the infection caused by *Nocardia asteroides* is usually from the soil and could be prevented by ensuring that effective sanitation measures are enforced before treatment with intramammary infusions [14]. Less common causes of bovine mastitis include *Bacillus cereus*, resulting in peracute and acute mastitis and also the human pathogens *Streptococcus pyogenes* and *S. pneumonia* that causes acute mastitis and is accompanied by fever symptoms in the host [9].

**Types of Mastitis:** Mastitis may be classified as clinical or sub clinical depending on the degree of inflammation [15].

**Clinical Mastitis:** Clinical mastitis can be defined as farmer observed abnormality in the milk and/or the udder. It is inflammation of the mammary gland with grossly visible changes in the udder and milk. It is characterized by abnormalities such as discoloration of milk, redness, increased temperature, pain and disturbance of function [1]. Clinical forms of mastitis may further be classified according to the severity of the inflammatory response as mild, acute, per acute or chronic. Clinical mastitis occur in all dairy herds, even in well managed herds as judged by somatic cell count level and cows with a high level of milk production, may be suffering from a high incidence of clinical mastitis, [16]. The most important bacteria that cause clinical mastitis are *Staphylococcus aureus*, *Escherichia coli*, klebsilla spp, *Streptococcus uberis* and *Streptococcus dysgalactiae*.

**Acute Clinical Mastitis:** Cases of acute clinical mastitis are always associated with distinct symptoms of udder inflammation, e.g. redness, swelling, elevated body temperature (above 39°C) and increased sensitivity of the udder skin and tissue, as well as changes in milk Secretion. The secretion of the mammary gland is visible altered; the milk often has a different consistency and appearance than normal milk [1, 4].

**Per-acute Clinical Mastitis:** This is the most serious form of mastitis. It commonly destroys extensive portions of udder tissue, affects the general well-being of the animal and frequently kills the cow. Symptoms like pain, fever (above 41°C), swelling, redness, shock, depression, Shivering and dehydration and body weight loss are common in affected cows [4].

**Chronic Clinical Mastitis:** Inadequate treatment of acute forms of mastitis is often the major reason for the development of chronic clinical mastitis. In this form of mastitis, the disease episode lasts for several weeks or months. Usually it is repeated but mild clinical attacks, generally without fever. The milk seems to have a lumpy texture and the quarters are sometimes swollen. The quarters may become hard (fibrous indurations). Antibiotic treatments often do not work and this seems to be the most obvious explanation why mastitogenic bacteria frequently survive in chronically affected udders. These are excreted with the milk and spread to healthy and susceptible udders by means of the bilker’s hands and or the milking machine. Thus, cows with chronic clinical mastitis are very dangerous sources of infection for healthy cows [4].

**Sub-acute Clinical mastitis:** This form of mastitis is a very mild and gradual progressive form of the disease.

Deviations from the healthy conditions of the udder are minimal and frequently Amount only to a reduction in milk yield and limited microscopic changes in the milk. Often flaky particles in the milk is observed, especially in initial ejection of milk [4].

**Environmental Mastitis:** This type of mastitis caused by bacteria such as coli form bacteria (e.g. *E. colli*) of which the main cause is a contaminated environment e.g., manure. Dairy cows may lie down in an enclosed area with a lot of manure present; therefore the coli form like bacteria can get easy access to the udder and teat canal [4].

**Sub Clinical Mastitis:** Sub clinical mastic refers to inflammation of the mammary gland in the absence of visible gross lesions in the udder or its secretion with the presence of pathogenic microorganisms and unusual number of somatic cells in the milk [1, 17].

**Infectious Sub-Clinical Mastitis:** The most important symptoms of infectious sub-clinical mastitis are elevated SCC’s and the presence of pathogenic bacteria in the milk, as well as decreased milk yield from the infected udder [18].

**Non-Infectious Sub-clinical Mastitis:** Non-Infectious or aseptic sub-clinical mastitis is characterized by an elevated SCC and the absence of pathogenic bacteria in milk and develop under traumatizing Conditions.
Irrespective of its cause, aseptic mastitis indicates a high risk factor or pre-disposing condition for the development of infectious mastitis [4].

It can be recognized by tests that detect infecting microorganisms or the products of inflammation such as somatic cells. Because of its subtleness, it may be overlooked but it is very important for the reason that, it is 15 to 40 times more prevalent than the clinical form; it is of long duration, reduces milk production and adversely affects milk quality [15, 19] suggested that the high prevalence rate of sub clinical mastitis as compared to clinical mastitis is due to the defense mechanism of the mammary gland acting to minimize the severity of the disease.

**Modes of Transmission:** Mastitis is most often transmitted by contact with the milking machine and through contaminated hands or materials. Various mechanisms of transmission have been identified, including flies and fomites found in the milking parlor, such as milking equipment, makers’ hands, common udder cloths and strip cups found IMI prevalence of 5.2% in herds that practiced fly control vs. 55.2% in herds that did not. Milk droplet impacts on teat ends due to malfunctioning milking equipment may also induce new S. aureus IMI. Literature indicates that S. aureus can be isolated from the environment, mammary secretions, streak canals and/or body sites of most dairy animals. Researchers have concluded that reservoirs for infection are most likely udders of infected heifers and cows. *Staphylococcus aureus* isolated and “fingerprinted” as those bacteria responsible for IMI were found to most likely originate from *S. aureus*-infected milk or body sites and could be transmitted from animal to animal by flies. Additional means of transmission include calves suckling other calves, especially those fed waste or mastitis milk. It is possible that all mechanisms of spread of *S. aureus* IMI are not yet known [18].

**Risk Factors**

**Environmental Risk Factor:** One of the environmental risk factor is season. Most cases occur during summer months in housed cattle & are commonly environmental infections; especially if the season is wet prevalence of infection is greater. Milking practice include efficiency of milking person, milking machine, too high milking speed management system [1]. Without proper management factors such asreproductive cycles, rearing, sheltering, culling, feeding, milking, hygiene, disease control and prevention can have a huge impact on the occurrence of mastitis. Geographic, seasonal, climatic and weather conditions eliciting stress in dairy cattle [4].

**Host Risk Factor:** Includes age of the animal, stage of lactation, breed & milk yield. The incidence of infected quarters increases with age, peaking at 7years, stage of lactation, most new infections occurs in the first 2 months of lactation, especially the environmental infections but in heifers there is a much greater incidence in the first month after calving. High yielding cows are generally considered to be more susceptible to mastitis & teat injury [1].

**Pathogenic Risk Factors:** Includes bacterial viability, colonizing ability & susceptibility to antibiotics. Bacteria viability means the ability of the organism to survive in the cows’ immediate environment, that its resistance to environmental influence including cleaning, disinfection procedures is characteristics of each species of bacteria. The causes of contagious mastitis are relatively vulnerable to the external environment than the cause of environmental mastitis. Colonizing ability; means the ability of the organism to colonize the teat duct, then to adhere to mammary epithelium & set up mastitis reaction. Susceptibility to antibiotics; means inherent or acquired resistance to antibiotics therapy usually due to excess exposure to the agent [1].

**Genetic:** Deficiencies of certain characteristics of modern dairy cows e.g. size shape and suspension of udder, morphology of teat and teat canal, milking ability and milk flow rate that affect the natural defense mechanisms of the udder against infection [18].

**Physiological:** Stress, milk stasis, mammary regression, fluctuating activity of the leucocytes udder barrier, parturient edema, stage of lactation, composition of udder secretion, age [4].

**Pathological:** Circulatory disturbances (e.g. hemorrhages, haematoma and edema). Trauma of udder and teats (e.g. external and internal lesions, penetrating and non-penetrating lesions of the teats). Disease other than mastitis (e.g. febrile diseases, metabolic diseases, disturbances of the digestive tract, genital conditions, skin diseases of udder/teats [4].

Bovine mastitis often follows a number of major factors involving the cow, the pathogen and the environment [19]. The general predisposing factors...
influencing the occurrence of mastitis are hygiene, milking equipment and techniques, housing conditions, breed, level of production, the shape of the udder and teats, season and bacteria present in the environment [1, 19].

Cows with large or pendulous udders are more susceptible to mechanical injuries which frequently predisposes to infection. Susceptibility to infection also increases with the length and diameter of the teat canal, consequently quarters with high milk flow rate due to dilation of the teat canal are more likely to be infected [1]. Susceptibility to infection increases with age perhaps because the teat canal becomes longer and more dilated with lactation. Inherent difference between cows is thought to affect susceptibility [20]. Infection with non-pathogenic organisms such as *S. epidermidis* and *C. bovis* cause elevation of milk cell counts. This increases the protection of the udder against infection. Furthermore, cows infected with *Str. agalactiae* or *S. aureus* are unlikely to succumb to Coli form infections. An unusual but striking form of mastitis with edema ("Flabby udder") may be caused by Leptospira. The pathogenesis and effect of this infection are still not fully understood [21].

**Clinical Sign:** The bacteria factors directly or indirectly serve as chemoatractance for leucocytes, immediate host response. If bacteria are to survive this response, the inflammation continues resulting somatic cell migration b/n adjacent mammary secretary cell toward the alveolar lumen. Prolonged diapedeses of leucocytes causes damage of mammary tissue, resulting in decreased milk production. Bacterial infection in the udder also increases permeability & alters the plasma content in the milk w/c turn alters ion balance. The alveolar epithelium is damaged by inflammation or by pressure from adjacent inflammatory process resulting in secretion of less milk [22].

**Diagnosis of Mastitis**

**Clinical Examination:** Individual udder quarters are examined for abnormal type of size, consistency, symmetry, fibrosis, inflammation signs by thorough inspection & palpation. Milk is examined for the detection of abnormalities such as discoloration, blood ting, wateriness, clots, flakes & pus [6].

**Somatic Cell Count (SCC):** The determination of SCC is widely used to monitor udder health. SC is normal Constituent of milk & only when they become excessive indicates the problem. When combined with bacteria logical culture results the factor of great importance can be determined. When SCC is elevated they consists primary leucocytes. During inflammation the major increases is SCC because of the influx of PNM into milk. The count in a healthy udder quarter of the cow should be fewer than 100 000 cells ml) [23]. A level >200 000 cells ml) indicates infection [24].

**Measurement of pH:** Normal milk has pH between 6.5 and 6.7. This figure approximate to that of the blood (7.2-7.4) when infection is present that it tends toward alkalinity with the use of reagent (sodium hydroxide) [25]. The procedure is either to use a tube containing 10cc milk add 2cc normal sodium solution & shake & observe the result or to deposit 5 drops of milk on slide, add 1 drop of sodium hydroxide, shake for 15sec. & read on a black back ground in the tube precipitation is manifested by a gelatinous appearance on the slide by the formation of flocules [26].

**California Mastitis Test (CMT):** CMT is simple, inexpensive, rapid screening test for mastitis. This test is based on a gelling reaction between the nucleic acid of the cells & reagent [25].

**Bacteriological of Milk:** The laboratory procedure of inoculating standard volume of hygienically collected milk agar culture medium has been the standard diagnostic method for bovine mastitis. The resulting bacterial growth is observed, quantified & tested. In fact use of milk culture is wide spread as a measure of determining udder health status. It has become the definitive standard diagnostic test [1].

**Pathology and Virulence Factors:** In addition to being commonly isolated from dairy animals, *S. aureus* is highly pathogenic and persistent in the mammary gland. Virulence factors possessed by *S. aureus* are partially responsible for the sub clinical, chronic type of mastitis that causes damage to secretory cells of the mammary gland. *Staphylococcus aureus* IMI cannot be solely characterized as sub clinical and chronic. In rare cases, *S. aureus* mastitis can be per acute, gangrenous and fatal [1]. Literature indicates that not all virulence factors relevant to *S. aureus* IMI have been discovered. Known virulence factors help *S. aureus* to evade the host’s immune defense and resist infused or parenteral antibiotics. Hyaluronidase is an enzyme possessed by *S. aureus* that enables it to penetrate mammary tissue to which it has
adhered. Micro abscesses form and eventually develop scar tissue which is impermeable to antibiotics. *Staphylococcus aureus* can be released if the micro abscesses or scar tissue breaks down. This contributes to chronicity, clinical flare-ups and the ability of the infection to spread further within the gland. *Staphylococcus aureus* also possesses another enzyme, coagulase, which is used to differentiate *aureus* from other *Staphylococcus* species. Coagulate reacts with inflammation products, yielding fibrin-like clots. These clots inhibit leukocyte mobility and hinder the action of the host’s immune system phagocytes. These clots may also prevent drainage of milk from ducts of the gland and lead to stasis or destruction of secretory cells. *Staphylococcus aureus* also releases toxins, including alpha, beta, gamma and delta toxins. Of these, alpha toxin appears to be the most toxic. It is particularly harmful to mammary tissues causing vasoconstriction, which leads to localized ischemia and cell necrosis. In times of rapid *S. aureus* growth, the effects of alpha toxin may lead to gangrenous mastitis. Additionally, Foster *et al.* noticed a lack of macrophages and neutrophils in areas where alpha toxin-producing *S. aureus* were growing in *in vitro* mouse mastitis models. The authors theorized that this was due to decreased chemo taxis of macrophages and neutrophils into regions where alpha toxin-positive bacteria were growing. Early research found that beta and gamma toxins were mostly tissue irritants, with beta toxin being the most predominant toxin of *S. aureus* isolated from animals. However, beta toxin has been found to increase bacterial growth in *in vitro* mouse mastitis experiments. Alpha and beta toxins and leukocidin caused cell damage and decreased secretory activity in mammary explants. More recent research indicates that alpha and beta toxins may play a significant role in *S. aureus* adherence to mammary epithelial cells. Some research has contradicted the idea that adherence is necessary for establishment of *S. aureus* IMI. Evaluated factors affecting *S. aureus* adherence to cultured mammary epithelial cells. Their data suggested that cellular damage by alpha toxin is a necessary step for *S. aureus* adherence in the mammary gland [18]. Mastitis can cause a decline in potassium and lactoferrin. It also results in decreased casein, the major protein in milk. As most calcium in milk is associated with casein, the disruption of casein synthesis contributes to lowered calcium in milk. The milk protein continues to undergo further deterioration during processing and storage. Milk from cows with mastitis also has a higher somatic cell count. Generally speaking, the higher the somatic cell counts, the lower the milk quality.

**Prevalence of Bovine Mastitis:** Prevalence of *S. aureus* in prepartum and prim gravid heifers ranges from 2.6 to 37.1%, with percentage of infected quarters ranging from 0.7 to 15.4%. *Staphylococcus aureus* has also been found to account for 2.4 to 46.2% of all intramammary infections (IMI) in primiparous animals near parturition prevalence of *S. aureus* in postpartum, primiparous heifers ranges from 2.8 to 20.4%, with the percentage of infected quarters ranging from 0.4 to 3.4 and found *S. aureus* prevalence in mixed parity animals to range from 9.1 to 33.7% using data from multiparous cows. It is understandable that the percentage of *S. aureus*-infected animals and quarters varies, as *S. aureus* IMI have proven difficult to consistently culture and isolate. Estimates indicate that 75 to 91% of *S. aureus* IMI are found in the first attempt to culture, with 98% confirmed with three attempts. *Staphylococcus aureus* infections in breeding age heifers may occur as early as 9 months of age and persist for periods of 1 year or more, even into the first lactation. Additionally, premature culling may be necessary to control *S. aureus* [18].

**Economic Importance:** Mastitis has been known to cause a great deal of loss or reduction of productivity to influence the quality & quantity of milk yield & to cause culling of animals at unacceptable age. A survey conducted in the major milk producing countries indicates that each year, mastitis affects 15 to 20% of cows. Most estimates have shown a 30% reduction in productivity per affected quarter & a 15% reduction in production per cow lactation [1].

Mastitis is generally considered the most costly disease facing the dairy industry (Harmon. in a comprehensive literature review reported losses of between 5-25%. In the USA, Philpot and Nickerson [15] estimated that national losses could be as high as 180 US $ per cow per year. The economic impact of mastitis in dairy production has been categorized by as follows:

Mastitis is a disease that leads to reduced milk yield and an increased number of clinical treatments, resulting in early cow culling. Thus mastitis inflicts heavy losses to the producers in the dairy industry. Numerous reports have been published on the direct economic impact of mastitis [1].

Furthermore, milk yield decreases following sub-clinical mastitis. Additional economic losses result from the invested labor, feed, replacement costs, antibiotics, antisepsics and laboratory and veterinary services. Several studies have tried to quantify the economic losses associated with mastitis. In South Africa available data
(relatively outdated) indicate that out of every 10 cows in a herd, 4 cows are mastitis negative, 1 has clinical mastitis and 5 cows have subclinical mastitis. The elevation of the seriously increased prevalence of sub-clinical mastitis in approximately 75% of herds, has considerable implications for the productivity and economy of dairy farming, dairy processing, public health and the Control of clinical mastitis. The losses from mastitis in South Africa during 1989 were estimated to be approximately 414 rand /cow/year. This amount is without any doubt much higher currently and will continue to escalate unless each dairy producer makes a determined effort in the prevention and control of mastitis. Of the total loss, only approximately 18% is due to clinical mastitis, whereas the major portion (82%) of the loss is associated with sub-clinical mastitis [27].

Zoonotic Importance: With mastitis there is the danger that the bacterial contamination of milk from affected cows may render it unsuitable for human consumption by causing food poisoning, or interfere with manufacturing process or, in rare cases provide a mechanism of spread of disease to humans. TB, Streptococcal & brucellosis may be spread in this way [1].

All over the world attempts are being made to control bovine mastitis due to the huge effect on public health and the changed composition of milk from animals with mastitis. These may have a harmful influence on the suitability of milk for processing and the quality of the processed products made from it. Mastitis commonly results in some degree of permanent impairment of milk secretion capacity in the cow. As milk from cows with clinical mastitis is unmarketable and milk from cows with sub-clinical mastitis is of inferior quality, an increasing number of milk processing plants and companies are paying much less for milk with a high SCC, than for good quality milk [18].

**Treatment:** Treatment is possible with long-acting antibiotics, but milk from such cows is not marketable until drug residues have left the cow's system. Antibiotics may be systemic (injected into the body), or they may be forced upwards into the teat through the teat canal (intramammary infusion). Cows being treated may be marked with tape to alert dairy workers and their milk is siphoned off and discarded. Vaccinations for mastitis do exist, but as they only reduce the severity of the condition and do not prevent new infection they should be used in conjunction with a mastitis prevention program. Useful information to treat mastitis are:

- Cow identification
- Quarters affected
- Date of mastitis event
- Lactation no.
- Date of calving
- Identification of pathogens
- Treatment used including dose, route & duration
- Milk with holding time & time when returning to the milking string
- Most recent level of milk production [1].

There are many medicines and remedies used worldwide to treat cows with mastitis.
These can be divided into several different groups, according to the origin, mode of action and type of medicine [4].

**Antibiotics:** These are chemical compounds (natural or synthetic) with anti-bacterial activity (bacteriostatic or bactericidal). Over the past few decades up to now, cows with mastitis (clinical or sub-clinical) are more likely to be treated with antibiotics. These are also used on many dairy farms worldwide as part of the prophylactic control of mastitis and are used when the cows are dried off. Their use increases the risk of the presence of antibiotic residues in the milk, which renders it unfit for processing. Antibiotic residues in the milk are not well tolerated by regulatory agencies, milk processors and consumers. Furthermore, increasing evidence of bacterial resistance against a vast range of antibiotics, also limit their sustainable use in mastitis control of dairy cattle [4].

**Homeopathic Remedies Against Mastitis:** Many farmers are currently focused on organic farming and therefore more natural or homeopathic remedies needed to be developed. While practitioners report good results of homeopathic treatment in clinical mastitis there are few studies showing acceptable results of these remedies [4].

**Isopathic and Homeopathic Remedies:** Isopathic-homeopathic treatment is a regulatory therapeutic modality with the aim to promote the natural restoration of destroyed physical processes with the aid of homeopathic remedies. The isopathic remedies are not directed against the illness and its symptoms, but they support the body’s own regenerative ability, thus facilitating the healing processes. Thus isopathic treatment normalizes the symbiotic balance of the endobiotic micro-organisms and their host. The healing of the sick cow and its sick udder can only succeed if it is possible for the whole body to be regulated. On the basis of isopathic remedy treatment, the treatment of mastitis is based on these pillars: removal of blockages and improvement of cell respiration; modulation of immune system; isopathic deconstruction of the mastitis-triggering organism back to a form which is non-pathogenic; cleansing of the bacteriological soil, for the development of infectious mastitis [4].

**Control and Prevention:** Practices such as good nutrition, proper milking hygiene and the culling of chronically infected cows can help. Ensuring that cows have clean, dry bedding decreases the risk of infection and transmission. Dairy workers should wear gloves while milking and machines should be cleaned regularly to decrease the incidence of transmission. As mentioned earlier, the occurrence of mastitis depends up on the complex interaction of the three epidemiological components: host, agent and environment. Thus for any control program to be successful, it should be geared towards correcting mastitis problems associated with these three factors. NMC [28] extensively reviewed the following as essential components of a comprehensive udder health program:

- Employ proper milking management methods
- Proper maintenance and use of milking equipment
- Dry cow management
- Appropriate therapy during lactation
- Cull chronically affected cows
- Maintenance of a clean environment
- Good record keeping
- Monitoring udder health status
- Periodic review of the udder health program
- Setting goals for udder health status

The specific steps for an udder health management program devised to fulfill the three basic epidemiological principles [1, 15] include:

**Elimination of Existing Infections:** This is achieved by such programs as proper milking hygiene and technique, teat dipping, dry cow therapy, treatment of clinical mastitis and culling. These procedures help to reduce either the rate of new infections or the duration of infections.

**Prevention of New Infections:** Procedures such as good milking management, environmental and nutritional management, as well as breeding methods are employed to prevent new infections.

**Monitoring of Udder Health:** The applications of cow-side tests, for example the strip-cu test to detect clinical mastitis, the CMT for sub clinical mastitis, automated electronic cell counters, NAGase test, etc enables one to monitor the udder health of dairy cows.

**Bovine Mastitis in Ethiopia:** In Ethiopia, the prevalence of bovine mastitis has been investigated in different parts of Ethiopia. The over prevalence rates of 44.1%, 32.6%, 68%, 62.6% were reported by Girma [29], Nibret et al. [30], Alebachew & Alemu [31] and Abebe et al. [32] at Holeta, Gondar, Addis Ababa and Hawassa dairy farms. The prevalence rates report of clinical and sub clinical mastitis
were 22.4% and 48.6% by Mekebib et al. [33], 21.2% and 46.8% by Alebachew & Alemu [31] in dairy farms of Holeta town, central Ethiopia and in Selected Commercial Dairy Farms of Addis Ababa, respectively. In case of sub-clinical mastitis, the cow level prevalence of 33.8% and 31.67% recorded by Girma [29] and Nibret et al. [30], respectively, in different parts of Ethiopia. Abebe et al. [32] reported the prevalence of 3.4% and 59.2% of clinical and subclinical mastitis at Hawassa milk shed, South Ethiopia, respectively.

**Conclusion and Recommendations:** Bovine mastitis causes serious economic problem in dairy cows besides its infections such as sub clinical which are not treated. As a result most of the infections act as a source of infection for other cows resulting economic losses from infection. The most important factors accounting for the occurrence of the disease are poor hygiene of the farm, lack of regular veterinary checkup and supervisions, lack of use of dry cow therapy and refuse of culling of cows with chronic mastitis. From this conclusion the following recommendations are forwarded:

- Check up for mastitis at a certain intervals with screening test, if possible isolation, identification of pathogen and drug sensitivity test.
- Treatment of mastitis of cow(s) with antibiotics on the basis of drug sensitivity test should be conducted.
- Strict hygiene should be kept with regard to milking practices, milkier hygiene and effective teat dipping, constant removal and disposal of manure and provision of adequate quality bedding.
- Culling of chronically infected cows with or without blind quarter, eliminates the potential source of pathogen and to avoid loss of economic and transmission of zoonotic disease.

**REFERENCES**